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Review Paper

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Design of Microcontroller Based Automatic Sprinkler Irrigation System

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Abstract
A properly designed irrigation system addresses uniform irrigation application in a timely manner while minimizing losses and damage to soil, water, plants, and nutrients of the field. The automatic controlled sprinkler irrigation system is one step to assure that water is applied in right amount in the right time at a rate at which soil can absorb the water without run off. A soil moisture sensor has been developed which is based on capacitance effect and the increase in dielectric constant of a soil-water mixture. This developed soil moisture sensor will be used in the proposed system to implement the automation in the sprinkler irrigation. The main parts of this irrigation system will be sensor, frequency oscillator, microcontroller, solid state relay, sprinkler and motor.

Key words: water management, sprinkler irrigation, soil moisture sensor, band pass filter, microcontroller, permittivity, frequency mixer.

Water is a key factor in increasing agricultural production. About 78% of India's water resources are used for agriculture out of this only 50% is actually used by plants and the remaining water resources are wasted either as deep percolation or as evaporation. Excess irrigation not only reduces crop production and damages soil fertility but also causes ecological hazards like water logging and salinity. With judicial use of water and its increasing scarcity, it has become compulsory to economise water use for optimum productivity. This is possible only through improved water management and adopting advanced techniques of irrigation. One such modern method is sprinkler irrigation system which is becoming more and more popular among the farmers across the country. Sprinkler irrigation system saves up to 50% of water compared to surface irrigation method and increases productivity by about 15-25% (www. docudesk.com).

Sprinkler irrigation method distributes water to crops by spraying it over the crop area in the form of artificial rainfall. The water under pressure flows through perforations or nozzles and sprays over the area. The pressure is provided by a pump of suitable capacity and horsepower. With careful selection of nozzle sizes, operating pressure and spacing, the actual water required for maintaining the soil moisture at field capacity is applied uniformly at a rate to suit the infiltration rate of soil thereby obtaining efficient water application. It is estimated that the sprinkler irrigation system substantially reduces the use of water and the crop productivity also increases. The sprinkler irrigation system is a suitable method for irrigation on slopped lands and on shallow soils. It is effective to coarse sandy terrain where the percolation loss is more and where as a consequence, the frequency of irrigation required is more. The sprinkler irrigation system is also suitable in undulating terrain where land shaping is expensive or technically not feasible(www.bae.ncsu.edu & www.nrcs.usda.gov)

The developed sensor is based on

capacitance effect. The dielectric constant measure the capacity of a non-conductor (soil) to transmit high frequency electromagnetic wave (0.3 to 1 GHz) or pulses when inserted into soil. The basis for use of this instrument is that dry soil has dielectric values which are near to 2 to 5 and that of water is 80 (Kant, 2010).

Material and Methods

The dielectric constant (ε) of materials or mixtures containing water increases markedly with moisture content because the dielectric constant of water is about 80 which is much higher in comparison to dry soil (2 to 5). The dielectric constant, and thus capacitance, is a function of the moisture content in soil. Hence a capacitor with a mixture of soil and water as the dielectric will display a significant, and proportional, capacitance increase with moisture content. The use of well-known parallel plate capacitance configuration, a field capacitance (Fig. 1) is used in order to project the sensing electric field into the surrounding material.

$C = \varepsilon A/d$

Where, $\varepsilon = \varepsilon_0 \times \varepsilon_r$

ε_r = relative permittivity,

ε_0 = Dielectric constant in vacuum;

A = Cross- sectional area of plates;

d = gap between the plates.

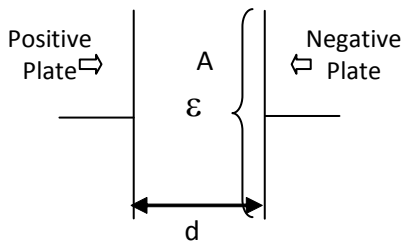

Fig 1: Parallel Plate Capacitor

The equivalent capacitance C_{eq} as given in Fig2 is the parallel combination of C_x and C_f where C_x is fixed capacitance when soil is dry and C_f is variable capacitance depends on moisture contents of soil.

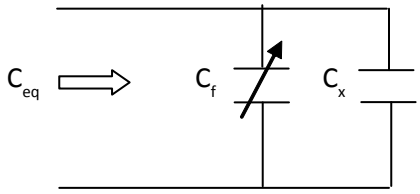

Fig 2: Equivalent Circuit Diagram

Dielectric constant behaviour with frequency

The dielectric constant increases with water content but, dependent on three other factors frequency, conductivity and particle size. At higher frequency error contribution of conductivity is significantly small. The theory of dielectric behaviour with frequency is calculated by Debye equation (Debey, 1929 & Wobschall and Lakshmanan, 2005). The equation for complex permittivity ε_c is

$$\varepsilon_c = \varepsilon_h + \{\varepsilon_l - \varepsilon_h\}/ (1 + j\omega t) \quad \ldots\ldots\ldots \quad (1)$$

Where,

$$\varepsilon_c = \varepsilon_{re} + j\, \varepsilon_{im}$$

ε_h = Dielectric constant at high frequency
ε_l= Dielectric constant at low frequency
ε_{re} = Real part of dielectric constant
ε_{im} = Imaginary parts of dielectric constant
ω = Angular frequency, t = Relaxation time (size and conductivity dependent),

The equation (1) states that the influence of conductivity on real part of dielectric constant is much greater at lower frequency hence, higher operating frequency is desirable.

The main parts of this irrigation system will be sensor, microcontroller, frequency oscillator, filter, solid state relay, sprinkler and motor. The sensor is encased in Gypsum block which is cylindrical and porous in nature, soaks/depletes moisture from/ to the surrounding soil. The Gypsum block sensor is easy to fabricate, cost effective and it laid down in the soil for complete period of crop. The microcontroller (Gaokar, 2013) controls the analog switches, read oscillator frequencies, calculate the frequency changes and encode the data. The

moisture content makes change in relative permittivity (ε_r) of soil and change the frequency of sensor. The output of the frequency mixer is multiplication of constant frequency of oscillator and angular frequency of sensor. The output of mixer is multiplication of two sinusoidal signal cos ($\omega_o t$) and cos ($\omega_s t$) where, ω_o ($2\pi fo$) and ω_s ($2\pi fs$) are constant oscillator frequency and sensor angular frequency respectively. We know from the trigonometric identities

$$\mathbf{2cos}\ (2\pi f_o t)\cos(2\pi f_s t) = \cos[2\pi(f_o + f_s)t] + \cos[2\pi(f_o - f_s)t] \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The equation (2) explains that |fs ±fo| are two output frequency components of mixture. By using frequency mixture selector, popularly known as band pass filter, used to pass the lower frequency band |fs - fo| (Lathi, 2004). With increase in moisture content in soil, the frequency generated due to the sensor (fs) makes to change in |fs - fo|. This proportionate change of frequency encoded in the microcontroller and the resultant value is related through calibration to soil moisture content. The soil moisture in the field will be measured, and stored in the memory with the help of microcontroller. The available water storage capacity of various soils is the amount of water that can be stored in the soil against the force of gravity. It depends on the soil texture, for example if the soil texture becomes finer, more water can be stored. Plants are capable of extracting only a portion of the water from the soil before getting stressed. The values of available water storage capacity of various soils are given in table 1 (www.bae.ncsu.edu). If the field moisture is less than 50% soil is under stressed condition and water supply is needed. For this motor will get command through proposed diagram (Fig 3) to ON/OFF the switch by using solid state relay. When field moisture becomes more than 50% the water supply will be discontinued by same procedure (Dass and Rai, 2011)

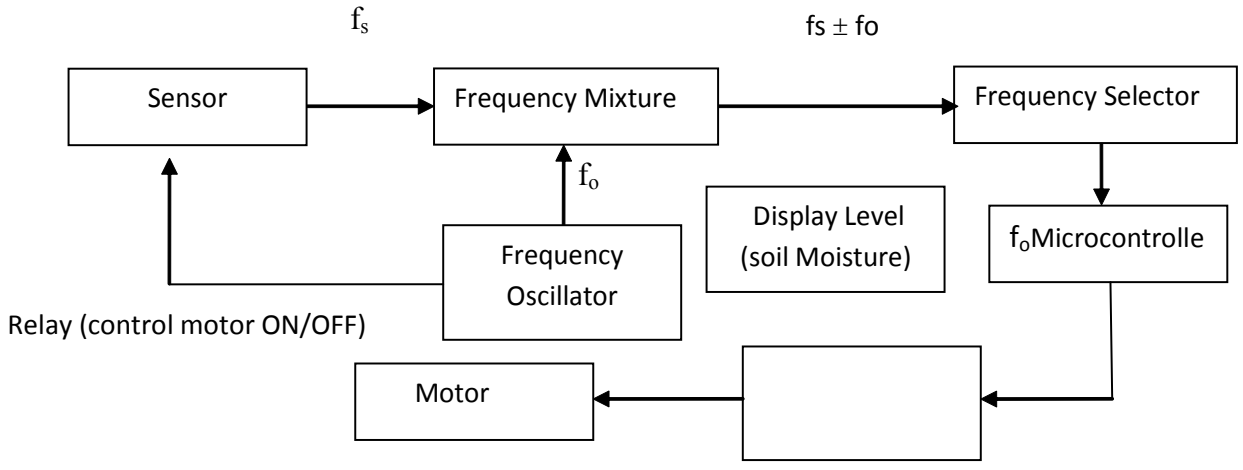

Fig 3: Block diagram of proposed system

Table: 1 Available Water Storage Capacity of Soils (www.bae.ncsu.edu)

(Inch of Water per Foot of Soil)

Soil Texture	Available Water Storage Capacity of Soils (Inch/Foot)	Linguistic Variable
Sand	1	Sandy
Loamy Sand	1.2	
Sandy Loam	1.5	
Fine Sandy Loam	1.7	Loamy
Loam	2.1	
Silt Loam	2.5	
Clay Loam	2.4	Clay
Clay	2.4	
Organic Soils	3	

Conclusion and Future Work

In case of flood irrigation technique large amount of water is required and most of the water get evaporated or absorbed by soil hence, there is much loss of water. By using automatic control system delivering the water to plants at right time and right amount is a key of effective and efficient irrigation. Thus by making automatic sprinkler irrigation system, can saves water, soil fertility, labour cost etc. The system can be designed so that categorization of the soil moisture level is possible viz dry (very low), low, medium, high and saturation level (very high). This system works at high frequency band hence, the wireless transmission of signal can also possible.

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Utilization of water chestnut in noodles and extruded food development

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Abstract

Water chestnut is predominately cultivated in Madhya Pradesh and used as raw or in the form of flour. In the present investigation, noodles and extrudates were made from water chestnut alone or in combination with potato and sweet potato flours. The results revealed that the product made form water chestnut alone was not superior. However, blending with potato and sweet potato enhanced the quality. They were further improved by fortification with 10% skimmed milk powder. Both the products made in the ratio of 60:20:20 (water chestnut, potato and sweet potato) supplemented with 10% skimmed milk powder had better quality in terms of both sensory as well as nutritional characteristics. They contained 11.21, 71.76, 2.95 per cent protein, carbohydrates and ash content respectively. The calcium, phosphorus and magnesium were 187.66, 177.66 and 164.72 mg/100gm product, respectively. The self life of the stored products packed in aluminum foil under normal and vacuum conditions were good at room temperature for the period of 3 months. Thus, utilization of water chestnut could be suggested in noodles and extrudates formulations, which may be as one of the ready to use available food products during religious festival and rituals.

Keywords: Barrel temperature, Blend, Extrusion, Hedonic scale, Potato, screw speed, Sensory quality

According to Havck and Huber, 1989; Castells *et al.*, 2005 extrusion cooking is a high-temperature, short-time process in which moistened, expansive, starchy and/or proteinaceous food materials are plasticized and cooked in a tube by a combination of moisture, pressure, temperature and mechanical shear, resulting in molecular transformation and chemical reactions. It is a unique process since it accepts relatively dry materials, adds liquids to plasticize the raw material, gelatinizes starch, denatures protein, and inactivates enzymes before expanding (texturizing) the finished product. It may also be used as a thermal process to eliminate undesirable flavours, inactivate growth inhibitors, and modify starch. The extrusion cooking may be characterized as an energy and space efficient technique for producing a variety of products depending on the selected raw materials, process conditions, and mechanical configuration (Harper 1981).

Water chestnut (*Trapa bispisona Roxburg*) is an annual aquatic warm season crop, commonly as *Singhara* in India. Madhya Pradesh is major Singhara producing state in the country where nuts worth Rupees 25 crore are produced in 5000 hectare area of water bodies. Cultivation of Singhara crop is main source of income for poor OBC families particularly *Dheemar* and *Burman* communities of the state. It is the richest sources of carbohydrates and contains good amount of protein and minerals. It contains very negligible amount of fat. The water chestnut flour is considered to be superior to rice in nutritive value. Literature reveled that there were no work on

utilization aspect of flour. Therefore, the present study was undertaken to explore the possibilities of its utilization in extruded and noodles development. Sweet Potato (*Ipomea batatas*) is most starchy crop grown in India and Abroad. It is called *Shakarkand* in Hindi and widely grown in Bihar, Tamilnadu, Maharashtra, Uttar Pradesh, Punjab and West Bengal. Area and production of Sweet Potato in Madhya Pradesh is nearly 9.3 thousand hectare and 54.2 thousand tones respectively (Bergale 1985). Sweet Potatoes are rich in beta-carotene, having five times more than the recommended daily allowance of vitamin A in one Sweet Potato. One medium Sweet Potato contains 3.4 g fibre, 31 mg Calcium, 396 mg Potassium, 28 mg Vitamin C and 62.7 mg Phosphorus. Potato (*Solanum tuberosum*) is the most important food crop of India. Potatoes are economical food and provide a source of low cost energy to the human diet. It contains 20.6 percent carbohydrates, 2.1 percent protein, 0.3 percent fat, 1.1 percent crude fibre and 0.9 percent ash. They are rich source of starch and minerals (*Singh et al. 2003*). In India Potato is cultivated in about 1.3 million hectare with a total production of 24.7 million ton (Agricultural statistics at a glance 2005 - 06). Skimmed Milk Powder (SMP) contains high biological value protein with good amount of calcium. The composition of SMP includes fat 10 to 20 %, carbohydrate 37 % and minerals 6 %. Milk powder acts as functional food ingredient. The functional attributes are essentially those of the milk protein and include solubility, emulsification, gelation, water binding, whipping/foaming, viscosity, browning/colour and flavour/aroma.

Materials and methods

Extrudates and noodles were developed from water chestnut flour alone and in combinations with other food commodities such as potato and sweet potato flours. Different types of product were formulated and developed in different combinations. The experiment conducted on Brabender laboratory model single screw extruder and hand extruder. These products were evaluated for their nutritional and sensory quality characteristics by the standard procedures.

Sensory analysis The extruded products were further evaluated for sensory attributes to obtain the most acceptable quality product. Sensory evaluation like colour, appearance, flavour, taste and overall acceptability was conducted on nine point Hedonic scale as described by Amerine (1999). Sensory evaluation done by 10 judges in the age group of 20 to 50 years comprising professors and students of the Department of Food Science & Technology.

Chemical analysis The ash content in the sample was estimated according to A.O.A.C (1980) and expressed as percent. The oil content in various samples was estimated by the procedure given in A.O.A.C. (1980) using petroleum ether (60-80^0 B.P.) as solvent. The nitrogen content in the samples was determined by using conventional Micro- Kjeldahl Digestion and Distillation procedure as given by A.O.A.C. (1980). The Crude Protein content was calculated by using a conversion factor of 6.25 and expressed in percent. Total carbohydrate was estimated by the acid hydrolysis process in which polysaccharides were broken down into hexose sugars. By utilizing its reducing action, it was estimated by titrating with mixture of Fehling solutions A and B (Hassid and Abraham 1973). Calcium and Magnesium in the above aliquot were determined by the Versenate titration method as described by Black (1965). Phosphorus content in the Diacid digested aliquot was determined by Vanado-Molybdo Phosphoric Acid method as described by Koenig and Johnson (1942).

Table: 1 Experimental Design

Blend Code	Water chest nut Flour %	Potato Flour %	Sweet Potato Flour	Skimmed Milk Powder %
Control	100	0	0	0
B_1	90	0	0	10
B_2	75	15	0	10
B_3	60	30	0	10
B_4	75	0	15	10
B_5	60	0	30	10
B_6	60	15	15	10
B_7	50	20	20	10

Results and Discussion

Bulk density of the product was lower in extrudates (0.18 to 0.28 g/cm^3) and higher in noodles (0.50 to 0.59 g/cm^3). Supplementation of potato and sweet potato enhanced the bulk density. The obtained result showed that bulk density of extrudates was highest in blend -7 and lowest in blend-1 and control. However, in noodles bulk density was highest in blend-7 and lowest in blend-1 and control. The noodles showed higher bulk density in comparison to extruded foods. Addition of potato or sweet potato increased the bulk density of the products. (Jha and Prasad 2003).

Table: 2 Bulk Density (g/cm^3) of Extrudates and Noodles made from different blends

Blend Code	Extrudates	Noodles
Control	0.18	0.50
B_1	0.19	0.52
B_2	0.26	0.56
B_3	0.27	0.57
B_4	0.22	0.52
B_5	0.25	0.56
B_6	0.26	0.57
B_7	0.28	0.59

Moisture content: The obtained results showed that moisture content of extrudates ranged from 4.16 to 4.47% and 6.47 to 6.99% in noodles with the highest in control and lowest in B_7.

Protein: They contained more or less same amount of protein (10.04 to 10.09%). Supplementation of potato and sweet potato increased the level by 15 to 20 percent. The highest protein content was exhibited by samples of B_1 which is blend of 90% water chest nut flour and 10% SMP. It is observed that products made from water chestnut contain lowest amount of protein. Addition of skimmed milk powder in the products increases the level of protein. However, subsequent supplementation of potato and sweet potato in milk supplemented extrudates and noodles again decreased the level of protein. It was also observed that extrudates and noodles contains more or less same amount of protein. These results are in agreement with the findings of Gehlawat and Sehgal (1997).

Carbohydrate: Highest amount of carbohydrates was present in extrudates and noodles made from blends -7 (71.76%). However, it was lower in the product made from water chestnut alone. It is observed that extrudates and noodles contained more or less same amount of carbohydrate with the no effect due to supplementation of milk powder. However, fortification of potato and sweet potato in both products increased the level of carbohydrate (Akubor 1997).

Ash content: Ash content was more or less same in all the products (2.82 to 2.98%).

Mineral content: supplementation of potato, sweet potato and milk powder drastically enhances the level of calcium in all the products. This indicates that supplementation of potato, sweet potato and milk powder is important from calcium point of view. Lowest amount of calcium was present in extrudates and noodles made from water chestnut alone (28.12 mg/ 100gm). However, it was significantly increased on blending (157.9 to 168.5 mg/100g). Magnesium content varied in the range of 157.9 to 168.5 mg/ 100g of product. The products made from water chestnut only contained lowest amount of magnesium. It appears that there were no effect on magnesium content of noodles and extrudates on supplementation of potato, sweet potato and milk powder.

The data reveals that phosphorus content varied from 29.16 to 177.66 mg/100g of the products. The product made from water chestnut only contained lowest amount of phosphorus (29.16 mg/100g). However, it was maximum in B_7 containing water chestnut, potato, sweet potato and milk powder in ratio of 50:20:20:10. The supplementation of water chestnut, potato, sweet potato and milk powder drastically enhanced the level of phosphorus. However, on blending of potato and sweet potato, it was significantly enhanced (145.6 to 177.6 mg/100g).

Sensory: The results showed that the mean score for various attributes ranged from 6.22 to 8.53 with a maximum value in B_3 and B_7 and minimum in control. This indicates that noodles and extrudates made from water chestnut only exhibited lower value for various sensory characteristics. However supplementation of milk powder did not have any effect. Potato and sweet potato had direct effect on the sensory quality of the product. Noodles and extrudates made in combination with potato and sweet potato had better quality of sensory in comparison to water chestnut alone and milk supplemented water chestnut product. Sensory score were lower in the product made from water chestnut alone. However, blending enhanced their sensory quality characteristics. Sensory score were lower in the product made from water chestnut alone. However, blending enhanced their sensory quality characteristics.

Table 3. Nutritional Evaluation of Extrudates made from different blends (dry basis)

Blend Code	Moisture %	Protein %	Carbohydrate %	Total Ash %	Calcium mg/100g	Magnesium mg/100g	Phosphorus mg/100g
Control	4.47	10.04	64.81	2.94	28.12	157.97	29.16
B_1	4.38	12.83	63.39	2.82	164.00	162.60	127.26
B_2	4.28	12.61	66.05	2.91	165.49	156.58	146.52
B_3	4.22	12.32	68.73	2.98	167.12	158.66	166.32
B_4	4.34	11.86	67.09	2.83	180.22	162.60	145.65
B_5	4.30	10.84	70.62	2.83	196.42	168.50	163.56
B_6	4.26	11.62	69.70	2.90	181.73	162.63	164.52
B_7	4.16	11.21	71.76	2.95	187.65	164.72	177.66

Table 4. Nutritional Evaluation of Noodles made from different blends (dry basis)

Blend Code	Moisture %	Protein %	Carbohydrate %	Total Ash %	Calcium mg/100g	Magnesium mg/100g	Phosphorus mg/100g
Control	6.99	10.09	64.85	2.94	28.12	158.00	29.16
B_1	6.68	12.86	63.42	2.82	164.00	162.60	127.26
B_2	6.59	12.63	66.10	2.90	165.48	156.58	146.50
B_3	6.56	12.37	68.79	2.98	167.12	158.69	166.34
B_4	6.66	11.91	67.15	2.82	180.20	162.61	145.68
B_5	6.60	10.89	70.65	2.81	196.42	168.49	163.52
B_6	6.58	11.68	69.74	2.90	181.72	162.61	164.52
B_7	6.47	11.26	71.80	2.96	187.66	164.70	177.62

Table 5. Sensory Evaluation of Noodles on 9 points of hedonic scale by the panel of 10 judges

Blend Code	Colour & Appearance	Texture	Taste	Overall Acceptability
Control	6.22	6.73	6.32	6.53
B_1	6.32	6.83	6.54	7.85
B_2	7.22	7.87	8.15	8.09
B_3	7.82	8.20	8.40	8.34
B_4	7.39	6.97	7.36	7.55
B_5	7.21	7.13	6.92	7.28
B_6	7.51	7.91	8.07	8.26
B_7	8.25	8.44	8.53	8.41

Table: 5 Sensory evaluations of extrudates on 9 points of hedonic scale by the panel of 10 judges

Blend Code	Colour & Appearance	Texture	Taste	Overall Acceptability
Control	6.10	6.23	6.31	6.27
B_1	6.32	6.46	6.32	6.41
B_2	6.72	6.32	6.37	6.54
B_3	7.26	7.63	7.83	7.56
B_4	6.41	6.58	6.78	6.62
B_5	6.34	6.46	6.36	6.39
B_6	6.91	6.84	6.58	6.72
B_7	8.00	8.10	8.11	8.14

Thus based on the above findings, it was concluded that water chestnut may be utilized in the formulation of extrudates and noodles in combination with potato, sweet potato alone and/ or both. The sensory quality of the product was good in the blend which consist of water chestnut, potato, sweet potato and skimmed milk powder in the ratio of 50:20:20:10, respectively and could be well stored in all packaging materials up to the period of 90 days without any deleterious affect.

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Analysis of Impact of eNAM on the stakeholders of Tikamgarh Region, Madhya Pradesh

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Abstract

The present study attempts to assess the present status of infrastructural facilities, innovative agricultural marketing practices adopted in regulated markets and problems of border markets in Bundelkhand Region of Madhya Pradesh. The study is based on both primary and secondary data. Primary data pertaining to the agricultural year 2016-17 were obtained from 120 farmers and 20 traders chosen from the selected markets. Secondary data were collected from the Madhya Pradesh State Agricultural Marketing Board,. Data were processed using descriptive analytical tools and techniques.

There was no difference between interior and border regulated markets with respect to facilities like market office, stalls/godown and telephone facilities, but the negative difference was observed in vehicle parking, fire fighting, rest rooms for farmers and conference hall, shed for animals. There was no difference between interior and border markets with respect to services like issuing license, collecting market fee, loading, unloading, weighing and recording of disposal, but the negative difference observed in the case of collection of taxes, computer facility and issuing gate pass service. Major constraint faced by the farmers in using ICT's was computer illiteracy (74.17%), followed by lack of interest, lack of computer facility, lack of time, costly technology and illiteracy. Maximum number of farmers used Television as the main source of the market information for its accuracy, timeliness and content. Lack of competitive bidding due to poor arrivals was the major problem faced by the farmers followed by poor infrastructure facilities. Major problem faced by the market intermediaries was poor arrivals, and hence, low turnover followed by quality constraints, and price difference at traditional and regulated markets.

Key words : regulated market, ICT, intermediaries, traditional market, border market

The agricultural sector has been one of the most important components of Indian economy. Agriculture continues to be a main stay of life for majority of the population; it contributes around 13.7 per cent of the GDP and employs 65 per cent of the workforce in the country. Food grains production in the country increased from 51 million tonnes to 247 million tonnes during 1950-51 to 2015-16. The agricultural sector in our country has flourished over the years due to Government's constant thrust on increasing agricultural production. Still the benefits are not percolating down to the farming community. Indian agriculture is characterized by lack of strong linkages between production and marketing which may be due to inadequate marketing infrastructure. However, better growth in agriculture production has resulted in higher marketed surplus in case of many crops. So, agriculture sector needs well functioning markets to drive growth, employment generation and economic prosperity in rural areas of the country.

Despite great strengths and performance, the growth of the agriculture sector in Madhya Pradesh has been stagnated for the last one decade due to lack of post harvest infrastructure, poor utilization of land, low value addition, poor facility for packaging and presentation. The share of agriculture and allied sector in total GDP is 13.7 in year 2012-13. In 12th five year plan (2012-17)

Government's focus is on "inclusive Growth of agriculture". The average growth rate of agriculture and allied sector in the year 2011-12 was 3.6 in percentage and it has declined to 1.8 in the year 2012-13.

The adoption of scientific technology of agricultural production by the farmers has created a great demand for better and improved inputs. The investment in new technology largely depends upon the gains of the farming community. It has, therefore, become imperative that arrangements should exist for efficient movement of the farmer's produce to the consumers and for adequate and timely supply of superior inputs to the farmers. In this context, regulation of marketing practices through establishment of regulated markets is a very important policy intervention aimed at improving agricultural marketing system in the country.

The regulated markets are considered institutions responsible for discharging all the functions connected with the sale of outputs, keeping in view the overall interest of the farming community and the ultimate consumers. These institutions are meant to regulate unethical trading practices followed in the marketing of agricultural produce. This helped in protecting the interest of both the producers and consumers, thus contributing towards the growth of orderly marketing and price stability through effective competition. Therefore, governments from time to time brought about the required legislations and development of market infrastructure from 1960's to 2000. However, in the recent years, the economy was liberalized and allowed private sector to participate in the trade of agriculture. In this direction, some of the states in India started bringing amendments to the market legislation and development.

Current Status in Madhya Pradesh

To ensure that farmers of the State get the right price for their produce, 58 krishi upaj mandis have been connected with 'e-NAM' trading portal. Farmers can sell their agricultural produce through this system.

While the information concerned with the trader who makes the bid is kept secret, the farmer also gets the benefit of the competition among the traders. Another benefit is that the traders of other Mandi areas and out of the Mandi area can directly make the bid of gins on the e-NAM portal. This enables farmers to get benefits of local market besides outside markets.

National Agriculture Market (e-NAM) is a PAN India electronic trading portal which is a good medium of current Krishi Upaj Mandi Samiti for construction of an integrated national market for agriculture related produce. e-NAM portal is capable of providing single window services for information and services related to all krishi upaj mandi samitis. Inflow and prices of agriculture produce in Mandi premises, purchase and sale of trade proposals, provisions of responses to trade proposals have also been included along with other services under this scheme.

e-NAM portal was started by Prime Minister Narendra Modi in April-2016. It was started with pilot project in Pandit Lakshminarayan Sharma Krishi Upaj Mandi Samiti Karond, Bhopal in Madhya Pradesh. By connecting to National Agriculture Market, any krishi upaj mandi can participate in the National Business Network. When the farmers bring their produce to the mandi for sale at local level, they have the alternative to sell their produce to traders from other states also through internet along with local traders.

Work is in progress to connect e-NAM portal with weights and measures. One thing special about the portal is that the payment of produce sold by the farmers is deposited in their accounts the same day. As many as 15 krishi mandis of Bhopal division, 9 mandis of Indore division,12 of Ujjain division, 6 of Gwalior division, 5 of Sagar division, 9 of Jabalpur division and 2 mandis of Rewa division have been connected to the National Agriculture Market.

Future Needs

As common facilities in many markets in the State are not of the desired level, farmers and traders are facing a lot of difficulties. The benefits available to the farmers from regulated markets depend on the facilities/amenities available rather

than the number of regulated markets in the area. Both covered and open auction platforms exist in two-thirds of the regulated markets. One fourth of the markets have common drying yards. Traders modules viz., shop, godown and platform in front of shop exist in 63 per cent of the markets. The cold storage units exist in only 9 per cent of the markets and grading facilities exist in less than one-third of the markets. The basic facilities viz., internal roads, boundary walls, electric light, loading and unloading facilities and weighing equipments are available in more than 80 per cent of the markets.

Of late, the need for these market infrastructure has been increased due to increased production and marketed surplus. The functional infrastructure such as assembling, drying, cleaning, grading and standardization etc are also required on a large scale as well as on small scale basis. The facilities such as packaging, ripening chambers, storage, value addition facilities, availability of power fans for winnowing, mechanical sorting, washing, surface cooling and other functional facilities, which are required for a specific commodities at a different levels of marketing in different regions of the regulated marketing system are negligible or absent in most of the APMC's. In addition to direct physical infrastructure, there is also a strong need for market intelligence infrastructure and information in terms of prices, farm inputs and weather forecasts.

Major markets are to be brought under the comprehensive electronic auction system in a time bound manner. Test parameters for every commodity and the testing process should be decided in consultation with all participants and well publicised. Weighing of produce to be integrated with the auction process, so that recording of the weight of the produce is done against the respective lot number without any manual intervention and the amount payable/receivable communicated to the buyer/seller as soon as the weight is captured in the system.

Opportunities

Integrating Markets

Integrating various markets transacting the same commodity supported by warehouses located in close proximity to the farm could eventually result in a better price for the farmer with minimum cost of transaction. Individual markets discover the price of the commodity on a given day, based on the interaction of supply and demand within their precincts. In a perfect market, additional supplies should rush when the price is high due to excessive demand and in case of lower prices, supply should either remain subdued or the commodity may move to more reassuring markets,this brings a phenomenon of Law of One Price.

For integration of markets and allowing participation by market participants in a remote location, standardization of quality and quantity parameters, and dissemination of these parameters to the buyers, clearing and settlement mechanisms and dispute resolution are key prerequisites. This would increase the number of buyers for the commodity and the price discovered would reflect the interplay of supply and demand in the region/ area where the commodity is transacted, with the transportation cost duly reckoned.

Commodity Funding

Goods stored in a scientifically managed warehouse easily lend themselves to funding by banks and other institutions. The lending bank marks a lien on the stored goods as security for the loan. The commodity accounting system should preclude offering lien marked goods for sale unless the borrower offers authority to pay off the loan amount to the bank and only the balance to be credited to the account of the seller. Adopting this process for commodity funding of goods in the warehouse gives staying power to the farmer and comfort not to go in for a distress sale.

Farmer Producer Organizations

To encourage and facilitate Primary Agricultural Cooperative Societies (PACS), Taluk

Agricultural Produce Cooperative Marketing Societies (TAPCMS) and other farmer producer organizations having the capability and are willing to take up the role of aggregators. Role of aggregators is very much essential for easy access to markets by the farmer. The aggregators must provide value added services like pooling of agriculture produce, grading, cleaning, weighing, packing, labeling, market information hubs and transportation to warehouses/markets. Farmer producer organizations may be identified and encouraged to enter this activity in a major way. These institutions would require training and employee skill enhancement to perform this role.

Thus, the need for the critical market infrastructures has increased due to increased production and marketed surplus. The functional infrastructure such as assembling, drying, cleaning, grading and standardization etc are also required on a large scale as well as on small scale basis. The facilities such as packaging, ripening chambers, storage, value addition facilities, availability of power fans for winnowing, mechanical sorting, washing, surface cooling and other functional facilities, which are required for specific commodities at different levels of marketing in different regions of the regulated marketing system are negligible or absent in most of the APMC's. In addition to direct physical infrastructure, there is also a strong need for market intelligence infrastructure and information in terms of prices, farm inputs and weather forecasts. Given good market infrastructure in certain markets, efficiency in delivering market services suffers in these markets. Innovations in marketing practices or services would certainly come handy towards enhancing the marketing efficiency. Innovations could be in one or several dimensions - technological, infrastructural, institutional, gender and policy. When this is the story in main or interior regulated markets, it is learnt that the regulated markets along the State border have some other problems or issues to be addressed.

What is the present status of infrastructure facilities and service delivery in the regulated markets? What are their future requirements? What innovations could be thought of in improving the marketing efficiency in the long run? What are the specific problems faced by farmers and market intermediaries in the border markets? What are the solutions to overcome these constraints? These are some of the researchable questions which have sown the seeds of this research endeavour. In this context, the present study is taken up with the following specific objectives.

Scope of the study

The agricultural sector in our country has flourished over the years due to Government's constant thrust on increasing agricultural production. Still the benefits are not percolating down to the farming community. Indian agriculture is characterized by lack of strong linkages between production and marketing, may be due to inadequate marketing infrastructure. These infrastructure facilities were underutilized or about 50 per cent of them were utilized at the primary and secondary wholesale markets due to diffusion of trade in the market hinterland (Kerur, 2008) . Over time, an arrival of agricultural produce to the APMCs has increased tremendously, while the infrastructure required to handle these quantities is not adequate in many markets. Some markets have adopted some innovations to overcome certain hurdles. A scientific assessment of the infrastructural facilities available in the regulated markets and their future needs is of utmost importance. Similarly, innovations practiced in some markets need assessment and up scaling. This study is a right step at a right time. Some of the issues raised above will be addressed by this study.

Limitations of the study

As it is true of any scientific investigation, being an academic study conducted by a single investigator, this study had the limitation of time, resources and other facilities. Despite all the constraints, efforts were made by the researcher to keep the study as objective as possible by deliberately following all norms of scientific research, well structured schedule and objective measurement.

Shakeel-Ul-Rehman and Selvaraj (2013)73 studied the perception of farmers towards regulated agricultural markets in Salem district of Tamilnadu. The study includes a sample of 260 farmers who sell their agricultural produce in the regulated agricultural markets in the study area. 13 regulated markets working in Salem district were selected for the survey. The sample was chosen by convenience sampling method for the ease of the researcher as the total population was unknown. The sample size consists of 20 respondent farmers from each of the 13 regulated markets respectively summing the overall sample to 260. A structured questionnaire was administered to collect the response as primary data. The findings of the study revealed that majority of the respondents feel a positive perception towards working of regulated markets in Salem district, but there still seems inadequacy of infrastructural facilities in these markets. The farmers are notfully satisfied with price stability in the markets, reasonable rates of produce in the market, reasonable methods of sale, price awareness, grievance redressal mechanism, transport facilities provided by the markets, internal road facilities and parking facility in the markets. The study suggests that the government must examine its policies and regulations with view to strengthen the marketing network and ensure that prices are being determined on competitive basis and markets are being manipulated.

Nizamuddin Khan and Mohammad Muqeet Khan (2012)72 carried out a study titled "Marketing of Agricultural Crops in Rural Indian Economy". The study examined the transaction of agricultural crops through rural markets and the price structure of different crops in rural markets of Ambedkarnagar district. The study has highlighted the composition and structure of sellers and traders engaged in the marketing process.

Madhusudan Ghosh (2011)70 examined the impact of agricultural policy reforms on spatial integration of food grain markets in India. The extent of spatial integration of food grain markets improved during the postreform period, as the regional markets, which were either segmented or poorly integrated during the pre-reform period, are found to be strongly integrated, and in most cases to such an extent that satisfies the relative version of the law of one price

Venkatachalam (2003) conducted a study on infrastructure and agricultural development in Karnataka state. The study mainly focused on the secondary data at state level for all the major states in the country regarding agricultural development and major infrastructural variables, for two time periods. Results of the study revealed that, though Karnataka State has achieved an impressive growth rate in the overall infrastructural development compared to other states in the country, the agricultural infrastructure development was not evenly distributed within the State. Assuming that the level of agricultural growth rate has a positive strong correlation with the overall development in general and the agricultural development in particular, the unequal distribution of infrastructure would result in regional imbalances affecting the welfare of the individuals.

Kerur et al. (2008) conducted a study on the performance analysis of regulated markets in Karnataka. The averages and compound growth rates were computed to ascertain the growth performance of the regulated markets in terms of physical and financial indicators such as market functionaries, market arrivals and commodities turnover of selected markets in Karnataka. The results revealed that amongst the market functionaries in the state, traders accounted for about 16.26 per cent followed by hamals (15.41%), exporters (11.73%), importers (10.95%), retailers (10.65%) and commission agents (9.59%). In terms of market arrivals, jowar from cereals had shown positive growth rate (2.23%), groundnut from oilseeds (-1%) and cotton (-6.89%) had shown negative growth rate due to low productivity and low prices.

Kerur et al. (2010) conducted a study on physical and financial performance of regulated markets in Karnataka. The averages and compound growth rates were computed to ascertain the growth performance of the regulated markets of Ranebennur, Bagalkot, Raichur and Gulbarga in terms of physical and

financial indicators such as market functionaries, income, expenditure, market arrivals and commodities turnover used for the period from (1990-2005). Results revealed that the overall growth of market functionaries in Ranebennur market showed a decreasing trend, a rapid drop in processors was observed in Bagalkot market and Raichur and Gulbarga markets had shown an increasing trend. Average income and expenditure had shown negative financial performance in Raichur and Bagalkot markets and positive financial performance in Ranebennur and Gulbarga markets.

Hegde and Madhuri (2013) conducted a study on marketing infrastructure for fruits and vegetables using ex-post facto research design in selected Ratnagiri and Ramanagara districts from Maharashtra and Karnataka States, respectively. Results of the study revealed that Indian system of agricultural marketing suffered from a number of defects. As a consequence, Indian farmer was deprived of a fair price for his produce. The main defects of the agricultural marketing system were improper warehouses, lack of grading and standardization, inadequate transport facilities, presence of a large number of middlemen, malpractices in unregulated markets, inadequate market information and inadequate credit facilities.

Mahendran (2013) has undertaken an empirical evaluation of the performance of regulated markets in Coimbatore district. Results of the study revealed that majority of the farmers prefer regulated market for disposing off their agricultural produce, but the preference to regulated markets for disposing agricultural produce is significantly related to the type of ownership of the land, type of market and type of membership. At the same time some of the farmers do not prefer regulated market from selling their produce because of hostile attitude of members, inaccessibility, limited and poor service of the regulated market.

Narayanamoorthy *et al.* (2013) conducted a district-level study on agriculture market access, infrastructure and value of output nexus, using data from 235 Indian districts pertaining to the period TE 2003-06. The variables that were used for carrying out the empirical analysis were average distance of agricultural market, number of wholesale markets, net sown area per agricultural market, percentage of villages electrified, fertilizer use per hectare of cropped area, percentage of irrigated area to gross cropped area, percentage of villages having road facility, tractors per thousand gross cropped area and value of agriculture output per hectare of cropped area. Both descriptive and regression analysis have been used for this study. Descriptive analysis reveals that value of agricultural output was relatively higher for the districts which have less distance to agricultural market as compared to the districts having higher distance. The results of the regression analysis showed that density of agricultural market had considerable relevance in determining the value of output along with the fertiliser, irrigation and tractor use.

Navalur *et al*. (2013) conducted a study to understand the status of market infrastructure, financial status of regulated markets and the extent of post harvest losses in Karnataka, using secondary data collected from different state government publications and official websites. The study revealed that the Karnataka's share in agriculture market infrastructure in India was very less and state should increase the investment in infrastructure. The study also reported that the Bangalore regulated market has had highest annual income, expenditure and profit.

Methodology

Sampling

For evaluating the objectives of the study Tikamgarh district of Madhya Pradesh was selected.

Two hundred farmers were randomly selected. To elicit the opinions from market intermediaries in the selected markets, five market intermediaries comprising of two commission agents and three wholesale traders were selected randomly.

Data

Both primary and secondary data were collected from a variety of sources. The present

study extensively used the secondary data. At the first stage the data were collected for state as a whole and in second stage the data were collected from the Tikamgarh market. The study utilized the secondary data for 5 years on various aspects like arrival, income, expenditure and production obtained from the offices like the DSO, the Department of Agricultural Marketing, which are located in sagar.

Primary data required for the study were elicited from the respondents by personal interview method using well-designed and pre-tested schedule prepared for the purpose. For analysing the primary data descriptive analytical tools were employed.

Results

The major findings of the study are summarized below:

1. Traders accounted for the largest proportion of the total number of market functionaries in the regulated markets in Tikamgarh, followed by hamals, retailers and commission agents. It was learnt that there was a decreasing trend in the case of ginners, brokers, transporters, pressers and crushers due to higher marketing margins absorbed by the existing functionaries.

2. Some infrastructural facilities like vehicle parking, rest house for farmers, conference hall, shed for animals and fire fighting facilities were available more in Tikamgarh when compared to other blocks of district, which might be to attract the farmers located nearby Tikamgarh.

3. The processing and display auction facilities were fully adequate in the selected market. Contrarily, weighing, grading, packing, drinking water facility for bullocks, rest rooms for farmers and waiting hall facilities were somewhat adequate. Transport inside the market, storage facility, display platform for open auction, drinking water for farmers, cafeteria, toilet, telephone, general shops and packing lot facilities are inadequate.

4. Wastage during loading and unloading, high cost of transportation, lack of knowledge about grading, inadequate storage facility, inadequate availability of market finance and lack of market information were the major constraints faced by farmers in marketing.

5. Among the suggestions for improvement, dissemination of information on market prices and schemes related to marketing by the APMCs was on top priority followed by training on good cultivation practices, cleaning, grading, packaging, WTO quality specifications, etc. The other suggestions given by the farmers to overcome the constraints faced by them were regulated market to provide transport facility at reasonable charges at the APMC yard, small scale rural based processing industries should be developed / encouraged and storage facilities in rural areas need to be created / strengthened, among others.

6. Farmers strongly agreed that the ICT application was a cheaper source of information. It also improved their social status, made farmers knowledgeable, improved economic status, changed the concept of marketing, and created the employment opportunities to the farmers in both interior and border markets.

7. Computer illiteracy, lack of interest, lack of computer facility, lack of time, costly technology and illiteracy were the some of the problems constraining the farmer from using ICTs in agricultural marketing.

8. Farmers were not satisfied with the innovative agricultural marketing practices adopted in the market in terms of technological like internet and kiosk system, in terms of infrastructural like cold storage and conference hall and in terms of institutional like supervision of sale by camera, computerized entry at the market gate and issuing gate pass.

9. Maximum number of the farmers used television as the main source for market information for its accuracy, timeliness and content in all the markets, followed by friends, radio and news paper and

meager number of farmers used information kiosks as source of market information.

10. Poor arrivals, and hence, low turnover followed by quality constraints, price difference at traditional and regulated markets, immediate cash payment of sale proceeds to farmers, seasonality of arrivals and wastage of produce during loading and unloading, were the major problems faced by the market intermediaries in the markets.

Policy implications

Based on the findings of the study, the following policy recommendations are suggested:

1. Cold storage, cleaning and grading infrastructure needs to be created or strengthened through establishment of such units at village level, if necessary in partnership with the private sector wherever perishable products are marketed in large quantities to enhance bargaining power of the farmers as well as increase their income through creation of additional form and time utilities.

2. Suitable capacity building programmes need to be organized by the State Government, NGOs and other developmental organizations to create awareness among various stake holders on quality standards and importance for creating demand in the market.

3. The electronic tendering system is having positive impact on arrivals, prices and has helped in better discovery of prices. Considering this, the scheme should be extended to other markets operating in the state.

4. Still there is a large gap persisting between the delivering and accessing of ICT application in agriculture by the farmers. The Central and State Governments should take necessary steps to start more ICT information service centers at village/ market levels with adequate facilities by way of preparing long range, useful and realistic information needed by the farmers to reduce the existing operational deficiencies and problems in agriculture sector.

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An optimal land water management plan for soil and water constrained tribal area of Jabalpur district

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Abstract

The basic motive of the study i.e. behind the current resources is to discover prospective of water management on selected tribal areas. An attempt has been made on current study to investigate the demand and supply by water resources for the both the tribal villages like Bichhua and Sanjari. The demand-supply deficit of water was analyzed and planning has been done to enhance the water availability. An optimum land and water use plan has also been derived considering current and proposed water resources availability for the efficient water utilization. Water adequacy plan aims towards optimum use of water for getting optimum profit per unit of land area.

At present cropping intensity of both the village is 166% and 135%. In order to achieve the maximum profit per unit of land i.e. cropping intensity more than 200% both village therefore an additional water supply plan was made for both the village individually to meet out these water demand supply gap. With this plan, It was found that the availability of water will be significantly increased to satisfy the water requirement for both the village. The cultivated land increased by 40 ha and 119.2 ha in Bichhua and Sanjari villages respectively. Hence the total cultivated area for Bichhua becomes 120 ha where for Sanjari it is 185.13 ha land available for Rabi season. An optimal land water management plan has been prepared for existing as well as future cropping pattern considering the proposed water conservation structure and results revealed that average income per capita will be increased in future for both the villages.

Key Words: Water management, Soil and water Constrained, Tribal Area

As water moves in time and space consistent with the hydrological cycle, the term 'water management' covers a variety of activities and disciplines. Broadly speaking, these can be divided into three categories: managing the resource, managing water services, and managing the trade-offs needed to balance supply and demand. The management of water is not merely a technical issue; it requires a mix of measures including changes in policies, prices and other incentives, as well as infrastructure and physical installations. (World Water Development Report 2012).

Water is a key driver of economic and social development while it also has a basic function in maintaining the integrity of the natural environment. However water is only one of a number of vital natural resources and it is imperative that water issues are not considered in isolation. (World Water Development Report 2012).

Managers, whether in the government or private sectors, have to make difficult decisions on water allocation. More and more they have to apportion diminishing supplies between ever-increasing demands. Drivers such as demographic and climatic changes further increase the stress on water resources. The traditional fragmented approach is no longer viable and a more holistic approach to water management is essential.

The competing demand for water in

agricultural, industrial and domestic uses resulting in fast depletion of the country's water resources. The agricultural sector continues to utilize over 90% of water resources. The ever widening gap between supply and demand necessitates greater need for efficient water conservation and management to increase area under irrigation. Further poor resource especially in tribal areas which are deprived of technical knowledge also led lower crop and water productivity. Developments by farmers along with scientific interventions are supposed to be the sustainable (Garg 2010).

Tribal area undulated in topography, dominated with low soil depth and meager irrigation facilities. Agriculture economy of the block is rain dependent. Farmers are not aware of new crop varieties, appropriate machineries and water management. Improving the agronomic practices such as planting methods and soil water management practices definitely increase crops production of new cultivars with reduction of water losses and increase water availability (Kawdeti 2015).

Scope for expanding the arable area (horizontal expansion) is rather limited; it becomes imperative to intensity biomass production under irrigated condition. There is a strong need for water budgeting, i.e demand and supply analysis from all sectors related to villages namely domestic, animal and agricultural sectors. Water available from all surface and underground sources i.e wells, tube-wells, hand-pumps etc. has to be estimated.

The basic motive behind the current resources is to discover prospective of water management on selected tribal areas. An attempt has been made on current study to investigate the demand and supply by water resources for the both the tribal villages.

Materials and methods

The area for current study was selected as Bichhua and Sanjari village of Kundam block of Jabalpur district about 24 km and 54 km from the headquarter respectively. The Survey of tribal both villages Bichhua and Sanjari was done with farmers on the basis of their size of land holding, awareness about new technologies, source of irrigation and type of crop taken in rabi and kharif season, water availability from all sources and willingness to do according to the new concept and ideas. Farmers were contacted personally to collect the desired information in Performa prepared for survey.

A detailed baseline survey was undertaken which involved household census survey, Bio-physical survey and Village level data collection. Household census survey includes a detailed questionnaire which was been filled by visiting each and every household in the village. Door to Door baseline survey was carried out through the Neighbor Hood Groups using structured questionnaire.

Bio-physical survey was undertaken to identify various natural resources available in the village. It included the soil typology, well in the area, crop taken in the field, Cropping pattern, fertilizer used and various sources of irrigation in the field.

Transect walk is a kind of exploratory walk, under taken by surveyor with the villagers to collect information on the soil type, land use pattern, cropping pattern, existing resource etc., In order to identify the areas to be treated, proposed work sites and assess the feasibility, the experts carried out a reconnaissance survey through transect walk.

The discharge of hand pumps, centrifugal pumps and tube wells were measured by volumetric method.

On the basis of Demand and Supply of water from both the villages for different classified sectors (i.e. domestic, livestock and agriculture) the deficit was assessed and planning was done to overcome shortage of water resources.

The base map of the area was prepared using the toposheet 64 A/4, 64A/8, of the Survey of India

(SOI) on a scale of 1: 50000. The toposheet was imported on GIS platform using Arc GIS 9.2 Software.

For georeferencing of the raster image data, at least four control points of the location should be identified. By using Geo-referencing tool in the main menu, and four control points at the four corners of the map by using Arc GIS 9.2 Software.

Procurement of Digital elevation model (DEM) was done from :URL: http:// bhuvan.nrsc.gov.in The DEM information was utilized for both the tribal villages for preparing Contour map, slope map and other useful map.

Contour map is a useful surface representation as they enable to simultaneously visualize flat and steep areas, ridges, valleys in the study area. The slope for different slope percentages derived from slope map. Study area has been classified. The slope categories were designated as per Land Use Capability Classification on the basis of slope categories.

Based on Topographical condition, the water sources like earthen dam, farm pond, open well and tubes well were proposed to overcome the deficit water condition for irrigation and other purposes.

The situation needs more attention when runoff water is required to be harvested as it is in the proposed study water adequacy plan was prepared keeping in mind the same objective for both villages transect through the area is rain fed and cropping intensity is very low, some crop like Wheat and Gram have the potential to grow well if irrigation is provided, therefore these two crops are taken for preparation of water adequacy plan.

A linear programming was performed to evaluate the optimal water requirement using the existing resource and considering proposed water sources and optimal planning was done to efficiently utilize with increase availability of water and cultivable land.

Linear programming using by Graphical method

By linear is meant a mathematical expression in which the variables do not have powers. (Hadley 1962).If Z is a function of two variables. In this method use in both condition existing and after propose resources.

(1) Objective Function - To maximize the net profit

$$\mathbf{Z\ max = C_1X_1 + C_2X_2}$$

Where,

C_1 = is represent Net profit per unit ha for Wheat crop (Rs/ha)

C_2 = is represent Net profit per unit ha for Gram crop (Rs/ha)

X_1 = Crop area for wheat crop (ha)

X_2 = Crop area for Gram crop (ha)

(2) Resource Constraints

(i). According to Water requirement of crop, crop area and water availability

$$\mathbf{= W_1X_1 + W_2X_2 \leq S}$$

Where,

W_1 = Water requirement for wheat crop (cm)

W_2 = Water requirement for Gram crop (cm)

S = Total Water Availability in the village (ha- cm)

(ii) According to crop (land) area

$$\mathbf{= X1 + X2 \leq A}$$

X_1 = Crop area for wheat crop (ha)

X_2 = Crop area for Gram crop (ha)

A = is represent for existing crop area for rabi season (ha)

(3) Non- negativity constraint

$$\mathbf{= X_1, X_2 \geq 0}$$

Cost of Cultivation and Return (Existing)

S. No.	Name of crop	Name of Varieties	Yield (q/ha)	Cost of Cultivation					Selling Price (Rs/q.)	Profit (Rs/ha)	Net profit (Rs/ha)
				Seed rate (kg/ha)	Fertilizer	Ploughing sowing etc.	Labour	Total cost (Rs/ha)			
1	Wheat	LOK-1, WH-147, Deshi	10	100 Kg @25 Rs	2000	4000	3000	11500	1500	15000	3500
2	Gram	JG-62, Deshi,	5	70 kg @50 Rs	1500	2500	3000	10500	4500	22500	12000

Results and discussion

Gap between demand and supply of water

The demand of water for domestic and animal use was calculated on daily basis while crop water requirement was calculated on crop season basis. The demand- supply gap of for water, if any, is presented in Table 1. It is clear from the table there was no shortage of water for domestic and animal use either of villages. However, for irrigation purpose, a gap of 1808.4 ha cm was noticed for village Bichhua (about Rabi crop area 80 ha) and Sanjari village a gap of 978.4 ha cm (about 65.77 ha). But this gap seems to be apparent because the rainfall in kharif season can easily compensate demand.

In present cropping pattern, the villages do feels shortage of water that causes equally important point is that, these villages were not utilizing their all field in all two seasons. Out of total cultivated area of 120 ha of Bichhua village, the area under Kharif was 120 ha, area under Rabi was 80 ha and 40 ha area not used in Rabi crop season whereas in summer no cultivation was practiced.

Table 1. Demand, Supply and Gap for Water for Bichhua villages

Name of Village	Demand		Supply		Gap Irrigation (ha cm)
	Domestic and Livestock (Litre/Day)	Irrigation (ha cm) Rabi crop	Hand pump and tubewell (Litre/Day)	Irrigation (well, tubewell, pond) ha cm	
Bichhua	42211	2550	42569.28	1142	-1408.65
					For 80 ha

Similarly in Sanjari village out of total cultivated area 256 ha Kharif cropped area was 185.13 ha and area under Rabi was 65.77 ha and 119.4 ha area not used in Rabi crop season whereas in summer season area was not cultivated.

Table 2. Demand, Supply and Gap for Water for Sanjari villages

Name of Village	Demand		Supply		Gap Irrigation (ha cm)
	Domestic and Livestock (Litre/Day)	Irrigation (ha cm) Rabi crop	Hand pump (Litre/Day)	Irrigation (well, tubewell, pond) ha cm	
Sanjari	46317.5	1646.55	46355.4	1203	-443
					For 65.77 ha

Contour map

Contour map is an essential map to identify the topographic character of the area. The contour lines were delineated by overlaying the village boundary over the topographic sheet and delineating over the contour lines on the topographic sheet. It was found that contour line elevation is lying between Bichhua villages is 500 m to 590 m. and Sanjari village is 390 m to 450 m. The elevation is higher at the extreme portions of the village and is decreasing towards the outlet of village and contour interval is 1m.

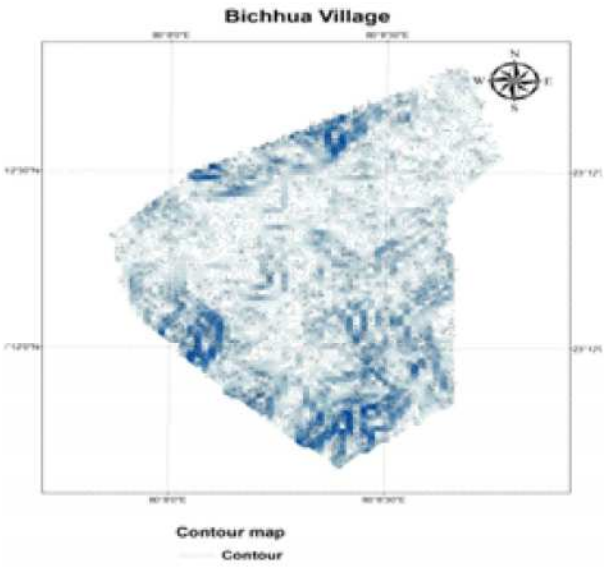

Fig. 1. Contour map of Bichhua village

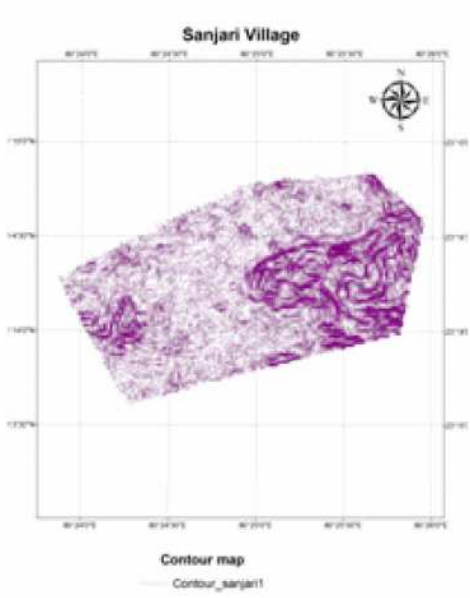

Fig. 2. Contour map of Sanjari village

Slope map

Slope map was prepared using the DEM. The slope categories were designated as per Land Use Capability Classification of Suresh (2012) on slope categories. The results obtained from the slope analysis Bichhua and Sanjari Villages are mapped.

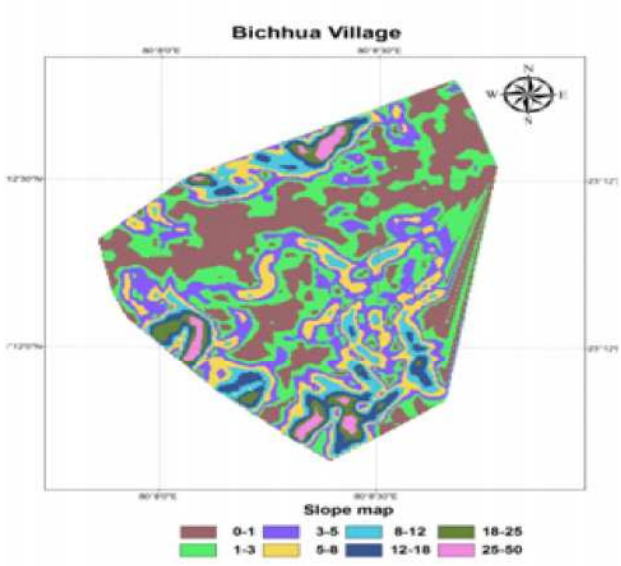

Fig. 3. Slope map of Bichhua village

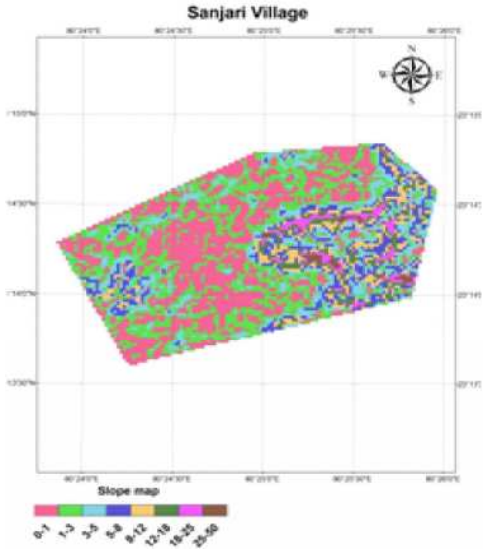

Fig. 4. Slope map of Sanjari village

Land Use Capability Classification (LUCC) based on slope

These villages to classify LUCC based on slope, present observed slope % in Bichhua and Sanjari village, Bichhua village and Sanjari village classify 8 classes are listed (Table 3 and 4.)

Table 3. Land Capability Classification of Village area (Bichhua)

Name of Class	Slope %	Land Capability classes	Area	
			(ha)	Percentage (%)
Nearly Level	0-1	I	9.72	4.86
Gently Sloping	1-3	II	51.63	25.815
Moderately Sloping	3-5	III	40.76	20.38
Strongly Sloping	5-8	IV	40.54	20.27
Moderately steep	8-12	V	26.98	13.49
Steep	12-18	VI	18.93	9.465
Very steep	18-25	VII	8.66	4.33
Very very steep	>25	VIII	2.78	1.39

Table 4. Land Capability Classification of Village area (Sanjari)

Name of Class	Slope %	Land Capability classes	Area	
			(ha)	Percentage (%)
Nearly Level	0-1	I	51.12	13.45
Gently Sloping	1-3.	II	177.02	46.54
Moderately Sloping	3-5.	III	43.42	11.42
Strongly Sloping	5-8.	IV	54.09	14.23
Moderately steep	8-12.	V	45.34	11.92
Steep	12-18.	VI	7.3	1.91
Very steep	18-25.	VII	1.6	0.42
Very very steep	>25	VIII	0.43	0.12

Drainage map

These selected villages in drainage pattern in the area shown below figures.

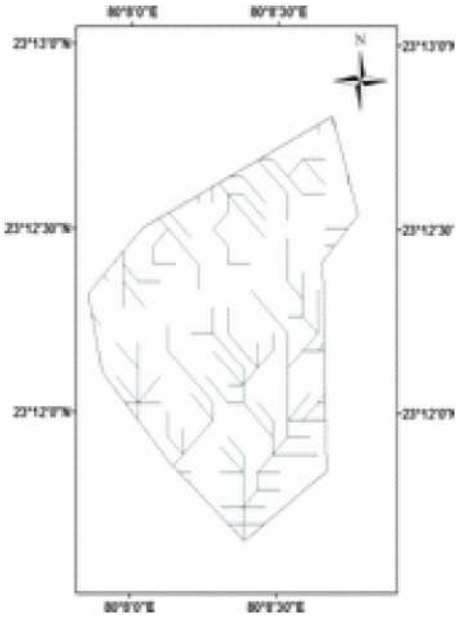

Fig. 5. Drainage map of Bichhua village

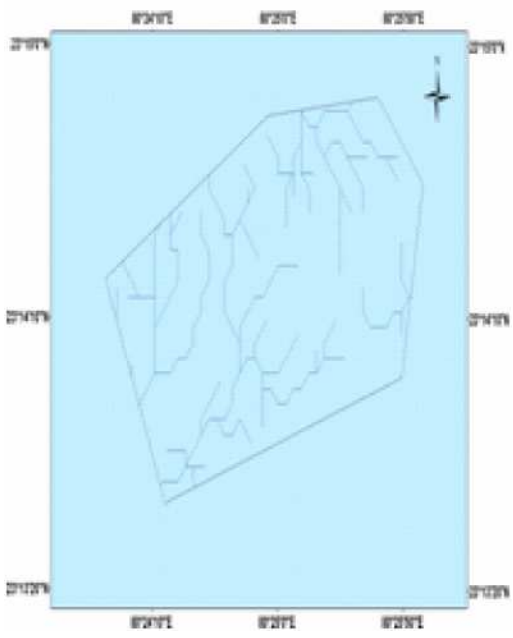

Fig. 6. Drainage map of Sanjari village

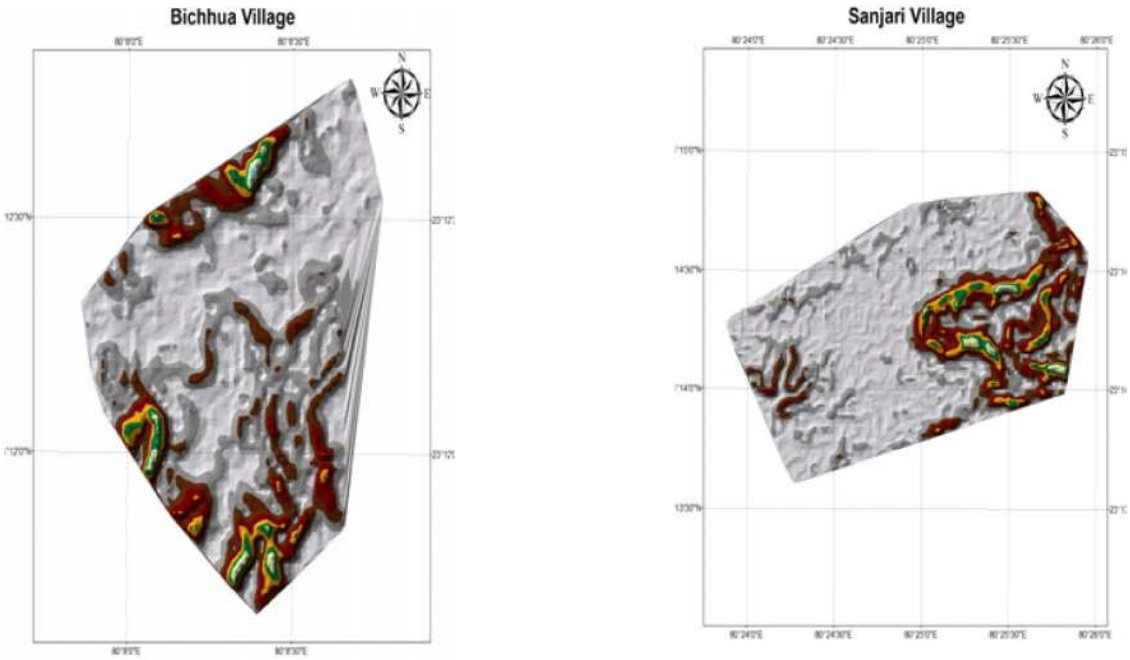

Fig. 7. 3D maps of both villages

Table 5. Water conservation structure for Bichhua village (Propose)

Name of village	Type of source (Proposed)	Quantity	Availability of water (ha cm)
Bichhua	Earthen dam	1	2825.8

Table 6. Water conservation structure for Sanjari village (Propose)

Name of Village	Type of Source	Power (Hp)	No. of quantity	Availability of water (ha cm)
Sanjari	Farm pond		8	2068.672
	Well	5	8	1240
	Tubewell	5	5	435
Total				3743.672 ha cm

Table 7. Comparison of the Present land use versus the proposed land use (Bichhua)

Particular	Status		Remark
	Present land use	Proposed land use	
Cropping intensity	166.66%	200%	Increase of 33.33 %
Water availability of all sources	1142ha cm	2825.8 ha cm	Total 3967.8 ha cm
Rabi Season Crop area	80 ha	120 ha	Increase Crop area 40 ha

Table 8. Comparison of the Present land use versus the proposed land use (Sanjari)

Particular	Status		Remark
	Present land use	Proposed land use	
Cropping intensity	135.40%	200.00%	Increase 64.54 %
Water availability of all sources	1203 ha cm	3743.67 ha cm	Total 4946.6 ha cm
Rabi Season Crop area	65.77 ha	185.13	increase Crop area119.36

Prepare land use plan for optimal water utilization

Considering the deficit condition for the villages, the optimal utilization of water resources is the need of time. So the optimal plan for land and water management was derived for efficient utilization using linear programming techniques.

Management planning for optimum utilization of existing resources plan and propose plan through linear Programming

Village	Bichhua		Sanjari	
	Existing	Proposed	Existing	Proposed
Objective Function	$Z_{max}= 3500X_1 + 12000X_2$	$Z_{max} = 3500X_1 + 12000X_2$	$Z_{max} = 3500X_1 + 12000X_2$	$Z_{max}= 3500X_1 + 12000X_2$
Resource Constraints	$45X_1 + 15X_2 \leq 1142$	$45X_1 + 15X_2 \leq 3964$	$45X_1 + 15X_2 \leq 1203$	$45X_1 + 15X_2$?4946
Non-negativity constraint	$X_1 + X_2 \leq 80$	$X_1 + X_2 \leq 120$	$X_1 + X_2 \leq 65.77$	$X_1 + X_2 \leq 185.13$
Results	$X_1 = 25$ ha, $X_2 = 76$ ha	$X_1 = 72$ ha, $X_2 = 48$ ha	X_1=7.2 ha, X_2 =48 ha	X_1=69 ha, X_2 =116 ha

The study was carried out in two villages Bichhua and Sanjari of Kundam block district- Jabalpur. Various data for water budgeting (to find out demand- supply gap) was obtained from a questionnaire and by undertaking door to door survey. The water availability has been assessed for future use as per the proposed water conservation structure and it was found that the availability of water will be significantly

increased to satisfy the water requirement for both the village. The cultivated land increased by 40 ha and 119.2 ha in Bichhua and Sanjari villages respectively. Hence the total cultivated area for Bichhua becomes 120 ha where for Sanjari it is 185.13 ha land available for Rabi season. This water supply plan provides additional water for irrigation purposes, which help in increasing the cropped area ultimately, increasing the cropping intensity and also provides life saving irrigation for kharif season. An optimal land water management plan has been prepared for existing as well as future cropping pattern considering the proposed water conservation structure and results revealed that average income per capita will be increased in future for both the villages. The adequacy plan adequately meet out the competing demand of water for domestic and irrigation purposes as the population is increasing at the rapid rate. This also helps in improving the socio-economic condition of the rural peoples.

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A Technique for Fertilizer Testing

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Abstract

Adulterations in phosphatic fertilizer have often being reported by various agencies. There is no readily available quick method for testing the level of adulteration especially in Single Super Phosphate and Di Ammonium Phosphate. The authors have used photometric Vanado Molybdo Phosphoric Yellow Colour Method for quantitative estimation of percentage Phosphorus (P) with the modification in sample preparation and standards. A small fertilizer testing meter has been designed consisting of Light Emitting Diode as a source of monochromatic radiation, cuvette, a photo detector, signal processing unit and digital panel meter.

In normal photometric method the quantity of the sample is to be in mg with large scale dilution needed for preparing working solutions of standard and sample. The complexity of the above makes this method suitable for laboratories and need trained man-power. In the newly evolved method the dilution procedure has been simplified for meeting required testing adulteration levels. The sample size needed is also easily weighable 1 gm quantity duly crushed and dissolved in 50 ml tap water for knowing the water soluble P. Strips of Watman filter paper no. 1 of size 5x1 sq cm have been optimized for making dilutions of the sample and standard solutions. For obtaining dilution strips are dipped in 5 ml of sample/standard solution taken in a petridish of 5.6 cm dia and 1.3 cm depth. The lower portions of the strip were vertically dipped and solutions after raising through capillary action upto a certain mark were transferred into 5 ml tap water. Thereafter 0.5 ml of molybdo Vanado reagent is added for colour development. The transmittance values of the colour at 470 nm wavelength were measured in the designed fertilizer testing kit. The system has been calibrated with the standard prepared on potassium dihydrogen phosphate by adopting the same technique of dilution and colour development. The performance of the equipment is very much satisfactory for quick testing of adulteration.

Keywords: Phosphatic fertilizer, adultration, photometric method, wavelength, water soluble

Fertilizers may be defined as any material organic or inorganic, natural or synthetic, which supplies one or more essential elements required for the plant growth.

Balanced and efficient application is essential to compensate for the optimum yields and sustainability of soil health. The consumption of fertilizers is increasing steadily with the progress of scientific agriculture in India. With the increase in demand, consumption and prices of fertilizers, the malpractice like adulteration in fertiliser or sale of sub-standard fertilizers are also reported to have increased to some extent. If adulterated fertilizers are allowed to be marketed, not only the farmers loose faith in the use of fertilizers but crop production also suffers. Moreover, there could be harmful effect on the soil, if undesirable material is used for adulteration of fertilizers. Farmers are rarely in a position to judge the quality of fertilizers. They have to trust the information and material supplied by the dealers. Thus, effective quality control measures become necessary.

In the present scenario the testing of adulterations in chemical fertilizers is based on gravimetric/volumetric/ instrumental. The methodologies are suitable to well established laboratory. As fertilizers are concentrated

agglomerate, their dilution to a level of ppm is very tedious and cumbersome. Without this, the testing is not possible. Any type of errors in dilution is multiplied many times while calculating the percentage of an element in a fertilizer. More -over the testing needs trained chemist. In view of the above it was thought to develop a kit based on known laboratory methods with modifications in dilution procedure enabling the methodology for quick testing at village level. This will only be a primary method to ascertain the adulteration and sample so segregated can be sent to laboratory for confirmation and to cover legal aspects of testing.

Material and methods

It is a known fact that quantitative estimation of composition in a fertilizer is determined by gravimetric/ volumetric methods. These methods are standard but time consuming and cumbersome. There are some recognized photometric methods for quantitative estimation of some fertilizers for knowing their constituent percentage, but they are not being used due to:

(i) very small quantity in the range of tenth of mg is needed for the preparation of standard and sample solutions. Any inaccuracy in their weighing multiplies the error at different stages.

(ii) a large-scale dilution is needed for preparing working solutions of standard and sample. This leads to the possibilities of error multiplication at different levels of dilution.

In the developed system, photometric method has been used for fertilizer analysis for quickly determining the adulteration to the level of acceptable quality. In this regard, a novel way of dilution of sample and standard has been evolved. The developed photometer consists of a monochromatic light source (blue LED). This radiation is allowed to pass through the prepared sample. Phototransistor is used as the detector. A part of light is absorbed by the sample (proportion to concentration of sample) and rest is transmitted through the sample and collected by the phototransistor. The intensity of the sample colour represents the concentration of nutrients in the fertilizer. The output of the phototransistor varies according to the concentration of the sample. The percentage of phosphorus in Single Super Phosphate (SSP) & Di Ammonium Phosphate (DAP), and Nitrogen in Urea can be obtained from the ready-reckoner chart developed.

Dilution procedure evolved

For obtaining required dilution Watman filter paper no. 1 strip of size 5x1 cm2 were dipped in 5 ml of sample/standard solution taken in a petridish of 5.6 cm diameter and 1.3 cm depth. The lower portion of strips was vertically dipped and solutions were allowed to rise up to a mark (definite height i.e. central mark) by capillary action. The strip was removed when the solution rises to the marked level. During the above procedure the strips were rested through the wall of the petridish and not required to be hold by hand. The weight of the strip was immediately taken to ascertain the quantity of absorbed fertilizer solution on the strip. The table 1 describes the amount of solutions absorbed on the strip.

Description of the system

The system for fertilizer testing is portable, low weight and of low cost. The block diagram of the system is shown in Fig 1. The kit consists of the following components for the measurement of water soluble phosphorus in SSP & DAP and nitrogen in Urea:

(i) Basic instrument (developed system).

(ii) Petridish, beaker, test tube, thissel funnel, measuring funnel, wash bottle.

(iii) Filter paper, filter paper strips (Watman filter paper no. 1) of sizes 5x0.5, 5x1 and 5x2 cm2.

(iv) Molybdo-vanado reagent for phosphatic fertilizers.

(v) P-dimethyl Amino Benzaldehyde reagent for

urea.

Calibration Procedure

The system is calibrated separately for SSP and DAP. For calibration purpose 2.195 g potassium dihydrogen phosphate is dissolved in 100ml water to form 5000 ppm P solution. 5,10,20,30 and 40 ml of 5000 ppm P solution is taken in 100 ml volumetric flask separately. The volume of each flask is make upto 100 ml by distilled water. The solutions thus formed are now 250, 500, 1000, 1500 and 2000 ppm respectively. Approximately 5 ml of each solution is taken in a petridish one by one. Dilution of all solutions is done as per dilution procedure evolved. The strips are taken out and absorbed quantity of standard are then transferred in 5 ml tap water and 0.5 ml of molybdo-vanado reagent is added for colour development. Blank solution is prepared by adding 0.5 ml of molybdo-vanado reagent to 5 ml tap water. Instrument's reading is adjusted to zero with the help of Zero set knob after placing the blank solution in the sample holder. Readings of standard solutions are then taken. Table 2 is the calibration table for SSP. The calibration graph is shown in Fig 2. Similarly Table 3 and Table 4 are calibration table for DAP and Urea respectively. Fig 3 and Fig 4 shows the calibration graphs of DAP and Urea respectively.

Determination of SSP

1 g of SSP fertilizer weighed and crushed to bring it to powder form. Dissolve the crushed powder in 50 ml tap water. Shake gently and filter the solution. Dilution is done as per dilution procedure evolved. The strip is taken out and absorbed quantity of fertilizer is then transferred in 5 ml tap water and 0.5 ml of molybdo-vanado reagent is added for colour development. The colour intensity is measured by the developed instrument.

Result and discussion

By adopting the above method, many fertilizer samples collected from Fertilizer Quality Control Lab of Jabalpur have been tested and found satisfactory results.

फास्फेटिक उर्वरक में मिलावट की सूचना विभिन्न एजेंसियों द्वारा की जा रही है। सिंगल सुपर फॉस्फेट और डाई अमोनियम फॉस्फेट में मिलावट के स्तर का तुरंत परीक्षण करने के लिए कोई विधि उपलब्ध नहीं है। लेखकों ने नमूना तैयार करने और मानकों में संशोधन के साथ फॉस्फोरस (P) प्रतिशत की मात्रात्मक अनुमान के लिए फोटोमेट्रिक वेनाडो मोलिब्डो फॉस्फोरिक पीला रंग विधि का उपयोग किया है। एक छोटे उर्वरक परीक्षण मीटर को विकसित किया गया है जिसमें प्रकाश उत्सर्जक डायोड को मोनोक्रोमेटिक विकिरण स्रोत के रूप में , क्युवेट, एक फोटो डिटेक्टर, सिग्नल प्रोसेसिंग यूनिट और डिजिटल पैनल मीटर इत्यदि का उपयोग किया गया है।

सामान्यतः फोटोमेट्रिक विधि में नमूने की मात्रा मिलीग्राम में ली जाती है एवं मानक और नमूने के घोल तैयार करने के लिए बड़े पैमाने पर तनुकरण करना पडता है। उपरोक्त जटिलता के कारण यह विधि प्रयोगशालाओं के लिए उपयुक्त है एवं इसके लिए प्रशिक्षित व्यक्ति की आवश्यकता होती है। नव विकसित विधि में तनुकरण की प्रक्रिया को सरल किया गया है।

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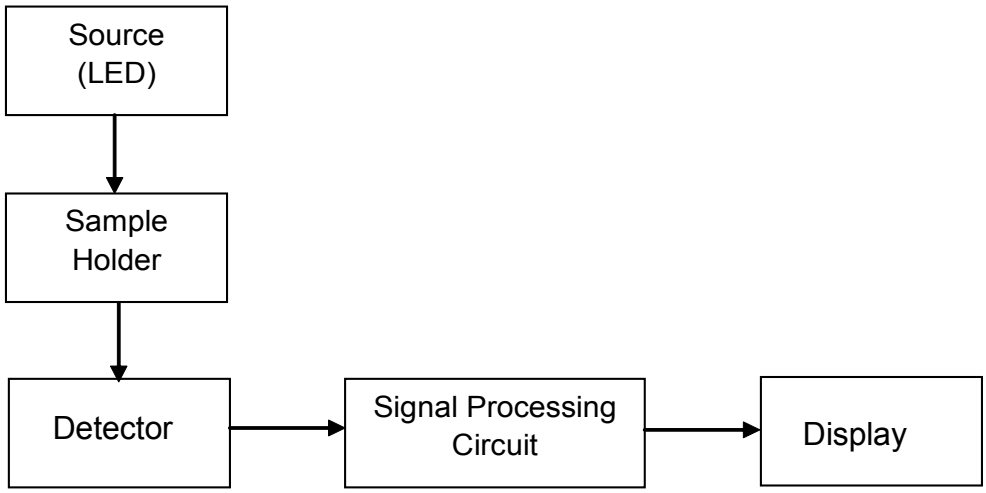

Fig 1. Block diagram of Fertilizer Testing Kit

Table 1: Quantity of Single Super Phosphate absorbed in filter paper strip (5x1cm2)

Wt of dry filter paper (in g)	Wt of filter paper after dipping in SSP solution (in g)	Wt of SSP (in g)	Ml of SSP	Mean of ml	Deviation	Standard Deviation
0.0250	0.0517	0.0267	0.0269		0.0007	
0.0263	0.0470	0.0207	0.0208		0.0068	
0.0272	0.0535	0.0262	0.0264		0.0012	
0.0261	0.0524	0.0263	0.0265		0.0011	
0.0266	0.0561	0.0295	0.0297	0.0276	-0.0021	0.00278
0.0262	0.0560	0.0298	0.0300		-0.0024	
0.0269	0.0548	0.0279	0.0281		-0.0005	
0.0250	0.0564	0.0314	0.0316		-0.0040	
0.0283	0.0570	0.0287	0.0289		-0.0013	
0.0262	0.0533	0.0271	0.0273		0.0003	

Standard error of mean=0.000874

Table 2 : Calibration Table for SSP

Standard P solution (ppm)	Reading I	II	III	IV	V	Mean	Deviation I	II	III	IV	V	Std. deviation	Std. error of mean
0	0	0	0	0	0	0	0	0	0	0	0	0	0
250	18	19	17	16	18	17.6	0.4	1.4	-0.6	-1.6	0.4	1.1401	0.5112
500	54	56	55	54	55	54.8	-0.8	1.2	0.2	-0.8	0.2	0.8366	0.3751
1000	89	90	89	87	86	88.2	0.8	1.8	0.8	1.2	-2.2	1.6431	0.7368
1500	120	118	121	121	120	120	0	2.0	1.0	1.0	0	1.2247	0.5491
2000	135	137	136	135	137	136	-1.0	1.0	0	-1.0	1.0	1.0	0.4484

Table 3 : Calibration Table for DAP

Standard P solution (ppm)	Reading I	II	III	IV	V	Mean	Deviation I	II	III	IV	V	Std. deviation	Std. error of mean
0	0	0	0	0	0	0	0	0	0	0	0	0	0
2500	115	117	117	116	115	116	-1.0	1.0	1.0	0	-1.0	1	0.4484
3000	121	120	121	120	122	120.8	0.2	-0.8	0.2	-0.8	1.2	0.8366	0.3751
3500	163	165	165	164	163	164	-1.0	1.0	1.0	0	-1.0	1	0.4484
4000	171	171	170	171	172	171	0	0	-1.0	0	1.0	0.7071	0.3170
4500	185	187	186	185	185	185.6	-0.6	1.4	0.4	-0.6	-0.6	0.8944	0.4010

Table 4 : Calibration Table for Urea

Quantity of Urea in mg dissolved in 10 ml water	Reading I	II	III	IV	V	Mean	Deviation I	II	III	IV	V	Std. deviation	Std. error of mean
0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	14	13	15	16	18	15.2	-1.2	-2.2	-0.2	0.8	2.8	1.9235	0.8625
250	37	36	38	37	39	37.4	-0.4	-1.4	0.6	-0.4	1.6	1.1401	0.5112
500	47	46	45	47	49	46.8	0.2	-0.8	1.8	0.2	2.2	1.4832	0.6651
1000	59	60	62	61	62	60.8	-1.8	-0.8	1.2	0.2	1.2	1.3038	0.5846

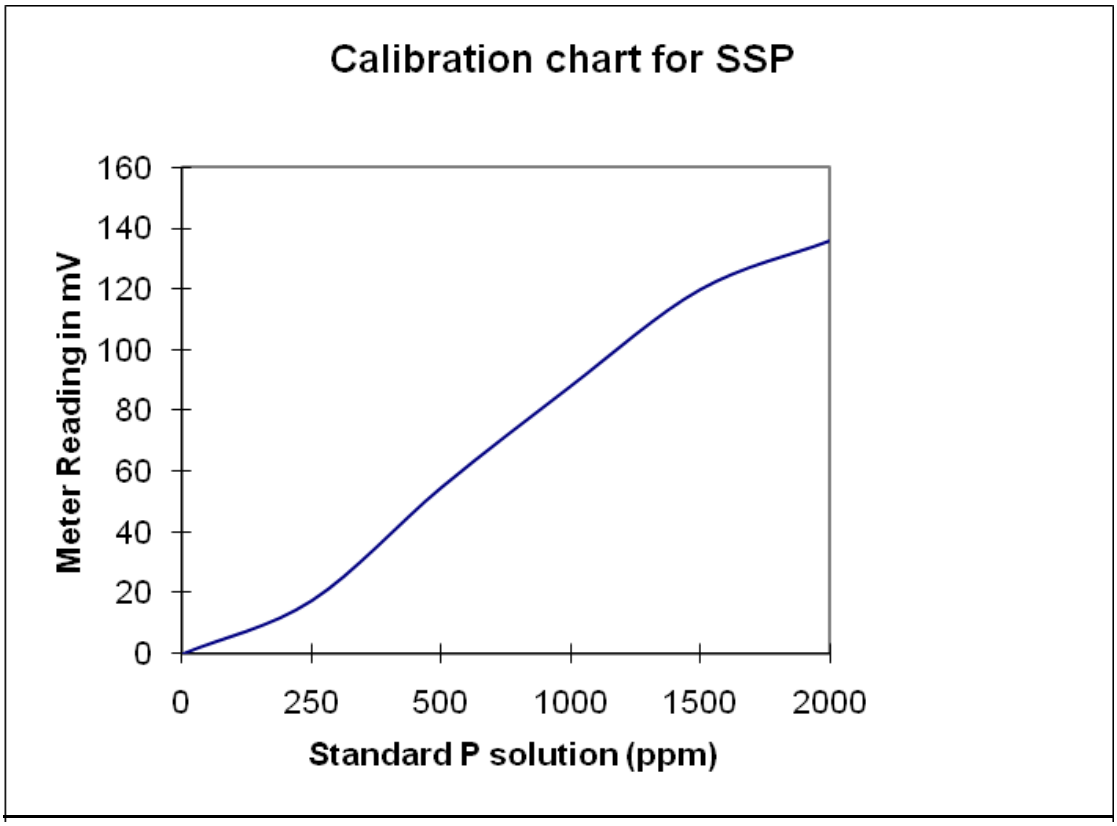

Fig 2. Calibration graph for SSP

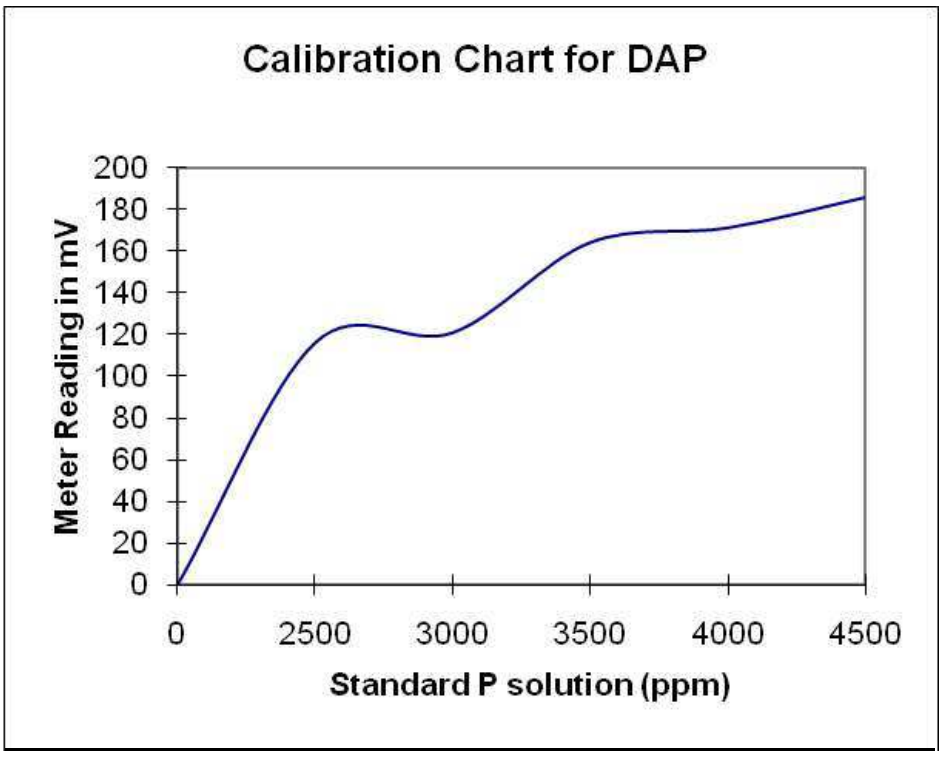

Fig 3. Calibration graph for DAP

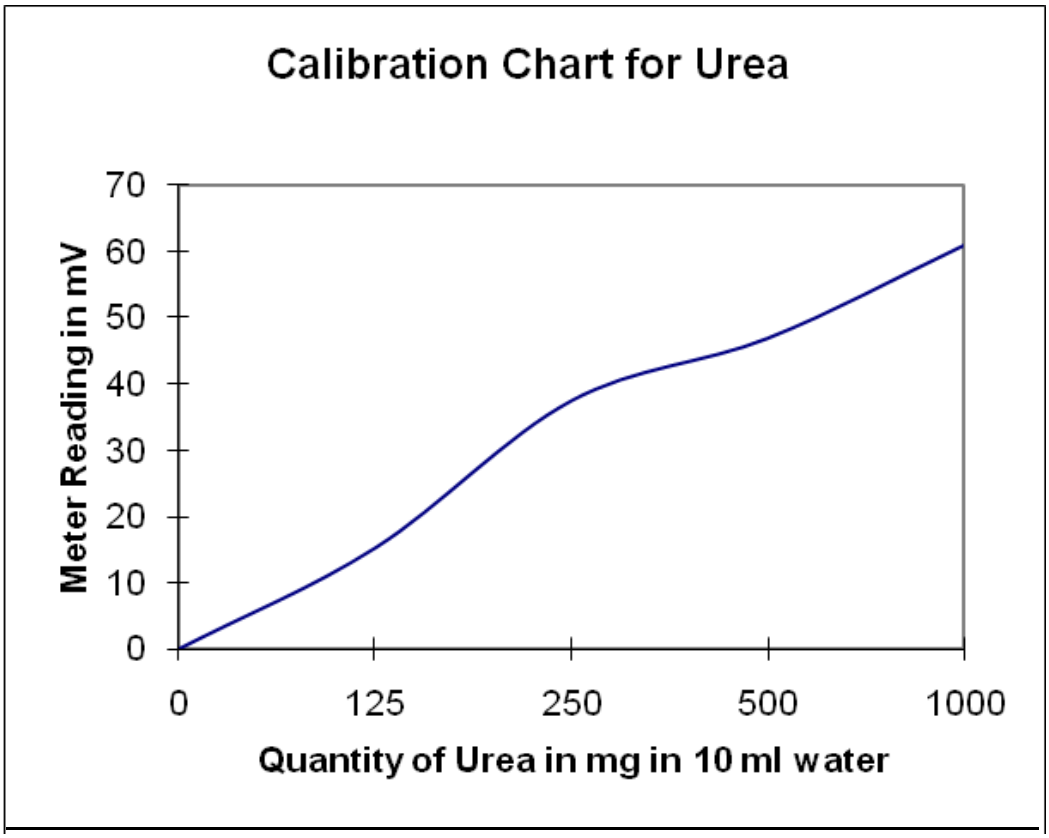

Fig 4. Calibration graph for Urea

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Drudgery reduction among farm women by adopting improved farm tools in Madhya Pradesh, India

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Abstract

Maximum number of farm women among 115 from six villages in Narsinghpur block of Narsinghpur district had low adoption level regarding improved farm tools. This study provides scope for promotion of technology in gender perspective towards the challenges of farm women that would help in reducing drudgery and occupational health problem of women workers in agriculture.

Keywords - improved farm tools, drudgery, farm women

Indian agriculture sector accounts for 18 per cent of India's gross domestic product (GDP) and provides employment to 50% of the countries workforce. It has been established as one of the drudgery prone occupation of unorganized sector due to lack of access to improved agricultural technologies. A huge number of rural women engaged in agricultural and allied sector, perform different activities viz. crop production, irrigation, manuring, post-harvest operations, agro/social forestry, livestock activities, fisheries (Sudharani and Raju, 1991).

Drudgery is a term used to represent the dissatisfactory experiences that constrain work performance in any activity. It is generally conceived as physical and mental strain, agony, monotony and hardship experienced by human beings, while all these resulting in decline in living and working condition affecting men and women alike (*Nayak et al.2015*). The farm women put in hard physical labour beyond their capacity. A continuous over work affects adversely their mental and physical well-being.The traditional tools used bywomen involves operating in bending or squatting posture which cause drudgery and serious healthissues such as back pain, knee pain etc. (*Khadatkar et al., 2017*). The farm womenare forced to use these tools due to unawareness and non-adoption of women friendly tools.

Consequently, it is imperative to empower the farmwomen through adoption of technology that results higher efficiency in the work with reduced drudgery through women friendly farm tools. Implements may include serrated sickle, hand ridger, seed treatment drum, Naveen dibbler, fertilizer broadcaster, twin wheel, sugarcane stripper etc.

Materials and Methods

Out of the total seven blocks of Narsinghpur district, the present study was conducted in Narsinghpur block and six villages were selected. Only 10 per cent of the respondents were taken from all the selected six villages by using proportionate random sampling method. Therefore, total 115 farm

women were selected for investigation to collect the data. Primary and secondary data were collected from different methods and sources. The data collected were analysed by using simple statistical techniques.

Results and Discussion

Improved farm tools like improved shovel, improved spade and hand operated bund maker used for land preparation, it was found that 20.88 per cent respondents had complete adoption of these improved farm tools followed by partial (32.17%) and no adoption (46.95 %) respectively (Table 1).

Seed treatment plays a significant role in improving the establishment of healthy crops; therefore, improved seed treatment drum is used. It was recorded that 13.04 per cent respondents had complete adoption of improved seed treatment drum followed by 73.92 per cent and 13.04 per cent of the respondents had partial and no adoption respectively.

Table 1: Extent of adoption of improved farm tools to reduce drudgery

S. No.	Statement	Adoption level					
		Complete		Partial		No	
		f	%	f	%	f	%
1	Improved farm tools like improved shovel, improved spade and hand operated bund maker used for land preparation	24	20.88	37	32.17	54	46.95
2	Seed treatment drum used for seed treatment	15	13.04	85	73.92	15	13.04
3	Hand operated seed drill used for sowing	18	15.66	-	-	97	84.34
4	Improved farm tools like twin wheel hoe, cono weeder, trench hoe and improved spade used for weeding	28	24.34	-	-	87	75.66
5	Improved fertilizer broadcaster used for fertilizer application	19	16.52	58	50.43	38	33.05
6	Improved farm tools like improved sickle, improved chaff cutter (chopper) used for harvesting	18	15.65	-	-	97	84.35
7	Improved farm tools like pedal operated paddy thresher, Maize Sheller, Sugarcane Stripper used for threshing	84	73.04	21	18.27	10	8.69
8	Winnower fan used for winnowing	66	57.39	22	19.13	27	23.48
9	Hanging type grain cleaner can be used for cleaning grains	32	27.82	-	-	83	72.18

For sowing purpose, hand operated seed drill was completely adopted by 15.66 per cent respondents whereas 84.34 per cent of the respondents had no adoption of this type of seed drill.

Improved farm tools viz. twin wheel hoe, cono weeder, trench hoe and improved spade used for weeding was completely adopted by 24.34 per cent respondents and 75.66 per cent of the respondents had no adoption.

For fertilizer application, it was observed that, 16.52 per cent, 50.43 per cent and 33.05 per cent of the respondents had complete, partial and no adoption of improved fertilizer broadcaster respectively.

As for as adoption of improved farm tools like improved sickle, improved chaff cutter (chopper) used for harvesting is concerned, 15.65 per cent and 84.35 per cent of the respondents had complete and no adoption respectively.

Majority (73.04 per cent) of the respondents

had complete adoption of improved farm tools i.e. pedal operated paddy thresher, Maize Sheller, Sugarcane Stripper used for threshing followed by 18.27 per cent had partial and 8.69 per cent respondents had no adoption.

More than half (57.39%) of the respondents had complete adoption of improved winnower for winnowing the crop produce followed by 19.13 per cent and 24.34 per cent had partial and no adoption respectively.

In case of hanging type grain cleaner, 27.82 per cent respondents had complete adoption; whereas 72.18 per cent of the respondents had no adoption.

Overall adoption

The distribution of respondents according to their extent of adoption of improved farm tools is presented in Table 2. It is observed that majority of the respondents (50.43%) had low level of adoption followed by medium (44.35%) and high (5.22%) extent of adoption of improved farm tools respectively (Table 2). Thus, majority of respondents had low level adoption of improved farm tools.

Table 2: Distribution of the respondents according to their extent of adoption

Categories	Adoption	
	Frequency	Percentage (%)
Low	58	50.43
Medium	51	44.35
High	6	5.22
Total	115	100.00

Majority of respondents had low level adoption of improved farm tools. The finding is supported with the work of Ahlawat and Singh (2018).

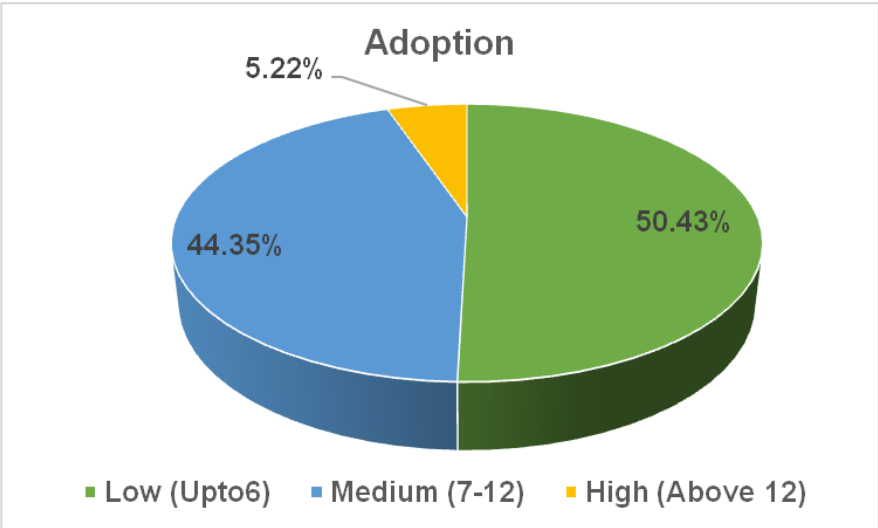

Figure 1 Distribution of the respondents according to their adoption of drudgery reducing improved farm tools

Women are backbone of agricultural workforce because they perform more than eighty percent of farm activities. Most of the agricultural activities performed by women involve lot of physical strain which adversely affect their work efficiency and causes fatigue. Women should be educated about the benefit of farm tools and trained in use and maintenance. This study provide scope for promotion of technology in gender perspective towards the challenges of farm women help in reducing occupational health problems of farm women in agriculture.

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Accuracy assessment of land use land cover mapping of a watershed of Narmada basin using Remote sensing and Geographical Information System

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Abstract

Formulation of an effective management plan for the development of watershed require accurate analysis of the past and present land use and land cover parameters as alterations in these parameters are greatly responsible for any sort of hydrological and ecological imbalances occurring within a watershed. Remote sensing (RS) and Geographical Information System (GIS) are very important toolset which provide the variety of information for the production of land use and land cover maps without compromising the quality and quantity of the data. The study explains the classification and accuracy assessment of land use and land cover mapping of Narmada basin (Banjar river watershed). A RESOURCE SAT II LISS III image of 2011 having a resolution of 30 m was used for this research work. The unsupervised and supervised classification was done in ERDAS IMAGINE software. Depending upon the classification the study area was divided into seven land use and land cover classes namely, river, water body, waste land, habitation, forest, agriculture/ other vegetation, open land/fallow land/barren land. The overall accuracy and kappa statistics of the classification was found to be 87.50% and 0.8422. The accurate areal extent information of land use and land cover of an area is useful for figuring out of developmental plans of an area.

Keywords: Land use and land cover classification, Accuracy Assessment, Kappa coefficient, Remote Sensing and Geographic Information System.

Land use/ land cover mapping is an essential component for policy makers to take effective decision for expanding the developmental index of earth resources. Land use relates to the human activity or economic function associated with a specific piece of land (*Lillesand et al. 2004 and Tiwari et al., 2017a*). Examples of land use include agriculture, urban development, grazing, logging, and mining. In contrast, land cover relates to the composition and characteristics of land surface elements (Cihlar, 2000). The accurate assessment of land use and land cover change provide a better understanding of the relationships and interactions between human and natural phenomena for the sustainable management of the earth resources (Tiwari, 2017b). Accuracy assessment or validation is an important step in the processing of remote sensing data (*Abubaker et al. 2013*). It determines the quality of information of the resulting data to a user. In order to determine classification accuracy, it is necessary to check whether the output map meets certain predetermined classification accuracy criteria.

Statistical approach to assess classification accuracy is with the use of an error matrix. Error matrix is formed by selecting the random pixels from the

thematic map and comparing these random pixels to the reference data. The number of random pixels is an important factor in determining the accuracy of a classification (Congalton & Green 1999 and Khorram, 1999). The Google Earth and Field visits can be as a means of ground verification of satellite data. The rows in the matrix represent the remote sensing derived land use map (i.e., Landsat data), while the columns represent the reference data (i.e., ground truth, in-situ samples) (Paliwal and Katiyar, 2015). The error or confusion matrix provides the information regarding the overall classification accuracy, percentage of omission and commission error by category, and the kappa coefficient (Tiwari 2017b). The most common error estimate is the overall accuracy, while Kappa coefficient (K) is the measure of agreement of accuracy. It provides a difference measurement between the observed agreement of two maps and agreement that is contributed by chance alone. The confusion matrix is used to enhance the value of the classification for the user. Thus the accuracy assessment assesses how well a classification worked.

With the advancement of technology, remote sensing has become the most effective tool for assessing and monitoring all transitions occurring on the earth's surface (Rex, 2015 and Brian, 2015). It is used for collecting the requisite data to solve problems relate to land use planning (*Sharma et al., 2010 and Patil et al., 2016*). RS and GIS are integrated to prepare the complex image classification, which includes determination of a suitable classification system, selection of training samples, image preprocessing, feature extraction, selection of suitable classification approaches, post-classification processing, and accuracy assessment as a major steps.

Objective of present study is to classify the satellite image of 2011 and estimate the accuracy of different land use and land cover classes of a watershed (Banjar river watershed) of Narmada basin located in between Balaghat and Mandla districts of Madhya Pradesh, India.

Materials and method

Study area

The present study has been carried out in a watershed (Banjar river watershed) of Narmada basin (Fig. 1) lies in Balaghat and Mandla districts of Madhya Pradesh, geographically located between $22^0$05'N to $23^0$29'N latitudes and $80^0$22'E to $81^0$00'E longitudes. The watershed covers total geographical area of 246084 ha up to gauging point. It is situated in the eastern part of Madhya Pradesh. Climate of the area is tropical with moderate winter and severe summers and well distributed rainfall received from southwest monsoon. The normal annual rainfall of study area is 1300 mm. Soils of the area are characterized by black grey, red and yellow colours, often mixed with red and black alluvium and ferruginous red gravel or lateritic soils. These soils are commonly known as black soils. In barren areas where soil is shallow, fine platy structure surface soil and compressed blocky structure subsurface soils are visible.

Methodology

The land use/cover classification of the study area and accuracy assessment was carried out as per the methodology presented in (Fig. 2). The RESOURCE SAT II LISS III data of 2011 having a resolution of 30m was obtained from Bhuvan Indian Geo-Platform of ISRO (bhuvan.nrsc.gov.in) site. The False Color Composite (FCC) was generated with the help of satellite image processing software by importing the data in the ERDAS Imagine 2011. The layer stack option in image interpreter tool box was used to prepare FCC (Fig. 3) for the study area. The satellite image was extracted from the georeferenced outline boundary of study area in ARC GIS environmen

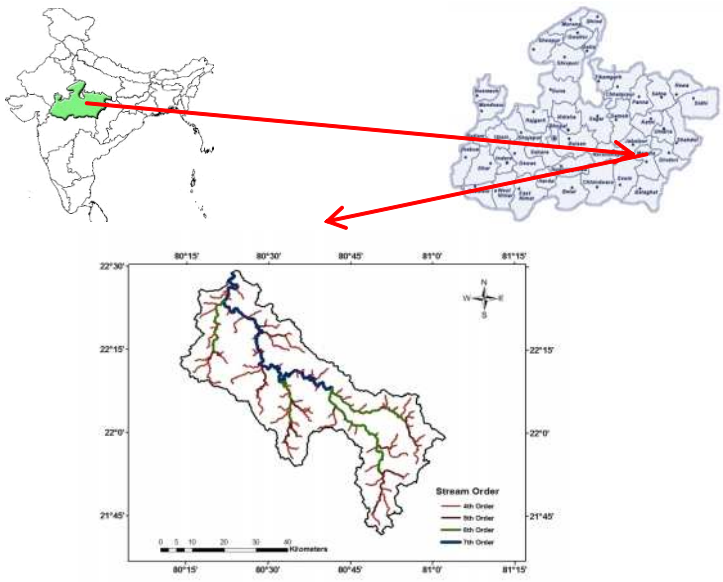

Fig. 1 Location map of study area

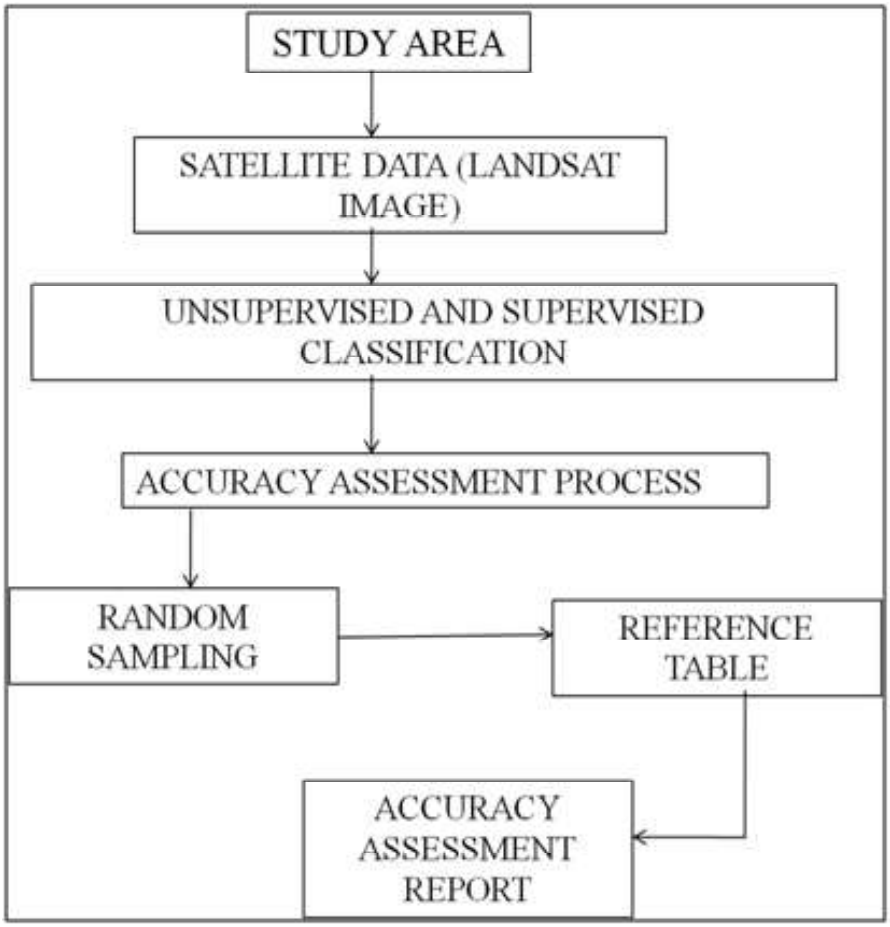

Fig. 2 Schematic of work flow for LULC and accuracy assessment

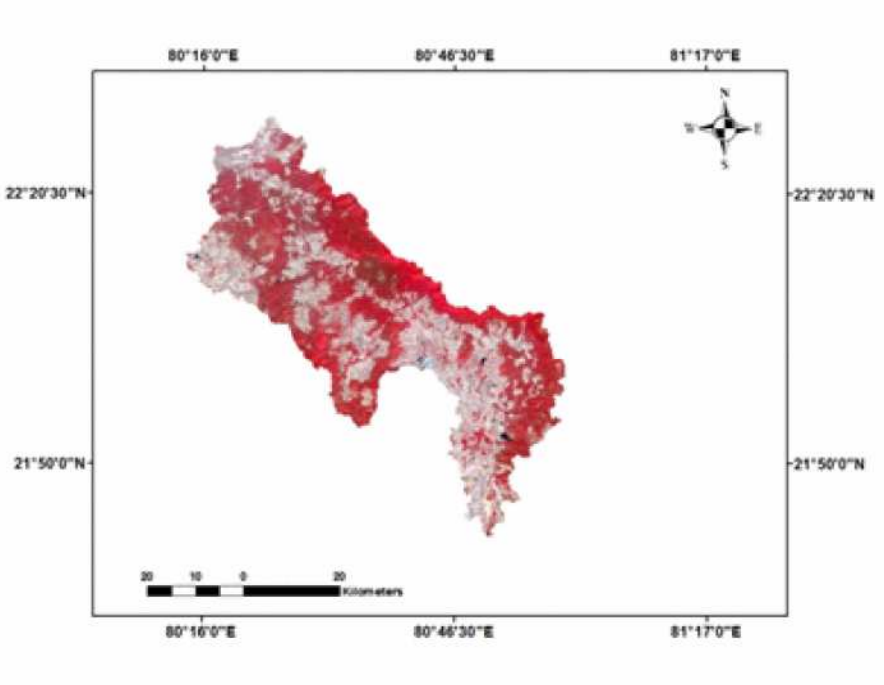

Fig. 3 FCC of study area of 2011

Land use and land cover classification Scheme

The study employed per-pixel supervised classification which group satellite image pixels with the same or similar spectral reflectance features into the same information categories (Campbell 2002). Pixels throughout the classified image were visually compared with the Google Earth image and also verified with the field visits photographs. Unsupervised classification is generally used for determining the main classes and as the base for supervised classification. Supervised classification method is applied for accurate mapping of different classes. Maximum likelihood supervised classification was performed in ERDAS IMAGINE 2011 software. The area was divided into seven land use and land cover classes, viz, river, water body, waste land, habitation, forest, agriculture/other vegetation and open land/fallow land/barren land.

Accuracy assessment

The increased usage of remote sensing data and techniques has made geospatial analysis faster and more powerful, but the increased complexity also increases the possibilities for error. Because of the increased chances for error presented by digital imagery, however, accuracy assessment has become more important than ever (Congalton 1991). Any supervised classification is useless to the end users until an assessment of its accuracy has been performed (Gomez and Monero 2011). For accuracy assessment 136 pixels were selected randomly and verified with the help of ground truth data. From the spatial analyst tool which is embedded in ARC GIS environment, accuracy assessment points tool was selected. The sample methods used for selecting the random points was stratified random. Then, each point land cover type was identified by interpreting the underlying image. (Fig. 4)

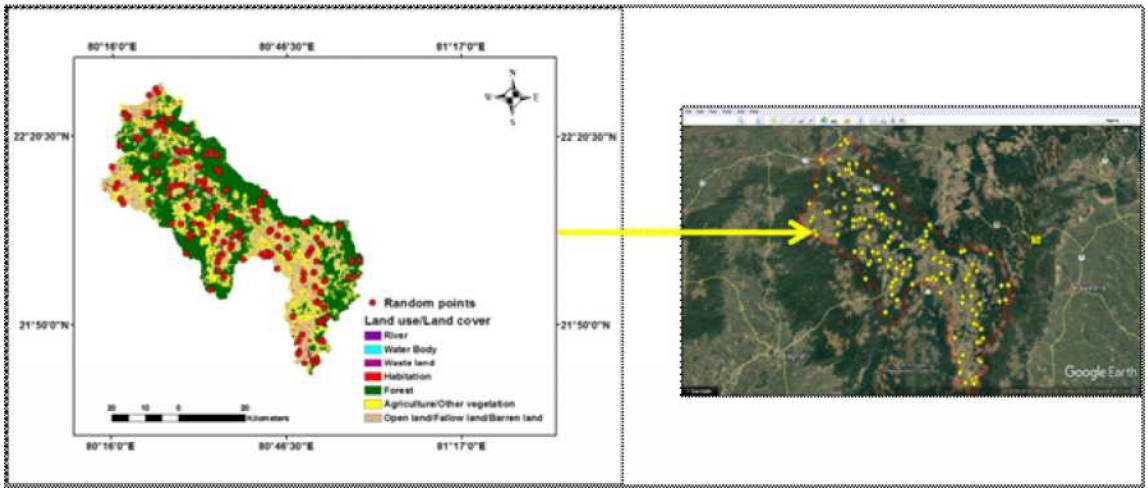

Fig. 4 Generated random points in Arc Map and opening the points in Google Earth

The error matrix is the most widely used approach for image classification accuracy assessment and can be used to derive a series of descriptive and analytical statistics (Congalton and Mead 1983, Congalton 1991, Congalton and Green 1999, *Smits et al. 1999*, Congalton and Plourde 2002, Foody 2002, *Liu et al. 2007* and *Tiwari et al. 2017a*). In present study accuracy assessment was performed by using error matrix (also known as confusion matrix) which compares on class by class basis classification data with known reference data and was derived with the help of confusion matrix tool available in the spatial analyst toolbox. The user's accuracy indicates the probability that a pixel on the image actually represents that class on the ground (Story and Congalton 1986). It is calculated for each class by dividing the correctly classified pixels in each category by either the total number of pixels in the corresponding columns or rows. Apart from the overall accuracy, the producer's and user's accuracies are also evaluated with the help of error matrix. The producer's accuracy is defined as the probability of a pixel being correctly classified and is mainly used to determine how well an area can be classified (Story and Congalton 1986). Equation 1, 2 & 3 represents the formula for overall accuracy, user's accuracy and producer's accuracy respectively.

Overall accuracy (%) = (Correctly classified pixels/ Total number of pixels) (1)

User's accuracy (%) = (Correctly classified pixels /Classified total pixels) (2)

Producer's accuracy (%) = (Correctly classified pixels/Reference total pixels) (3)

The kappa coefficient was also estimated for detailed interpretation and evaluation of classification accuracy. The kappa coefficient is a measure of difference between the actual agreement between reference data and automated classifier and the chance agreement between the reference data and a random classifier. The kappa coefficient generally ranges from 0 to 1. Equation 4 represents the formula for kappa coefficient estimation.

$$\hat{K} = \frac{N\sum_{i=1}^{r} x_{ii} - \sum_{i=1}^{r}(x_{i+} \times x_{+i})}{N^2 - \sum_{i=1}^{r}(x_{i+} \times x_{+i})} \qquad (4)$$

Where,

r = number of rows in the error matrix

x_{ii} = number of observations in row i and

column i (on the major diagonal)

x_i+ = total number of observations in rows i (shown as marginal total to right of the matrix)

$x+_i$ = total number of observations in column i (shown as marginal total at bottom of the matrix)

N = total number of observations included in matrix

Result and Discussion

The open land, fallow land and barren land are recoded as one class because in this study area most of open land cover class are generally represented the land uses that were non built-up land with no, sparse or with insignificant vegetation cover. After an accurate classification, list of seven land use and land cover classes were identified in the study area namely, river, water body, waste land, habitation, forest, agriculture/other vegetation, open land/fallow land/barren land. Fig. 5 depicts the land use/cover classes of study area in 2011. Areal distribution of different land use and land cover classes are presented in Table 1.

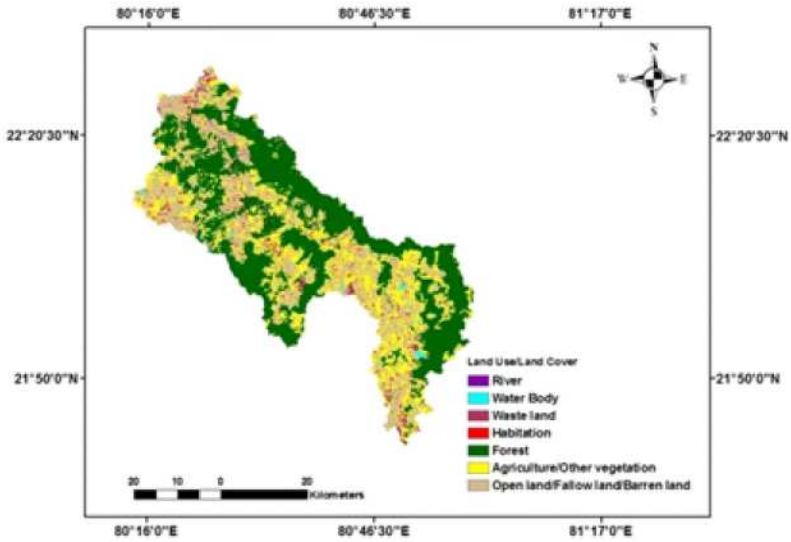

Fig. 5 LU/LC status of study area in 2011

Table 1. Area under different Land use/land Cover classes in study area in 2011

Class Name	Area (ha)
River	1517.28
Water body	2351.34
Waste land	4541.67
Habitation	2128.68
Forest	107935.40
Agriculture/ Other vegetation	53357.30
Open land/Fallow land/Barren land	74252.30
Total	246084.00

The overall land use and land cover scenario of study area reflected that the forest was the dominated land cover as maximum covered area was that of sal, teak, bamboo and mixed forest. As the highly covered area was of forest the study area has considerable less population. In comparison to agriculture/other vegetation the area under open land/fallow land/ barren land was found to be high, this statistics shows that there is necessity of implementation of agricultural practices. Areas covered under grazing land, land temporarily out of cultivation and land which cannot be brought under cultivation was classified as open land/fallow land/barren land. As the study area is situated on the bank of Banjar river, the soil is fertile and one of the common occupation of people living there is farming, therefore the extent of area under agriculture/other vegetation was found to be quite more than area covered under wasteland. The degraded land area having outcrops (stones and rocks) was classified as waste land. The least area was found to be covered under river followed by water body.

Class wise accuracy assessment has been performed by comparing the classified land use map with the reference data (ground truth). The classification of error matrix for each category for 2011 is presented in Table 2.

Table 2. Error matrix accuracy totals for the classified image (2011)

Class Name	River	Water Body	Waste Land	Habitation	Forest	Agriculture/ Other vegetation	Open land/ Fallow land/ Barren land	Total
River	10	0	0	0	0	0	0	10
Water Body	0	9	0	0	0	1	0	10
Waste land	0	0	8	0	0	1	1	10
Habitation	0	0	1	8	0	1	0	10
Forest	0	0	0	0	44	0	0	44
Agriculture/Other vegetation	0	0	2	0	2	18	0	22
Open land/Fallow land/Barren land	0	0	0	0	5	3	22	30
Total	10	9	11	8	51	24	23	136

Once accuracy data were collected in the form of pixels and summarized in a confusion matrix, they were subjected to detail interpretation and further analysis of statistical data. The kappa statistics was used as a measure of agreement between model predictions and reality. The kappa coefficient generally ranges from 0 to 1 (Cohen 1960). A standard overall accuracy for land use and land cover maps is set between 85 and 90% (Anderson et al. 1976 and Lins and Kleckner 1996). In 2011, the overall accuracy for 2011 was found to be 87.50% and kappa statistics 0.8422. It was observed that the overall accuracy of land use/land cover classification in 2011 was above 85% which represents quite accurate classification. The variation in the accuracy of different classes occurs due to the error. The error reflects the points which are included in the category while they really do not belong to that category and the number of points which are not included

in the category while they really belong to the category. The lowest accuracy in some classes would be explained by the fact that study area is highly covered with the dense forest and has sparse vegetation which led to the confusion with the wasteland and fallow land. The land use and land cover classification efficiency 2011 is presented in Table 3.

Table 3. Land use and land cover classification efficiency of 2011

Class Name	2011	
	Producer's Accuracy	User's Accuracy
River	100.00%	100.00%
Water Body	100.00%	90.00%
Waste land	72.73%	80.00%
Habitation	100.00%	80.00%
Forest	86.27%	100.00%
Agriculture/ Other vegetation	75.00%	81.82%
Open land/Fallow land/Barren land	96.65%	73.33%

Based on the results obtained by employment of remote sensing and GIS applications to achieve the specific research objectives, it is concluded that the accuracy assessment of land use/land cover classification enhanced the quality of research work and hence the classified image found to be fit for further research. The result depicts that the overall accuracy and kappa coefficient values for satellite data of 2011 is quite accurate. The resulted land use and land cover map and analysis of accuracy could be utilizes for better planning of land management and agriculture development schemes.

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Microbial and Enzymatic Activities of Saline Soils

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Abstract

The present study on biological properties of the soils viz. microbial population and enzyme activity were estimated in two sets of soils at different periods. One set of soil samples representing various salinity levels were collected during last week of June 2014 (Pre-monsoon). The other set of samples were collected in chickpea fields (post-monsoon) grown at various salinity levels at flowering and harvest stages of the crop. The results showed that the microbial populations as well as enzyme activity decreased with increase in salinity of the soils. Further the biological activity was maximum at flowering than at harvest in chickpea.

Keywords: Soil salinity; Microbial population; Enzyme activity; Phosphatase; Dehydrogenise.

Salinization is an abiotic soil factor, which affects the crop production. Soil salinization is of great concern for agriculture in arid and semi-arid regions of the world. In recent times, attention has been turned to study the impacts of salinity on soil biological activity. The relation between soil organisms and soil functions are observed to be incredibly complex. The interconnectedness and complexity of this soil 'food web' may be understood by taking into account the interactions of soil with living communities that exist within the soil. The soil organisms break down organic matter, making nutrients available for uptake by plants and other organisms. The nutrients stored in the bodies of soil organisms prevent nutrient loss by leaching. Microbial exudates act to maintain soil structure. In balanced soil, plants grow in an active and steady manner. The mineral content of the soil and its healthy structure are important for their well-being, but it is the life in the earth that powers its cycles and provides its fertility. In the process of supplying nutrients to plants soil microbes contribute significantly to the weathering of minerals and the formation of soils. Without the activities of soil organisms, organic materials would accumulate and litter the soil surface, and there would be no food for plants.

Understanding the ecology of soil system, therefore, is important to be conversant with the soil microbial activities, which show quick response to little change in the soil environment. Soil salinity could be one such factor, that causes osmotic stress as a result of large concentrations of salts in soil solutions (Oren, 1999) leading to reduced size and activity of the microbial community. In India, out of 6.72 million ha of salt affected soils, 2.95 million ha (44%) are saline in nature (including coastal sands). About 1.75 M ha is under inland salinity and 1.2 M ha is distributed in the east and west coasts of India. In undivided Andhra Pradesh out of 2,74,207 ha of salt affected soils, 77,598 ha are saline (*Mandal et al., 2010*). Uppugunduru region of Prakasam district, Andhra Pradesh soils are of saline with low productivity. In the present study an attempt was made to study the biological activity of soils as

influenced by soil salinity during pre-monsoon period and post monsoon period.

Materials and Methods

Pre-monsoon sampling was done during last week of June 2014 from selected areas of variable salinity. Post monsoon samples were collected in chickpea fields at flowering and maturity. Soil samples were collected up to a depth of 25 cm, processed and subjected to characterization of physico-chemical and biological properties. The pH and ECe were estimated in 1:2.5 and saturation extracts, respectively (Jackson, 1973). The organic carbon content of the soils is estimated by following the method described by Jackson (1973).

The microbial population (CFU g^{-1}) i.e. bacteria, fungi and actinomycetes in the soil samples was carried out by following the standard dilution plating technique (Spread Plate Method) using nutrient agar, Martin's Rose Bengal and Kuster's agar, respectively (Dhingra and Sinclair 2000).

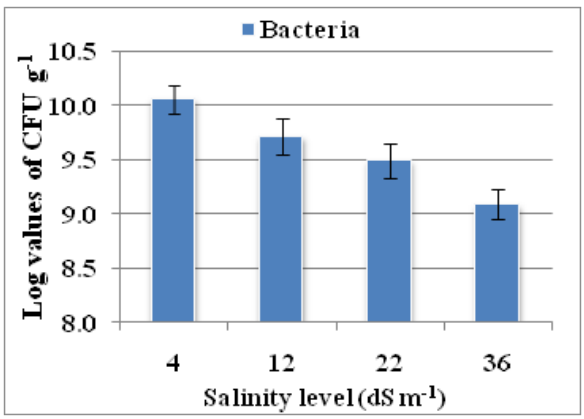
Phosphatase activity (µg para-nitrophenol g-1 h^{-1}) of samples was determined by following the procedure of Eivazi and Tabatabai (1977). Dehydrogenase activity in the soil sample was determined by following the procedure described by *Klein et al. (1971)*. The amount of triphenyl formazon (TPF) formed was interpreted from the standard curve drawn in the range of 10 µg to 90 µg TPF mL^{-1}. The results are expressed as µg TPF day^{-1} g^{-1}soil.

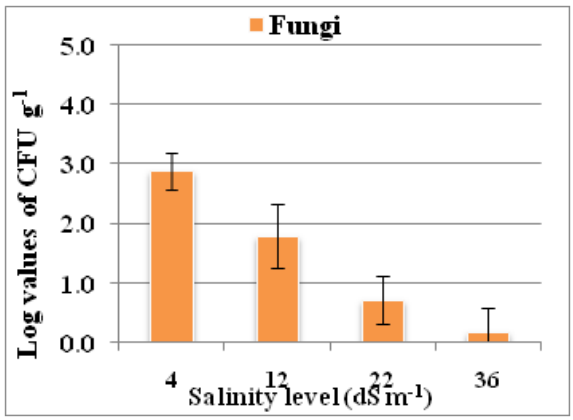
Results and Discussion

The mean electrical conductivity of pre-monsoon soil samples collected for biological activity ranged from 4.0 to 36.0 dS m^{-1}. The pH and organic carbon content of the samples 7.5 to 8.0 and 2.10 to 6.80 g kg^{-1}, respectively at different salinity levels.

Microbial population in Pre monsoon samples

The data pertaining to microbial populations are presented in figure 1. The bacterial population was found to be maximum (10.06 log values of CFU g^{-1} soil) at the lowest salinity level of 4 dS m^{-1} and it followed a decreasing trend with increase in salinity up to 36 dS m^{-1}, which recorded the least bacterial population of 9.09 CFU g^{-1} soil (log value). The other two levels recorded the intermediate values. Fungi population in pre-monsoon samples at different salinity levels viz., 4, 12, 22 and 36 dS m^{-1} were 2.90, 1.79, 0.72 and 0.18 log values of CFU g^{-1} soil, respectively. Actinomycetes also followed similar trend of decreased population counts with increased soil salinity. The actinomycetes in pre-monsoon samples were 8.14, 7.79, 7.52 and 7.32 log values of CFU g^{-1} soil at the salinity levels of 4.0, 12.0, 22.0 and 36.0 dS m^{-1}, respectively.





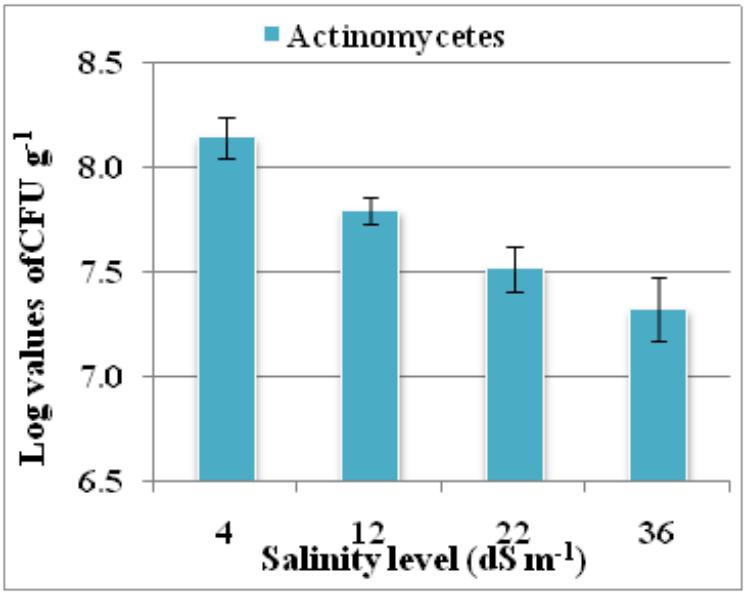


Fig: 1 Microbial population in different salinity levels at pre-monsoon soil samples.

Perusal of the data presented related to microbial population in soils revealed that fungi are more sensitive than bacteria and actinomycetes. The fall in fungal population with increase in salinity from 4 dS m^{-1} to 36 dS m^{-1} was 93.79 per cent while, it was only 10.07 and 9.64 per cent for actinomycetes and bacteria, respectively.

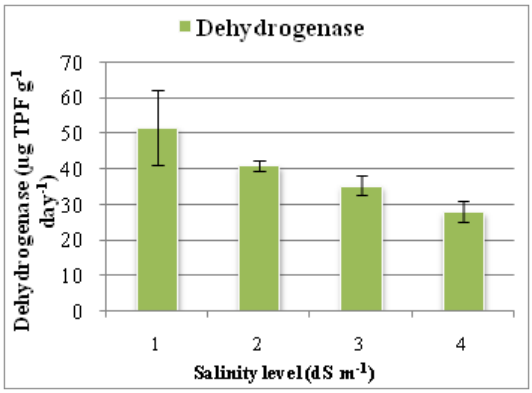
There was a significant negative correlation (r = -0.985**, -0.896** and r = 0.950** for bacteria, fungi and actinomycetes, respectively) between ECe and microbial population.

Study conducted by Matsuguchi and Sakai (1995) at different salinity levels revealed variation in microbial populations as affected by salinity stress. The detrimental effect of salinity on the activity of microbial population at different salinity levels could be due to the manipulation of the growth of living cells either by disrupting the normal physiological activities or intracellular macromolecular structures (*Vogel et al., 2010*). The decline in microbial population could also be due to increase in salt concentration, which decreased osmotic potential and lead to reduction in activity of surviving cells *(Ibekwe et al., 2010)*. Similar results were also reported by *Wichern et al. (2006)*.

The high influence of salinity on fungi was also reported earlier and was attributed to genetic diversity (Van and Semenov, 2000) and cell damage by the low osmotic potential (Hagemann, 2011).

Enzyme activity

The results pertaining to dehydrogenase and phosphatase activity are presented in figure 2. The dehydrogenase activity at different salinity levels of 4, 12, 22 and 36 dS m^{-1} was 51.8, 41.0, 35.4 and 28.0 µg TPF $g^{-1}day^{-1}$, respectively. The dehydrogenase activity, an indication of microbial respiration has followed the same trend as that of the microbial population. The enzyme activity has fallen to a tune of 45.95 per cent when the conductivity of the saturation extracts increased from 4 to 36 dS m^{-1}.



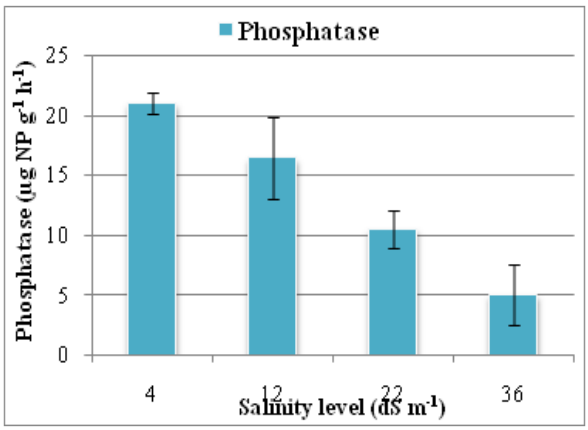


Fig: 2 Enzyme activity in different salinity levels at pre-monsoon soil samples.

Excessive amounts of salts in the soils exhibited an adverse impact on alkaline phosphatase activity. The maximum activity of 20.8 µg PNP g-1 h-1 was observed at the lowest conductivity value of 4 dS m-1 while, the activity dropped to 5.0 µg PNP g-1 h-1 at the highest salinity level of 36 dS m-1. The enzyme activity was decreased by 75 per cent as the salinity increased up to 36 dS m-1.

The correlation coefficients revealed a highly significant negative correlation (r =-0.933** and -0.997**) between soil salinity and activity of both the enzymes (dehydrogenase and alkaline phosphatase).

The reduction of enzyme activity in saline sails could be due to the osmotic dehydration of the microbial cells that liberate intra cellular enzymes, which become vulnerable to the attack by soil proteases with a consequent enzyme activity. The salting out affect modifies the ionic conformation of the protein enzyme active site, and specific ion toxicity causes a nutritional imbalance for microbial growth and subsequent enzyme synthesis *(Frankenberger and Bingham, 1982)*.

The decrease in enzyme activity with soil salinity can be explained by the fact that in the semi arid soils many of the enzymes are extracellular and form complexes with the organics and mineral colloids *(Garcia and Harnandez, 1996)*. *Zahir et al. (2001)* reported that the soil enzymes like dehydrogenase activity was severely inhibited in salinized soils and their variation in soils seemed to be related to the physico-chemical and microbial properties of soils.

The decline in enzyme activity with increasing salinity appeared to be associated with change in osmotic potential of the soil due to higher salt concentrations, specific ion toxicities and salting out effect of soluble salts on enzyme protein (Iftikhar and Khan, 1988). An excessive content of easily-soluble inorganic salts in soil has a nega-tive effect on the changes in the conformation of enzymatic protein which results in a decrease in its catalytic activity *(Siddikee et al., 2011)*.

Soil samples in chickpea fields (Post monsoon samples)

Microbial population

Results pertaining to microbial populations (flowering and harvest) are presented in figures 3 and 4.

The highest bacterial population of 11.52 (log

values) CFU g^{-1} soil at flowering was recorded at lowest salinity level of 2 dS m^{-1}. The bacterial population followed a decreasing trend with increase in soil salinity level with lowest population of 10.14 log values of CFU g^{-1} at 17 dS m^{-1}. The fungi and actinomycetes also followed similar trend of the highest (4.44 and 9.30 log of CFU g^{-1}, respectively) and lowest (2.17 and 7.86 log of CFU g^{-1}) populations recorded at the lowest and highest salinity levels (2 and 17 dS m^{-1}), respectively.

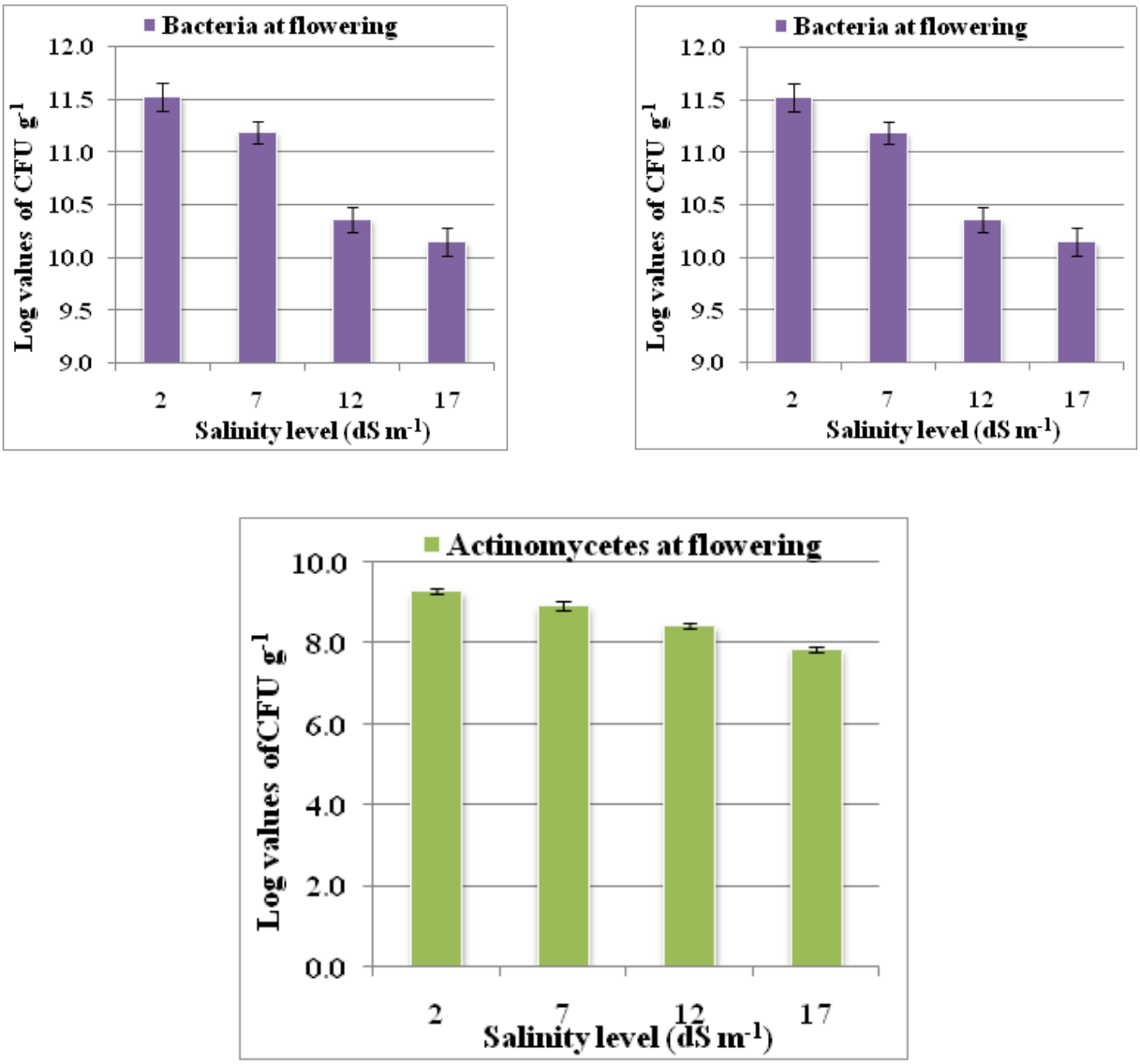


Fig: 3 Microbial populations at flowering stage of chickpea at different salinity levels

The samples collected at harvest of chickpea also followed similar trend with the highest counts of 11.6, 3.53 and 8.83 log values of CFU g-1 of bacteria, fungi and actinomycetes, respectively recorded at the lowest salinity level. While, the lowest 9.76, 0.54 and 7.80 log values of CFU g-1of bacteria, fungi and actinomycetes, respectively were reported at the highest salinity level of 17 dS m-1.

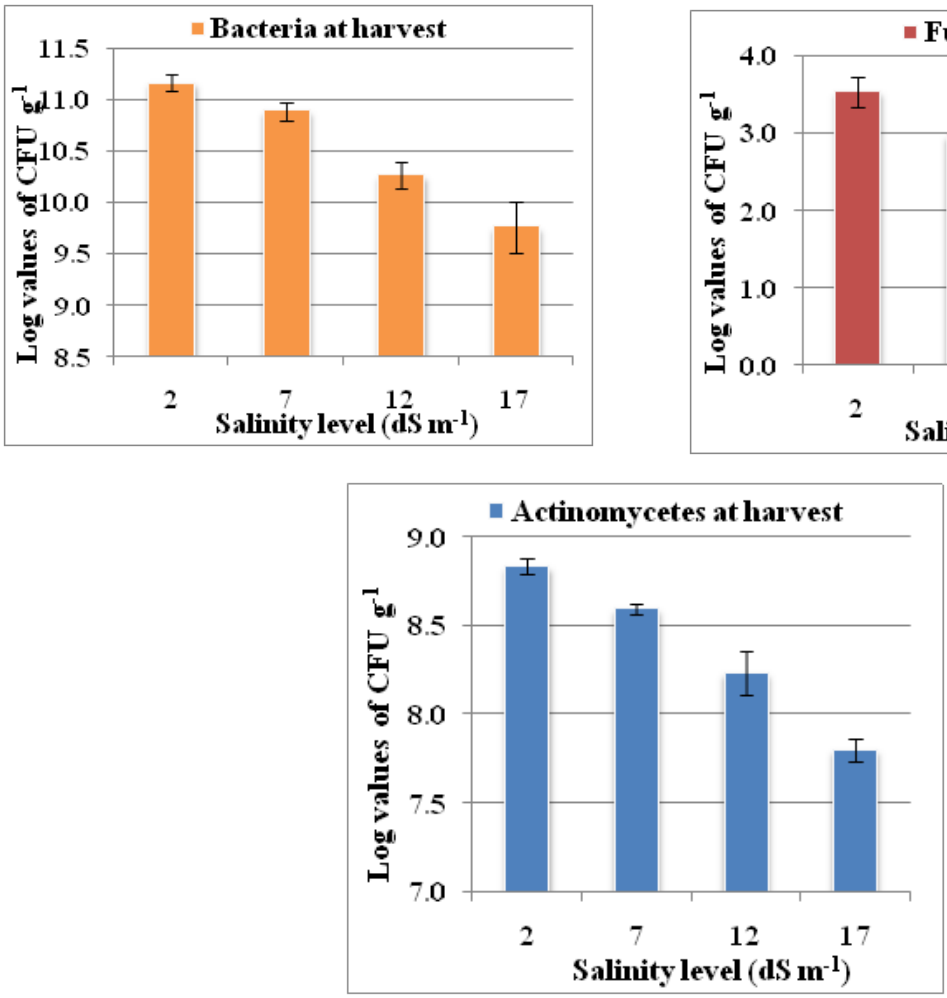


Fig: 4 Microbial populations at harvest stage of chickpea at different salinity levels

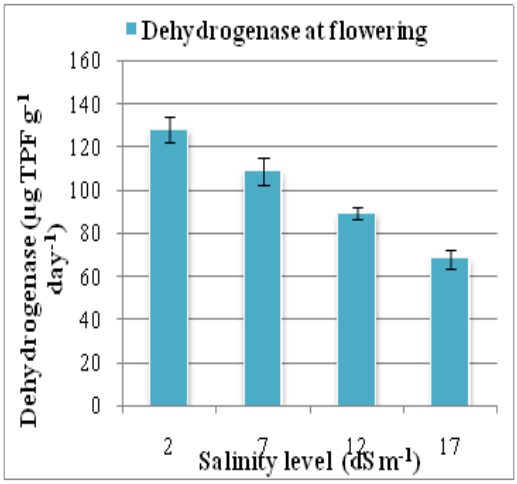
The critical observation of the data at both the growth stages revealed that the overall microbial activity was maximum at flowering than harvest at all salinity levels. The high population counts at flowering could be attributed to the active growth period of the plant, which results in release of more root exudates. Several root exudates act as substrates for microorganisms thereby enhance their proliferation.

At both growth stages of chickpea, the microbial population decreased with increase in salinity. The fall in fungi was maximum (51.12%) followed by actinomycetes (15.48%) and bacteria (11.97%) at flowering. At harvest also similar order of fall in microbial population was observed but the per cent fall of fungi (84.70%) and bacteria (12.54%) was high compared to actinomycetes (11.66%) at flowering stage.

Enzyme activity

The enzyme activity at flowering and harvest stages are shown in figures 5 and 6, respectively.

The soil dehydrogenase activity at flowering and harvest stages of chickpea crop was maximum (128.2 and 88.4 µg TPF g^{-1} day^{-1}) at the lowest salinity level (2 dS m-1) while, it followed a decreasing trend with increase in conductance value of saturation extract up to the highest level of 17 dS m^{-1}. The per cent decline in the enzyme activity was 68.2 at flowering and 40.8 at harvest



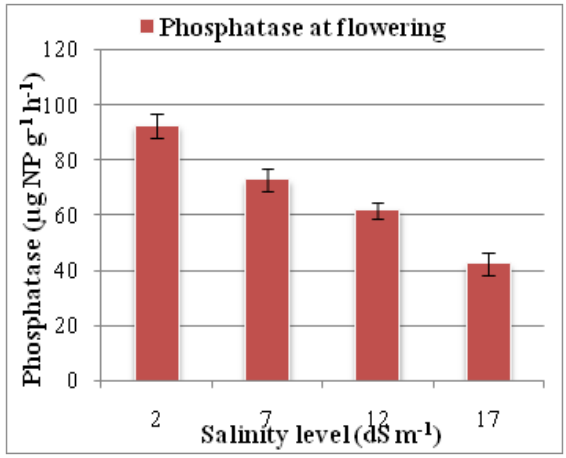
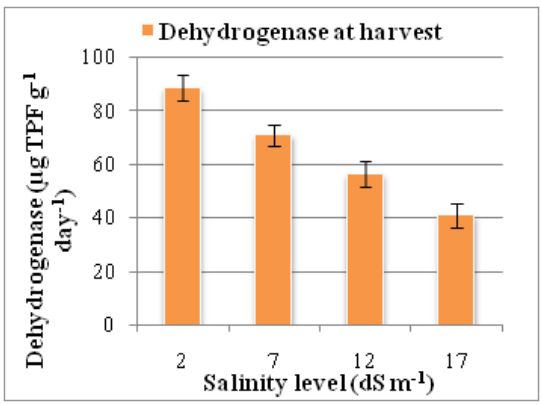


Fig: 5 Enzyme activity at flowering stage of chickpea at different salinity levels

The alkaline phosphatase activity also followed the trend of decreased activity with increased soil salinity. At flowering stage the highest activity of 92.38 µg PNP g^{-1} h^{-1} was observed at the lowest salinity level (2 dS m^{-1}) while, the lowest activity of 42.16 µg PNP g^{-1} h^{-1} was recorded at the highest salinity level of 17 dS m^{-1}. The alkaline phosphatase activity at harvest also followed similar trend with the highest (57.82 µg PNP g^{-1} h^{-1}) and the lowest (15.64 µg PNP g^{-1} h^{-1}) values recorded at a salinity level of 2 and 17 dS m^{-1}, respectively. It was also observed that the activity of the enzyme was affected to an extent of 54.36 and 72.95 per cent, respectively at flowering and harvest with increase in salinity from 2 to17 dS m^{-1}.



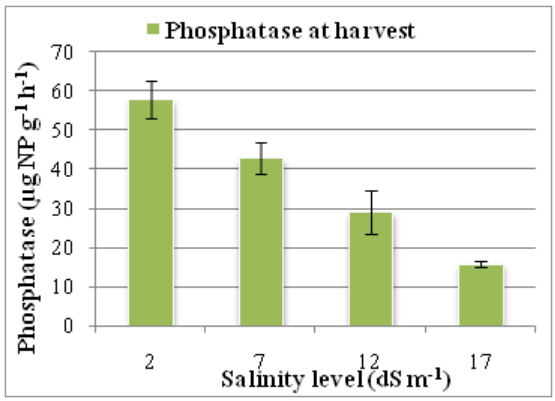


Fig: 6 Enzyme activity at harvest in different salinity levels at posts-monsoon soil samples.

The critical observation of the data revealed that the influence of salinity on dehydrogenase activity was less than alkaline phosphatase activity at both the growth stages of the crop. Similar results were noticed by Batra and Manna, (1997) in salt affected soils of semiarid and arid regions and Tripathi, (2007) in coastal soils of India.

The soil enzyme activity was maximum at flowering stage and later decreased with advancement of crop growth. The higher enzyme activity at flowering could be due to the active growth of the crop with enhanced root activity and the release of extracellular enzymes in to soil solutions which resulted in higher rate of microbial populations and production of the enzyme.

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Phytochemical characteristics of indian soybean cultivars for food processing

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Abstract

The present study was done on phytochemical characteristics of improved soybean cultivars. The soybean seeds have crude carbohydrate 28.03-29.70,crude fiber 13.51-15.83, Soluble saccharides 8.71-10.51,reducing sugars 1.38-1.81,non-reducing sugars 7.18- 8.70 and oils content 19.03-20.83, and good quality protein 37.45-41.27% having all the essential amino acids beside energy value were 442.35-456.19 Kcal/100g. Starch content range from 1050-1150, amylase 234.35-247.93 and amylopectin 802.07-904.14 mg/100g of dry matter.

The naturally occurring phytochemicals be healthful played preventive and therapeutic roles for several diseases and potential for heart problem, cancers, obesity, osteoporosis, HIVs and menopause especially to female. Non-nutrients antioxidative and biological functional phytochemicals known as medifood factor such as saponins 459-649mg/100g, phenotic contents 1350-1573mg/100g and flavonoids 443-617mg/100g of unprocessed seeds flour. The anti-nutritional trypsin inhibitor ranged from 14.46-19.50mg/g protein of raw seed affected the protein quality and digestibility of protein. Soybean seeds are a rich source of biocatelitics specially to peroxidase and lipoxygenase calculated 20.40-22.99PODU/g and 10.03-12.10 LOXU/g respectively contribute to the important food characteristic, fresh beany, green odor, its owing richest natural occurring antioxidants properties with rich in Nitrogen 6432 mg100g; and Na 3.17, K 1800, P 635, Ca 304, Mg 277, Mn 3.17, Fe 13.15, Cu1.37 and Zn 4.18 mg/100g, respectively; which 5.10 to 5.22 percent ash of dry matter the most essential for bone formation an ideal skeleton. The high quality low cost food nutrients can be targeted for malnourish community suffering about thirty percent of total population in the India or under malnourished. Soybean be used whole in both traditional and modern kitchen as therapeutic food source for communities.

Keywords: Trypsin Inhibitor, Peroxidase, Lypoxygenase, Flavonoids, Protein, Therapeutic.

Soybean [Glycine max (L.) Merrill.] Belongs legume growing for oil seed mostly were produced 11.65-14.66 million tons in 2011-13 (*Agri.Stat.at a glance,2011-13*) India. Owing to its majorly food phytochemicals profiles, proteins are considered to be among the most abundant cell components and except for storage proteins composed of various elements including C, H, N, O and S are formed into twenty different amino acids, which are linked together by peptide bonds to form protein, essential to biological functions for plant, animals and human body. The majority of polysaccharides are non-digestible soluble and insoluble are commonly dietary fiber. Carbohydrates are mono, di, oligo and polysaccharides.

Moreover, beside this excellent natural biofunctions or medifood factors and antioxidant bioactive such as phenolic contents, saponins, flavonoids and crude fibre has important role in nutritional security by phytochemicals and protect from most of the chronic diseases great deal of medicinal potential with pharmacological effects such as antiarrhythmic, anticholinergic, analgesic, antitumor, antihypertensive, antipyretics, antimalarial, stimulant, anti-HIV, antileukmic, cardiotonic,lipid lowering, antiulcer,

hepatoprotective, anti-inflammatory,antineoplastic, antimicrobial, antioxidant, and hypoglycemic activity, lowers the risk of heart certain free radical related pathophysiology (*Duthie et al., 2000*). Phenolic compounds have tremendous antimicrobial potential, strong antioxidant and antimutagenic activities, saponins acts as anti-bacterial and antineoplastic, hypocholesterolemic and antidiabetic properties (*Rupasinghe et al., 2003*) and dietary supplements nutraceuticals in traditional medicine used as heart drugs and anticancer properties (*Asl, 2008*).

The phytochemicals in soybean cultivars are varies by genotypic characteristics, soil types and climatically variation such as temperature and rainfall (Ali,2005). The most important anti-nutritional phytochemical trypsin inhibitors are the serious problem affects its protein quality and digestibility (*Yadav and Chauhan, 2005*). The biocatelitics peroxidase and lipoxygenase are main barriers for acceptability of whole grain and its products interested of demands. (*Wu et al.,1995 and Loiseau et al., 2001*). Soybean contributes of oil seeds with edible oils 25 percent producing in India. The great demanding varieties were covered more than 90 percent of total soybean cultivated area of India.

Objectives of research study of phytocemicals and chemical composition and nutrients natural products in soybean seeds.

Material and methods

The experimental material of five popular cultivars (V_1) JS-20-29, (V_2) JS-20-34, (V_3) JS-97-52, (V_4) JS-93-05 and (V_5) JS-95-60 were collected from Soybean Research Unit (BSP) JNKVV, (M.P.)

Chemicals analysis of seeds were first dried in cabinet type dryer at 65^0C till the equilibrium moisture content, cooled and grinded by mini-mill, pack into plastic airtight container the chemical analysis were carried out of raw seeds on the dry weight basis.

Protein, fat, carbohydrate, crude fiber, moisture and ash were determined by procedure as describe AOAC (2000). Soluble saccharides determined the procedure as described by Ranganna (1991). Starch was determined by the method suggested Lane and Eynon(1966), and Amylopectin of tested samples was calculated according to the formula by *Juan et al.(2006*). Total phenolic, flavonoides, saponin, amylose were estimated according to method as described by Sadasivam and Manickam (1991). Calorific energy value determined as described by Mudambi and Rajagopal(1983). For germination test 100 seed were kept in wet muslin cloths rolled and kept in BOD seed germinator at 25±1 0C and 90-92% humidity for 96 hours sprouted seed counted and calculated percentage of germination. The bulk densities were calculated by weight / volume of 1000 seed weight and their volume in diesel at 20^0C room temperature. Seed size was estimated using a weight of number ratio 100 soybean seed will be randomly selected and weighed these size data was reported as grains per hundred seed was used to evaluate soybean size (*Wei and Chang, 2004*). Water weight increase ratio (WIR) was calculated using method adopted by Wei and Chang 2004. The trypsin inhibitor activity in soybean was determined method given by Keshun Liu and Pericles Markakis (1989).Lipoxygenase was examined method suggested by *Axelrod et al.*, (1981).The activity of lypoxygenase was determined an absorbance at 234 nm. Peroxidase was estimated by the suggested method of Gomori (1955) and Munir and Dordric (2000). Peroxidase activity was measured at 510 nm expressed as described by *Ghaemmaghami et al., (2010) In-vitro* protein digestibility was obtained by calculating with pepsin kjeldahl nitrogen AOAC (2000) was multiplied by the factor 6.25 obtain crude protein. The in-vitro starch digestibility was determined by the method according Singh and Jambunathan(1982). The nitrogen estimated by kjeldhal method, mineral digestion was done using AOAC (1990) method and the minerals calcium, phosphorus, iron, were estimated by Ranganna(1999) magnesium, potassium, sodium copper, zinc and manganese were detected by using (ASS) following the digestion of sample in ternary acid mixture (HNO_3:H_2SO_4:HCl_4;10:1:4 v/v) and Na, K were analyzed by Flame Photometry. Statistical analysis

including five cultivars with three replications and results were explained in triplicates mean of seeds of each cultivars.

Results and discussion

Protein content of soybean (Table-1) were found significantly difference among the cultivars V_5 41.27% recorded significantly higher closely followed by V4 40.65% cultivars. However variety V_3 39.92% was superior to V_1 38.80% over the V_2 37.54% significantly lowest. Similarly justified as proteins one of the nature's wonderful nutritional super gift of plant origin natural product, Ali (2005) and Gandhi (2009). The oil content cultivar V_1 20.83% significantly superior, followed by V_2 19.87%, V_3 19.40% and V5 19.22%. The cultivar V_4 19.03% recorded significantly lower justified Ali. (2005) and T.B. (2009) that soybean is a rich source of PUFA (ω-3) fatty acids oil. Soybeans have total carbohydrates content range from 28-32% in raw seeds. The cultivar V_4 29.70% recorded significantly higher at par with cultivars V3 29.57%&V5 29.53% however, cultivar V_2 28.43% superior to V_1 28.09% significantly low in crude carbohydrates content among the varieties similarly advocated by Yadav and Chauhan (2005). The soybean variety V_2 14.83% recorded significantly higher crude fiber closely followed by V_1 13.43%, V_4 13.31%. and V_5 13.17%. The V_3 12.51% recorded low fiber content in seed as *Geater et al. (2000)*.

Soybean cultivar V_1 10.51% recorded significantly higher total soluble saccharides followed by the rest. In which V_5 had 8.71% significantly low soluble saccharides justified by *Geater et al. (2000)* and Hymowitz and Collins (1974) and Bewley (2006).The variety V_3 21.23% recorded significant higher of nitrogen free extract (NFE) followed by variety V_2 20.74%, V_4 20.13% and V_1 19.97%. Variety V_5 19.46% found lowest the nitrogen free extract similar by Bewley (2006).Cultivar V_1 1.81% performed the significantly highest of reducing sugars closely followed by variety V_2 1.69%, V_5 1.53% and V_3 1.43%. However,V_4 1.38% recorded significantly low reducing sugars content in raw seed of soybean. Soybean variety V_1 8.70% recorded significantly superior in non- reducing sugars followed by rest cultivars. The V_4 7.40% was the lowest non reducing sugars in seeds.

The in vitro protein digestibility (IVPD) were found significant differed among the cultivars however V_3 67.57% recorded significantly higher closely followed by V_4 66.73%. Cultivar V_5 65.86% was superior to V_1 64.63% and V_2 64.63% similarly Kayamben and Rensburg (2013). Whereas the in vitro starch digestibility (IVSD) were found significant differed between the cultivars seeds V_4 65.37% recorded significantly higher overall respective. The V_2 55.62% at par with V_1 53.04% and V_3 52.74%, whereas V_5 52.37% recorded lowest in vitro starch digestibility raw seed of soybean.

Cultivars were found significantly differed among themselves of lipoxygenase in soybean seeds, cultivar V_5 12.10 LOXU/g recorded significantly higher followed by V_4 11.92, V_1 11.12 and V_3 10.96 however, variety V_2 10.03 recorded significantly lower as justified by *Wu et al., (1995)*, *Loiseau et al., (2001)* and *James et al., (2015)* (Fig.1). Peroxidase was V_4 22.99PODU/g protein recorded significantly higher at par with V_1 22.60, however V_2 22.39 and V_3 22.02 are superior to V_5 20.44PODU/g which is significantly had lowest peroxidase (Fig.1). Trypsin inhibitory activity cultivars recorded significantly differed thus V_2 19.50 (TI mg/g protein), which was significantly higher to among. Variety V_4 17.51 and V_3 17.19 were at par with V_1 17.84, but superior to V_5 14.46 (TI mg/g protein) which recorded the minimum similarly findings and sited by (*Yadav and Chauhan 2005*). *Dixit et al. (2011)*, and *T. B. (2009)* (Fig.1).Crude Saponins content in soybean variety V_3 649(mg/100g) significantly higher followed by V_1 549.50, V_2 485.80, and V_5 461(mg/100g) however, V_4 459.10 (mg/100g) was lower. Similarly finding justified by Rupasinghe, *et al. (2003)* (Fig.2).Total flavonoids content variety V_4 617.55 (mg/100g) recorded significantly higher followed by V_1 547.55, V_2 473.52, V_5 444.56 and variety V_3 443.10 (mg/100g) recorded significantly low in flavonoids contents as advocated by Asl *et al. (2008)* (Fig.2).Total phenolic content in variety V_1 1573 (mg/100g) recorded significantly higher closely followed by V_4 1536. The V_2 1497 was superior to V_3 1450 over the V_5 1350 (mg/

100g) of phenolics content in soybean rich source with antioxidants, which is occurs naturally bound to sugars as justified by, Mc Cue and Shatty (2004). *Duthie et al., (2000)*, Houghton (2006)(Fig.2).The soybean seed have starch content variety V_3 1150 (mg/100g) recorded significantly upper closely followed by V_2 1100, V_4 1100 and V_5 1070. The V_1 1050 (mg/100g) was lowest of starch content among them as *Geater et al. 2000*).Amylose content in seed of soybean were found significantly differed V_1 247.93 (mg/100g) higher closely followed by V_3 245.86. The V_2 240.70 better to V_4 238.63. Hence, V_5 234.50(mg/100g) recorded content. The content of amylopectin in soybean were found significantly differed among the cultivars however, V_3 904.14(mg/100g) recorded higher closely followed by V_4 861.37 and V_3 859.30 however, V_1 802.07 (mg/100g) recorded low content of amylopectin in seeds.The value of energy in soybean cultivars significantly differs V_5 456.19(Kcal/100g) in seeds recorded significantly higher among themselves therefore lower was V_2 442.35 (Kcal/100g)(Table. 2).Seed weight of cultivars significantly differs V_1 159.89 higher among the varieties hence, V_5 80.87 gram of one thousands seeds. Bulk density of seeds calculated significantly differed V_3 1.22 (g/cc) higher among the rest however, V_2 1.13(g/cc) found lower. Germination percentages were calculated significantly differed among themselves V_3 91% recorded higher but V_1 87% minimum. Moisture content found significantly differed V_1 11% higher received and V_3 9% minimum moisture content of received fresh seeds. Water weight increase ratio of cultivar V_4 265 (ml/100g) significantly higher however, V_1 241(ml/100g) (WIR) was low absorbed the water content by Wei and Chang (2004) (Table. 2).Seed Size range of soybean are used a weight to soybean number ratio as gram per 100 seeds most important character for the point of industrial processing views, V_2 8.04 mm range are bold most significant lower following the rest beside of V_5 12.36 mm highest size were smallest of per seeds as justified by Wei and Chang 2004)(Table. 2).

Organic matter total nitrogen (Table.3) significantly differed were performed of themselves specially major and first elements for life, such as nitrogen V_5 6736 recorded higher and V_2 6051(mg/100g) was lowest, Calcium V_4 319(mg/100g) was higher than V_2 291 lowest, Sodium found V_2 3.41maximum and V_3 2.91lowest, The amount of potassium were V_4 1831calculated higher than V_3 1713(mg/100g) was lowest. However, phosphorus V_4 640 higher than V_5 630(mg/100g) in seeds recorded with no significant differed in among the varieties. As well as minor minerals such as Cu V_2 1.52(mg/100g) higher and V_4 1.20 was low, Zn in V_2 4.33(mg/100g) found higher than V_4 4(mg/100g) was lowest, Mn were V_3 3.70(mg/100g) higher than 2.48 was lowest the most essential one of them Fe was V_4 14.90(mg/100g) recorded higher than V_2 & V_3 12.35 were satisfactory with smallest place. However, especially for Mg V_3 291(mg/100g) found higher then V_2 242 was low recorded in seeds with non-significant among the cultivars.

Conclusion:

Soybean used in different food industries for making full-fat soy flour, protein isolate, fermented and non fermented food products such as snack food, cookies, tempeh etc and meal for animal feeding on the basis of phytochemical, chemical compositing, physical and biological qualities parameter specially peroxidase, lipoxygenase and protease trypsin inhibitor be used by the processing industries as well as pharmaceutical and pharmacological on technologists demand.

सोयाबीन की उन्नत किस्मों का पादप रासायनिक विशेषताओं का अध्ययन करना वर्तमान शोध में प्रमुखता से वर्णित है । सोयाबीन की विभिन्न किस्में जो कि भारत में सर्वाधिक लोकप्रिय एवं खेती की जाती है, कार्बोहाइड्रेट की मात्रा (28.03 से 29.70) प्रतिशत तक पाई गई एवं कुल रेशा का मात्रा 13.51 से 15.83 प्रतिशत, घुलनशील शर्करा 8.71 से 10.51 प्रतिशत, अपचायकशर्करा 1.38 से 1.81 प्रतिशत, अ–अपचायक शर्करा 7.18 से 8.70 तक पाई एवं तेलीय मात्रा 19.03 . 20.83 प्रतिशत, प्रोटीन 37.45–41.27 प्रतिशत जो कि मुख्यतः सभी आवश्यक अमीनों अम्लों से युक्त पाई जाती है इसके साथ ही ऊर्जा का स्तर 442.35–456.19 कि.कैलोरी प्रति सौ ग्राम के साथ–साथ स्टार्च की सीमा 1050 से 1150ए अमाइलोज 234.50 से 247.93 एवं अमाइलोपेक्टिन 802.07 से 904.14 मिलीग्राम प्रति सौ ग्राम शुष्क मात्रा पर पाई गई । सोयाबीन में प्राकृतिक तौर पर पाये जाने वाले पादप रसायन स्वास्थ्य बर्धक एवं पौषणिक कार्य कारक के साथ मुख्यतः ह्रदय रोग उपचार में, केन्सर, मोटापा, अस्थिरोग,

रजोनिवृत्ति एवं एड़स के निवारण में मानव के लिये उपयोगी है । जो अपोषक, आक्सीकारण निरोधक जैवरासायनिक कारी, चिकित्साकारक, जैसे सेपोनिन 459. 649), फिनोलिक 1350.1573 एवं लेवोनॉइड 443.617 मि.ग्रा. प्रति सौ ग्रा. बीज मे पाई गई । पौषणिक प्रतिरोध एवं ट्रिप्सन अवरोधक 14.46 से 19.50 मि.ग्रा. पाई जो कि प्रोटीन की पाचन एवं गुणवत्ता निर्धारक है । सोयाबीन बीज में जैवरासायनिक कारक पर ऑक्सीडेज़ 20.40–22.99 युनिट/ग्राम एवं लिपॉक्सीजिनेज़ 10.03–12.10 युनिट/ग्राम पाई सोयाबीन बीज की गुणवत्ता एवं अप्रियगंध कारक घटक है । अकार्बनिक तत्वों से भरपूर जो अक्सीकरण निरोधक प्राकृतिक तौर पर गुणधारी होते है । इनमें नाइट्रोजन 6432 मि.ग्रा. प्रति सौ ग्रा. सोयाबीन बीज, सोडियम 3.17, पोटाशियम 1800, फास्फोरस 635, कैल्सियम 304, मैग्नीशियम 277, मैग्नीज 3.17, आयरन 13.15, कॉपर 1.37 और जिंक 4.18 मि. ग्रा. प्रति सौ ग्रा. सोयाबीन पाई गई । सामान्यतः जिनका प्रतिशत 5.10 से 5.22 तक पाया गया । जो हडिड्यों को निर्माण एवं विकाश में आवश्यक होते है । उच्चगुणवत्ता, कम कीमत युक्त पोषक, कुपोषण जिससे एक तिहाई जनसंख्या प्रभावित है के लिये सीधे तौर पर घरेलू उपयोग में लाया जा सकता है ।

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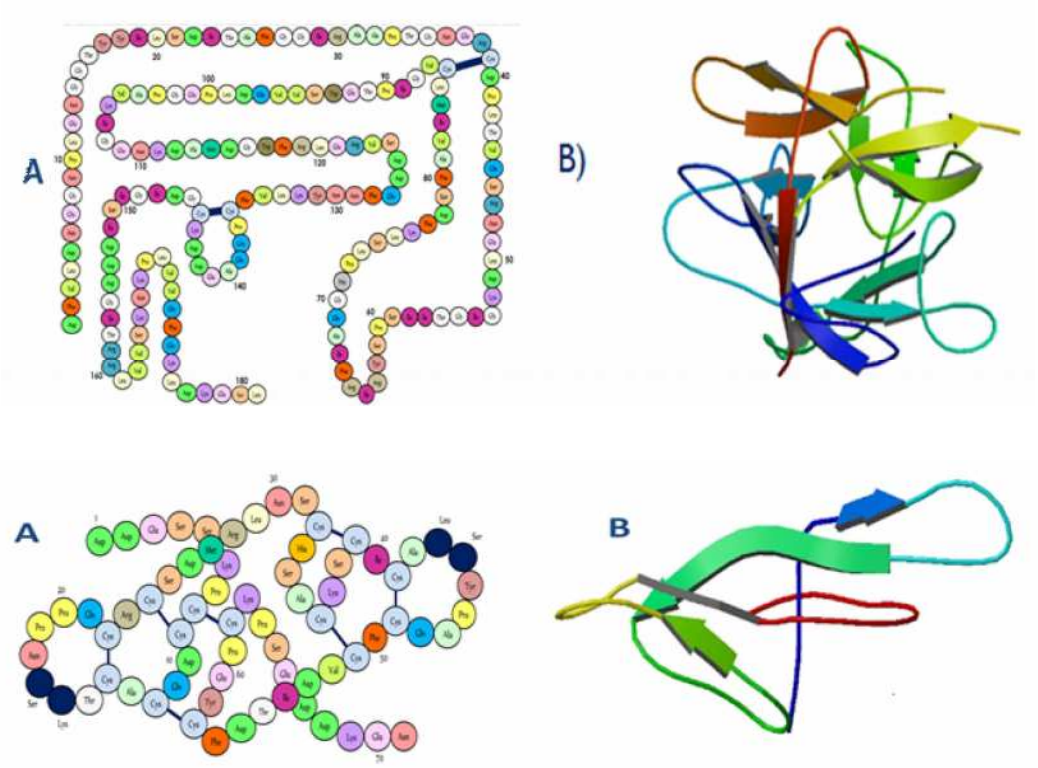
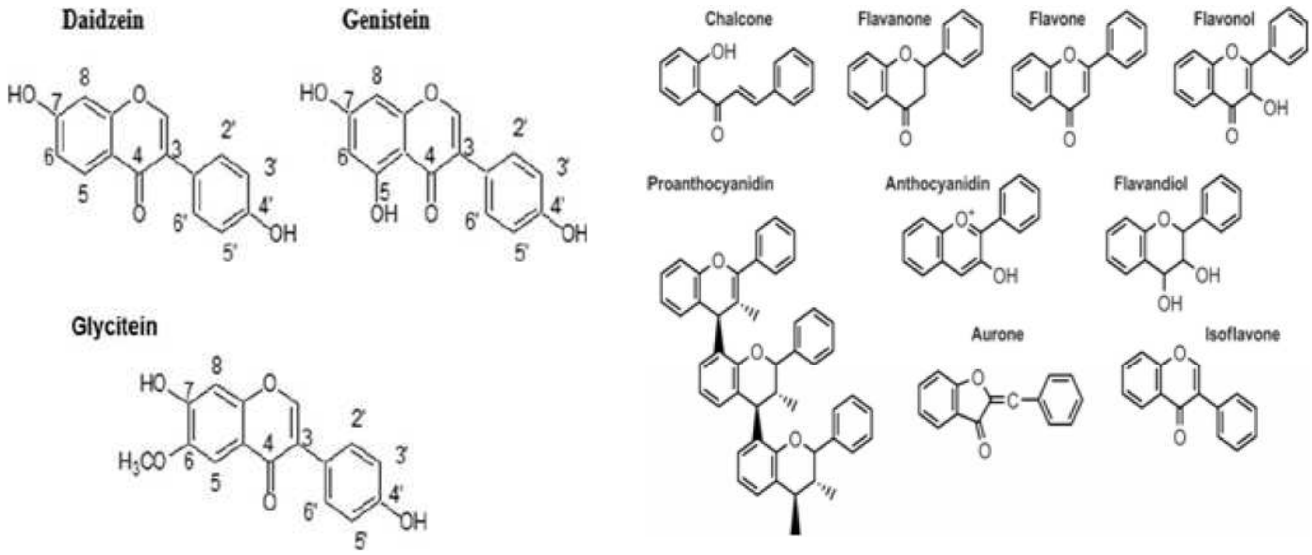
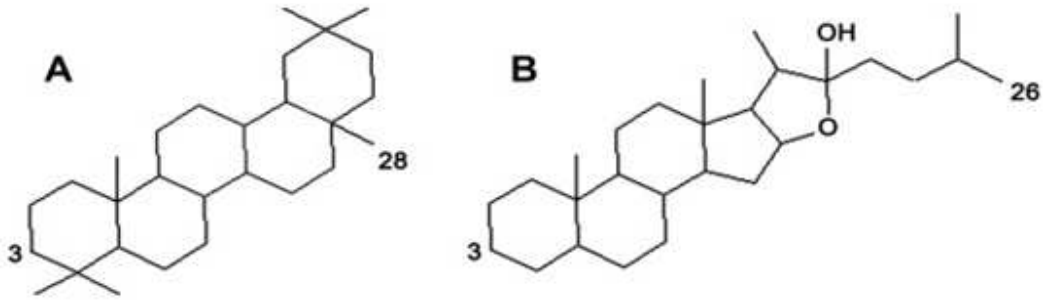


Chemical Structure of soybean Trypsin inhibitors (SKTI &BBI)



Chemical Structure of Phenolics & Flavonoids



Chemical Structure of Saponin A &B

Table 1. Chemical and characteristics of different cultivars of soybean (g/100g).

Cultivars	Protein	Oil	Total Carbohydrates	Crude fiber	Moisture	Ash	Soluble saccharide	NFE	Reducing sugar	Non-reducing sugar
V_1	38.81	20.83	28.09	13.43	11.00	5.10	10.51	19.97	1.81	8.70
V_2	37.45	19.87	28.43	14.83	10.00	5.12	9.91	20.4	1.69	8.21
V_3	39.93	19.41	29.57	12.51	9.00	5.10	9.75	21.23	1.43	8.32
V_4	40.66	19.03	29.70	13.31	9.66	5.46	8.79	20.13	1.38	7.40
V_5	41.27	19.22	29.53	13.17	10.00	5.2	8.71	19.46	1.53	7.18
SEm±	0.217	0.050	0.142	0.230	0.372	0.046	0.037	0.303	0.390	0.034
CD at 5%	0.627	0.146	0.411	0.665	1.083	0.032	0.108	0.877	0.003	0.099

Table 2. Physico-chemical and processing characteristics of different cultivars of soybean

Cultivars	1000 Seed weight (g)	Density (g/cc)	seed Size (mm)	Energy (Kcal/100 g)	WIR (ml/100g)	Germination %	IVPD %	IVSD %
V1	159.86	1.18	6.25	455.05	241	87	64.63	53.04
V2	124.28	1.13	8.04	442.35	248	89	63.84	55.62
V3	91.58	1.22	10.92	447.34	255	91	67.57	52.74
V4	121.33	1.21	8.23	452.60	265	89	66.73	65.37
V5	80.87	1.16	12.36	456.19	246	88	65.86	52.37
SEm±	0.052	0.014	0.012	2.693	0.910	0.632	0294	0.122
CD at 5%	0.145	0.040	0.035	7.776	2.620	1.826	0.850	0.352

Table 3. Mineralogical characteristics of different cultivars of soybean (mg/100g)

Cultivars	N	P	K	Na	Ca	Mg	Fe	Cu	Zn	Mn
V_1	6233	636	1826	3.34	295	281	12.70	1.45	4.17	2.48
V_2	6051	633	1816	3.41	291	242	12.35	1.52	4.33	2.61
V_3	6555	635	1713	2.91	317	291	12.35	1.29	4.10	3.70
V_4	6584	640	1831	3.34	319	259	14.90	1.20	4.00	3.43
V_5	6736	630	1828	3.08	297	278	13.43	1.40	4.30	3.65
SEm±	5.092	2.323	7.952	0.059	1.465	9.006	0.019	0.014	0.020	0.016
CD at 5%	14.706	6.710	22.965	0.172	4.232	26.009	0.055	0.042	0.060	0.047

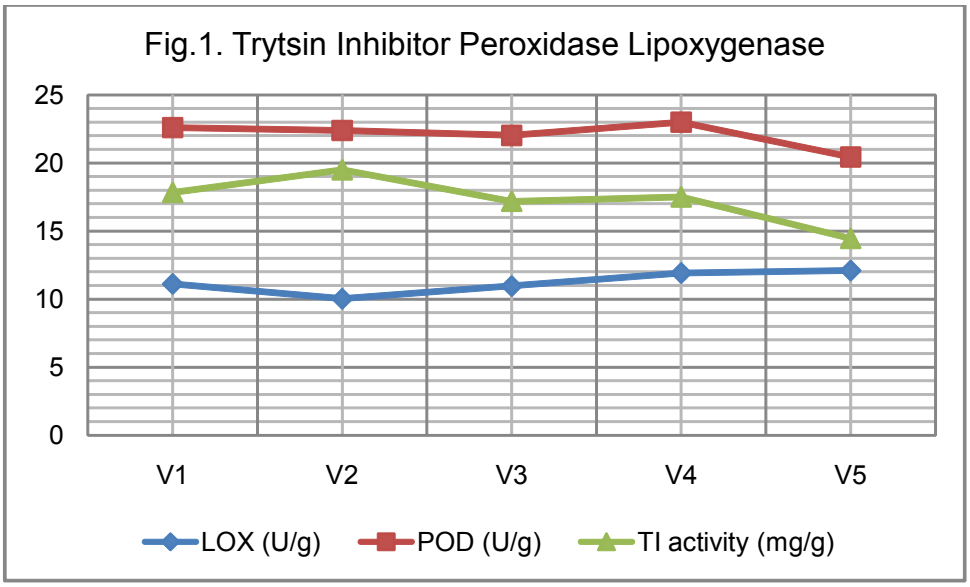


Fig.1. Trytsin Inhibitor Peroxidase Lipoxygenase
25
20
15
10
5
0
V1
V2
V3
V4
V5
LOX (U/g)
POD (U/g)
TI activity (mg/g)

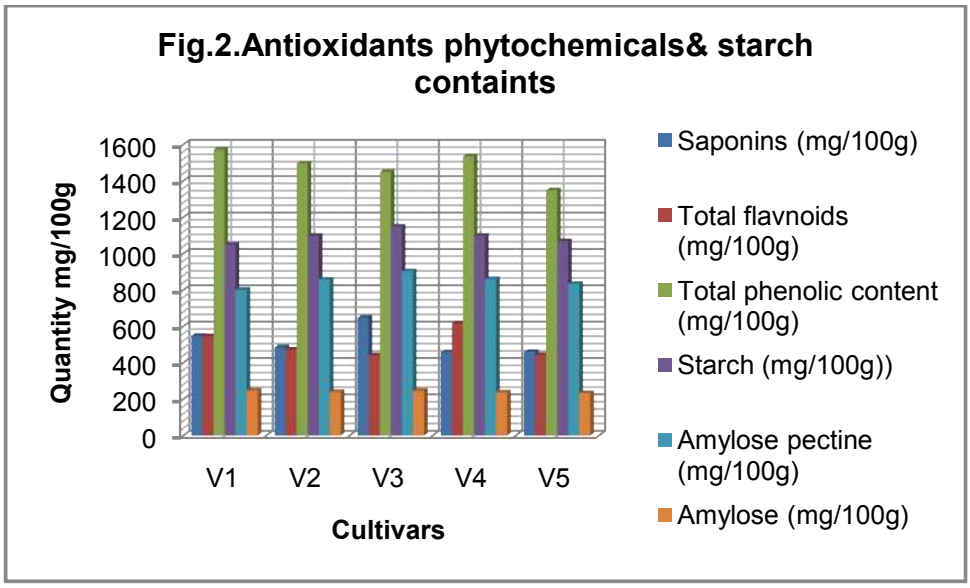


Fig.2.Antioxidants phytochemicals& starch containts
Quantity mg/100g
1600
1400
1200
1000
800
600
400
200
0
V1
V2
V3
V4
V5
Cultivars
Saponins (mg/100g)
Total flavnoids (mg/100g)
Total phenolic content (mg/100g)
Starch (mg/100g))
Amylose pectine (mg/100g)
Amylose (mg/100g)

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Residual effect of tillage and weed management practices adopted in rice and wheat on succeeding summer mungbean and soil property in rice-wheat-mungbean cropping system under conservation agriculture

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Abstract
Among the tillage treatments, maximum density and dry weight of *E. colona* were found in fallow plots of mungbean after conventional tillage in both transplanted rice and wheat under CT (TPR)-CT (W)-fallow system, followed by zero tillage in mungbean after zero tillage in riche and wheat under ZT+S(R)-ZT(W)-ZT(M) being minimum when zero tillage was done in mungbean in the absence of wheat residues after conventional tillage in both rice and wheat under CT+S(R)-CT(W)-ZT(M). Herbicidal treatment had no significant influence on density and dry weight of *E. colona.* Plant height and seed yield were did not change significantly due to the residual effect of tillage practices but both were numerically higher when zero tillage was done in mungbean in absence of wheat residues under CT+S (R)CT(W)-ZT(M) system due to superior value of number of branches and pods per plant (3.11 and 11.57, respectively). All the above parameters attained the minimum values when zero tillage was done in mungbean after zero tillage in rice and wheat in presence of previous crop residues under ZT+S+MR(R)-ZT+RR(W)-ZT+WR (M). Root nodules were minimum (55.07/plant) when zero tillage was done in mungbean in absence of wheat residues under CT+S(R)-CT(W)-ZT(M) and these were slightly increased (56.67/plant) in ZT+S(R)-ZT(W)-ZT(M) being maximum (60.14/plant) when zero tillage was done in mungbean in presence of wheat residues under ZT+S+MR(R)-ZT+RR(W)-ZT+WR (M). Similarly, Weedy plots had lower plant height, number of branches, pods and grain yield but higher number of nodules than the herbicides treated plots. However, soil pH, EC and OC remain unchanged due to the different tillage and weed management practices.

Keywords- Mungbean, conservation agriculture, root nodules, rice-wheat-mungbean

Rice-wheat-fallow is the cropping system in the central India. Fields remain fallow for 70-80 days during summer after the harvest of winter crops. Short-duration crops like summer greengram can be grown during this period with assured irrigation. This practice has received wide acceptance among the farmers and has occupied an area of about 1.0 Mha as it provides additional income, improves soil fertility and ensures efficient land utilization (*Sharma et al., 2000; Sharma & Sharma, 2004*). Current cultivation practice involves conventional tillage (excessive tillage) for good seed bad preparation and facilitates proper germination but cause soil health deterioration including loss in soil organic carbon. Now conservation agriculture become popular over the past 2-3 decade now for achieving sustainability in intensive cropping system (*Sharma et al., 2012*). It involves zero tillage, retention of previous crop residues and inclusion of legumes in summer. As tillage is the very imported practice which cause direct or indirect (residual) effect on weed dynamics and succeeding crop growth including higher weed seed bank in CA based cropping system (*Kumar et al., 2005*). Whereas, lower density of Phalaris minor was reported in wheat due to the lower weed seed bank of on account of in zero tillage practices (Mishra and Singh, 2011). Continuous zero tillage in maize-wheat-mungbean cropping system gave higher root dry weight and volume but lower root length and seed yield of succeeding mungbean due to higher in bulk density in zero tilled plots (*Meena et al.,2015*). Beside this

zero tillage system shows higher weed seed bank as compared to conventional tillage system, thus weed management is very important part of conservation agriculture (*Sharma et al., 2015*). Weeds can be controlled by herbicides, but some researches have reported residual effect of some pre-emergence herbicides on succeeding crop. However, *Kiran et al*. (2015) observed that root length, shoot length, seedling vigour and seed yield of succeeding mungbean were not affected when bispyribac was applied in the previous transplanted rice. Since many previous researcher have reported direct effect of tillage and weed management practices on weeds and crop growth but information on residual effect of tillage and weed management practices done in rice and wheat are still lacking. Henceforth comprehensive study was planned to see the residual effect of tillage and weed management practices adopted in rice and wheat on succeeding summer mungbean and soil property in rice-wheat-mungbean cropping system under conservation agriculture

Materials and Methods

A field experiment was conducted at Directorate of Weed Research, Jabalpur (M.P.). The climate of the area is sub-tropical, with an average rainfall of 1386 mm, minimum temperature of 4-7 oC in January and maximum temperature of 42-45 oC in May. The soil of experimental site was loamy in texture. The experiment was consisted of Fifteen treatments comprising of five tillage as main-plot treatments (T_1- conventional tillage in rice + Sesbania - conventional tillage in wheat - zero tillage in mungbean, T_2- conventional tillage in rice +Sesbania + mungbean residues - conventional tillage in wheat + rice residues -zero tillage in mungbean + wheat residues , T_3- zero tillage in rice + Sesbania - zero tillage in wheat - zero tillage in mungbean, T_4- zero tillage in rice + Sesbania + mungbean residues - zero tillage in wheat + rice residue - zero tillage in mungbean+ wheat residues, T_5- conventional tillage in transplanted rice - conventional tillage in wheat - fallow) and three weed control as sub plot treatments [W_1- weedy check, W_2- application of bispyribac 25g/ ha in rice and application of tank mix solution of clodinafop 60 g/ha and sulfosulfuron 25g/ha in wheat as post emergence during both the years and W_3- application of chlorimuron + metsulfuron-methyl 4.0g ready mix /ha (post emergence) during 2014 and bispyribac 25g/ha (post emergence) during 2015 in rice and application of clodinafop 60 g/ ha+2,4-D 0.5kg/ha (post emergence) during 2014-15 and mesosulfuron 3% + iodosulfuron methyl 0.6% 12+2.4 g/ha (post emergence) during 2015-16 in wheat] were laid out in split plot design with three replications. Summer mungbean variety 'Samart' was sown in 20 cm row spacing with happy seed drill under zero tillage in first week of April during both years of experimentation. Data on weeds and crop growth were recorded at 45 DAS during both the years and mean data of two years are presented in (Table 1). Whereas, soil data were recorded at the end of each cropping cycle and there initial values were taken from the project report of DWR Jabalpur.

RESULTS AND DISCUSSION

Weed density and dry weight

Echinochloa colona was only the dominant weed in mungbean. Density and dry weight of *E. colona* were influenced due to the residual effect of tillage and weed management practices adopted in rice and wheat (Table 1). The maximum density (3.43/ m_2 and 4.08 g/m_2, respectively) was found in fallow plots where no tillage was done after conventional tillage in both transplanted rice and wheat under CT (TPR)-CT (W)-fallow system followed by zero tillage in mungbean in absence of wheat residues after zero tillage in rice and wheat (3.14/m_2 and 3.10 g/m_2) under ZT+S(R)-ZT(W)-ZT(M). However, the minimum density and dry weight (2.59/ m_2 and 2.61 g/m_2, respectively) of *E. colona* were found when zero tillage was done in mungbean in the absence of wheat residues after conventional tillage in rice and wheat under CT+S(R)-CT(W)-ZT(M). In CT(TPR)-CT(W)-fallow system, weeds grew on fallow land without any tillage operation on account of more weed seeds on the soil surface after conventional tillage. Conventional tillage in the absence of preceding crop residues (T_1) facilitated germination due to soil pulverization during tillage. It also

provided better seed-soil contact which enhanced germination and quick growth of mungbean. As a consequence, weeds were suppressed due to smothering effect of mungbean. The finding are agreement with *Nath et al. (2016)* in wheat-greengram cropping sequence.

Among the different weed management practices adopted in rice and wheat, the maximum density and dry weight (4.13/m_2 and 4.39 g/m_2, respectively) of *E. Colona* were recorded under weedy check plots at 45 DAS due to uninterrupted growth of weeds on account of non-adoption of weed control measures. However, density and dry weight of E. Colona were reduced under both the herbicidal treatments, either in regular use (2.49/ m_2 and 2.42 g/m_2) or rotational use of herbicides (2.58/m_2 and 2.80 g/m_2). But significant difference did not exist between the treatments in terms of dry weight and density of *E. colona*. It might be due to the fact that all the herbicides which were applied in rice and wheat were removed by climatic factors (temperature and moisture) decomposed by the microbial activity (Das, 2008) and hence did not have any residual effect on weeds in mungbean.

Growth and yield of mungbean

It was remarkably noticed that, plant height and seed yield were remain unchanged due to the residual effect of tillage practices, however numerical values of above parameters were higher (30.26 cm and 1.17 t/ha) when zero tillage was done in mungbean in absence of wheat residues under CT+S(R)-CT(W)-ZT(M). Number of branches/plant root nodules/plant and pods/plant were significantly influenced by the residual effect of tillage practices (Table1). The minimum number of branches and pods/plant (2.89 and 9.66, respectively) were found when zero tillage was done in mungbean after zero tillage in rice and wheat in presence of previous crop residues under ZT+S+MR(R)-ZT+RR(W)-ZT+WR (M). These were slightly increased in increased when zero tillage was done in mungbean after conventional tillage in rice and wheat under CT+S(R)-CT(W)-ZT(M) and zero tillage was done in mungbean in present of wheat residue after conventional tillage in rice and wheat with previous crop residues under CT+S+MR(R)-CT+RR(W)-ZT+WR (M) and reached maximum (3.11 and 11.57 /plant, respectively) when zero tillage was done in mungbean in absence of wheat residues under CT+S(R)-CT(W)-ZT(M). Whereas, numbers of root nodules were minimum (55.07/plant) when zero tillage was done in mungbean in absence of wheat residues under CT+S(R)-CT(W)-ZT(M) and these were slightly increased (56.67/plant)in ZT+S(R)-ZT(W)-ZT(M) being maximum (60.14/plant) when zero tillage was done in mungbean in presence of wheat residues under ZT+S+MR(R)-ZT+RR(W)-ZT+WR (M). Reason behind less number of nodules in CT+S(R)-CT(W)-ZT(M) might be that intensive tillage practices reduces microbial population and their activity by reversing carbon accumulation and breaking down soil structure. But in case of zero tillage, where previous crop residues were retained in more quantity, had more organic carbon, which enhanced the microbial population and their activity and ultimately produced more nodules in pulses (Lupwai et al, 2012) and hence, ZT+S+MR(R)-ZT+RR(W)-ZT+WR (M) had more numbers of nodules than other tillage practices.

Weedy plots showed lower plant height (27.34 cm), branches (2.74/plant), pods/plant (8.56) and seed yield (0.80 t/ha) as compared to herbicide treated plots, because crop growth was hampered by weeds due to severe crop-weed competition. However, these parameters were appreciably increased with regular application of same herbicides (29.61 cm, 2.99, 10.84 and 1.23 t/ha, respectively) and rotational application of herbicides (31.65 cm, 2.23, 12.34 and 1.27 t/ha, respectively) in rice and wheat. As a consequence of lower inter species competition crop had quick and rapid growth and suppressed the post emergent weeds and finally produced, more branches per plant, pods and seeds per pod and ultimately recorded higher yields (Singh et al, 1996). Whereas, root nodules were highest in weedy plots (64.81/plant) lower as compared to herbicides treated plots (49.84 and 55.50 in W3 and W2 respectively) it might be due to the higher

microbial activity (*Singh et al., 2015*).

Soil chemical property

Soil pH, EC and organic carbon remain unchanged due to tillage and weed management practices (Table 3). Whereas, soil pH, EC and OC were affected due to carry over effect of tillage practices done in proceeding years and there where change over their initial status during completion of second year of experimentation. At the end of the experiment, soil pH was decreased and EC was increased from their initial status irrespective of different tillage practices. Soil organic carbon shows drastic changes, it was reduced (0.59%) from their initial status (0.60%) when conventional tillage was done in direct as well as transplanted rice, whereas, zero tillage in all the component crops including mungbean with or without previous crop residues shows enhancement in soil organic carbon at the end of experiment from its initial status. After the decomposition of plant residues organic matter, carbonic acids are produced which declined soil pH. The reason behind lower organic carbon in conventional tillage in transplanted rice and wheat that reduction and meneralization of soil organic carbon in rice and wheat respectively. Similarly carbonic acids were produced after decomposition of organic matter in conventional tillage which declined soil pH and reduction of organic carbon in soil. Similarly, Day (2016) also reported higher soil organic carbon under direct seeded rice + brown manuring- zero till in wheat

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Table 1. Effect of tillage and weed management practices on weed density, dry weight , growth and yield attributes of mungbean

Tillage	Density E. colona/ M^2	Dry weigh E. colona (g/M^2)	plant height (Cm)	Number of branches/ plant	Root nodules/ plant	Pods/ plant	Seed yield (t/ha)
Tillage practices							
T_1- CT+S(R)-CT(W)-ZT(M)	2.59 (6.19)	2.61 (6.32)	30.26	3.11	55.07	11.57	1.17
T_2 - CT+MR+S(R)-CT+RR(W)-ZT+ WR(M)	2.99 (8.46)	2.86 (7.71)	29.86	2.97	56.92	10.94	1.14
T_3 - ZT+S(R)-ZT(W)-ZT(M)	3.14 (9.36)	3.10 (9.11)	28.95	2.97	56.07	10.15	1.07
T_4 - ZT+MR+S(R)-ZT+WR(W)-ZT+WR(M)	3.19 (9.66)	3.36 ()10.82	28.26	2.89	60.14	9.66	1.01
T_5 - CT(TPR)-CT(W)	3.43	4.08 (3.43)	16.12)	-	-	-	- -
SEm±	0.19	0.44	0.91	0.10	1.22	0.41	0.05
CD (P=0.05)	0.61	1.44	NS	0.34	4.20	1.43	NS
Weed management							
W_1	4.13						
	(16.59)	4.39	27.34	2.74	64.81	8.56	0.80
W_2	2.49 (5.68)	2.42	29.61	2.99	55.50	10.84	1.23
W_3	2.58 (6.17)	2.80	31.65	3.23	49.84	12.34	1.27
SEm±	0.17	0.22	0.73	0.10	1.00	0.34	0.05
CD (P=0.05)	0.51	0.66	2.19	0.32	2.99	1.01	0.15

W_1 - Weedy check,

W_2 - Bispyribac 25 g/ha in rice and Clodinafop 60 g/ha + Sulfosulfuron 25 g/ha in wheat (during both the years)

W_3 - Chlorimuron +metsulfuron-methyl (I^{st} year) and Bispyribac 25 g/ha -(II^{nd} year) in rice and Clodinafop 60 g/ha+2,4-D 0.5 kg/ha (I^{st} year) and Mesosulfuron +Idosulfuron methyl 12+2.4 g/ha -(II^{nd} year) in wheat

Table 3. Effect of tillage and weed control practices on soil pH and electrical conductivity of rice-wheat-mungbean cropping system

Treatments	Soil pH			Electrical conductivity (dS/m)				OC (%)	
	Initial	2014-15	2015-16	Initial	2014-15	2015-16	Initial	2014-15	2015-16
Tillage treatments									
T_1- CT+S(R)-CT(W)-ZT(M)	7.18	7.17	7.15	0.40	0.40	0.42	0.60	0.60	0.58
T_2 - CT+MR+S(R)-CT +RR(W)-ZT+WR(M)	7.16	7.15	7.13	0.39	0.40	0.41	0.60	0.61	0.63
T_3 - ZT+S(R)-ZT(W)-ZT(M)	7.13	7.11	7.09	0.37	0.38	0.39	0.61	0.63	0.65
T_4 - ZT+MR+S(R)-ZT +WR(W)-ZT+WR(M)	7.11	7.09	7.07	0.34	0.41	0.42	0.61	0.64	0.65
T_5 - CT(TPR)-CT(W)	7.19	7.18	7.16	0.37	0.36	0.39	0.60	0.60	0.59
SEm±	**0.04**	**0.07**	**0.06**	**0.04**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Weed management									
W_1	7.09	7.06	7.04	0.33	0.37	0.39	0.65	0.65	0.66
W_2	7.12	7.16	7.11	0.38	0.38	0.39	0.60	0.61	0.61
W_3	7.24	7.19	7.20	0.40	0.41	0.44	0.57	0.56	0.58
SEm ±	**0.04**	**0.03**	**0.05**	**0.03**	**0.03**	**0.02**	**0.03**	**0.02**	**0.02**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

W_1 - Weedy check,

W_2 - Bispyribac 25 g/ha in rice and Clodinafop 60g/ha+Sulfosulfuron 25 g/ha in wheat (during both the years)

W_3 - Chlorimuron +metsulfuron-methyl (I^{st} year) and Bispyribac 25 g/ha-(II^{nd} year) in rice and Clodinafop 60g/ha+2, 4-D 0.5 kg/ha (I^{st}year) and Mesosulfuron+Idosulfuron methyl 12+2.4 g/ha-(II^{nd}year) in wheat

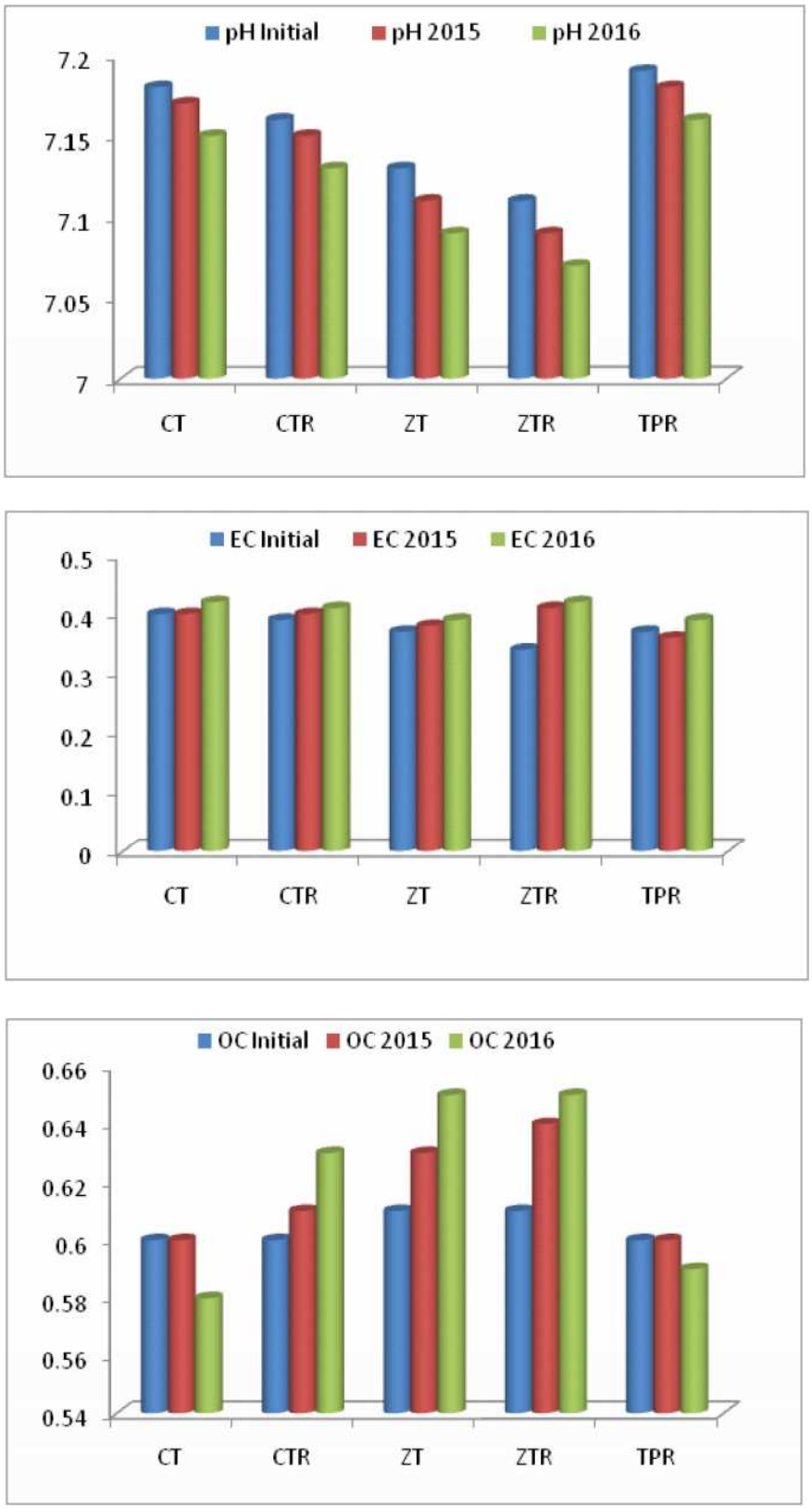

Figure 1. Residual effect of tillage on Soil pH, EC and organic carbon

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Use of Media as a source of market information by the farmers of Narsinghpur District, Madhya Pradesh

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Abstract

It was observed that majority of the farmers had low level of extent of use of media for market information in ten villages of Narsinghpur district and block among 130 randomly selected farmers. It is concluded that there is better scope for increasing the use of media for market information by means of addressing the problems.

Keywords- media, source, market information

Agriculture contributes about 18% to the total GDP. In India most of the farmers sell away their surplus produce to the village moneylenders and traders at a very low price, more than 50 per cent of the agricultural produce are sold in these village markets in the absence of organized markets. This is mainly due to lack of knowledge about the market. Absence of market intelligence or information system in India is a major constraint. Indian farmers are usually not aware of the current prices of the produce prevailing in big markets. Thus, they have to accept any un-remunerative price for the produce as offered by traders or middlemen. Thus, there is need for proper and efficient Market Information system. Market Information includes all the facts, estimates, opinions and other information which affect the marketing of goods and services. It ensures smooth and efficient operation of the marketing system. Accurate, adequate and timely availability of market information facilitates decision about when and where to market the products. It provides daily information regarding market prices of agriculture produce.

The traditional approach of providing market information through extension education services is overstretched and under-resourced. Thus, use of various media such as print and electronic media will enable farmer to get the requisite information about the market prices of the produce, input prices at the right time and in a cost-effective manner. This study sought to find out which medium, technology or channels were appropriate to disseminate market information to farmers.

Materials and Methods

Investigations were undertaken in Narsinghpur District of Madhya Pradesh that comprised of six blocks namely Narsinghpur, Kareli, Gotegaon, Chawarpatha, Chichli and Saikheda. Out of 6 blocks, Narsinghpur block was selected randomly. Narsinghpur block comprised of 209 villages, out of which 10 villages were selected randomly. Thus total 130 respondents were selected as the sample of the study on the basis of proportionate random sampling method from all selected villages. The data was collected using interview schedule.

Result and Discussion

Table 1: Media sources available to the respondent farmers

N= 130 (Multiple responses)

Media available	Frequency	Percentage (%)	Rank
Radio	52	40.00	III
Television	126	96.92	I
Newspaper	31	23.85	IV
Mobile Phone	119	91.54	II
Magazine	9	6.92	V

It was observed that 96.92 per cent of the respondents possessed television, 40.00 per cent possessed radio, 23.85 per cent have newspaper, 91.54 per cent have mobile and 6.92 per cent have news magazine. Thus, majority of the respondents have television as the main source of media available. The possible reason could be that television is an audio-visual medium and hence it is a great source of information as well as entertainment to the farmers. This result is similar to the findings of Singh (2011) and Ovwigho *et al.* (2009).

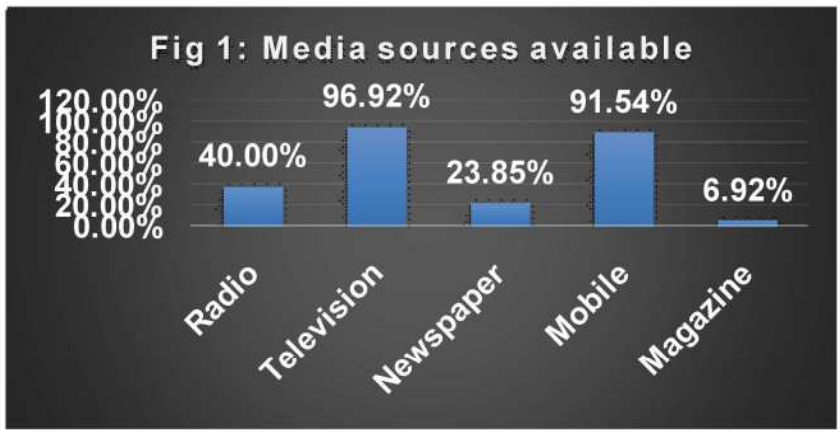


Table 2: Extent of use of media by the farmers for seeking market information

Media	Extent of use of media for Market Information											
	Daily once		Weekly once		Fortnightly once		Monthly once		Whenever needed		Never	
	f	P (%)	F	P (%)	f	P (%)	F	P (%)	f	P (%)	f	P (%)
Radio	16	12.31	9	6.92	0	0	0	0	11	8.46	94	72.31
Television	73	56.15	17	13.08	0	0	0	0	18	13.85	22	16.92
Newspaper	15	11.54	0	0	0	0	0	0	16	12.31	99	76.15
Mobile	87	66.92	16	12.31	0	0	0	0	16	12.31	11	8.46
Internet	4	3.08	0	0	0	0	0	0	35	26.92	91	70
Others	0	0	0	0	0	0	0	0	7	5.38	123	94.62

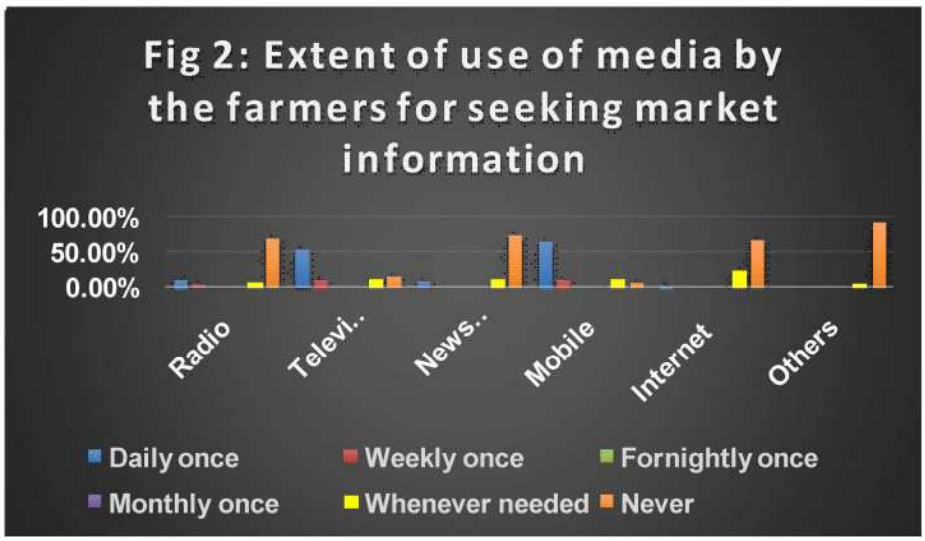
It is evident that 27.69 percent of the respondents were using radio out of which 12.31 percent were using it daily once, 6.92 percent were using it weekly once and 8.46 per cent were using it whenever needed whereas 72.31 percent of the respondents had never used it for market information (Table 2).

Majority of the respondents (83.08%) were using television for Market Information out of which 56.15 percent were using it daily once, 13.08 percent were using it weekly once, 13.85 percent were using it whenever needed whereas 16.92 percent had never used it for market information.

About 23.85 per cent of the respondents were using newspaper for market information in which 11.54 percent were using it for daily, 12.31 percent were using it whenever needed.

Majority of the respondents (91.54%) were using Mobile phone for acquiring Market Information out of which 66.92 percent were using it daily once, 12.31 percent were using it weekly once and 12.31 percent were using it whenever needed.

About 30 percent of the respondents were using Internet and 5.38 percent were using media other than this for market information.

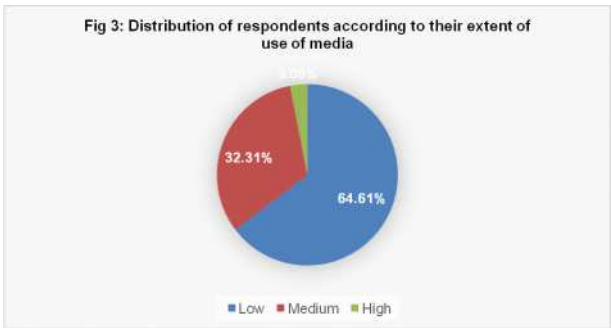


Extent of Use of Media

Table 3: Distribution of respondents according to their extent of use of media

Category	Frequency	Percentage (%)
Low	84	64.61
Medium	42	32.31
High	4	3.08
Total	**130**	**100.00**

It is observed that 64.61 per cent of the respondents belonged to low extent of use, 32.31 percent had medium extent and 3.08 percent belonged to high level of extent of use of media (Table 3). It could be due to lack of awareness and knowledge to the farmers about the usage of media for market information and also the respondents are less cosmopolites and their social participation is also less. This result is in conformity with the research findings of Naveena (2015) and Tomar (2016).



Maximum number of respondents had television (96.92%) and mobile (91.54%). Radio was used by 27.69% of the respondents for market information. Majority of the respondents (83.08%) were using

television. About 23.85 percent of the respondents were using newspaper. Majority of the respondents (91.54%) were using Mobile for acquiring Market Information. About 30.00 percent of the respondents were using Internet and 5.38 percent were using media other than this for market information. Majority i.e. 64.61 percent of the respondents belonged to low extent of use, 32.31 percent had medium extent and 3.08 percent belonged to high level of extent of use of media for market information.

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Effect of different microbes on the yield and quality of chickpea

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Abstract

An experiment was conducted to evaluate the effect of different inoculants on chickpea. Six treatments of different inoculations and combination with humic acid viz. *Rhizobium,* PSB, Rhizobium+PSB, Rhizobium +HA, PSB + HA and a control (un inoculated) were taken on low nutrient status of soil in four replications under randomized block design. No chemical fertilizer was incorporated to the soil. Keeping in view the objective of the experiment, the lignite based culture of *Rhizobium* and phosphorus solubilising bacteria were seed inoculated at the time of sowing separately and in combinations with humic acid.

The effect of microbial inoculation was significantly effected the grain and straw yields of chickpea over control. The increase in yield was many folds higher than the control. Comparatively the control yield was 3.03 qha^{-1} under adverse conditions of heavy continuous rain at pod formation stage followed by hail storm. However, the higher crop yield recorded can be attributed to the microbial effect applied through seed inoculations. Similarly the percent nitrogen content and the protein content be also in the similar trend of increase over control, the number of nodules per plant were also significantly effected due to inoculation representing 116 and 114 percent over control. The protein content was also increased by 9 & 8 percent due to PSB and *Rhizobium* + PSB treatments, respectively. It can be thus concluded that the use of biofertilizers is important for improving the soil health and plant growth, direct or indirect effects of pathogenic bacteria can also be suppressed by use of microbial inoculants but this needs further studies for eco-friend benefits of biofertilizers as compared to chemical fertilizers.

Key words: Microbes, Bioculture, Rhizobium.

In India pulses are cultivated in 23 million hectare of land with 19 million tones production in 2012-13. Nitrogen harvest index in pulses is around 70% with Biological Nitrogen fixation (BNF) contribution in total gram nitrogen ranging between 60-70% (Beck *et al* 1991, Khan *et al* 2003) remaining 30-40% of grain nitrogen is reserved from soils and other sources. The average productivity of pulses is less than one tone per hectare, there is lot of difference in pulses grain yields obtained at research farm and farmers field potential yield of new varieties are however calculated when recommended plant nutrients are supplied and proper inoculation with Rhizobium cultures is adopted. The contribution of BNF in increasing pulses production is due to microbial resources economizing N fertilizer. Bio-fertilizers are being essential component of organic farming are the preparations containing live or latent cells of efficient strains of different microorganism capable of nitrogen fixing, phosphate solubilizing or cellulolytic micro-organisms used as seed treatment / fortification for application to soil or composting areas with the objective of increasing number of such microorganisms and accelerate those microbial processes which augment the availability of nutrients that can be easily assimilated by plants. Biofertilizers play a very significant role in improving soil health increasing soil fertility by fixing

atmospheric nitrogen, both, in association with plant roots, solubilise insoluble soil phosphates and produce plant growth substances in the soil. They are in fact being promoted to harvest the naturally available biological system of nutrient mobilization (Venkastashwarlu, 2008). Besides above facts, the long term use of bio-fertilizers is economical, eco-friendly, more efficient, productive and accessible to marginal and small farmers over chemical fertilizers.

Chickpea (*Cicer arietinum* L.) is a cool season legume crop and is grown in several countries worldwide food source. Seed is the main edible part of the plant and is a rich source of protein, carbohydrates and minerals especially for the vegetarian population. As in case of other legume crops, even chickpea can fix atmospheric nitrogen through its symbiotic association with *Rhizobium* sp.; thus helping in enhancing the soil quality for subsequent cereal crop cultivation.

Rhizobia are gram negative soil bacteria capable of inducing formation of nodules in leguminous plants in which atmospheric nitrogen is reduced to ammonia. Looking to the more use of chemical fertilizers the soil health is getting down gradually resulting in low yields and low nutrient release. The use of biofertilizer in the soil is only way to enrich the soil with microorganisms for sustainable agriculture. Rhizobium, phosphorus solublising bacteria and humic acid being organic sources alternative to nitrogen and phosphorus, it was interesting to study their impact on the performance of chickpea.

Materials and methods

The field experiment was conducted to evaluate the effect of different biofertilizers and their combinations with humic acid on the performance and quality of chickpea. The experiment was laid out at Biofertilizer Production Centre, JNKVV, Jabalpur. The soil was neutral in reaction but low in available N, P and K. The experiment consisted of six treatments, replicated four folds under the Randomized block design (RBD) with 24 plots of 4 X 2.5 m^2. Chickpea variety JG - 315 and Seed rate 80kg ha^{-1} was sown on and the crop was harvested on 15 March 2015.

The nitrogen content was estimated by wet Kjeldahl method (AOAC, 1965) and distilled by KELPOL instrument analysis.

$$\text{Nitrogen (\%)} = \frac{\text{Normality of } H_2SO_4 \text{ X Volume of } H_2SO_4 \text{X1.1}}{\text{Weight of Sample}} \times 100$$

The data of Grain and straw yield were analyzed statistically in simple Randomize Block Design to draw suitable inference as per standard procedure described by Panse & Sukhatme (1970). Nodulation study was done at 45 days after sowing by uprooting 5 plants per plot very carefully to avoid any disturbance around rhizosphere, soil was washed in the running water. Nodules per plant were counted manually. After the harvested of the crop fresh weight bundle were made plot wise and recorded fresh weight of bundle. Manual threshing was done plot wise and straw & grain yield were recorded.

Result and discussion

Effect of treatments on the nodule formation in chickpea

The performance of all the bacterial inoculations significantly increased the number of nodules, seed yield, nitrogen content and protein content of chickpea, which was better in the inoculated plots as compared to control.

The effect of different treatments of inoculants significantly influenced the nodule formation with PSB treatment alone followed by rhizobium + PSB in combination over control. The

inoculated treatments increased number of nodules but differed non significantly.

The maximum number of nodules were recorded in treat which was inoculated with PSB alone followed by *Rhizobium* + PSB inoculation having 34 and 33 nodules per plant on an average respectively. When compared with control the increase in number of nodules were 116 and 114 per cent more due to PSB alone and rhizobium with PSB respectively. The root nodulating Rhizobium species reflected in effective nodule number, similar report has been also reported by Raut and Kohire (1991), Tiwari *et al* (2000)

Effect of treatments on the grain and straw yield of gram

The various treatments of microbial preparation affected the grain yield of gram significantly. Grain yield among treatments ranged from 3.03q. ha^{-1} (Control Un Inoculated) to 13.56 q. ha^{-1} (Inoculated with Rhizobium).However, Rhizobium + PSB combination had recorded 13.46 q.ha^{-1} and 11.18q.ha.$^{-1}$ respectively were found to be with PSB alone which was statistically at par with Rhizobium treated has been reported by Jagdale *et al* (1980) Singh and Gupta (1985). All treatments were significantly superior over control. The low yield obtained is due to the hailstorm occurred during pod formation stage which shattered the flowers and tender pods.

The straw yield due to all treatments have proved significantly better performance when compare to control. Straw yield among treatments ranged from 8.77q.ha^{-1} under Un Inoculated to 31.97q. ha-1 having treated with PSB alone. However, Rhizobium alone have given 31.16q ha^{-1} and 30.35q ha^{-1} with HA +Rhizobium combination were found to be statistically at par with PSB treatment alone. All treatments were significantly superior over control, signifying the effect of inoculated bacteria. Singh and Gupta (1985), Shaktawat (1988), Sharma et al (1989), Singh et al (1998), Namdeo and Gupta (1999) have also reported that inoculation with Rhizobium to gram seed improved yield attributes yield and protein content in the seed of gram.

Effect of different treatments on nitrogen content in gram grain

The treatment effect on percent nitrogen content of gram grain was recorded to be affected by the different inoculation has been given in table 4.3 and the response is depicted in figure 4.3 showing that the effect was significantly superior over control, indicating the effect of inoculation of Rhizobium and PSB alone and in combination. The effect of humic acid with rhizobium and PSB alone was 3.13 and 3.19 percent respectively which was also superior over control. The highest nitrogen content was recorded in PSB (3.29) followed by Rhizobium + PSB (3.27). Gour and Ostwal (1972), Sattar and Gour (1987) have also reported similar observations. The percent increase in the nitrogen content due to inoculation was highest of 9.66 over control by PSB alone, while dual inoculation of Rhizobium with PSB increased only upto 9.0 percent Parmar and Dadarwal, (1999), Gupta (2004) have also reported similar effect of inoculation in chickpea.

Effect of different treatments on protein content in gram grain

The inoculation effect on the protein content in gram grain, which was also found to be significantly superior over control. The highest protein content was recorded in PSB alone treated plot having highest of 20.58 percent followed by Rhizobium + PSB, Rhizobium, HA + PSB and HA + Rhizobium inoculated treatments having 20.43, 20.30, 19.98, 19.75 and 18.78 percent respectively. Raju and Verma (1984), Patel and Patel (1991) also reported the similar results. If the percent increase in protein content is compared with the control it was found that the increase ranged between 6.38 to 9.58 percent, among the inoculated treatments there was no much difference, hence statistically non significant, however, bacterial inoculations gave higher assimilation of protein in gram seed, indicating bacterial activities in releasing the nutrients for plant growth. Singh *et al* (1998) have also reported similar effects justifying the treatments.

Legume inoculation is an old era practice

being carried out for centuries in agricultural system (Catsoux *et al.*, (2001). Plant nutrients are observed from soil through root system. The root releases wide range of organic compounds which attracts millions of microbes around rhizosphere creating vigorous microbial activity, interacting with nutrients in soil making them easily available to the plants. Among these rhizobacteria, Rhizobium is one of them which is capable of fixing atmospheric nitrogen in legumes.

Soil is a dynamic medium where plant and microorganism coexist and are mutually related to one another. The inoculants have affected the nodules significantly over control having maximum number in rhizobium treated alone but was *at par* with other treatments of PSB and humic acid alone or in combination with rhizobium. The maximum number of nodules formed was due to rhizobium microorganisms. The microbial seed inoculants such as Azotobactor, Beijerinkia, Rhizobium or Phosphorus solibilizing microorganism may help in establishment of beneficial microorganisms in the rhizosphere. The increases in number of nodules are due to inoculation attributed to growth promoting substances excreted by the bacteria [Jain and Trivedi (2005)]

The grain yield was also significantly affected by the microbial treatments which were lowest in the uninoculated control 3.5 q. ha^{-1} and highest 13.56 q. ha^{-1} due to rhizobium followed by PSB alone or in contribution with Rhizobium and humic acid. The rhizobium inoculated treatment had 13.56 q. ha^{-1} which was at par to other treatments have been also reported by Jagdale *et al* (1980) and Singh *et al* (1998). Since the results are difficult in specific bacteria capable of nodulating chickpea, depending on the climatic condition and the variety planted, significant increase in yield over control have been reported. The inoculation is so inexpensive that farmers have taken to inoculating all pulses with Rhizobium to insure against crop failure.

Microbial seed inoculants such as Azotobactor, Beijerinkia, Rhizobium or Phosphorus solubilizing microorganisms may help in establishment of beneficial microorganisms in the Rhizosphere. The increased germination due to inoculation may be attributed to growth promoting substances excreted by the bacterium.

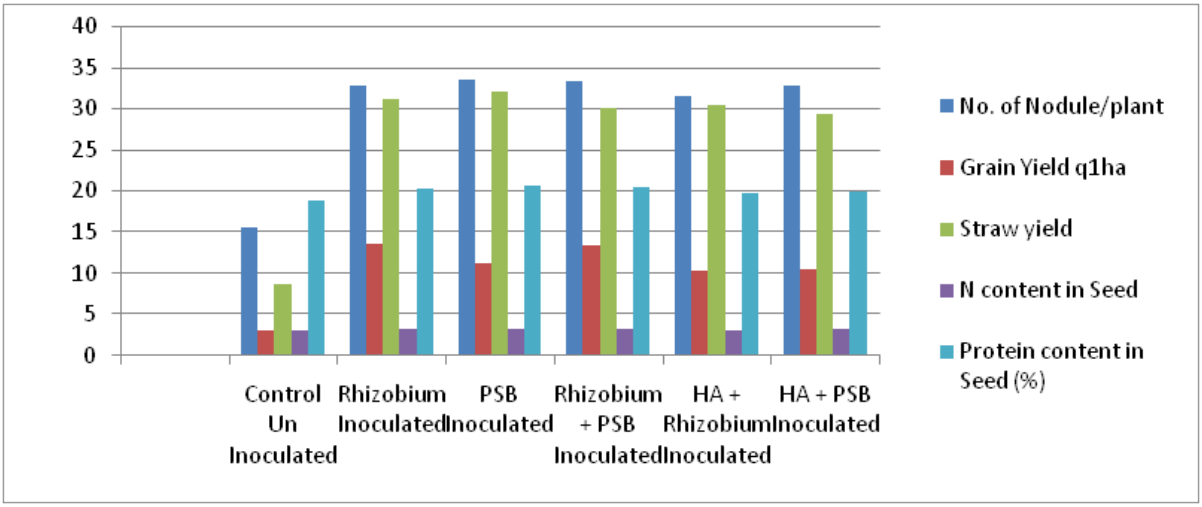
It is recorded that the grain yield of chickpea significantly increased over control by many folds while there was increased by 20-21 % over the single inoculation of PSB alone when compared to Rhizobium and Rhizobium +PSB. Over all the yield increased due to inoculation. The treatments of inoculations had responded well with respect to control, the combined treatment containing Rhizobium were better for nodulation than the use of Rhizobium alone.

Good agricultural practices for achieving high yield requires high amount of nutrients which are supplemented through chemical fertilizer, which are costly as well as may cause many problem deteriorating soil environment and ultimately human health hazards. Consequently there has recently been a growing level of interest in environmental friendly sustainable agricultural practices (Connell 1992) extending the role of inoculation with microorganism (biofertilizers) which may reduce the need of chemical fertilizers (Connel 1992).

Inoculation with Rhizobium have been shown to increased grain yield in chickpea (Parmar and Dadarwal, 1999 and Sindhu et al., 2002). In this study the outcome result is of great importance in planning for organic cultivation of gram with good agricultural practices.

Table 1. Effect of different inoculants on the Nodule, Seed & Straw yield, Nitorgen content and Protein content of Chickpea-

Treatment	No. of Nodule /plant	Grain Yield q^1ha	Straw yield q. ha^{-1}	N content in Seed (%)	Protein content in Seed (%)
Control Un Inoculated	15.50	3.03	8.77	3.00	18.78
Rhizobium Inoculated	32.75	13.56	31.16	3.25	20.30
PSB Inoculated	33.50	11.18	31.97	3.29	20.58
Rhizobium + PSB Inoculated	33.25	13.46	30.05	3.27	20.43
HA + Rhizobium Inoculated	31.50	10.24	30.35	3.13	19.75
HA + PSB Inoculated	32.75	10.45	29.24	3.19	19.98
S Em ±	1.14	0.17	1.04	0.02	0.17
CD (p=0.05)	3.43	0.51	3.15	0.08	0.53



Conclusion

The present investigation was taken at the Biofertilizer production centre of the Department of Soil Science & Agricultural chemistry JNKVV Jabalpur was occur plashed during Rabi 2014-15 taking chickpea variety with objective to study the effect of inoculation the yield and quality of chickpea.

Six treatments of different inoculations and combination of bioculture viz. Rhizobium, PSB, Rhizo+PSB, Rhizobium +HA, PSB + HA and a control (un inoculated) were taken on low nutrient status soil in four replications in randomized block design. No chemical fertilizer was incorporated in the soil. Keeping in view the objective of the experiment, the lignite based culture of Rhizobium and phosphorus solubilising bacteria were seed inoculated at the time of sowing separately and in combinations with humic acid.

The effect of microbial inoculation was significantly effected the grain and show yield of chickpea over control. The increase in yield was many fields higher than the control. Comparatively the

control yield was 3.03 qha^{-1} thus low yield achieved in adverse condition of heavy continuate rain at pod formation stage followed with hail storm. However the crop yield recorded can be attributed to the microbial effect applied through seed fortifications. Similarly the percent nitrogen content and the protein content were also in the similar trend of increase over control, The number of nodules were also significantly effected due to inoculation having 116 & 114 percent over control. The protein content also increased by 9 & 8 percent due to PSB and Rhizobium + PSB treatments respectively, it can be thus concluded that the use of biofertilizers or the microbial inoculants are important for improving the soil health and plant growth, direct or indirect effects of pathogenic bacteria can be suppressed by use of microbial inoculants but this needs further studies for eco friendly benefits of biofertilizers in compare to chemical fertilizers.

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tributes of pulse growers towards climate change scenario in Jabalpur district of Madhya Pradesh

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Abstract

In India, major pulses like chickpea, lentil and pigeon pea account for 39, 10 and 21% of the total pulse production in the country respectively. The changing climatic conditions have a major impact on pulses. Pulses are reported to be particularly sensitive to heat stress at the bloom stage; only a few days exposure of high temperature (30-35ºC) can cause heavy yield losses through flower drop or pod damage. The climatic parameters like rainfall and temperature are the major determinants of pulse productivity besides other factors like quality seed availability and associated biotic stresses. The study was conducted in the Jabalpur district of Madhya Pradesh to determine the different attributes of pulse growers under climate change scenario. It was revealed that most of the pulse growers of the study area were belonged to middle age group and acquired education up to middle school with a low annual income. Maximum of them were found to belong to the group of small farmers, found to be practicing *rabi* farming (pulse) in an area up to 1 ha. It was found that maximum respondents had pump-sets along with other farm power and implements. Regarding experience of the pulse cultivation, it was revealed that maximum number of pulse growers had an experience of 21 to 30 years. Among different technological components the knowledge and adoption level of pulse growers about improved pulse production technology was found to be high, with a high economic motivation and scientific orientation. The pulse growers of the district were found to have a medium score for the use of information sources and extension participation.

Keywords: pulse grower, climate change, socioeconomic attributes, knowledge

India is the largest producer and consumer of pulses in the world with 25 % share in global production. Chick pea, pigeon pea, mungbean, urdbean, lentil and field pea are important pulses crop contributing 39%, 21%, 11%, 10%, 7% and 5% to the total production which was estimated 14.76 million tones and area of 23.63 million hectare with average productivity 651.2 kg/ha. (Anonymous 2009)

Most of the cereals, pulses and oilseed are grown in rainfed area, which are important for the agrarian economy of our country. Rainfed agriculture in India is practiced in two -thirds of the total cropped area of 162 million hectares (66 %), which supports 40 % of the national food basket. The significance of rainfed agriculture is obvious from the fact that the 90 per cent of pulses are grown in rainfed area.

A large area of land under rainfed agriculture is expected to undergo changes in rainfed patterns, temperature, and extreme events (like frost, drought, flash floods etc.). Climate change a variation in properties of climate system is due to a change in global temperature or rainfall or both by either natural or human interference over a longer period of time, affecting the quality and distribution of natural resources and also influencing the livelihood security of the people. Several reports (Intergovernmental panel for climate change IPCC, 2007 and UNDP- HDR, 2007 - 08) on climate change

projected an increase of 1.8 to 4^0C in temperature instability in biosphere including agricultural production.

The state of Madhya Pradesh is a major contributor of the national pulse productivity. Growth, phonology and seed yield of a pulse crop is mainly controlled by temperature, day length and water availability. The reproductive phase of the crop coincides with the rising temperature often exposing the crop to sub optimal thermal regimes. Hence, in the climate change scenario conditions will become much more adverse.

Material and Methods

The study was conducted in Jabalpur district of Madhya Pradesh which comprises of 7 blocks, out of which Jabalpur was selected purposively because the block comprises maximum area under pulse cultivation. The selected block i.e Jabalpur comprises of 196 villages out of which only 5 villages were selected randomly and considered for study on the basis of larger area coverage under pulse cultivation. A list of pulse growing farmers of each selected villages was prepared and out of which 110 pulse growers were selected by using proportionate random sampling.

Result and Discussion

Socio-economic, communicational and psychological attributes of pulse growers were studied in climate change perspective.

Socio-economic attributes of pulse growers

In case of socio-personal-economic characteristics, most of the pulse growers i.e. 55.45% belonged to middle age group followed by 25.45 percent young age group. Higher percentages (29.09%) of respondents were acquired education up to middle school level followed by 18.18 percent of primary level. Fifty per cent respondents belonged to the group of small farmers who were found to be practicing rabi farming in an area up to 1 ha as rest of the area was covered under cereal and other crop. It was found that maximum pulse growers (51.81 percent) had pump sets along with other farm power and implements were as the least number of the respondents i.e. only 0.909 per cent had disc harrow or power tillers. This shows that the more number of farmers are going for the adaptation of irrigation facilities in this climate change scenario. Out of the total, maximum pulse growers (28.17 percent) had an experience of 21 to 30 years in pulse cultivation followed by 31 to 40 years and 41 to 50 years of experience. It is evident from the table that higher percentage of the pulse growers (72.73%) had low annual income followed by 11 percent found in below poverty line. The findings confirm with the findings of Wakle et.al (2003).

Psychological attributes of pulse growers

It is indicated that higher percentage of pulse growers were having high economic motivation (79.10%) and scientific orientation (63.64 per cent) whereas none of pulse grower were found in low level in both the attributes. Raghuvanshi (2010) found that higher percentage (41.67%) soybean grower had high economic motivation . Krishnamurthy and Siddaramaiah (1994) reported that majority of the respondents had high and remaining had medium to low scientific orientation.

In relation to knowledge among pulse growers under climate change scenario taken under study it was found that out of total maximum 89.10 percent were found in high level of knowledge about improved pulse production technology. Similarly higher percentage (59.10%) of the pulse growers were having high level of adoption about improved pulse production technology. Sharma (2007) reported that maximum respondents were medium to high adopters of chick pea technology.

Communicational attributes of pulse growers

Table revealed that out of total pulse growers, 27.27 per cent had low information source, whereas 67.27 per cent had medium and only 5.46 percent were using high information source for seeking information about improved production technology of pulse crops. Midame (2011) reported that majority (55%) of respondents had medium to high use of information source. It is clear in the study that higher

percentage (51.82%) of the pulse growers had medium level of participation in extension activities. Solanki (2008) also found medium participation in extension activities.

Table 1 Socio-economic, communicational and psychological attributes of pulse growers

S.N.	Variables	Categories	f	%
Socioeconomic Attributes				
1	Age	Young	28	25.45
		Middle	61	55.45
		Old	21	19.10
2	Education	Illiterate	18	16.36
		Up to primary school	20	18.18
		Middle school	32	29.09
		High school	17	15.45
		Higher secondary school	12	10.92
		Graduate	11	10.00
3	Land Holding	Marginal farmer	33	30.00
		Small farmer	55	50.00
		Medium farmer	20	18.18
		Large farmer	02	1.82
4	Farm Power	Bullock pair	41	37.27
		Tractor	17	15.45
		Sprayer	36	32.72
		Trolley	06	5.45
		Duster	02	1.81
		Thresher	07	6.36
		Pump set	57	51.81
		Cultivator	09	8.18
		Seed drill	02	1.81
		Disc Harrow	01	0.909
		Power tiller	01	0.909
		Sprinkler	04	3.63
5	Annual Income	Below poverty line (upto Rs.24000/-)	13	11.82
		Low annual income	80	72.73
		Medium annual income	11	10.00
		High annual income	06	05.45
6.	Experience	Up to 10 years	15	13.64
		11 to 20 yrs	22	20.00
		21 to 30 yrs	31	28.17

		31 to 40 yrs	26	23.64
		41 to 50 yrs	15	13.64
		Above 50 yrs	01	0.91
Psychological Attributes				
7	Economic Motivation	Low	00	00.00
		Medium	23	20.90
		High	87	79.10
8	Scientific orientation	Low	00	00.00
		Medium	40	36.36
		High	70	63.64
9	Knowledge	Low level	00	00
		Medium level	12	10.90
		High level	98	89.10
10	Adoption	Low level	00	00
		Medium level	45	40.90
		High level	65	59.10
Communicational characteristics				
11	Information Source	Low	30	27.27
		Medium	74	67.27
		High	06	5.46
12	Extension Participation	Low	52	47.27
		Medium	57	51.82
		High	01	0.91

Conclusion

It is concluded that most of the pulse growers of the study area were belonged to middle age group and acquired education up-to middle school with a low annual income. Maximum of them were found to belong to the group of small farmers, practicing rabi farming (pulse) in an area up to 1 ha. It was found that maximum respondents had pump-sets along with other farm power and implements. Regarding experience of the pulse cultivation it was revealed that maximum number of pulse growers had an experience of more than twenty years. Among different technological components the knowledge and adoption level of pulse growers about improved pulse production technology was found to be high, with a high economic motivation and high scientific orientation, whereas they were found to have a medium score for the use of information sources and extension participation.

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Effect of tillage and weed management practices on productivity of greengram and physic-chemical properties of soil under soybean-wheat-greengram cropping system

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Abstract

A long term experiment was conducted in soybean-wheat-greengram cropping system at ICAR- DWR Jabalpur during 2013-14 and 2014-15 to study the effect of tillage and weed management practices onproductivity of greengram and physic-chemical properties of soil. Result indicated that theseed and stover yields of greengram were maximum when zero tillage in presence of residues of preceding wheat in greengram under ZT+R-ZT+R-ZT+Rsystem followed by ZT-ZT+R-ZT+R tillage system. Pre emergence application of pendimethalin 750 gha^{-1} + 1 HW was recorded the highestgrain and straw yields of greengram. Among the interaction,pre emergence application of pendimethalin 750 gha^{-1} + 1 HW was was applied afterzero tillage in presence of residues of preceding soybean in wheat under ZT+R-ZT+R-ZT+R and ZT-ZT+R-ZT+R system were havinghigher seed and straw yields of greengram after zero tillage in presence of residues of preceding wheat in greengram under ZT+R-ZT+R-ZT+R system. The change in bulk density was relatively small even with regular addition of crop residues. There was no change in organic carbon, pH, EC and available nutrients (N, P and K) and due to tillage and residue management treatments. The variation in soil physical properties was also small and a significant improvement may be expected over several years of continuous application of crop residue and ZT.

Key words -Zero tillage, Bulk Density, Organic carbon, Seed and Stover yields

Soybean-wheat cropping system is commonly practiced in the semi-arid to sub-humid tropical regions of Malwa, Vindhyan Plateau and some part of Kymore Plateau and Satpura Hill zones of Madhya Pradesh on 4.5 M ha area, and contributes nearly 57.6 and 8.8 % of the total soybean and wheat production in the country respectively (Monsefiet al., 2011). Tillage has been found an essential component of wheat in soybean-wheat cropping system as it loosens soil, enhances the release of nutrients from the soil, kills weeds and regulates the circulation of water and air within the soil (Reicosky and Allamaras, 2003). However, intensive tillage has been found to have adverse effect on soil structure and causes excessive breakdown of aggregates, leading to soil erosion. Besides this, carbon loss occurs from soil to atmosphere as CO_2 due to faster decomposition of crop residues on account of buildup of congenial conditions. As a consequence, concentration of greenhouse gases in the atmosphere is increasing and in turn helping in global warming. Therefore, many countries switching towards conservation agriculture in which minimum or zero soil disturbance and retention of crop residues is done on soil surface, and legumes are included in crop rotation. The efficiency of inputs use viz., water, fertilizer, herbicides and others depend on tillage and crop establishment practices. It is, therefore essential that the soil environment be manipulated suitably for ensuring a good crop stand and improve

resource use efficiency. Crop residue is important to soil nutrient cycling and soil fertility. Crop residue removal causes the deplete on of soil nutrients, such as N, P, K which could decrease agronomic productivity and increase soil degradation (Tarkalson et al., 2009). The information on the effect of tillage and residue management on growth and yield of soybean-wheat cropping system and physico-chemical properties of soil is not available. Therefore, an attempt has been made to examinethe impact of sequential tillage and residue management on the performance of soybean-wheatcropping system.Keeping aforesaid facts in view the comprehensive study was undertaken to see the effect of tillage and weed control practices on productivity of greengram and physic-chemical properties of soil under soybean-wheat-greengram cropping system

Materials and Methods

The field experiment was conducted at Research Farm, ICAR- Directorate of Weed Research, Maharajpur Jabalpur (M.P.), situated at 23^0 09' North latitude and 79^0 58' East longitudes with an altitude of 411.78 meters above the mean sea level during rabi season 2013-14 and 2014-15. The soil was clayey loam in texture, neutral in pH (7.2) with bulk density of 1.12 Mg m^{-3}. It was medium in organic carbon content (0.6 %), available nitrogen (251.0 kg ha^{-1}), phosphorus (18.5 kg ha^{-1}) and high in available potassium (289.7 kg ha^{-1}). The total rainfall of the area was 116.4 and 218.3 cm during the year 2013-14 and 2014,-15 respectively.The experiment was consisted of fifteen treatments comprising of five tillage as main plot treatments viz., T_1- conventional tillage in soybean-conventional tillage in wheat and fallow in *summer* (CT-CT-fallow), T_2-conventional tillage in soybean-zero tillage in wheat-zero tillage in green gram (CT-ZT-ZT tillage system), T_3- zero tillage with preceding crop residue in soybean - zero tillage in wheat- zero tillage with preceding crop residue in green gram (ZT+R-ZT-ZT+R tillage system), T_4-zero tillage in soybean- zero tillage with preceding crop residue in wheat- zero tillage with preceding crop residue in green gram (ZT-ZT+R-ZT+R tillage system), T_5 -zero tillage with preceding crop residue in soybean- zero tillage with preceding crop residue in wheat- zero tillage with preceding crop residue in green gram (ZT+R-ZT+R-ZT+R tillage system) and three weed management as sub plot treatments viz., W_1 -weedy check in all crops, W2 -Pendimethalin 750 gha^{-1}*fb*imazethapyr 100 gha^{-1}in soybean-mesosulfuron 12 gha^{-1} + iodosulfuron 2.4 gha^{-1} (Atlantis) in wheat - Pendimethalin 750 gha-1in green gram,W_3 -Metribuzin 500 gha^{-1} + 1 HW at 25 DAS in soybean - metsulfuron 4 gha^{-1} + clodinafop 60 gha^{-1}(Vesta) in wheat- pendimethalin 750 gha^{-1}+1 HW in green gram, were laid out in split plot design on fixed site and replicated thrice.To evaluate the physico-chemical properties of soil of the experimental field, ten soil samples were drawn randomly from the depth of 0-15 cm from different spots with the help of soil augar. After this, all soil samples were thoroughly mixed together to make a composite sample. After proper drying, the composite sample was powdered finally with the help of pistal and morter and then subjected to various analysis in the laboratory, Department of Agronomy, JNKVV, Jabalpur. Observation were recorded on Bulk density, Available N,P, K organic carbon and seed and straw yields of greengram.

Results and Discussion

Bulk density of soil

It is evident the results described in previous chapter that bulk density (BD) of soil remained almost unchanged under different tillage and weed management practices after first year of field experiment (Table 1). However, during second year, minimum BD was found when conventional tillage was done in soybean and wheat under CT-CT-fallow tillage system being maximum when zero tillage was done in presence of residues of preceding crop in all component crops under ZT+R-ZT+R-ZT+R tillage system (T_5). In case of CT-CT-fallow system soil become loose and pulverized by intensive tillage operations (*Bhattacharya et al., 2006*). Celik (2011) also reported that bulk density was higher under no tillage treatments than the tilled plots and increased with depth. He further underlined that the values of soil compaction indicators were significantly greater under no tillage as compared to conventional tillage.

Table 1. Bulk density as affected by tillage and weed control practices

Treatment	Bulk density (g cc^{-1})		
Tillage practices	**Initial**	**2013-14**	**2014-15**
CT - CT	1.27	1.25	1.24
CT - ZT -ZT	1.26	1.26	1.25
ZT + R - ZT -ZT+R	1.27	1.27	1.27
ZT - ZT + R -ZT+R	1.26	1.28	1.29
ZT + R - ZT + R -ZT+R	1.28	1.29	1.30
SEm±	**0.02**	**0.02**	**0.004**
CD(P=0.05)	**NS**	**NS**	**0.011**
Weed management			
W_1	1.28	1.27	1.28
W_2	1.27	1.27	1.25
W_3	1.25	1.27	1.27
SEm±	**0.01**	**0.01**	**0.01**
CD(P=0.05)	**NS**	**NS**	**NS**

W_1 - Weedycheck, W_2- Pendimethalin 750 gha^{-1} *fb*imazethapyr 100gha^{-1}- Mesosulfuron + iodosulfuron 12 + 2.4 gha^{-1}-Pendimethalin 750 gha^{-1} , W3 -Metribuzin 500 gha^{-1}+1HW, metsulfuron + clodinafop 4+60 gha^{-1} ,Pendimethalin 750 gha^{-1}+1HW

Soil pH, electrical conductivity and organic carbon

The data on changes in soil pH, electrical conductivity and organic carbon from their initial status are presented in Table 2. The above parameters statistically did not vary due to different tillage and weed management practices in soybean-wheat-greengram cropping system. Numerically zero tillage in presence of residues of previous crop in all component crops under ZT+R-ZT+R-ZT+R tillage system had lower pH but higher EC and organic carbon contrary to conventional tillage in both soybean and wheat crop under CT-CT-fallow tillage system. Das (2016) also reported higher soil EC due to increase in organic matter under conservation agriculture. Reduction of tillage intensity resulted into less disruption of soil aggregates and sequestered more organic carbon inside the macro aggregates (*Six et al., 2000*). Reason behind higher pH, lower EC and OC under CT-CT-fallow tillage system that conventional tillage having higher infiltration rate so all pore spaces were filled with water and neutralized the soil pH Reddy (2014). In addition to this, wheat was cultivated after conventional tillage without amendment of previous crop residues. Consequently CT-CT-fallow system showed higher pH than other treatments during second year, but lower than its initial status.

Available N, P, K in soil

It is evident from the data that available N,P and K in soil did not exhibit remarkable changes over their initial status under different tillage practices during both the years of experimentation(Table 2). But during the second year, ZT+R-ZT+R-ZT+R recorded numerically higher N, P and K compared to other tillage practices. Soil fertility is the inherent capacity

of soil it cannot be easily changed through external factors. The present investigation was two years old and previous crop residues were regularly added in ZT+R+S-ZT+R-ZT+R system which might have enriched soil with NPK as a result of decomposition of soil organic matter. Alam et al. (2014) also reported higher N in zero tillage as compared to conventional tillage in wheat-mungbean cropping system.

Effect of weed control practices on physico-chemical property

Soil physico-chemical property viz., bulk density, soil pH, EC and available P,K did not vary due to the weed management practices except available N. It was significantly minimum under weedy plots where no weed control practices were adopted being maximum when pre emergence application of metribuzin 500 g ha^{-1} + 1 HW in soybean , ready mixture of metsulfuron + clodinafop 4+60gha^{-1} in wheat and pre emergence application of pendimethalin 750 gha^{-1}+1 HW in greengram (W_3) being at par to sequential application of pendimethalin 750 g ha-1fbimazethapyr 100 g ha^{-1} in soybean , ready mixture of mesosulfuron + iodosulfuron 12+2.4 g ha^{-1} in wheat and pre emergence application of pendimethalin 750 g ha^{-1} in greengram. In weedy check plots heavy amount of weeds residues are left which are decomposed and increasing population of microbes and present in the soil for metabolic activities utilized more amount of nitrogen as compared to herbicidal plots where reverse was true.

Seed and stover yield of green gram

Seed and stover yield of greengram did not influence by tillage practices (Table 3 & 4). Dodwadia and Sharma (2012) also reported similar results effect of zero tillage in summer greengram. Seeds per pod and seed index were not affected due to tillage practices, which did not affect the seed as well as stover yield of greengram.Growth parameters, yield attributing characters and yields were lower in weedy checks plots, due to heavy infestation of weeds, especially grassy weeds which grew faster and suppressed the crop growth by sharing the growth resources, which led to poor values of growth and yield attributes and finally poor yields. However, these parameters were appreciably increased with pre emergence application of pendimethalin 750 gha^{-1} being maximum when pre emergence application of pendimethalin 750 gha^{-1}+1 HW was done.Better control of pre emergent weeds by pendimethalin and mechanical removal of post emergent weeds through hand weeding in greengram, declined the crop-weed competition and increased plant growth, yield attributes and finally yields (Malik *et al.*, 2005). Jinger *et al.* (2016) also recorded application of pendimethalin 1 kg ha^{-1}*fb* 1 HW receiving plots had higher seed and stover yields.

Table2. Changes in chemical properties of soil over their initial status due to different tillage and weed control practices under soybean-wheat-greengram cropping system

Treatment	Soil pH		Electrical conductivity (dS/m)		OC (%)		Available nutrient (kg ha^{-1})					
							N		P		K	
Tillage practices	**initial**	**final**	**initial**	**final**	**initial**	**final**	**initial**	**final**	**Initial**	**final**	**initial**	**final**
CT - CT	7.19	7.17	0.34	0.36	0.60	0.60	250.22	248.22	17.83	17.83	280.16	277.16
CT - ZT -ZT	7.18	7.18	0.37	0.38	0.60	0.60	250.56	248.56	18.03	18.23	280.89	283.19
ZT + R - ZT -ZT+R	7.16	7.15	0.39	0.40	0.61	0.61	250.78	249.67	18.05	18.57	285.93	286.81
ZT - ZT + R -ZT+R	7.13	7.11	0.37	0.40	0.61	0.63	253.33	251.89	18.09	18.57	289.29	293.01
ZT + R - ZT + R -ZT+R	7.11	7.09	0.40	0.41	0.60	0.64	253.44	251.89	18.79	18.60	276.00	288.01
SEm±	0.04	0.07	0.04	0.03	0.03	0.03	5.96	4.11	0.45	0.33	4.75	2.87
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed management												
W_1	7.09	7.06	0.33	0.37	0.65	0.65	249.87	244.87	17.71	18.66	277.98	277.82
W_2	7.12	7.16	0.38	0.38	0.60	0.61	250.50	250.80	18.26	18.20	285.15	283.88
W_3	7.24	7.19	0.40	0.41	0.57	0.56	254.63	254.47	18.51	18.22	284.24	295.21
SEm±	0.04	0.03	0.03	0.03	0.03	0.02	2.77	2.12	0.24	0.21	3.51	2.84
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	6.26	NS	NS	NS	NS

W_1 -Weedy check, W_2 -Pendimethalin 750gha^{-1}*fb*imazethapyr 100gha^{-1}- Mesosulfuron + iodosulfuron 12 + 2.4 gha^{-1}-Pendimethalin 750 gha^{-1} , W_3 -Metribuzin 500 gha^{-1}+1HW, metsulfuron + clodinafop 4+60 gha^{-1} , Pendimethalin 750 gha^{-1}+1HW

Table 3. Seed yield of greengram as affected by tillage and weed control practices (mean of two years)

Weed management	Tillage practices					
	CT-CT (T_1)	CT-ZT-ZT (T_2)	ZT+R - ZT - ZT+R (T_3)	ZT- ZT +R - ZT+R(T_4)	ZT+R - ZT +R - ZT+R(T_5)	Mean
W_1	-	0.58	0.59	0.66	0.65	0.50
W_2	-	1.26	1.31	1.41	1.44	1.08
W_3	-	1.39	1.41	1.43	1.44	1.13
Mean	-	1.08	1.10	1.16	1.18	0.90

W_1-Weedy check, W_2- Pendimethalin 750 gha^{-1}, W_3- Pendimethalin 750 gha^{-1} + 1HW

	Tillage practices (T)	Weed management (W)	Interaction (T×W) at same T	Interaction (T×W) at same W
SEm±	0.10	0.07	0.16	0.05
CD (p=0.05)	NS	0.21	0.47	0.14

Table 4. Stover yield of greengram as affected by tillage and weed control practices (mean of two years)

Weed management	Tillage practices					
	CT-CT (T1)	CT-ZT-ZT (T2)	ZT+R - ZT- ZT+R (T3)	ZT- ZT +R - ZT+R(T4)	ZT+R - ZT +R - ZT+R(T5)	Mean
W_1	-	1.34	1.14	1.26	1.28	1.34
W_2	-	3.28	3.36	3.45	3.45	3.28
W_3	-	3.47	3.66	3.64	3.72	3.47
Mean	-	2.70	2.72	2.78	2.82	2.70

W_1-Weedy check, W_2- Pendimethalin 750 gha^{-1}, W_3- Pendimethalin 750 gha^{-1} + 1HW

	Tillage practices (T)	Weed (W) management	Interaction (T×W) at same T	Interaction (T×W) at same W
SEm±	0.09	0.11	0.24	0.07
CD (p=0.05)	NS	0.32	0.72	0.20

Conclusion

Thus, it is concluded that zero tillage in presence of residues of wheat in green gram along with pre emergence application pendimethin750 gha-1 found effective for seed and stover yield but physico-chemical properties was not affected by treatments from initial values to final values.

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Impact of income and employment generation of krishi vigyan kendra women trainees

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Abstract

The present investigation was focused to determine the level of income and employment generation of vocational women trainees. Result of Respondents (120) selected from 5 villages of Sidhi district reveals that the majority (75%) of respondents were from young age group, Complete majority of respondents were educated, (78.33%) having medium family structure, Highest (58.33%) using interpersonal channel and (62.50%) Highest extension participation, Highest moderate (65%) mass media exposure, Highest (65.83%) attended more than one training in Krishi Vigyan Kendra.

The variables like age, education, size of family and number of trainings attended were found non-significantly associated with employment and income generation of the respondents, whereas use of interpersonal channels, extension participation and mass media exposure were found significantly associated with employment and income generation of the respondents.

Keywords : impact, income, employment and women trainees

Vocational training is defined as the part of vocational education that provides the specialized professional knowledge and skills, which attribute professional adequacy to the trainee and are the focus of every vocational training programme. The finding find support with the work of Tabasum (2002) of present finding. As education is the means for bringing socio-economic transformation in a society, various measures are being taken to enhance the access of education to the marginalized sections of the society. Vocational Education in a broader sense cover education and skill development at all levels from post primary to tertiary education - both through formal and non-formal programmes. A Centrally Sponsored Scheme on vocationalisation of secondary education provides for diversification of educational opportunities so as to enhance individual employability, reduce the mismatch between demand and supply of skilled manpower and an alternative for those pursuing higher education. Krishi Vigyan Kendra are conducting location-specific and need based vocational training programs for rural women of the major thematic areas are from fruit preservation, jute product making, handicrafts, embroidery, lace making and stitching etc.

The present investigation was undertaken to know the impact of vocational trainings imparted by KVK Sidhi employment and income generation among rural women.

Material and method

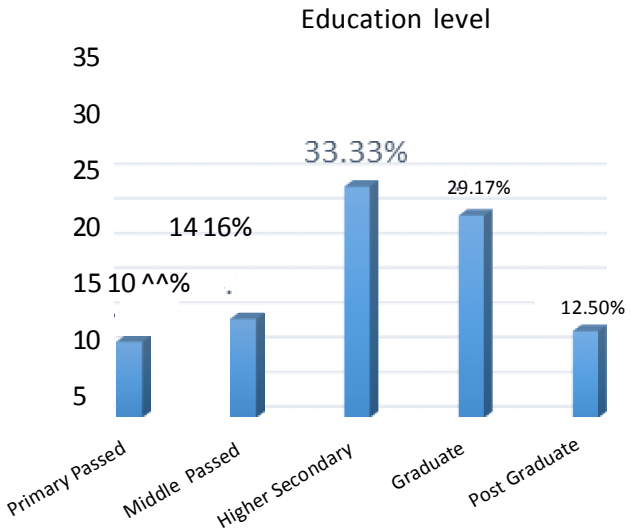
The present investigation was conducted at KVK Sidhi, which is located in tribal dominant area. Various vocational trainings had been organized during 2012-16, out of which lace making, jute product making, handicrafts, embroidery, and stitching were selected purposively for the study. From the list of beneficiaries, all 120 women were selected as the respondents for the study. The finding find support with the work of Annapurna *et al.* (2000) of present finding The data were collected using survey method through a pre-tested interview schedule and responses were recorded.

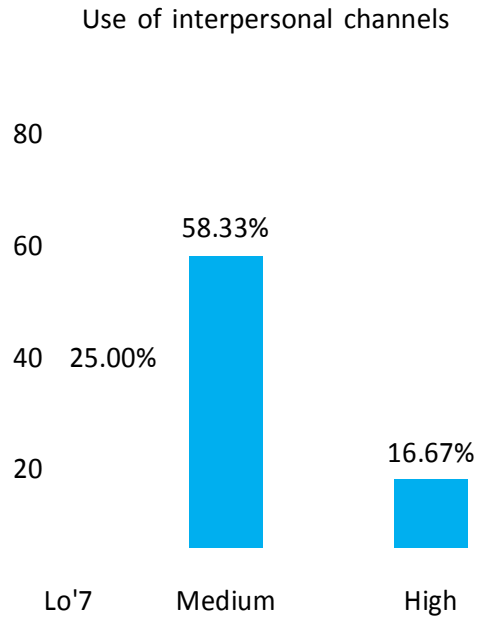
Result and Discussion

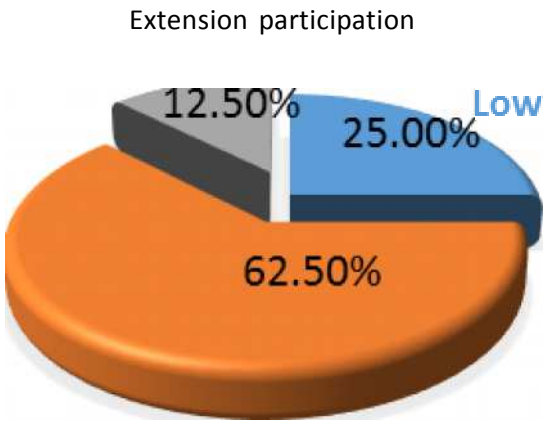
The majority of respondents were from young age group (75%) followed by formally educated (89%), had medium family size (78.33%), had medium utilization of interpersonal channel (58.33%), had medium extension participation (62.50%), had medium mass media exposure (65%) and two training attended (65.93%).

Table 1. Profile characteristics of trainees

Characteristics	Categories	f value	Percentage
Age	Young	90	75.00
	Middle	17	14.16
	Old	13	10.84
Education level	Illiterate	13	10.84
	Primary school	17	14.16
	Middle school	40	33.33
	secondary school	35	29.17
	College education	15	12.50
Size of family	Small family	17	14.17
	Medium family	94	78.33
	Large family	09	7.50
Use of interpersonal channels	Low	30	25.00
	Medium	70	58.33
	High	20	16.67
Extension participation	Low	30	25.00
	Medium	75	62.50
	High	15	12.50
Mass media exposure	Low	27	22.50
	Medium	78	65.00
	High	15	12.50
Number of training attended	One	20	16.67
	Two	79	65.83
	More than two	21	17.50


Education level
35
30
25
20
15
10
5
10 ^^%
14 16%
33.33%
29.17%
12.50%
Primary Passed
Middle Passed
Higher Secondary
Graduate
Post Graduate


Use of interpersonal channels
80
60
40
20
25.00%
58.33%
16.67%
Lo'7
Medium
High


Extension participation
12.50%
25.00%
Low
62.50%

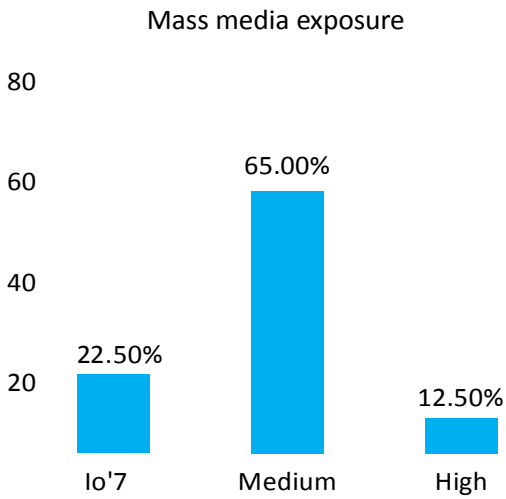

Mass media exposure
80
60
40
20
22.50%
65.00%
12.50%
Io'7
Medium
High

Table 2. Relation of attribute of trainees with income and employment genration

Attribute	Income generation χ^2	Employment generation χ^2
Age	0.506 Ns	2.81 Ns
Education level	5.858 Ns	3.569 Ns
Size of family	2.505 Ns	6.885 Ns
Use of interpersonal channels	16.250**	11.82**
Extension participation	10.151**	9.72**
Mass media exposure	11.359**	9.93**
Number of training attended	3.066 Ns	7.14 Ns

Extent of Income and Employment Generation

Table 3. Distribution of respondents according to their level of employment generation

(N = 120)

S. No	Categories	f	Percentage
1.	Low (10 to 130 days)	75	62.50
2.	Medium (131 to 250 days)	31	25.83
3.	High (251 to 360 days)	14	11.67
	Total	120	100.00

Out of the total respondents, 62.50 per cent were getting 10 to 130 days of employment, 25.83 per cent were getting 131 to 250 days of employment and 11.67 percent were getting 251 to 360 days employment (Table 3).

Table 4. Impact of vocational training programme on employment generation:

Training	Before	After	% change
Lace making tailoring	114.20	135.00	18.21
Jute product making	193.68	256.73	32.55
Handicraft	186.09	248.45	31.89
Embroidery	203.00	236.69	16.59
Stitching	223.00	308.00	38.11

Impact of different vocational training programme on employment generation maximum 38.11 percent change observed in stitching followed by jute product making (32.55%), handicraft (31.89%), lace making (18.21%), embroidery (16.59%) (Table 4).

Table 5. Impact of vocational training programme on income generation

Training	Before	After	% change
Lace making tailoring	256.09	408.00	59.31
Jute product making	1,197.00	1,621.58	35.47
Handicraft	403.22	731.82	81.49
Embroidery	845.73	1,226.40	45.01
Stitching	1,706.00	2,661.79	56.02

As regard to impact of vocational training programme on income generation the data shows that 81.49 per cent income generated through handicraft training programme followed by lace making tailoring (59.31%), stitching (56.02%), embroidery (45.01%) and jute product making (35.47%) (Table 5).

It was concluded that age, education, size of family and number of training attended had no significant association with income and employment generation whereas use of interpersonal channels, extension participation and mass media exposure had significant association with income and employment generation. The percentage of stitching beneficiaries was significantly higher in comparison to the other categories of farm women in both income and employment generation. Out of the total respondents, 62.50 per cent were getting 10 to 130 days of employment under low category

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Technological Gap in different practices among Mung Bean growers in Jabalpur district, Madhya Pradesh

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Abstract

Technological gap in mung bean cultivation was investigated in the year 2019-20 in Kundam block of Jabalpur district. With 120 mung bean growers were randomly selected from 12 villages of Kundam block. The data were collected with the help of structured interview schedule. Results revealed that majority of mung bean growers (45.84%) had high technological gap followed by (37.50%) medium technological gap and 16.66 per cent had low technological gap. It was observed that very high technological gap was observed regarding use of seed and sowing management, harvesting, insect and disease management, and weed management in mung bean cultivation. It is revealed that the technological gap had negative and significant relation with land holding, social participation, farm power, family type, family size, extension participation, risk preference, annual income and area under mung bean crop indicated negative and significant relation with technological gap, whereas age, SES, occupation and education had negative and significant whereas caste, house, material possession and mass media exposure indicated non-significant relation with technological gap. The highly perceived problems in technological gap of cultivation of improved recommended practices of mung bean which were faced by the farmers were irregular visit of RHEOs in the village, high cost of input like manure, seeds, fertilizers, equipment, diesel etc, irregular supply of electricity, low price of their product in the market, lack of cooperative societies in villages and lack of knowledge about improved varieties.

Keywords: Technological gap, Constraints, Mung Bean growers.

India is one of the leading mung beans producing country. India alone has nearly 52.5 percent of the world average and production of green gram. In Madhya Pradesh the total area covered under mung bean 2.51 lakh ha with 1.16 lakh tones total production and productivity was 464 kg/ha (Annual Report DPD 2016-17).

In Jabalpur district the total area covered under mung bean is around 1000 ha, production was 627 tonnes and productivity 450 kg/ha. The traditional method of crop raising still dominates in mung bean cultivation which causes low production of crops. In spite of agricultural modernization in mung bean crops, farmers are still facing diverse technological gap in cultivation. Keeping these in view, an attempt was made to analyze the factors that affect the production.

Materials and Methods

The present study was carried out in Kundam block of Jabalpur district in Madhya Pradesh. In the block, out of 180 villages, twelve villages were selected randomly. A total number of 120 respondents those were selected through random sampling method on the criteria of mung bean growers were interviewed personally for data collection. The socio-economic characteristics of the respondents were studied on basis of SES (Socio Economic Scale) with suitable modifications (Trivedi and Pareek 1964). The respondents were grouped in three categories i.e. low, medium and high technological gap.

Result and Discussions

Table 1. Distribution of mung bean growers according to their technological gap in different package of practices:

Package of practices	Mean	Rank
Field preparation	4.958	IV
Seed and sowing management	7.008	I
Fertilizer management	3.216	VI
Irrigation management	2.258	VIII
Insect and disease management	5.108	III
Weed management	3.241	V
Harvesting	5.250	II
Storage management	2.275	VII

The technological gap of package of practices of mung bean was worked out. The maximum technological gap was observed in seed and sowing management (7.008) followed by harvesting (5.250), insect and disease management (5.108), Field preparation (4.958), weed management (3.241), fertilizer management (3.216), Storage management (2.275) and the least technological gap was recorded in Irrigation management (2.258) (Table 1). This wide gap in field preparation is attributed to the common practice and lesser requirement of irrigation in mung bean crop. The maximum technological gap in case of seed and sowing management, harvesting management, insect and disease management and field preparation must be minimized through educating the farmers by imparting training, conducting result demonstrations and field visits.

Table 2 Distribution of respondents according to their technological gap

Categories	Frequency	Percentage
Low (Up to 45)	20	16.66
Medium (46 to 65)	45	37.50
High (Above 65)	55	45.84
Total	120	100.00

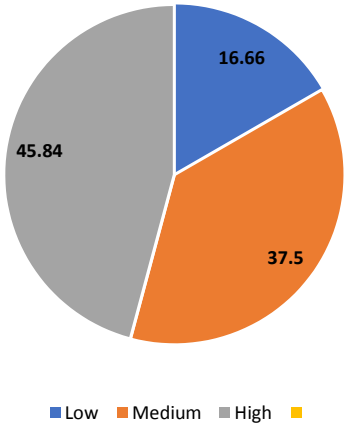

Fig 1 Distribution of respondents according to their technological gap

Majority (45.84%) of the respondents belonged to high technological gap while, about 16.66% belonged to low technological gap regarding improved mung bean production technology (Table 2).

The findings of Varme R. (2011), Rajput HK *et al* (2016), Shinde A.H. (2017), Singh A.K. *et al* (2018) and Malviya (2018) support the present work.

As per results, the highest technological gap was evident in seed and sowing management followed by harvesting, insect and disease management, field preparation, weed management, fertilizer management, Storage management and irrigation management, whereas the majority of the mung bean growers fell under high technological gap category, which may be due to poor socio-economic conditions, less awareness of package of practices from the grass root level workers and poor mass-media exposure and extension participation. Hence, efforts should be made to bridge the gap. Intensive dissemination of technology should be followed for reducing the technological gap in adoption of recommended mung bean production technology.

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Awareness of farmers regarding use of bio-fertilizers in agricultural practices

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Abstract

A representative sample of 120 farmers were selected for the study spread over 8 villages of Panagar and Shahpura blocks of Jabalpur district. The majority of the respondent farmers were middle aged (34-51 years), had to middle level of education, medium land holding, had Rs. 1,07,701 to 3,41,700 annual income, medium level of social participation, medium level of mass media exposure, medium level of extension contact, medium level of scientific orientation, medium level of innovativeness, medium level of risk orientation and medium level of awareness about bio-fertilizer users. Education, land holding, annual income, social participation, mass media exposure, extension contact, scientific orientation, innovativeness, risk orientation were positive and significantly associated with the awareness level of farmers. Further, coefficient of correlation indicated that the age has negative and significant relationship with their awareness level.

Key words: Awareness, Bio-fertilizers

Bio-fertilizers are applied in the agricultural field as a replacement to conventional chemical fertilizers. Bio-fertilizer contains microorganisms which promote the adequate supply of nutrients to the host plants and ensure the proper development. Bio-fertilizers being essential components of organic farming play vital role in maintaining long term soil fertility and sustainability. The production process of bio-fertilizer technology is simple and requires less energy, capital, technology and labor force whereas inorganic fertilizer production requires huge energy, high capital and large number of human resources (Raimi *et al.,* 2017).

In present day agriculture, due to higher application of chemical fertilizers and toxic pesticides on the crops, sustainability of the agriculture systems has adversely affected, cost of cultivation soared at a high rate, income of farmers stagnated and food security and safety became a daunting challenge. Indiscriminate and imbalanced use of chemical fertilizers along with chemical pesticides and unavailability of organic manures has led to considerable adverse impact on soil health.

Technology adoption is influenced by perceived profitability, costs of the technology and clarity at which the new knowledge and information is communicated in a recipient population (Boahene et al., 1999). In a study on mapping the innovation system of bio-fertilizers: constraints and prospects to enhance diffusion presents lack of awareness on the efficacy of bio-fertilizers compared to their familiarity with tried and tested use of inorganic fertilizers is major reason hindering adoption of biofertilizer (Baconguis *et al.*, 2012). The present study thus, focuses on awareness of farmers regarding use of bio-fertilizers in agricultural practices

Material and methods

The present study was conducted in Jabalpur district of Madhya Pradesh which comprises of seven blocks. Out of 7 blocks, Panagar and Shahpura blocks were selected as maximum number of villagers of these

two blocks had purchased bio-fertilizers from the Microbes Research and Production Centre (MRPC), JNKVV, Jabalpur. From each selected block, four villages were selected based on maximum number of users of bio fertilizer. From each selected villages, 15 respondents were selected. Thus, total 120 respondents were selected for the present investigation. Seven variables were measured, in that age, education, land holding, annual income, social participation, mass media exposure, extension contact is measured by self scoring and three variables i.e. scientific orientation, innovativeness, risk orientation were measured by scale developed by eminent scientists. In order to measure awareness of farmers regarding use of bio-fertilizers in agricultural practices, a structured schedule was developed by reviewing related literature and seeking expert's suggestions. The data were collected by personal interview method. Statistical tools were used to analyze the data.

Results and Discussion

Profile of bio-fertilizer users

Personal profile of the respondents indicated that maximum (63.33%) of the respondents belonged to the middle age group i.e. 34 to 51 years. Maximum (50.0%) of the respondents had middle education. More than half (54.17%) of the respondents had medium size of land holding i.e. 2.01 to 4 ha. Maximum (68.33%) of the respondents were having medium annual income between Rs.1,07,701 to Rs. 3,41,411. Maximum (68.33%) of the respondents were having medium level of social participation. Maximum (63.33%) of the respondents had medium level of mass media exposure. More than half (55.0%) respondents had medium level of extension contacts. Most (65.0%) of the respondents had medium level of scientific orientation. Maximum (61.67%) of the respondents were having medium level of innovativeness. Maximum (56.67%) of the respondents were having medium level of risk orientation. This finding is in conformity with Hiremath (2011), Patel (2012), Vanpariya (2018), Chavan (2015) and Nigade (2018).

Table 1: Distribution of the respondents according to the personal characteristics

S.No.	Category	Frequency	Percentage
Age			
Young (25 to 33 years)		24	20.00
Middle (34 to 51 years)		76	63.33
Old (52 to 80 years)		20	16.67
Education			
Illiterate		04	3.33
Primary education		18	15.00
Middle education		60	50.00
High school and above		38	31.67
Land holding			
Marginal land holding (Up to 1 ha)		8	6.67
Small land holding (1.01 to 2 ha)		28	23.33
Medium land holding (2.01 to 4 ha)		65	54.17
Large land holding (4.01 and above)		19	15.83

Annual income		
Low (up to Rs.1,07,988/-)	20	16.67
Medium (Rs.1,07,989 to 3,41,411/-)	82	68.33
High (Rs. 3,41,412/- and above)	18	15.00
Social participation		
Low (up to 3 scores)	17	14.17
Medium (4 to12 scores)	82	68.33
High (13 and above scores)	21	17.50
Mass media exposure		
Low (up to 4 scores)	24	20.00
Medium (5 to 11 scores)	76	63.33
High (12 and above scores)	20	16.67
Extension contact		
Low (up to 3 scores)	28	23.33
Medium (4 to 8 scores)	66	55.00
High (9 and above scores)	26	21.67
Scientific orientation		
Low (up to 10 scores)	26	21.67
Medium (11 to 23 scores)	78	65.00
High (24 and above scores)	16	13.33
Innovativeness		
Low (9 to 14 scores)	24	20.00
Medium (15 to 23 scores)	74	61.67
High (24 and above scores)	22	18.33
Risk orientation		
Low (up to 8 scores)	28	23.33
Medium (9 to 21 scores)	67	56.67
High (22 and above scores)	25	20.00

2. Awareness regarding use of bio-fertilizers in agricultural practices

Table 2 (a): Awareness regarding bio-fertilizer use in agricultural practices

Specific awareness about bio-fertilizer users	Awareness level	
	Frequency*	**Percentage**
Type of the bio-fertilizer	84	70.00
Application of bio-fertilizer in difference crops	68	56.67
Method of application of bio-fertilizers	69	57.50
Source of availability	66	55.00
Time of application of bio-fertilizers	70	58.33
Nutrient supplied by the bio-fertilizers	80	66.67
Amount of bio-fertilizer	58	48.33
Cost of bio-fertilizers	55	45.83

*Multiple responses were allowed

Acquisition of awareness is the first step in the use of any innovation. Since most of the respondents had education upto middle level as can be seen from the results. They might have exposed themselves to print media which carry the information about new agricultural technology. Besides, their contact with locally available extension workers is also instrument in acquiring medium level of knowledge. The results reveals that 70.00 per cent of the respondents had knowledge about different types of bio-fertilizer, 66.67 per cent were aware about the nutrient supplied to the crop by the bio-fertilizer, near about sixty per cent had awareness regarding time of application of biofertilizers (58.33%), method of application of bio-fertilizers (57.50%), application of bio-fertilizer in different crops (56.67%), source of availability (55.00%), amount of bio-fertilizer (48.33%) and cost of bio-fertilizers (45.83%) (Table 2(a)).

Table 2 (b): Overall awareness regarding use of bio-fertilizers in agricultural practices

Awareness	Frequency	Percentage
Low (Up to 71 scores)	21	17.50
Medium (72 to 98 scores)	80	66.67
High (99 and above scores)	19	15.83
Total	120	100.00

A perusal of results indicates that maximum (66.67%) percentage of the respondents had medium level of awareness about bio-fertilizer followed by 17.50 per cent and 15.83 per cent of respondents had low and high level of awareness about bio-fertilizer use in agricultural practices, respectively (Table 2 (b).

3. Relationship between profile of farmers with the awareness of bio-fertilizer use in agricultural practices

Table 3: Relationship between profile of bio-fertilizer users with their awareness level

Variables	Coefficient of correlation
Age	-0.243
Education	0.856
Land holding	0.455
Annual income	0.288
Social Participation	0.470
Mass media exposure	0.515
Extension contact	0.524
Scientific orientation	0.775
Innovativeness	0.784
Risk Orientation	0.695

The correlation coefficient (r) with respect to ten variables indicate that education, land holding, annual income, social participation, mass media exposure, extension contact, scientific orientation, innovativeness, and risk orientation had positive and significant relationship with the awareness level of farmers (Table 3). Whereas age has negative and significant relationship with the awareness level about bio-fertilizer use in agricultural practices. These findings are in conformity with findings of Hiremath (2011) and Dhavne (2018).

Conclusion

It is concluded that majority of the respondent farmers were middle aged (34-51 years), had to middle level of education, medium land holding, had Rs. 1,07,701 to 3,41,700 annual income, medium level of social participation, medium level of mass media exposure, medium level of extension contact, medium level of scientific orientation, medium level of innovativeness, medium level of risk orientation. The result shows that most of the farmers were having medium level of awareness about bio-fertilizer uses. The awareness for bio-fertilizers can be increased through other farmers and also through research institutions, extension personnel, agriculture officers, and using print and electronic media. The awareness must be provided to the farmers emphasizing the various benefits of biofertilizers starting from high yield in the long run to the quality of the crops produced without deteriorating the content of the soil as in case of chemical fertilizers.

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Variation in sensory attributes of Jamun (*Syzgium cumini*) juice over three months storage

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Abstract

Jamun (*Syzgium cumini*) is an important fruit of Indian origin. Two types of jamun are grown in the Indian subcontinent. The big fruit with a small seed is an early maturing type while the late maturing fruit is small with a large seed. Jamun is very useful for curing many diseases, such as diabetes, diarrhea, and dysentery. Recent studies have shown that it markedly lowers blood pressure. The present endeavour aims at encompassing the variation in sensory attributes of jamun juice over a period of 90 days. Jamun juice was prepared in the laboratory of the department as per the standard procedure. It is observed that time of boiling does not depend on the appearance of the Jamun Juice. Since there is no any significant difference among the treatment but highest score has been observed in treatment I (i.e. 5 minutes boiling) with 0.12% preservative. The highest score for 10 minutes boiling was observed when the juice was boiled with 0.08% and 0.10% of preservative, whereas when boiled in pressure cooker best result was obtain when boiled in 0.10% preservative. Though all are insignificant at 5% level of significance and since the time of boiling is independent on the appearance and the concentration of the preservative added (range0.08- 0.12%). The energy required for sterilizing Jamun Juice was found to be maximum 2131.3 K calories when sterilized in open pan with 10 minutes boiling while minimum 1454.2 K calories when sterilized in pressure cooker. Although the energy required for sterilization is minimum in pressure cooker but the colour , appearance and flavour was found to be better when sterilization was done in open pan with five minute boiling.Therefore, five minutes boiling with minimum preservative i.e. 0.08% sodium benzoate is suitable for preservation of Jamun juice.

Keywords: Jamun juice, heating, pressure cooker. preservation and sensory attributes.

Jamun (*Syzgium cumini*) is an important fruit of Indian origin. Two types of jamun species are cultivated in the Indian subcontinent. The big fruit with a small seed is an early maturing type while the late maturing fruit is small with a large seed (Morton, J.1987). Jamun is very useful for curing diarrhoea and diabetes. It is stomachic, carminative and diuretic apart from having cooling and digestive properties as reported by Morton, J.1987. . Recent studies have shown that it markedly lowers blood pressure to a great extent. In Madhya Pradesh Jamun is available in late summer and in early rainy season. Its period of availability is between 25 to 30 days during the season. The proximate analysis of Jamun (Per 100 g.) as reported by Choudhary P.et.al. 2007 is as follows:

Moisture	-	83.20	Anthocyanin	-	0.14
Nitrogen	-	0.0.13	Ascorbic acid	-	0.25
Fat	-	0.30	Ash	-	0.33
Crude fiber	-	0.90	Tannin	-	1.90
Reducing Sugar	-	14.0			

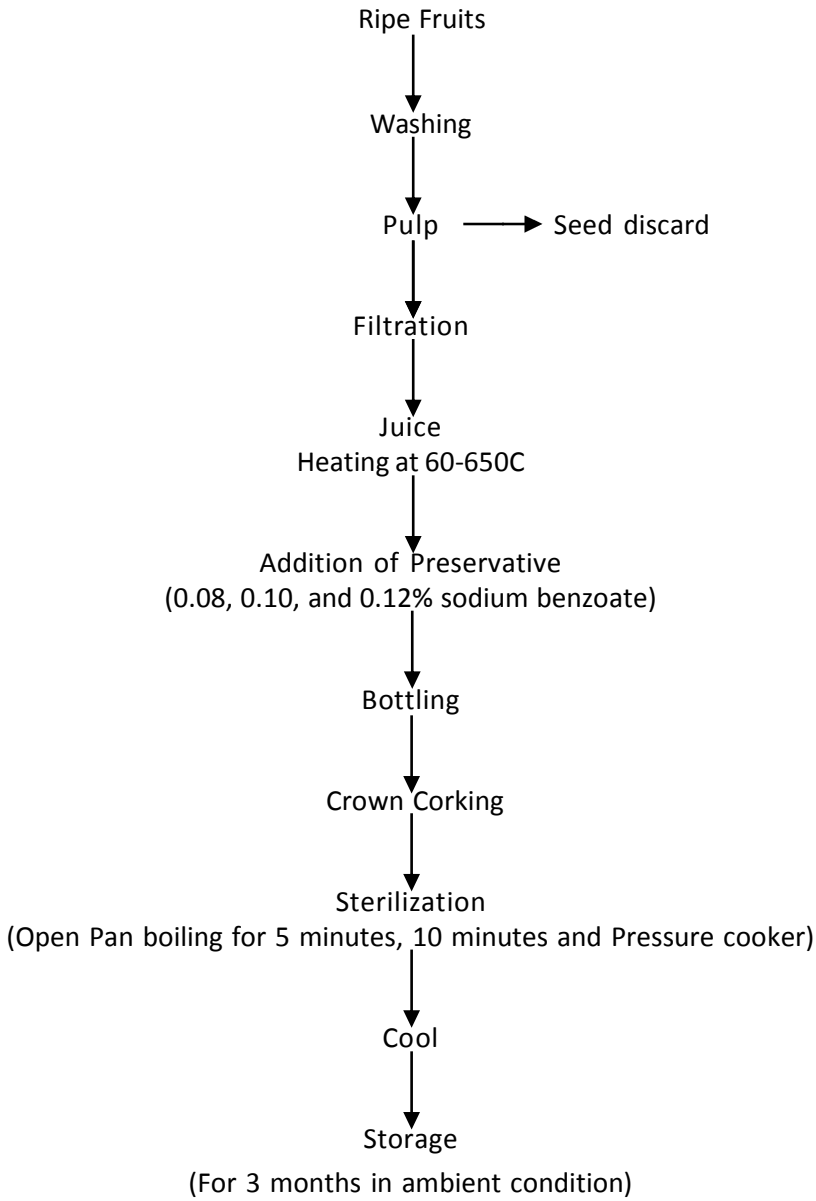
The sugar content of Jamun fruit consists principally of reducing sugar. The high tannin content is mainly responsible for its astringency and colour is mainly due to anthocyanin pigments. Jamun fruits are highly perishable and cannot be stored more than 24 hr. at room temperature. Only in cool storage (3-4°C and

85-90% RH) the fruits can be stored for up to 12 days, Jamun has never been exploited commercially for preparation of different products. It is reported that the fruits are used for making jam, jelly, beverages, wine, and vinegar (T.K. Bose *et. al.*) In the presents study an attempt has been made to study the effect of different concentration of preservative (sodium benzoate) on storage of jamun juice prepared by different heat treatment on the sensory attributes.

Materials and Methods

Fresh jamun fruit of big size with small kernel were procured from the local market of Jablapur. The fruit were washed with running water and then with the help of pulper, pulp was separated from the kernel. The pulp was then filtered through muslin cloth and juice was collected and the residue, which was left on the muslin cloth, was discarded. The juice was prepared as per the flow chart shown below.

Flow Chart for Preparation of Jamun Juice



Pulp to Seed Ratio

Ratio of pulp: Seed was calculated on the weight basis and results are presented in Table No.1.

Pulp to Juice Ratio: Initially the weight of the pulp was measured with the help of weighing balance (Capacity 2 kg.), and the juice was measured with the help of measuring cylinder and results are presented in Table 1.

The juice thus obtained was heated in on open pan for 15 min, till the temperature of the juice reaches to 85% and then it was allowed to cool so that the suspended material settled to the bottom of the container and the upper supernatant was taken and mixed with 3 different concentration of preservative (sodium benzoate) viz. 0.08, 0.10, and 0.12 %(Plate 1-3). The juice was then filled in sterilized bottle up to it neck and corked and again the bottle were heated in boiling water for 5 and 10 minutes and also in pressure cooker up to 1st whistle. Three replicates of each treatment were taken the juice was then stored at ambient condition and over 3 months of storage period, sensory quality of juice was judged by the panel of untrained judges. The results of which is given in Table 2.

Results and Discussion

From Table No.1 it is clear that in ripe jamun fruit the ratio of Pulp: Kernel& Pulp: Juice is in the

range of 2.4:1-2.7:1 and 1:1.25- 1:1.26 respectively. It is evident from Table No.2 that time of boiling does not depend on the appearance of the Jamun Juice. Since there is no significant difference between the treatment but highest score has been seen in treatment I (i.e.5minutes boiling) with 0.12% preservative. The highest score for 10 minutes boiling was observed when the juice was boiled with 0.08% and 0.10% of preservative, where as when boiled in pressure cooker. Best result was obtained when boiled in 0.10% preservative. Though all are insignificant at 5% level of probability and the time of boiling did not show any significant effect on the appearance and the concentration of the preservative added (range 0.08- 0.12%). The energy required for sterilizing Jamun Juice was found to be maximum 2131.3 K calories when sterilized in open pan with 10 minutes boiling while minimum 1454.2 K calories when sterilized in pressure cooker and 1679.9 K calories, when it was boiled for 5 minutes in open pan.. Although the energy required for sterilization is minimum in pressure cooker but the colour, appearance and flavour was found to be better when sterilization was done in open pan with five minute boiling, therefore, five minutes boiling with minimum preservative i.e. 0.08% sodium benzoate is suitable for preservation of Jamun juice.

Carotenoid, lutien, anthocyanins and lycopene are highly unsaturated compounds and are known to be principal pigments in jamun fruits so it is susceptible to oxidation, isomerisation and other chemical changes during processing and storage(Boskovic,M.A. 1979).The colour of the jamun juice changes from light violet to dark violet during processing and storage in present investigation was also observed which may be due to a distinct colour shift when heated as has been observed in some high carotenoid content vegetables in which the colour changes during heating in water(Purcell,A.E. et.al..1969).However in the present investigation there is change in colour from light violet to dark violet but was distinctive and acceptable to consumers

Five minutes boiling with 0.08% preservative gave the best result in appearance colour and flavour. Same results have also been observed for taste and over all acceptability. Since all result have been found at par but better reported in 5 min. boiling with 0.08% conc. of preservative which will be recommended as the best treatment because on boiling the juice there is considerable loss of vitamin C. Also lot of biochemical reaction may occur which lead to change in the concentration of the biochemical parameter as compared to its original composition also the concentration of the preservative is injurious to human health hence minimum conc. of preservative i.e. 0.08% with 5 min boiling has been recommended. Apart from this the energy input is less in 10min boiling than other treatment (viz. 10 minutes boiling, pressure cooker, and 0.10, 0.12% preservative.)

OBSERVATION

Table No.1: Ratio of Pulp: Kernel& Pulp: Juice of Jamun Fruit

Pulp: Kernel (Weight basis)	Pulp: Juice (Weight/Volume)
2.5:1	1:1.25
2.5:1	1:1.26
2.5:1	1:1.26
2.5:1	1:1.25
2.4:1	1:1.26
2.7:1	1:1.26
2.5:1	1:1.25

Table 2 : Mean Score of Sensory Attribute of Jamun Juice after three months storage:

Sensory Attribute	Preservative in %	Treatment I	Treatment II	Treatment III
Appearance	0.08	7.1667	7.5000	7.1667
	0.10	7.1667	7.5000	7.3333
	0.12	7.5000	7.1667	7.1667
	SEm	0.28	0.39	0.31
	CD5%	0.85	1.18	0.95
Colour	0.08	7.625	7.870	7.625
	0.10	7.625	7.870	7.750
	0.12	7.750	7.750	7.125
	SEm	0.30	0.23	0.34
	CD5%	0.88	0.69	1.02
Flavour	0.08	6.750	7.000	7.500
	0.10	6.750	7.000	6.875
	0.12	6.875	7.250	6.125
	SEm	0.43	0.32	0.49
	CD5%	1.28	0.94	1.46

Taste	0.08	6.667	6.444	6.333
	0.10	6.444	7.111	6.778
	0.12	6.555	6.000	6.000
	SEm	0.32	0.59	0.71
	CD5%	0.94	1.74	2.09
Over all Acceptability	0.08	6.875	7.375	6.875
	0.10	7.250	7.125	7.000
	0.12	6.875	6.875	6.125
	SEm	0.23	0.39	0.67
	CD5%	0.69	1.14	1.97

Treatment I: 5 minutes boiling
Treatment II: 10 minutes boiling
Treatment III heating in pressure cooker

Plate1: Jamun) Juice stored after 5min. boiling

Plate2: Jamun Juice stored after 10min. boiling

Plate 3: Jamun Juice stored after heating in pressure cooker up to 1st whistle

Since no significant difference was found with the variation of heat treatment and concentration of preservative added (range 0.08-0.12% of sodium benzoate) on the sensory attributes of jamun juice stored for three months it was concluded that with minimum heat treatment and minimum quantity of preservative used (five minute with 0.08%preservative)should be recommended to preserve jamun juice at room temperature for the period of three months.

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Perception of rural youth towards agriculture as an occupation in Shahpura block of Jabalpur, Madhya Pradesh

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Abstract

The present study was conducted in Shahpura block of Jabalpur district, 8 villages were selected purposively on the basis of maximum respondent's population and 120 respondents were selected for study. The majority of the respondents belonged to high school level; married, belonged to nuclear family had 5-8 members had annual income more than 50,000 Rs, majority had possessed 2-5 ha. (69.16%) in marital status, had agriculture as their occupation. Majority of the respondents were found medium in extension contact, formal social participation, social participation, mass media exposure, economic motivation, risk orientation, middle born in sibling status. Majority of the respondents had favorable perception towards farming as an occupation. Level of education, annual income, land holding, family occupation, extension contact, formal social participation, informal social participation, mass media exposure, economic motivation and risk orientation had positive and significant relationship with perception of rural respondents towards agriculture as an occupation while family type, size of family, marital status and sibling status had positive and non significant relationship with perception of rural respondents towards agriculture as an occupation.

Keywords: Rural youth, perception, agriculture, occupation

Perception is a psychological process through which everything is interpreted. Perception is based on thoughts, beliefs and behavior which later define the way. Youth are the most potent segment of population of a country. India is said to be the land of youth and villages. Also, in India it is well known that agriculture and youth are the backbone of our country. Development of youth determined the development of community and country.

As per provisional reports of Census India, population of Jabalpur in 2011 is 1,055,525; of which male and female are 545,510 and 510,015 respectively. Shahpura is a Block in the Jabalpur District of Madhya Pradesh, total area of Shahpura is 878 km² including 871.26 km² rural area and 6.66 km² urban area. Shahpura has a population of 1, 91,710 peoples.

Materials and Methods

The study was conducted in Shahpura block of Jabalpur district, 8 villages were selected purposively on the basis of maximum respondent's population and 120 respondents were selected for study. The data were collected by personal interview method with the help of structured interview schedule. Perception scale developed by Preethi *et al.* (2014) was used. The scale consisting of 18 statements was administered to total respondents. The responses were collected on the five point continuum viz., strongly agree, agree, undecided, disagree and strongly disagree. With a scoring pattern of positive statements may be given the scores as strongly agree-5, agree-4, undecided-3, disagree-2 and strongly disagree-1 were given and for negative statements the scoring procedures was in reverse order as that of for positive statements. The respondents were grouped in three categories

i.e. less favorable, moderately and highly favorable perception.

Result and Discussion

Table 1: Distribution of rural youth according to their level of perception

Level of perception	Frequency	Percentage
Low (18-42)	21	17.50
Medium (43-66)	62	51.67
High (67-90)	37	30.83
Total	120	100.00

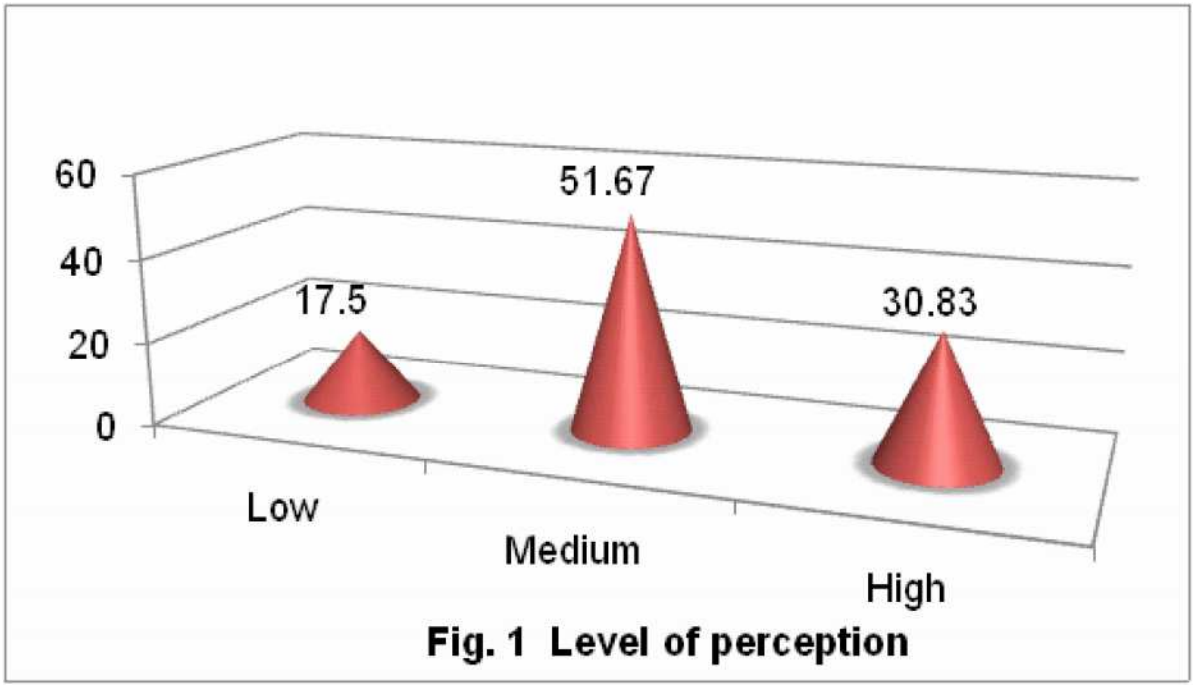

Fig. 1 Level of perception

Majority of youth (51.67%) had medium level of perception towards agriculture as an occupation followed by (38.83 %) youth fall in high level of perception and (17.5%) in low level of perception respectively (Table 1). Thus, it is concluded majority of youth fall into medium level of perception towards agriculture as an occupation. The results are confirmative with the finding of Preethi *et al.* (2014).

Table 2: Correlation analysis of independent variables with perception of rural youth towards farming as an occupation

Characteristics		Correlation (r- value)
Level of schooling		0.30054**
Family type		0.09645NS
Size of family		0.07693NS
Annual income		0.38188**
Land holding		0.20098**
Marital status		0.00072NS
Family occupation		0.220501**
Extension contact		0.228338**
Social participation	Formal	0.277147**
	Informal	0.233727**
Mass media exposure		0.250351**
Economic motivation		0.260745**
Risk orientation		0.338626**
Sibling status		0.01652NS

**: significant at 0.01 per cent level of significance.

NS: Indicates for non significant

Among selected characteristics of respondents vi, level of schooling, Annual income, land holding, family occupation, extension contact, formal social participation, informal social participation, mass media exposure, economic motivation and risk orientation had positive and significant relationship with perception of rural respondents towards agriculture as an occupation at 0.01 per cent level of probability (Table 2).The variable family type, size of family, marital status and sibling status had positive and non significant relationship with perception of rural respondents towards agriculture as an occupation.

The work of Kitturmath (2012) Anshu rani et al. (2016), Pakhmode et al. (2017), Tripathi et al. (2018), Vihari A M (2018) in line with the study.

It is concluded that rural youth have medium level of perception. In general rural youth in family farm require technical support and an enabling environment in the form of increased access to agriculture research and extension services, entrepreneurship skill, input, credit and markets.

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Assessment of adoption of improved wheat production technology and its constraints

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Abstract

The adoption behaviour of wheat growing farmers for improved wheat technology and its constraints were analysed in four adopted villages Uchehra, Kakraha of Satna district and Kapsa, Amrah of Rewa district in Madhya Pradesh. The results of the study revealed that majority of the wheat growing farmers exhibited medium level of adoption trend in marginal and small group of farmers. The marginal farmers were found to adopt more improved technologies then that of small farmers. 95% adoption of specific technology i.e. use of seeds of high yield varieties and use of recommended dose of fertilizer were found in marginal farmers Probably due to more capacity of adoption and extension contract. While, in small farmers the maximum (59.38%) adopted technology was the use of original material for improving nutrient status the study also exhibited drought problems as major constraints in wheat cultivation as perceived by the farmers in rabi during flowering and grain filling period.

Wheat (*Triticum estivum L.*) is an important winter-season food cereal. Currently, India's total wheat production is 92.29 million metric tonnes from an area of more than 35 million hectares (Anon. 2016). The production is 18410000 metric tones with yield of 3115 kg per hectare from an area of 5911000 hactare in M.P. In district Rewa the production is 398000 metric tones with yield of 2107 kg/ha from an area of 189000 hactare. And in Satna district the production is 390000 metric tones with yield of 2952 kg/ha from an area of 132000 hactare. To meet the growing demand of population it is very important to give more emphasis in wheat cultivation through improved cultivation technology. A good number of high yielding varieties, recommended doses of fertilizers with nitrogen coupled with the control of weeds, insects and disease can help in increasing the productivity. In the project we have demonstrated the improved wheat cultivation technology under FLD's amongst the marginal and small farmer during 2011-12, therefore, this study was aimed to analyzed the adoption behaviors of wheat farmers for improved cultivation technologies and its constraints, which will help in understanding the problems and also in developing suitable strategies in the spreading of recommended technologies in order to increase the production.

Materials and Methods

Eight important production technologies which had major role in the wheat production were selected for the study. The study was conducted in four adopted villages Uchehra, Kakraha of Satna district and Kapsa, Amrah of Rewa district in Madhya Pradesh during the year 2011-12. Data were collected from 50 wheat growing farmers comprising of marginal and small categories. The important technologies viz. use of seeds of high yielding varieties, use of organic material for improving nutrient states, seed treatment with fungicides, use of recommended dose of fertilizer, use of herbicide for weed control, use of insecticides for pest control and use of fungicides for disease control at appropriate time were assessed for their adoption level in different categories of wheat growing farmers. Meetings were held with farmers and objectives and activities of based on wheat production technology components and their timely applications were explained to

farmers i.e. improved variety HD 2864, balanced dose of fertilizer (100N:60P:40K) and PSB and Azotobactor @ 5gm/kg of seed as seed treatment were taken. A total 20q seed of wheat variety HD 2864, (40kg for each farmer) was distributed in target villages. Fifty demonstrations were conducted in 50 farmer's field at target during 2011-12 rabi crop season. The major constraints in wheat cultivation as perceived by wheat growing farmers were also analyzed and ranked accordingly.

Results and Discussion

Data in relation to yield showed that the concern variety shown better yield performance with an average of 2.34 t/ha in respect to desi / local varieties used by farmers with an average of 2.06 t/ha. Therefore, farmers preferred 'variety HD 2864' at Satna and Rewa district because of higher yield and grain quality. The tested variety of wheat grown in targeted villages of district Satna and Rewa were profitable and cost-effective.

The adoption behaviour of specific recommended practices of wheat production technologies by the wheat growing farmers was analyzed using percentage. The data in table 1 exhibited that 95% of marginal farmers had adopted fully to important recommended technology i.e. the use of seeds of high yielding varieties and recommended doses of fertilizer followed by the use of insecticides at appropriate time (91.2%). While small farmers had maximum adoption (83.13%) of use of organic material in their field for improving nutrient status probably due to their less buying capacity of in organic fertilizer. It is interesting to note with regards to both categories of farmers the maximum adoption (82%) of use of recommended doses of fertilizers because even category of small farmers were also aware that for obtaining the maximum production recommended doses of fertilizer practices play important role.

The practices which are less adopted by both the categories of farmers were, use of fungicide for diseases control at appropriate time (51%), use of insecticides for pest control (41%) at appropriate time and use of herbicide for weed control (35%). The adoption of their recommended technologies has been presented in table 1. The data pertaining to distribution of respondents based on their level of adoption of recommended wheat production technologies by the wheat growing farmers is presented in table 2. The result showed that 50% of marginal farmers belonged to medium adoption category while, high and low adoption categories was 35% and 15% respectively. In comparison to this a 28% of small farmers belonged to low level of adoption category. Hence the adoption behaviour of both marginal and small farmers was quits dissimilar. Further in the pooled sample it was found that more number of farmers (45%) belonged to medium level of adoption.

In order to find out the major constraints as perceived the wheat growing farmers have been presented in table 3 and it was found that the drought problem in rabi was perceived the most important constraint by the farmers. The other constraints in order to rank were on word, low fertility status in upland, problem of improved high yielding seeds material more damage to crop due to aphids attack and occurrence of fusarium head blight, leaf rust and powdery mildew on leaves causing low yield. The findings of the study are similar to the results of Kumbhare and Singh (2011), Njane and Wangare (2007), Judicate et. al. (1998), Ndiema (2002), and Yirga and Beyene (1990)

It is concluded from the adoption percentage was more in marginal farmers then small farmers for improved wheat production technologies 95% adoption were found in the use of improved high yielding varieties and use of recommended dose fertilizers in marginal farmers while the small farmers had higher adoption (83.13%) of use of organic material for improving nutrient status of the soil. Weeds problem coupled with terminal drought was found as major constraints in the wheat production.

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Table I: Adoption of specific recommended practices of wheat production technology by the wheat growing farmers.

S.No	Practices adoption	Marginal farmers (n=25)				Small farmers (n=25)				Total farmers (n=50)			
		Adopted		Not adopted		Adopted		Not adopted		Adopted		Not adopted	
		f	%	f	%	f	%	f	%	f	%	f	%
1	Improved varieties	24	95.00	1	5.00	15	59.38	10	40.63	39	77	11	23
2	Use of organic material for improving nutrient status	20	79.80	5	20.20	21	83.13	4	16.88	41	81	9	19
3	Seed treatment with fungicides	22	89.30	3	10.70	14	55.10	11	44.90	36	72	14	28
4	Use of recommended dose of fertilizer	24	95.00	1	5.00	17	69.35	8	30.65	41	82	9	18
5	Split application of fertilizer (N)	20	79.80	5	20.20	17	67.45	8	32.55	37	74	13	26
6	Use of herbicide for weed control	22	89.30	3	10.70	10	39.90	15	60.10	32	65	18	35
7	Use of insecticide for pest control at appropriate time	23	91.20	2	8.80	7	27.55	18	72.45	30	59	20	41
8	Use of fungicide for disease control at appropriate time	19	75.05	6	24.95	6	23.75	19	76.25	25	49	25	51

f = Frequency, % = Percentage

Table 2: Adoption of different categories of farmers in adopting wheat production technology

S.No.	Categories	Marginal farmers		Small farmers		Total farmers	
		f	%	f	%	f	%
1	Low	4	15	7	28	11	21.5
2	Medium	13	50	10	40	23	45
3	High	9	35	8	32	17	33.5
4	Total	25	100	25	100	50	100

f = Frequency, % = Percentage

Table 3: Major constraints in wheat cultivation as perceived by wheat growing farmers of Satna and Rewa district of M.P.

S.No.	Perceived/constraint	Marginal farmers			Small farmers			Total farmers		
		f	%	Rank	%	f	Rank	f	%	Rank
1	Improved seed problem	22	87.5	IV	23	93.7	III	45	90.6	IV
2	Low fertility status in up lands	25	100	I	25	100	I	50	100	I
3	Drought at flowering and onwards	23	93.7	II	24	97.9	II	48	95.8	II
4	Insect problems	23	91.6	III	24	95.8	IV	47	93.7	III
5	Disease problem	10	41.6	V	22	87.5	V	32	64.55	V

f = Frequency, % = Percentage

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Phytochemical screening of honey tree (Medhuca indica) and traditional uses in Eastern Madhya Prades

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Abstract

The traditional uses of the honey tree medhuca indica (Gmel.) family Sapotaceae is presented in this communication with its vernacular name, taxonomy uses of parts, method of preparation, administration and ethnomedicinal uses. Analysis of phytoconstituents of this plant viz. carbohydrate alkaloid, saponin, Flvonoids and tanine have also been done and reported. Plant are the source of many Bio-active compounds. Primary metabolities are directly involved in fundamental plant physiology processes are rasely considered to be major determination of host plant resistance. The phytochemical screening of *Madhuca indica* was done by using various plant parts and they were respectively reported to have the presence of secondary metabolities like alkaloids and flavinoids.

Keywords: Phytochemical screening, traditional uses, flavonoids, alkaloid.

The universal role of plants in the treatment of disease is exemplified by their employment in all the major system of medicine, irrespective of the underlying philosophical premise (Evens and Trease 1987). Plants are having a great importance to pharmaceutical industry, because these are rich source of drugs and a vast reservoir of chemical diversity for screening programs aimed at new drug discovery. Most of the drugs which are mention in the Indian medicinal system are from plant source. (Hoffman and Leaders, 1996). Screening programs which are based on the part of natural plant have achieved great success in identifying very useful chemical constituents.

The world health organization is now actively focusing his attention towards the developing countries to encourage them to use herbal medicine, which they have been traditionally, used for centuries. They have identified 3000 plants from forest of India (Agrawal and Paridhavi 2009). Herbal medicine can be defined as those products which are simply derived from the any part of plant (Ansari, 2007). The most advantage of the herbal medicine is that they contain a wide variety of different component (Londis *et al.*, 1997).

The large number of ethnomedicinal plants are used by local health care by tribals, that help to increase in tradition knowledge. The screening has been done to trace the presence or absence of some important chemical constituents viz. carbohydrate, saponin Lipid, Tannin, flavonoid, and alkaloid content of this plant under study.

The knowledge of traditional medicine put the light on the discovery of new and potent medicine. The common difficulty that researchers and worker face with medicinal plant is about the purity of authentic information on the identity of the plant, its habit and the condition required for its collection and than its utilization as a medicinal plant (Chopra *et al.*, 2006). Another important things about medicinal plant is prerequisites information for safety and efficacy must be know for address quality (Miller, 2005).

Material and Methods

Collection of plant materials

Information regarding the plant *Madhuca indica* (Gmel.) was collected by visiting different area of Jabalpur. The authentic identification of the plant was done by consulting the floristic literatures by (Oomachan and Shrivastav, 1996). Sample were deposited in the herbarium of State Forest Research Institute, Polypather, Jabalpur. (Ref. Accession No. SFRI 11536/14368).

The flowering season extends from February to April. The matured fruits fallon in May and July in the North August and September in the south.

The fruit are collected and water and rinsed in distilled water and dried under shade. For one week. After drying the fruit were dried in sealed envelope made from newspaper in order to pressure the splitting of fruits.

Preparation of Phytochemical extracts

This powder was extracted in the soxhlet using Aqueous Methanol, Ethyle, Petrolium ether and subjected to qualitative phytochmical screening for the identification of various chemical constituents using the method described by Trease and Evans (1987) and by Harbone (1973). The plant extract were screened for the present of secondary metabolities such as alkaloids, flavonoids, Rasine, tannins, saponins, triterpenes, glycoside and caumerins.

Test for Alkaloids

One milliliter of aqueous extract was stirred and placed in 1% aqueous hydrochloric acid on a stream bath. Then, 1 ml of the filtrate was treated with Dragendorff s and Mayer s reagent, white precipitate indicated the presence of alkaloids.

Test for Carbohydrate: 1 ml of extract was added to 1 ml of Benedict's reagent and heated for 5 min. Formation of orange precipitate indicated the presence of oligosaccharides.

Test for Protein: To 1 ml of extract, 0.25ml of nitric acid was added. Appearance of white precipitate indicated presence of proteins.

Test for Lipids: 1 ml of plant extract was evaporated to get few milligrams of dried powder in a test tube. Few drops of petroleum ether was poured into the test tube and shaken. Complete dissolution of extract indicated the presence of lipids.

Test for saponins: Foam test is a usual way to test presence of saponins. 1 ml of plant extract was taken in a test tube with small amount of water. Sodium bicarbonate was added to it and shaken vigorously for 5min. Formation of foam indicated the presence of saponins.

Test for Flavonoid (Shindo s test): To 0.5 ml of plant extract 5 ml diluted ammonia is added followed by 1ml of concentrated Sulphuric acid. A yellow coloration that disappears on standing indicated the presence of flavonoids.

Test for Resins: In a dry test tube, 2 ml of acetic acid and 2 drops of conc. sulphuric acid were added to 0.5 ml of plant extract. A purple color which changes to violet within 10 min indicated the presence of Resin.

Test for Tannins : For the qualitative tests of tannins, 10 ml of all the plant extracts were dried. The residue was dissolved in 10 ml of water and filtered. The tests were performed using this filtrate.

Test for Sterols: To 0.5 ml of the extract, 2 ml of chloroform and 2 ml of concentrated Sulphuric acid was added from the side of the test tube. The test tube was shaken for few minutes. The development of red color in the chloroform layer indicated the presence of sterols.

Test for Glucosides: 5 ml of plant extract was evaporated to get the residue. A few milligram of residue was diluted to 5 ml with water. 2 ml of glacial acetic acid containing one drop of ferric chloride solution was added to it. This solution was underplayed with 1 ml of conc. Sulphuric acid. A brown ring at the interface indicates presence of deoxy sugar characteristic of cardiac glycosides.

Result and Discussion

The preliminary phytochemical analysis of the fruit extract revealed the presence of alkaloids, tannins flavonoids, glycosides, saponins, (Table 1). The most abundant compounds in the ethanol and petrolium

either fruit extract were the glycosides. Carbohydrade lipic and protein were also seen in higher amounts but lesser than glycosides, and strol. Alkaloids, Tanins and Saponin were seen in moderate levels and Flovonide and saponins were seen in least amounts. The test for Triterpens, coumarins and Anthracuinone showed negative result.

Table -1 Phytochemical screening of extract of *Madhuca indica* fruit

#	Qualitative test		Fruit			
			Aqueous	Methanol	Ethyle Acetate	Petroleum Ether
1.		**Alkaloids**				
	a.	Mayer' test	-	+	-	-
	b.	Dragendroff's	-	-	-	-
	c.	Wagner's test	-	-	-	+
2.		**Carbohydrate**				
	a.	Molisch's test	+	-	-	+
	b.	Benedict's	+	+	-	+
	c.	Fehling's test	-	-	-	+
3.		**Protein**				
	a.	Xanthoprotic	+	+	-	-
	b.	Biuret	-	-	-	+
4.		**Lipids**				
	a.	Solubility	+	-	+	+
	b.	Glycerol	-	+	+	-
	c.	Sudan III	-	-	+	-
5.		**Saponins**				
	a.	Foam test	-	+	+	-
6.		**Flavinoids**	+	-	-	-
7.		**Resins**	-	-	+	-
8.		**Tannins**				
	a.	Gelatin test	-	+	-	+
	b.	Lead acetate	-	-	-	-
	c.	Ferric chloride	-	+	-	-
9.		**Sterols**				
	a.	Salkowaski	+	-	+	-
	b.	Liebermann's	-	-	-	-
10.		**Cardiac glucosides**				
	a.	Keller-Killiani	-	-	+	+
11.		Triterpenes	-	-	-	-
12.		**Caumerins**	-	-	-	-
13.		**Anthraquinone**	**-**	-	-	-

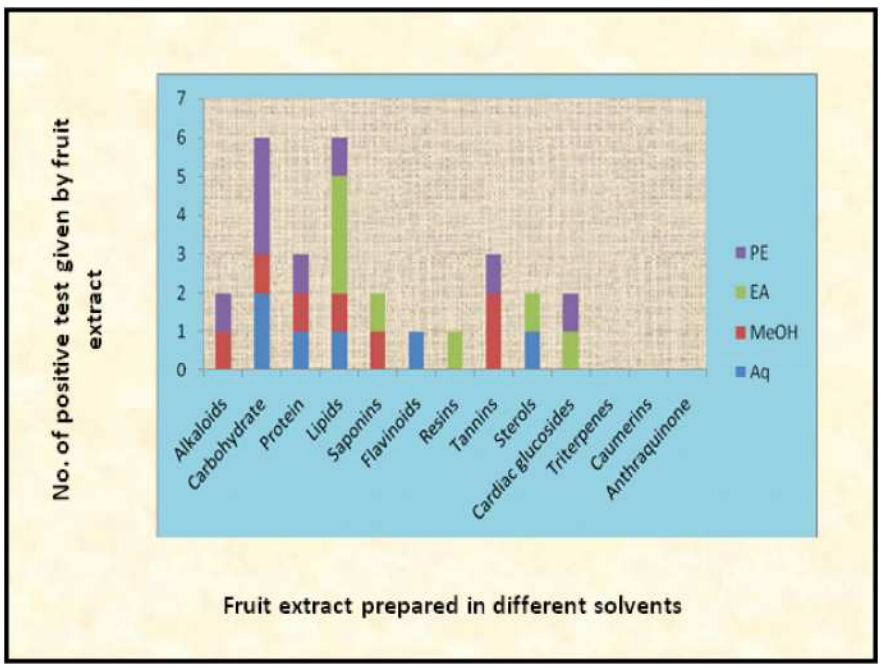
Keyword : + Positive (present), - Negative (absent)

Every part of any plant posses some medicinal properties, either in small of large proportion. Different parts of a plant often contain an quit different active ingredients, so that one part may be toxic and another one quite harmless. The plant consist of several parts, they may be classified according to the function. They are root, bark, leaves, flowers, fruits, seeds, oil.

The therapeutic value of the plant depends on the active constituents present inside the different part of the plant, which may be present in the small or large quantity. The secondary metabolites are the important substance responsible for the main medicinal properties in the curde drugs. The leaves of Mahua tree contain saponin, an alkaloid and glucoside. Sapogenin and other basic acid and found in the seeds. Various Photochemical studies on Mahua include characterization of Sapogenin, triterpenoids, steroids, saponin, flavonoids and glycosides. In view of the aides and attributed medicinal properties.

Plants

Fruits



Preliminary phytochmical studies of stem bark with ethanol, water and chloroform extract indicated the presence of starch, terpenoids, proteins, mucilage, anthraquinone, glycosides, cardiac glycosides, saponins and tannins (Gopalakrishnan *et al.*, 2012).

Madhuca indica, belonging to the family Sapotaceae, is an important economic tree growing throughout India. Traditionally, *Madhuca indica* bark has been used against diabetes, rheumatism, ulcers, bleeding and tonsillitis. The flowers, seeds oil of Madhuca have great medicinal value. Externally, the seed oil massage is very effective to alleviate pain. In skin disease, the juice of flowers is rubbed for oleation. It is also beneficial as a nasya (nasal drops) in disease of the head due to pitta, like sinusitis. The Mahua have several pharmacological potency and it is being used from the tradition.

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Health and nutritional practices adopted by tribal farm women in Balaghat District, Madhya Pradesh

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Abstract

The present study was conducted in Birsa block of Balaghat (M.P.) to assess the adoption of health and nutritional practices by tribal farm women. Total 120 tribal farm women were selected from ten villages of Birsa block by using proportionate random sampling. The study concluded that majority of the tribal farm women had medium level of adoption regarding health and nutritional practices.

Key words: Health and Nutritional practices, adoption, tribal farm women

Women are the backbone of an agriculture workforce and perform the most tedious tasks in agriculture, animal husbandry and homes. Her hard work has mostly been unpaid and unrecognized. Women constitute about 70% of the agricultural labour force in the rural sector, producing much of the country's food.

The tribal farm women also play multifarious socio-economic activities, inside as well as outside the home such as child care, collection of fodders and fuels, cooking, fetching water, attends farm activities, animal husbandry and extending helping hand in rural artisanship and handicrafts. Therefore, consumption of energy by the farm women needs to maintain good health but majority of tribal farm women has lack of knowledge about health & nutrition and also they don't take care of themselves. Therefore it is very much important for farm women to properly educate about health and nutrition then only they can change the status of family and help in progress of the community.

Material and Methods

The study was conducted in Birsa block of Balaghat District of Madhya Pradesh. Balaghat district comprises of ten blocks, out of which Birsa block was selected purposively because as per the land record sources maximum number of tribal farm women. The Birsa block comprises 149 villages out of which 10 villages were selected purposively on the basis of maximum tribal farm women population. Thus, total 120respondents were selected as the sample of the study on the basis of proportionate random sampling method from all selected villages. The data were collected through pre-tested interview schedule.

Result and discussion

Adoption of health and nutritional practices by tribal farm women

Distribution of the respondents according to their adoption of health practices

Table 1 Distribution of the respondents according to their adoption of health practices

Statement	Adoption level (n=120)					
	Complete		Partial		No	
	f	P (%)	f	P (%)	f	P (%)
Vaccination of child	34	28.33	54	45.00	32	26.67
Regular health check-up of child every month in the child health centre	2	1.67	76	63.33	42	35.00
Proper arrangements to drain dirty water and clean the surroundings	120	100.00	-	-	-	-
Taking boiled/filtered water for drinking	120	100.00	-	-	-	-
Washing vegetables before cutting	-	-	79	65.83	41	34.17
Washing hands before holding and feeding the baby.	-	-	51	42.50	69	57.50
Consulting doctors for health related diseases due to not taking precautions during menstruation	-	-	110	91.67	10	8.33

It was observed that 28.33 percent respondents had complete adoption, 45 percent had partial adoption and 26.67 percent of the respondents had no adoption about vaccination of child (Table 1 A). Maximum i.e. 63.33 percent tribal farm women had partial adoption regarding regular health check-up of child every month in the child health centre, whereas 35 percent had no adoption and 1.67 percent had complete adoption of the same practice. Cent percent respondents had complete, adoption about 'proper arrangements to drain dirty water and clean the surroundings. Cent percent respondents were having complete adoption about 'taking boiled / filtered water for drinking'. Majority of the tribal farm women (65.83%) had partial adoption whereas remaining (34.17%) had no-adoption about 'washing the vegetables before cutting them'. More than half of the respondents (57.50%) had no adoption whereas 42.50 percent had partial adoption about 'washing hands before holding and feeding the baby'. Majority (91.67%) of the tribal farmwomen had partial adoption about 'consulting doctors for health related diseases due to not taking precautions during menstruation'; only 8.33 percent had no adoption.

Distribution of the respondents according to their adoption of nutritional practices

With regards to balance diet, all the respondents (100.00%) had partial adoption about consuming balanced diet. Majority (99.17%) of the respondents had complete adoption and very few (0.83%) had partial adoption of the practice 'consumption of green leafy vegetables and fruits' More than half of the respondents (67.50%) had partially adopted 'consumption of milk and milk products' whereas 25.83 per cent and 6.97 percent had no adoption and complete adoption of the practice respectively (Table 1B). It was found that only 1.67 percent respondents had complete adoption, 53.33 percent had partial adoption and 45.00 percent of the respondents had no adoption regarding 'consumption of sprouted pulse/dal'. It was observed that 54.17 percent respondents had partial adoption and remaining (45.83%) respondents had no adoption about 'consumption of khichdi and dal by children in their diet'. With regards to food conservation and nutrition garden, majority (76.67%) of the respondents had complete adoption and established kitchen garden on a

small patch whereas remaining (23.33%) had partial adoption of the practice.

Table 2 Distribution of the respondents according to their Adoption of nutritional practices

Statement	Adoption level (n=120)					
	Complete		Partial		No	
	f	P (%)	f	P (%)	f	P (%)
a) Balanced diet						
Consuming balanced diet	-	-	120	100.00	-	-
Consumption of green leafy vegetables and fruits	119	99.17	1	0.83	-	-
Consumption of milk and milk products	8	6.67	81	67.5	31	25.83
Consumption of sprouted pulse/dal	2	1.67	64	53.33	54	45.00
Consumption of khichdi and dal by children in their diet	-	-	65	54.17	55	45.83
b) Food Conservation and Nutrition Garden						
Established kitchen garden on a small patch	92	76.67	28	23.33	-	-
Growing seasonal fruits and vegetables in the kitchen garden	19	15.83	101	84.17	-	-
Value addition of seasonal vegetables by drying for use in off season	34	28.33	86	71.67	-	-
Use of seasonal fruits and vegetables to make pickles for consuming round the year	1	0.83	119	99.17	-	-
c) Preservation of nutrition during cooking						
Washing the raw material/ vegetables before cooking them	119	99.17	1	0.83	-	-
Always cover the utensils during cooking food and cook on medium heat.	1	0.83	119	99.17	-	-
Washing fruits and vegetables before cutting	119	99.17	1	0.83	-	-
Consuming coarse flour	95	79.17	19	15.83	6	5.00
d) Nutritional deficiency diseases						
Eating nutritious food as curative measure for malnutrition and other diseases	2	1.66	98	81.67	20	16.67
Using green and yellow fruits and vegetables to improve eye sight.	11	9.17	107	89.17	2	1.66
Eating jaggery and gram, munga (Moringa), beetroot, green leafy vegetables, tomatoes and carrots to recover from anemia	13	10.83	76	63.34	31	25.83
Consumption of fruits, vegetables and milk daily to overcome the deficiency of calcium and other nutrients	2	1.67	47	39.16	71	59.17

Majority of the respondents (84.17%) had partial adoption and remaining (15.83%) had complete adoption about growing seasonal fruits and vegetables in the kitchen garden. Maximum tribal women (71.67%) had partial adoption and remaining (28.33%) had complete adoption about 'value addition of seasonal vegetables by drying for use in off seasons'. Regarding 'use of seasonal fruits and vegetables to make pickles for consuming round the year' it was found that 0.83 percent and 97.17 percent of the respondents had complete and partial adoption, respectively. With regards to preservation of nutrition during cooking majority (99.17%) of the respondents had complete adoption and very few (0.83%) respondents were having complete and partial adoption about washing the raw material/ vegetables before cooking them. Maximum respondents (99.17%) partially adopted the practice in which they always cover utensils during cooking food and cook on medium heat, whereas very few respondents (0.83%) had complete adoption regarding the same. Higher percentage (99.17%) of the respondents had completely adopted the practice of 'washing fruits and vegetables before cutting' and only 0.83 percent of the respondents had partially adopted the practice. More than three forth of the respondents (79.17%) had completely adopted the practice of 'consuming coarse flour' followed by partial (15.83%) and no adoption (5.00%) respectively. With regards to nutritional deficiency diseases, it was found that 1.66 percent, 81.67 percent and 16.67 percent of the respondents had complete, partial and no adoption respectively regarding 'eating nutritious food as curative measure for malnutrition and other diseases'. Majority (89.17%) of the tribal farm women partially adopted the practice of 'using green and yellow fruits and vegetables to improve eye sight', whereas 9.17 percent had completely adopted and 1.66 percent not adopted the practice. It is inferred that 10.83 percent respondents had complete adoption, 63.34 percent had partial adoption and 25.83 percent no adoption regarding 'eating jaggery and gram, munga (moringa), beetroot, green leafy vegetables, tomatoes and carrots to recover from anemia'.

Regarding the practice of 'consumption fruits, vegetables and milk daily to overcome the deficiency of calcium and other nutrients', it was found that only 1.67 percent had complete adoption, 39.16 percent had partial adoption and 59.17 percent of the respondents had no adoption.

Overall Adoption level of health and nutritional practices by tribal farm women

Table 3 Distribution of the respondents according to their overall level of adoption of health and nutritional practices

Categories	Frequency	Percentage
Low (Up to16)	0	0.00
Medium (17 to 32)	112	93.33
High (Above 32)	8	6.67
Total	**120**	**100.00**

The distribution of respondents according to their adoption of health practices (Table 3). It is concluded that majority of the tribal farm women (93.33%) had medium level of adoption; where as remaining 6.67 percent had high level of adoption of health and nutritional practices.

This result is in conformity with the research findings of Sharma *et al*. (2013), Datir (2017), Dave (2019) and Patil and Sankangoudar (2019).

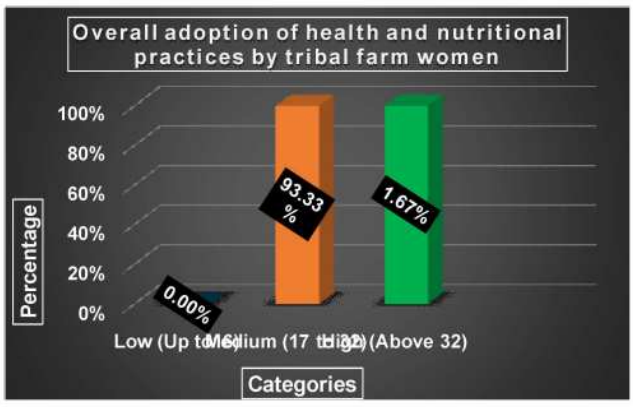

Fig.1 Distribution of the respondents according to their overall adoption of health and nutritional practices by tribal farm women

It is concluded that the intake of proper health practices and nutritional practices (balance diet, food conservation and nutrition garden, preservation of nutrition during cooking and nutritional deficiency diseases) was medium. The overall conclusion about adoption of health and nutritional practices by tribal farm women, majority of the tribal farm women belonged to medium level adoption of health and nutritional practices.

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Impact assessment of weed management interventions by farmers of Narsinghpur district of Madhya Pradesh

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Abstract

The study was conducted in Saikheda block, Narsinghpur district of Madhya Pradesh to assess the impact of weed management interventions, applied by farmers. Before applying weed management interventions majority (88.33%) of respondents were medium adopter whereas after intervention 63.33 percent respondents had high adoption of weed management practices. Consequences of weed management practices were also observed as, severity of weeds, production losses, area of crops and yield of crops. The study revealed considerable differences between before and after intervention of weed management practices regarding adoption of weed management practices, severity of weed, production losses etc.

Key words: Adoption, Impact assessment, weed, weed management.

Weeds are the special class of pests which seriously limit the production of the major crops. They compete with the crops for nutrients, air, light and moisture and thus reduce the crop yield. They are alternate host for insects, pests and other micro-organism as well as affect human health and cattle health. They deteriorate crop yield thus reduces seed quality. The yield losses are as high as any other pests in crops that is 37% (ICAR-DWR Vision Document 2030). In general weeds reduces crop yield by 31.5 and 22.7% in winter season and 36.5% in summer and kharif season in India (Anonymous 2007). Expenses on weed control is one of the major input costs of crop production, farmer's needs to adopt improved weed management practices to reduce crop yield loss and cost of production. They are more competitive with crops during the initial stages of their growth (2-6 weeks after planting). Weed control during this period may realize maximum crop yield (ICAR-DWR Vision Document 2030). According to Rao and Nagamani (2011), 103 million tonnes food grain, 15 mt of pulses, 10 mt of oilseeds and 52 mt of commercial crops per annum production can be increased if properly weed management practices adopted. The farmer's of selected area were adopted hand weeding, mechanical control and chemical control.

The present research is an attempt to assess the impact of weed management intervention on its adoption, severity of weed, production losses, cropping area and crop yield among the farmers.

Material and methods

The investigation was conducted in Saikheda block of Narsinghpur District of Madhya Pradesh during 2015. Total 120 farmers were selected from each village by proportionate random sampling method (Daivadeenam and Somani 2013). Data were collected personally by contacting all the respondents with the help of pre- tested structured interview schedule. Impact is assessed on the basis of adoption of weed management interventions/ practices as per method advocated by Islam (2005).

Result and discussion

Adoption of weed management practices

Overall adoption level was compared as before and after application of weed management interventions/ practices.

Table 1 Distribution of farmers according to their adoption of weed management practices

Categories	Before intervention		After intervention	
	Frequency	Percentage	Frequency	Percentage
Low	0	(00.00%)	0	(00.00%)
Medium	106	(88.33%)	44	(36.67%)
High	14	(11.67%)	76	(63.33%)
Total	120	100	120	100

Z value (0.01) 8.463

Majority (88.33%) of farmers had medium adoption before application of weed management interventions whereas after application of the intervention maximum (63.33%) farmers had high adoption of weed management practices. The reason might be due to the fact that maximum farmer's had more knowledge about the weed management practices. There was a significant difference in adoption of weed management practices before and after application of the intervention.

Due to adoption of integrated weed management practices, major changes was seen in farmers with respect to severity of weed, production losses due to weed infestation, area of crop and yield of crops on the basis of before and after intervention of weed management practices.

Severity of weeds

Severity of weed infestation was examined in Table 2 which shows percentage distribution on severity of weed.

Table 2: Distribution of respondents according to severity of weeds

Categories	Before intervention		After intervention	
	Frequency	Percentage	Frequency	Percentage
Low	13	(10.83%)	59	(49.16%)
Medium	39	(32.50%)	56	(46.67%)
High	68	(56.67%)	5	(4.17%)
Total	120		120	

Z value (0.01) 11.388

Before the intervention of weed management practices, maximum 56.67 per cent farmers had high severity of weeds in their field whereas after the use of intervention, near to half (49.16 percent) farmers had low severity of weed in their field. It is also clear that there was significant difference between before and after

intervention weed management practices regarding severity of weed.

Production losses

Difference in yield loss was compared by before and after the use of weed management practices.

Table 3 Distribution of farmers according to production losses

Categories	Before intervention		After intervention	
	Frequency	Percentage	Frequency	Percentage
Low	9	(7.50%)	82	(68.33%)
Medium	27	(22.50%)	38	(31.67%)
High	84	(70.00%)	0	(00.00%)
Total	120		120	

Z value (0.01) 15.673

High production losses were observed by majority of farmers (70%) before weed management intervention where as maximum 68.33 percent farmers beard low production losses as they applied the interventions (Table 3). It is because of adoption of weed management practices, that control weeds and reduces yield loss. The difference in production loss was found noteworthy between before and after application of weed management practices.

Cropping area

The cropping area of cereals, pulses, oilseed and cash crop was compared before and after application of weed management practices.

Table 4: Cropping area before and after intervention of weed management practices

Categories	Before intervention area (ha)	After intervention area(ha)	Change in area
Cereals	289.0	246.5	-14.70%
Pulses	96.7	83.9	-13.23%
Oilseed	101.8	92.3	-9.13%
Cash crop (Sugarcane)	203.3	236.7	+16.42%

The area of cereals (rice, wheat), pulses (pigeon pea, chickpea), and oilseeds (soybean) was decreased (i.e. 14.70%, 13.23%, and 9.13% respectively), whereas in cash crop (sugarcane) area was increased up to 16.42%. The possible reason for increasing the area of sugarcane may be that it is wide row space crop in which weed management can be easily done.

Crop yield

Average yield and percent change in yield of different crops (i.e. paddy, pigeon pea, soybean, wheat and

gram) are shown in table 5.

Table5: Yield of crops before and after intervention of weed management practices

Crops	Before intervention Yield (q/ha)	After intervention Yield (q/ha)	Percentage change
Rice	35	50	42.85%
Pigeon pea	11	17	54.54%
Soybean	12	19	58.33%
Wheat	31	44	41.93%
Chickpea	12	16	33.33%
Sugarcane	581	921	58.51%

The respondents were taken different crops out of which, maximum per cent change in yield was observed in sugarcane i.e. 58.51 % followed by Soybean and pigeon pea 58.33 per cent and 54.54 per cent respectively.

Conclusion

It is concluded that after application of weed management interventions majority of farmers had high adoption and due to it the severity of weeds and production losses (due to weed infestation) were reduced. Similarly the area and yield of the cash crop (Sugarcane) has been increased after the application of weed management interventions. Looking to the present agriculture scenario, the findings of this investigation will help the extension system and policy makers to redesign the activities for the transfer of technologies in adoption of integrated weed management practices. It will also help in identifying major factors for adoption of integrated weed management practices and feedback for the research system.

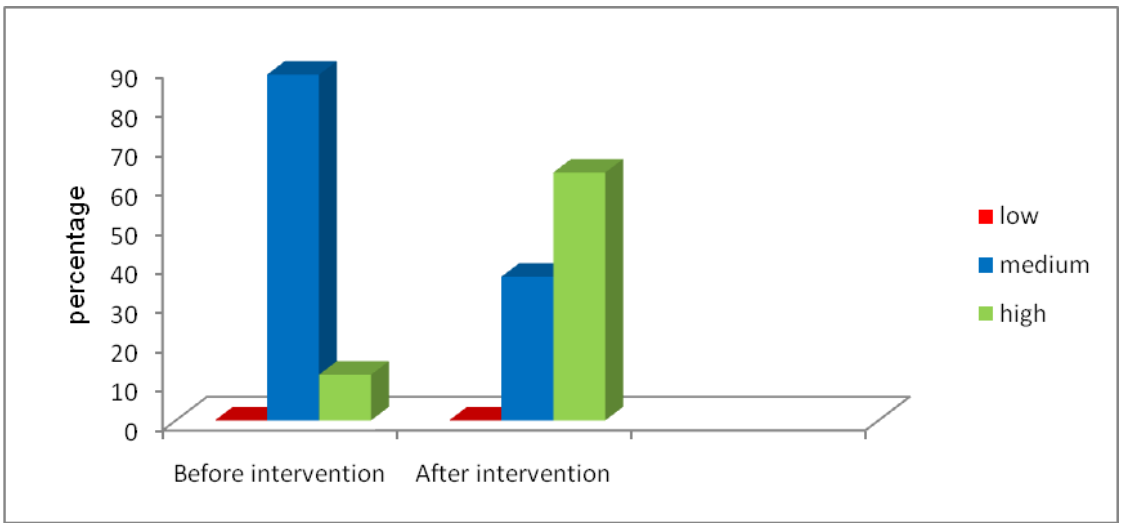

Fig.1. Distribution of respondents according to adoption of weed management practices

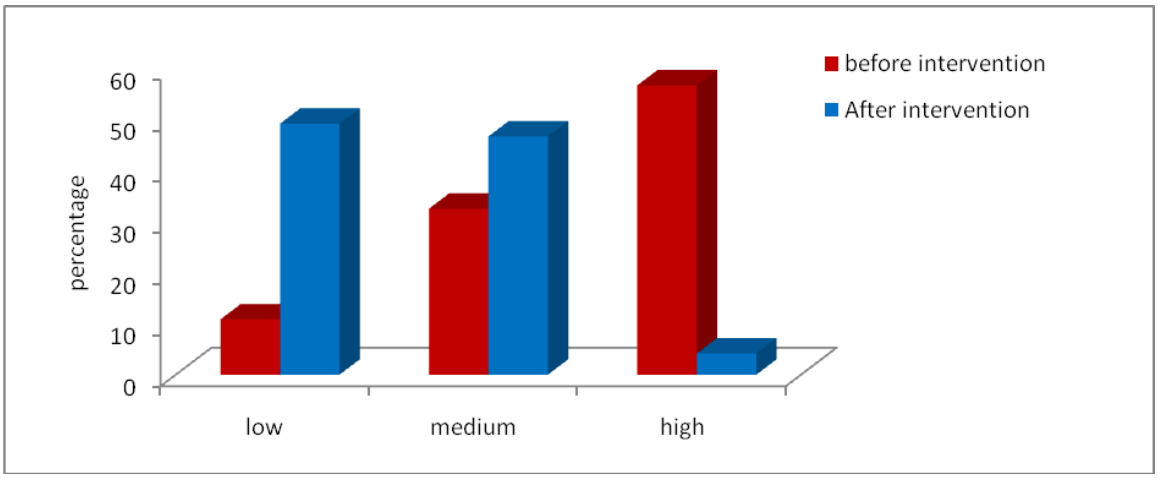

Fig. 2. Distribution of respondents according to severity of weed

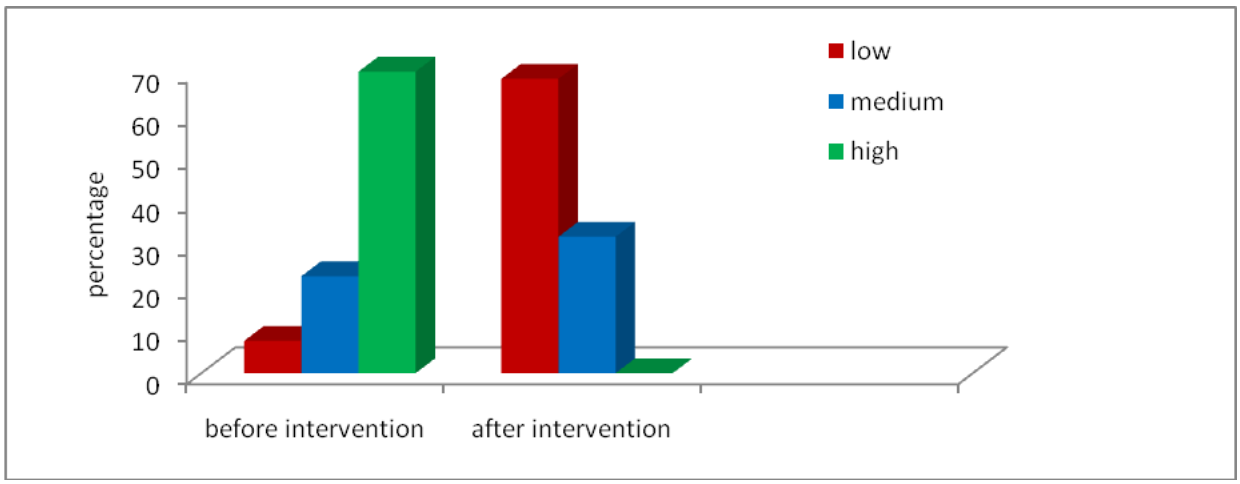

Fig.3. Distribution of respondents according to production losses

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Influence of soil moisture stress on growth, physiological efficiency and productivity of gram (Cicer arietinum L.)

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Abstract

The Present investigations were carried out in the polyhouse having controlled conditions during the Rabi season of 2009-2010 and 2010-11. The investigations revealed that when the soil moisture content was reduced from 30% to 10% there was an average reduction of 70.44 % in leaf area index, 49.59 % in stomatal conductance, 44.75 % in transpiration rate, 51.35 % in net photosynthesis, 36.02 % in photosynthetically active radiation (PAR) absorption, 66.05% in CO_2 utilization, 28.02 % in relative water content and 52.66 % in leaf water potential with increase of 9.1 % in leaf temperature. A decrease of 65.34% in number of flowers/plant, 68.75 % in number of pods/plant, 73.68 % in number of seeds/plant, 71.44 % in seed index, 52.94 % in seed yield and 57.38% in biological yield, respectively was also noted under similar moisture stress conditions.

Keywords: Moisture stress, physiological efficiency, Chickpea

The major constraints for low productivity are abiotic stresses like; water, temperature, nutrient and salts. Among them water and temperature stresses are the important abiotic stresses for growth and productivity, because drought is the major constraint which reduces the productivity of crop. It is known that chickpea thrives well under drought prone conditions. However, there is a greater variability for yield performance in different chickpea genotypes under drought conditions. Gupta *et al.* (1995) opined that there is a positive correlation between drought period with plant height, leaf area, and leaf dry weight reduction. Stress is measured in relation to plant survival, crop yield, growth (Biomass accumulation) or the primary assimilation processes (CO_2, photosynthetically active radiation (PAR) interception and mineral uptake) which are related to overall growth. Water deficiencies if severe can injure crops and induce them to adapt with certain physiological and morphological processes. Yield plateau of gram under water stress is an important issue.

Chickpea (*Cicer arietinum L.*) is an ancient legume crop believed to have originated in south eastern Turkey and the adjoining part of Syria. It is second most important pulse crop in the world. It covers 15% of the cultivated area and contributes 14% (7.9 million tonnes) of the world's pulse production out of total production of 58 million tonnes (*Singh et.al. 1997)*. In India, chickpea ranks in the first position among all the pulses occupying about 30% of total cultivated area and 40% of the total pulse production (*Reddy et al. 2007*). Nearly more than 85% of chickpea is grown as rainfed, mostly on the residual soil moisture after the harvest of kharif crops. Besides being an important source of human and animal food, chickpea also plays an important role in the maintenance of soil fertility, particularly in the dry rainfed areas (*Katerji et al. 2001*) In India.

The most important effect of water deficits is observed on the transport of nutrients and water to the roots and on the root growth and extension. Frequent drought besides lowering the crop yield

also decreases seed quality by reducing seed size. The component traits & drought resistance in pulse crops include drought avoidance, root trait and transpiration efficiency (*Serraj et al. 2004*). The development of moisture stress leads to a wide range of changes in partitioning of plant dry matter like diversion of biomass to undesirable plant parts. Therefore, the improved chickpea genotypes with better water use efficiency and high yield will be suitable for cultivation in drought prone areas and can prove a boon to improve the economy of poor farmers of dry land areas.

Earlier studies indicated that the moisture stress conditions were found to be associated with reduced yields. Keeping in view of the above mentioned facts the investigations were undertaken to assess the morpho-physiological traits and physiological mechanisms responsible for reducing the yields in chickpea under varying moisture stress levels.

Material and Methods

The Present investigations were carried out in the polyhouse having controlled conditions under Department of Plant Physiology, JNKVV, Jabalpur (M.P.) during the Rabi season of 2009-2010 and 2010-2011 in a complete randomized design with four replications.

The treatments consisted of five moisture levels viz; 30%, 25%, 20%, 15% and 10%, respectively. 30% moisture level was considered as control. The moisture level was maintained by allowing the soil to dry close to the selected moisture regimes by withholding water supply as described by Goyal *et. al.* (1998) which was determined gravimetrically on a parallel set of identical pots maintained for this purpose in the polyhouse and then maintained by adding requisite amount of water if required. These pots were maintained for various moisture stress treatments. The pots of 491.07 cm^2 filled with garden soil were used in the investigations. The seed sowing of chickpea collected from their natural populations was carried out in each pot so as to maintain 10 seedlings /pot. The average temperature in the polyhouse was kept $25^0C \pm 3^0C$.

The quantification of the physiological traits viz. stomatal conductance, transpiration rate, net photo synthesis, photosynthetically active radiance absorption, canopy temperature & CO_2 utilization was carried out by using infra-red gas analysor (IRGA) Li Cor - 6200 (Li Cor Instruments USA) as per method suggested by Kannan *et. al.* (2007).

The relative water content (R.W.C.) was estimated as per method given by Barrs and Weatherly (1962), whereas Leaf water potential (LWP) was measured by pressure chamber equipment as per method suggested by Sinclair and Ludlow (1986).

Results and Discussion

Photosynthetically active radiation and net photosynthesis

Agricultural systems are basically photosynthetic systems and must be assessed for their efficiency in conversion of solar irradiance in terms of both primary productivity and useful end products. The morphological features as characterized by the geometrical structure of plant communities, PAR interception and its utilization have a great influence on the productivity, which is an interaction between plants and environment through the modification and interception of fluxes of radiations, heat, CO_2 etc. consequently, the canopy structure is obviously determinant of the photosynthetic productivity of the plant communities.

Light has been recognized as one of the factors controlling plant growth. Solar radiation produces a set of reactions in the plants, which are evaluated in terms of energy reactions. The high light energy reactions are largely manitested in the storage of solar energy by photosynthetic enzymes in the form of chemical energy. On the other hand low light reactions are recognized by photomorphogenesis, which implies the effect of visible light over growth, development and differentiation of plant parts.

The interception of radiation in green plants is done by green leaves, which is influenced by the size, shape, angle and orientation. The canopy structure in terms of radiation interception varies with climatic conditions viz; sunangle, direct and diffused

radiation, properties of absorbing surfaces, CO_2 profiles and microclimate of crop. The crop stand is the product of amount of solar energy intercepted and the efficiency of intercepting tissues (Hesketh and Baker, 1967).

The PAR refers to the wavelengths (400-700 nm) which are absorbed by the chlorophyll molecules resulting in excitation and release of electrons which ultimately results in synthesis of ATP and $NADPH_2$ molecules. This energy is utilized for the CO_2 reduction in the dark reaction of photosynthesis.

It has been observed in the present investigations (Table 1) that PAR absorption was optimum between 30 - 60 DAS thereafter it decreased which may be attributed to reduction in leaf area index (LAI) (Table 2) and leaf area duration (LAD) in all the treatments. The higher magnitude of PAR despite of a comparatively low LAI during 30-60 DAS period may be attributed to the absorption of PAR by non leaf structures like, stem and pods along with leaf lamina. It has also been concluded that reduced soil moisture levels resulted in decreased PAR uptake due to decrease in magnitude of assimilatory surface area. There has been a (36.02%) reduction in PAR absorption when the soil moisture levels were declined from 30% to 10%. Reduced canopy absorption & incident PAR resulted reduced yield in maize and other grain crops Earl and Davis (2003).

The stomatal closure likely to play a major role in decrease of photosynthesis during the water stress. The net photosynthesis was found to be decreased sharply with increasing levels of soil moisture stress Shen *et al.* (2004). The present study revealed (Table 3) that the net photosynthesis increased as the age of the crop advanced in almost all treatments till 90 DAS (days after sowing) thereafter it had a reduction which may be accounted to the decrease in LAI, LAD, CGR (Crop growth rate) and RGR (Relative growth rate). The reduced moisture levels were found to be associated with reduced net photosynthesis. It was recorded when the moisture content was reduced from 30% (control) to 10% there was a reduction of 51.35% in net photosynthesis which may be attributed to the closure of stomata due to decrease in leaf water potential with increasing soil moisture stress.

Transpiration, Stomatal conductance and CO_2 utilization

The transpiration rate had an increasing trend with advancement in growth span of the crop till 90 DAS thereafter, it declined (Table 4) which may be ascribed to the reduction in surface area of leaf mesophyll cells. The higher transpiration rate is a beneficial trait in terms of higher CO_2 assimilation in initial stages of growth but after a certain period of time if the transpiration rate exceeds the absorption as a result of water stress this will create the water scarcity in the transpiring tissues resulting in closure of stomata thereby reducing CO_2 entry in the plant cells and subsequently photosynthesis. The water scarcity also reduces the PAR absorption due to reduction in functional activity of PS II (Photosystem II) resulting in disturbance in electron transport process Nogues and Barker (2000).

The transpiration rate was found to be reduced with increasing moisture stress in the present investigations which may be attributed to the closure of stomata and reduced water uptake. Anyia and Herzog (2004) and Shen *et al*. (2004) too reported similarly. 44.75% reduction in transpiration rate was noted in the present study when soil moisture level was reduced from 30% to 10%.

The higher stomatal conductance is indicative of higher water loss due to wide opening of stomata which is beneficial trait as long as availability of water is in abundance. In the present Study (Table 5) it has been recorded that the stomatal conductance had increased upto 60 DAS thereafter it decreased due to decreased turgidity of guard cells of stomata due to water stress as a result of in ageing.

The moisture stress treatments in the present study showed a decrease in stomatal conductance with increased moisture stress in soil. A reduction of 49.49% was noted in stomatal conductance when soil moisture level was reduced to 10% from 30% i.e. control. The results were in accordance with the findings of Anyia and Herzog (2004), Siosernardh *et*

al. (2004) and Shen *et al.* (2004). However under sufficient water supply the stomatal conductance has been reported to be increased Leidi (2003).

The water stress caused a significant increase in the internal CO_2 concentration Siosemardeh *et al.* (2004). The higher CO_2 utilization is an important characteristic of a genotype for higher photosynthetic efficiency. In the present Study (Table 6) the CO_2 utilization was found to be decreased with increasing age of the plant which may be attributed to decrease in rate of enzymatic reactions as a result of chemical desiccation Haley and quick (1998) in later growth phase of plant. The Present study also showed that the moisture stress significantly influenced the CO_2 utilization which may be attributed to the reduction in production of ATP and $NADPH_2$ molecules required for CO_2 reduction. The moisture stress reduces the rate of electron transport process required to generate the energy in the form of ATP and $NADPH_2$. A reduction of 66.03% was noted in CO_2 utilization when there was a reduction of soil moisture from 30% to 10%.

Leaf water potential

The leaf water potential is an important trait required for stomatal regulation. A decrease in leaf water potential (LWP) causes stomatal closure which in turn adversely affects the gaseous exchange thereby reducing kinetics of biochemical reactions required for growth.

In the present study (Table 7) a reduction in magnitude of LWP was noted as the age of the crop is progressed till maturity. The reduction may be attributed to decrease in RWC of plant. It has been noted in the investigation that the LWP had declined with reducing the moisture levels in the soil. There has been a decrease of 52.66% in LWP when the soil moisture contents were dropped from 30% to 10%. The results were in accordance with findings of Mujeeb *et al.* (2004).

Relative Water content (RWC)

The RWC is an important trait for selection of genotypes against the drought conditions. The plants having higher RWC can withstand adverse environmental conditions. The turgidity is the function of available water and it invariably decides the magnitude of physiological processes occurring in a leaf issue. If turgidity is down the dry matter production is reduced considerably. The maintenance of higher RWC under moisture stress conditions maintains leaf temperature, leaf diffusive resistance and net photosynthetic rate through stomatal regulation and mesophyll resistance Sandhu and Horton (1978).

In the present study (Table 8) the RWC was found to be decreased as age of the crop advanced till maturity which may be attributed to the reduction in cell membrane integrity to retain the water consequently increasing the water saturation deficit (WSD).

There was a reduction of 28.02% in RWC when soil moisture content was declined to 10% from 30% Atteya (2003) and Tejpal *et al.* (2004) also reported that under moisture stress conditions RWC decreased.

Canopy temperature

The canopy temperature is an important trait greatly influenced by the transpiration by the leaf foliage. The increasing canopy temperature is an indication of stomatal closure which reduces the transpiration rate and thereby cooling of canopy.

In the present study (Table 9) it has been observed that the leaf temperature had increased as the age of the crop reaches the maturity due to initial increase in transpiration rate followed by a decline resultant of stomatal closure during later phase of growth. The moisture stress significantly influenced the canopy temperature. There has been an increase of 9.1% in canopy temperature with deceased soil moisture content from 30% to 10%.

Yield and yield components

The study revealed (Table 10) that there was a reduction in yield components subsequently yield when the moisture content of soil had declined. There was a reduction of (65.34%) in number of flowers/plants, (68.75%) no of pods/plant, (73.68%)

no of seeds /plant, (71.44%) seed index, (57.38%), biological yield and (52.9%) seed yield g/plant when the soil moisture content was reduced to 10%. However, the harvest index did not show any definite trend and was found to be maximum in 20% soil moisture level.

Conclusions

Thus the investigations revealed that when the soil moisture content was reduced from 30% to 10% there was an average reduction of 70.44 % in leaf area index, 49.59 % in stomatal conductance, 44.75 % in transpiration rate, 51.35 % in net photosynthesis, 36.02 % in photosynthetically active radiation (PAR) absorption, 66.05% in CO_2 utilization, 28.02 % in relative water content and 52.66 % in leaf water potential with increase of 9.1 % in leaf temperature. A decrease of 65.34% in number of flowers/plant, 68.75 % in number of pods/plant, 73.68 % in number of seeds/plant, 71.44 % in seed index, 52.94 % in seed yield and 57.38% in biological yield, respectively was also noted under similar moisture stress conditions.

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Table 1: Photosynthetically active radiation absorption (µmol/m^2/s)

Treatments	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**Average**
T1	119.9	129.3	122.2	63.98	108.85
T2	115.4	108.1	103.4	50.75	94.41
T3	110.0	94.97	74.35	35.42	78.69
T4	100.9	90.42	71.90	36.85	75.02
T5	94.27	83.05	59.30	41.92	69.64
SEm±	2.15	2.68	8.44	3.54	4.20
CD5%	6.48	8.08	25.43	10.67	12.67

Table 2: Leaf area index

Treatments	30 - 60 DAS	60 - 90 DAS	90 - 120 DAS	Average
T1	1.20	2.46	2.00	5.66
T2	1.08	1.79	1.64	4.51
T3	0.75	1.67	1.38	3.8
T4	0.37	1.24	0.73	2.34
T5	0.25	0.91	0.60	1.76
SEm±	0.09	0.12	0.17	0.38
CD5%	0.28	0.36	0.50	1.14

Table 3: Net photosynthesis (µmol/m²/s)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	Average
T1	6.05	8.35	9.3	5.91	7.40
T2	5.37	7.19	8.3	2.78	5.91
T3	5.15	6.22	7.02	5.60	6.00
T4	4.62	6.18	5.4	5.90	5.53
T5	4.09	3.37	4.84	2.10	3.60
SEm±	0.50	0.31	0.62	1.86	0.82
CD5%	-	0.93	1.86	-	1.40

Table 4: Transpiration rate (mmol/m²/s)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	Average
T1	8.35	14.9	17.42	8.02	12.17
T2	7.25	13.7	16.45	6.47	10.97
T3	6.32	12.9	15.42	5.25	9.97
T4	5.55	10.17	13.40	4.75	8.60
T5	4.75	8.87	10.32	2.95	6.72
SEm±	0.20	1.17	0.80	0.28	0.61
CD5%	0.60	3.52	2.42	0.85	1.85

Table 5: Stomatal conductance (mmol/m²/s)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	Average
T1	671.30	899.55	599.63	476.97	661.86
T2	583.90	885.05	566.40	397.07	608.11
T3	518.63	678.27	482.90	341.10	505.23
T4	486.73	587.87	378.83	289.62	435.76
T5	445.25	502.25	274.35	115.30	334.29
SEm±	24.20	12.05	14.33	17.81	17.10
CD5%	72.93	36.32	43.19	53.68	51.53

Table 6: CO_2 Utilization (ppm)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	Average
T1	251.35	103.3	95.72	20.3	117.67
T2	93.30	86.5	87.38	16.5	70.91
T3	90.50	78.62	80.22	14.7	66.01
T4	47.45	72.27	75.22	13.7	52.16
T5	45.62	40.62	64.35	9.05	39.91
SEm±	48.06	5.75	2.21	1.34	15.10
CD5%	144.82	17.33	6.65	4.03	43.21

Table 7: Leaf water potential (bar -)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	Average
T1	0.5	0.55	0.75	1.04	0.71
T2	0.6	0.7	0.87	1.52	0.92
T3	0.8	0.9	1.1	1.82	1.15
T4	0.82	0.97	1.2	2.27	1.31
T5	0.92	1.05	1.25	2.77	1.49
SEm±	0.05	0.06	0.06	0.11	0.07
CD5%	0.15	0.19	0.18	0.33	0.21

Table 8: Relative water content (%)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	Average
T1	76.36	72.89	70.50	40.00	64.94
T2	82.17	66.39	64.92	32.80	61.57
T3	79.42	64.55	61.37	30.5	58.96
T4	75.97	64.45	43.42	16.80	49.96
T5	62.2	55.92	50.85	10.00	46.74
SEm±	4.95	0.57	6.49	0.81	3.21
CD5%	-	1.70	-	2.45	2.08

Table 9: Canopy temperature (^{0}C)

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	Average
T1	27.65	37.25	38.30	39.12	35.58
T2	33.37	36.92	35.87	41.0	36.79
T3	35.10	35.3	37.75	44.25	38.10
T4	35.92	35.15	37.27	43.12	37.87
T5	35.52	36.25	39.30	45.67	39.18
SEm±	0.86	0.94	0.69	0.67	0.79
CD5%	2.61	-	2.07	-	2.34

* DAS - Days after sowing

Table 10: Yield & yield components under various soil moisture levels.

Treatments	Number of flowers/ plant	Number of pods/ plant	Number of seeds\ plant	Seed yield (g\plant)	Seed index (g)	Biological yield (g/plant)	Harvest index (%)
T1	25.25	20.00	14.25	8.31	20.14	19.83	34.29
T2	24.75	17.00	15.00	7.40	19.05	18.43	35.72
T3	18.00	16.00	14.23	5.79	17.97	15.94	45.57
T4	15.75	12.50	8.00	5.71	16.47	13.61	42.06
T5	8.75	6.25	3.75	3.91	5.75	8.45	39.01
SEm +	0.83	0.73	1.29	0.59	0.56	0.78	3.54
CD5%	2.49	2.19	3.90	1.76	1.70	2.34	10.67

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Effect of sowing dates on growth and productivity of Chandrasur (*Lepidium sativum* L.)

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Abstract

The present research experiment was conducted during rabi season 2009-10 at Research Farm, Department of Plant Physiology, JNKVV, Jabalpur (M.P.). The research experiment was laid-out in a Randomized Block Design with four replications and treatment comprised of five different sowing dates. The different sowing dates exhibited a significant variability in physiological growth determinants, morpho-physiological yield attributing parameters and economic yield of Chandrasur. An increasing trend in LAI and LAD was recorded with advancement of crop age upto 60-75 DAS and thereafter declined sharply; maximum were at 60-75 DAS in D_1 (14th October). Similar pattern was noted with SLA, SLW, CGR, RGR and NAR. As far as yield attributing parameters concerned, early sowing date D_1 exhibited a superior performance among other sowing dates with improvement in yield attributing parameters viz plant height (85.75 cm), number of node/plant (15.65), number of capsules/plant (320.33), total dry matter/plant (8.68), biological yield (71.59 q/ha), seed yield/plant (1.13), seed yield (9.16 q/ha) and harvest index (13.10). It may be concluded from this research investigation that the sowing date D_1 (14th October) was found suitable for the sowing of Chandrasur in Satpura and Kymore plateau agro-climatic zone. so this sowing date resulted in better establishment of crop stand with improved physiological and morphological parameters which in turn enhanced seed yield.

Keywords: Chandrasur, sowing date, physiological, morphological

The World Health Organization (WHO) has estimated that 80% of the populations in developing countries rely on traditional medicine derived from plants for their primary health care needs. The demand of medicinal plants is increasing throughout the world. Madhya Pradesh has rich biodiversity in medicinal and aromatic plants due to wide variability in climatic and edaphic conditions. In india, it is grown mainly in Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra and Tamil Nadu for seeds (*Govika et al, 2004*). Recently, the major medicinal plants which were cultivated in M.P. are Safed musli, Buch, Muskdana, Chandrasur, Kalihari etc.

Chandrasur (*Lepidium sativum* L.) is an important crop that is now being cultivated in Madhya Pradesh owing to its therapeutic potential. It belongs to the family Cruciferae. It is also known as Garden Cress. The seeds contain an alkaloid, glucotropaeloin, sinapin, sinapic acid, mucilaginous, matter and uric acid. Its oil contains palmitic, stearic, arachidic, behenic, lignoceric and linolenic acid. The oil has anti-oxidant properties due to these chemical constituents. The seeds have several medicinal uses such as stomach-disorders, skin-disorders, sunburn, for amoebic infection, and as an insect-repellent. Presently, cultivation of the crop is mainly confined to North Indian states. However, due to increase in its usage, besides an assured remuneration, there is a need to expand the area under this valuable medicinal crop. Hence, there is an urgent need to conduct research investigation on location specific

sowing season of the crop for obtaining the quality seed.

Material and Methods

The experiment was carried out at Research Farm, Department of Plant Physiology, JNKVV, Jabalpur (M.P.) during the Rabi season 2009-10. The experiment was laid out in Randomized Block Design with four replications and treatment comprised of five different sowing dates viz. D_1 (14th October), D_2 (21st October), D_3 (29th October), D_4 (6th November), D_5 (14th November).

The plant growth analytical parameters viz LAI, LAD, CGR, RGR, NAR, SLA and SLW were quantified as per specification given by Watson (1974), Briggs (1920), Gregary (1926) and Gardner *et.al.* (1985). At harvest various morpho-physiological yield attributing parameters were recorded and data were analyzed as per standard statistical procedure.

Results and Discussion

Physiological growth determinants

Sowing time plays an important role to fully exploit the genetic potential of a variety as it provides optimum growth conditions such as temperature, light, humidity and rainfall. Moreover, sowing at proper time allows sufficient growth and development of a crop to obtain a satisfactory yield and different sowing dates provide variable environmental conditions within the same location for growth and development of crop and yield stability. Yield potential may be operationally defined as the yield of a crop when grown in environment to which it is adopted with nutrients and all stresses effectively controlled. Therefore, the realization of maximum yield potential of any crop may only be achieved by designing a suitable plant type, with vigorous growth habit and a suitable canopy architecture which utilize maximum solar energy.

The physiological growth determinants are the important selection indices for evaluation of potential productivity of any crop. Different sowing dates had a significant influence on accumulation of leaf area index of Chandrasur at different crop growth stages. A linear trend of increase in LAI was noted upto 75 DAS and there after declined (Table 1). Maximum LAI was noted in D_1 date of sowing-14th October (1.249) followed by D_2 (1.235) and minimum was noted in D_4 (1.146). This increase in photosynthetic surface area might be ascribed to overall improvement in plant growth, vigour and production of sufficient photoassimilates through increase in leaf area, nitrogen, phosphorus and potassium being major nutrients and their physiological activity was enhanced by organic manures and biofertilizers inoculations and resulted in more leaf area index (Singh, 1990). The LAI at harvest will be reduced due to natural senescence of older leaves. Increased LAI will result in greater light interception by the crop which might have contributed for the vegetative growth of crop. Similar results were observed in Isabgol when seeds were sown in November resulting in maximum LAI followed by October sowing (Das, 2011).

Leaf area duration represent the magnitude and the persistence of assimilatory surface area of leafiness during crop growth period. The different sowing dates significantly affected the LAD at different growth stages. Progressive pattern of increase in leaf area duration (LAD) was recorded with advancement in crop age upto 60-75 DAS. Maximum leaf area duration (LAD) was significantly noted in early sowing date D_1 (11.66 m^2/day) and minimum was noted in late sown conditions D_4 (9.240 m^2/day) (Table 1). Chauhan *et al.* (1999) reported that LAD and LAI measured at 30-45 days after sowing (DAS) had positive and significant association with dry matter accumulation at 50% flowering. Sahoo and Gaur (1998) observed positive association of LAD, LAI and with grain yield.

The different sowing dates significantly affected SLA and SLW production in Chandrasur at all growth stages with a progressive pattern of increase upto 60-75 DAS and thereafter declined (Table 1). The maximum SLA (0.062 m^2g^{-1}) and SLW (58.352 gm^{-2}) were noted in earlier sown conditions (D_1) while late sowing reduced these parameters.

The gain in weight of a crop community on a unit of land in unit of time is crop growth rate which ascribed crop productivity per unit land area, it is a single and important index of agriculture productivity on the rate of dry matter production. The relative growth rate is the basic component of growth analysis and is declined at any instant of time as increase of material per unit of material present. Different sowing dates significantly affected CGR and RGR at all growth stages with a progressive pattern of increase in CGR and RGR upto 60-75 DAS and thereafter declined (Table 1). Highest value of CGR and RGR were noted in earlier sown conditions D_1 (1.992 (g/m^2/day) and 0.100 g/day) and lowest value was noted in late sowing D_4(1.387 g/m^2/day and 0.051 g/day). (Pal *et al.* 1996) reported that CGR gradually increased with crop age and reached its maximum peak during 70 to 90 days thereafter declined. RGR was recorded maximum during the early vegetative stages and thereafter decline with the advancement of growth stages. This might be due to the photosynthates produced in the leaves were rapidly consumed by plant in reproductive phase. These results are in agreement with the findings of Yadav *et al.* (2013), Saraswathi *et al.* (2014) and Ahirwar *et al*. (2014). The NAR is the net gain of assimilate per unit leaf area and time. Different sowing dates showed significant influence on NAR with a progressive increase trend was noted upto 60-75 DAS. Maximum and minimum NAR was noted in D_1 (0.841 (gm/m^2/day) and D_4 (0.641 (gm/m^2/day) respectively. Vignes *et al*. (1979) stated that NAR depended upon leaf temperature and stomatal movements. High temperature reduced net photosynthesis and the efficiency of an agro-system was linked to a great extent to foliage exuberance under irrigation condition.

Table 1. Effect of sowing dates on LAI, LAD, SLA, SLW, CGR, RGR and NAR at different growth stages

Treatment	LAI	LAD (m^2/day)	SLA (m^2/g)	SLW (g/m^2)	CGR (g/m^2/day)	RGR (g/day)	NAR (g/m^2/day)
D_1	1.249	11.665	0.062	58.352	1.992	0.100	0.841
D_2	1.235	11.543	0.060	57.456	1.820	0.090	0.752
D_3	1.198	10.651	0.035	45.896	1.528	0.080	0.672
D_4	1.146	9.240	0.030	36.256	1.387	0.051	0.641
D_5	1.224	9.892	0.038	45.245	1.430	0.056	0.695
Mean	1.210	10.598	0.045	48.641	1.631	0.075	0.720
SEm±	0.043	0.138	0.007	6.955	0.140	0.009	0.097
CD @ 5%	0.134	0.424	0.022	21.345	0.431	0.027	0.300

Morphophysiological structural components of yield and seed yield

The yield attributing parameters were significantly influenced by dates of sowing. The different sowing dates had significant influence on plant height and number of nodes. Maximum plant height and number of nodes were recorded in early sowing D_1 (85.75cm) & (15.65 per plant) respectively and minimum were recorded in D_4 (82.50) & D_3 (10.00 per plant) (Table 2). The various sowing dates also significantly affected the number of capsules per plant and total dry matter. Higher number of capsules per plant and total dry matter were recorded in D_1 (320.33 per plant) & (8.68 gm) respectively which were at par with D_2 and lower value were recorded in D_5 (139.60 per plant) & (8.03 gm). This might be due to favorable weather conditions prevailing during their growing season, which influenced the plants to grow taller by increasing cell division and cell elongation, where as the plant height was observed to be less in delayed dates of sowing. Favourable

weather conditions helped in formation of more lateral buds resulted in more number of branches per plant. These results were in agreement with the study of Yadav *et al.* (2013) and Soleimani *et al.* (2011).

The significant decrease in morphological trait following the delay in sowing can be associated with higher temperatures that the plants at the other sowing dates experienced which limited their growing period and assimilate production because of the forces early maturity of plants. Thus, the plants did not have adequate opportunity for photosynthesis and their height and branch-bearing capacity decreased. Also, it seems that the decrease in height at the last sowing date was brought about not only by shorter growing period, but also by shorter day length which accelerated flowering and thus, stunted the growth of main stem. These results are in agreement with the results of Gobadi and Gobadi (2010) and Pan *et al.* (2003).

Table 2. Effect of sowing dates on plant height, no. of nodes per plant, no. of capsules per plant and TDM per plant

Treatment	Plant height (cm)	No. of nodes per plant	No. of capsule per plant	TDM/plant (g)
D1	85.75	15.65	320.33	8.68
D2	83.75	14.00	250.33	8.52
D3	83.50	10.00	183.64	8.50
D4	82.50	13.56	234.37	8.15
D5	82.75	12.00	139.60	8.03
Mean	83.650	13.042	225.65	8.376
SEm±	5.769	0.997	16.275	0.490
CD @ 5%	17.706	3.062	49.948	1.506

Biological yield or total dry matter production is the resultant of the interplay of a cultivar to physical, morphological, physiological and biochemical factors which may be arranged into a model of the integrated system. The different sowing dates significantly affected biological yield and seed yield. Maximum biological yield (q/ha) and seed yield per hectare were registered in D_1 (71.59) and (1.13) while minimum were recorded in D_5 (64.90) and (0.75). Seed yield (q/ha) was found to be highest in D_1 (9.16) and lowest in D_5 (5.67) (Table 3). Lower yield in late sowing circumstances might be attributed to unfavorable temperature during the crop season i.e. high temperature at the time of germination in late sowing. The reduction in yield due to delay in sowing might be ascribed to less flowering and seed setting on account of unfavorable temperature accompanied by winds coinciding with flowering and seed setting stage of the late sown crop responsible for reduction in seed yield with delayed sowing. Kumar et al. (2002) have also reported marked reduction in seed yield of mustard due to delay sowing. Randhawa et al. (1977) revealed that the crop sown on November 15th increased significantly the test weight over December 1st, January 1st and January 15th. Harvest index was affected by different sowing dates in Chandrasur and significantly higher harvest index was noted in D_1 (13.10) and lower in D_5 (8.73). Harvest index is an indicator of plants efficiency of produce economic yield. Generally, it is a genetically governed trait but also influenced by environment.

Table 3. Effect of sowing dates on Biological yield (q/ha), seed yield/plant seed yield (q/ha) and harvest index

Treatment	Biological yield (q/ha)	Seed yield/ plant (g)	Seed yield (q/ha)	Harvest index
D1	71.59	1.13	9.16	13.10
D2	69.80	1.02	9.15	12.80
D3	67.07	0.97	7.89	11.76
D4	65.05	0.96	6.50	9.99
D5	64.90	0.75	5.67	8.73
Mean	67.682	0.966	7.674	11.276
SEm±	2.311	0.076	0.134	0.136
CD @ 5%	7.092	0.234	0.413	0.417

Conclusion

It may be concluded from this research investigation that the sowing date D_1 (14th October) was found suitable for the sowing of Chandrasur in Satpura and Kymore plateau agro-climatic zone. So this sowing date resulted in better establishment of crop stand with improved physiological and morphological parameters. As a result of said improvements as well as proper duration for the phenophase; the crop yielded maximum seed yield when sown on 14th October which is most suitable date for sowing high seed yield and quality produce.

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Physiological evaluation of Pearl Millet (*Pennisetum glaucum L.*) genotypes for drought resistance and productivity

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Abstract

The present investigations were carried out during Kharif season of 2011-12 at the Research Farm Area, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P). The treatments comprised of seven pearl millet genotypes. Genotype IVTPM 7 possessed the maximum leaf water potential (-0.29 MPa) and leaf proline content (1.74μmol/ g), genotype IVTPM 6 - the maximum membrane thermostability (1.19μmhos cm^{-1} electrical conductivity), canopy temperature (29.44 ^{0}C), photosynthetic rate (27.71 μmol/m^2/s), water use efficiency (8.73 μ mol/m mol), IVTPM 3 - desiccation tolerance (0.95 μmhos cm^{-1}) , IVTPM 2 - root shoot ratio (0.29), IVTPM 5 - lowest stomatal conductance (0.32 mol/m^2/s), transpiration rate (2.60 m mol/m^2/s), highest relative water content (87.85 %) and lowest water saturation deficit (12.15 %), respectively. These traits may be used for developing the genotypes for drought prone areas. IVTPM 7 out yielded (37.60 g/plant and 5401.66 kg/ ha) other genotypes owing to its highest no. of cobs/plant (5.30), highest cob length (32.00 cm), no. of tillers/plant (5.33), a quite higher HI (36.52 %) and biological yield (85.23 g/plant and 15341.4 kg/ha). IVTPM 5 was ranked second in yield performance (32.58 g/plant and 5146.66 kg/ha).

Key words: Water use efficiency, membrane thermostability, water potential

Pearl millet (*Pennisetum glaucum L.*) is an important millet crop adapted to various adverse conditions of weather and provides staple food for the poor as well as fodder purpose in the arid and semiarid tracks of the country. Pearl millet is dual purpose crop as it provides nutritious food for human being, feed for poultry birds and dry and green fodder for cattle. Pearl millet is also a nutritious food among cereals. The nutritive value of pearl millet is higher than many other cereal crops. According to Pingle (1978) the pearl millet grains contain protein 0-13%, fat 3-6%, carbohydrates 71.5%, crudefibre 1.5%, ash 2.0%, lysine 3.5% and triphotophane 2.4% respectively. The calories values in the grains of pearl millet are equal to that of wheat. The pearl millet grains also contain vitamin 'A' and 'B' and also a fast growing nutritive forage crop and two cuttings may be harvested. It can be grown during summer conveniently as it dose not contain HCN (Hydro Cyanic Acid). The pearl millet forage contains, in general, 8 to 10 percent protein and about 55.68% digestible dry matter.

The pearl millet plants are subjected to various adverse environmental conditions throughout their life time which includes periods of drought, low moisture contents, cold temperatures, hot temperatures, desiccating atmospheric conditions, ultraviolet rays which may cause injury to the plants resulting in reduced growth and productivity. Drought resistance is complex of many morphological and biochemical characteristic. During the grain filling period the pearl millet crop is subjected to moisture stress resulting in severe drought. Therefore, there is need to screen out the

pearl millet genotypes having higher photosynthetic efficiency, water use efficiency and drought resistance characteristics which could be incorporated in a breeding program for obtaining genotypes of desired trait. A physiological efficient genotype can withstand adverse edaphic and climatic conditions. Keeping in view of the above facts the present investigations were undertaken.

Material and methods

The present investigations entitled "Physiological evaluation of pearl millet (*Pennisetum glaucum L.*) genotypes for drought resistance and productivity" were carried out during Kharif season of 2011-12 at the Research Farm Area, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P). The research experiment was laid out in a randomized block design replicated thrice. The treatments comprised of seven pearl millet genotypes Viz., IVTPM 1, IVTPM 2, IVTPM 3, IVTPM 4, IVTPM 5, IVTPM 6 and IVTPM 7 which were assessed for parameters imparting drought resistance and productivity.

The membrane thermostability was recorded as per Sullivan's method (1972), whereas desiccation tolerance was determined as per specifications of Sullivan and Ross (1979). The leaf water potential (LWP) was measured by pressure chamber equipment as per method suggested by Sinclair and Ludlow (1986).The relative water content (RWC) and water saturation deficit (WSD) were estimated as per method given by Barrs and Weatherley (1962). The water use efficiency was determined as per method given by Kannan *et al*. (2010) as follows: WUE = Pn/E where, Pn represents the net photosynthesis and E refers to the transpiration rate. The proline content in leaves was determined by following the method of Bates et al. (1973). The root and shoot ratio was determined after drying the roots and shoots in an electric oven at 80 ^{0}C for two or more days till constant weight. The quantification of the physiological traits Viz, stomatal conductance, transpiration rate, net photosynthesis, canopy temperature and air temperature was carried out by using infra- red gas analysor (IRGA) Li cor-6400 (Licor instruments USA) as per method suggested by Kannan *et al* (2010).

Results and Discussion

1. Parameters for drought resistance

Membrane thermostability

The membrane thermostability is very important trait under drought conditions. The severe drought conditions may lead to the damage of cellular membrane which results in leakage of solutes during the time of imbibition. The drought conditions increases the permeability of cellular membrane. Gupta *et al.* (2000) reported the lower membrane stability in susceptible genotypes of wheat, maize and groundnut under drought. In Table 1 the genotypes IVTPM 6, IVTPM 7 and IVTPM 1 possessed the higher membrane thermostability as indicated by the lowest electrical conductivity of the water in which the treated (damaged) leaf tissues of genotypes were immersed. On the other hand genotype IVTPM 5 was associated with lowest membrane thermostability.

Desiccation tolerance

During the time of drought conditions there is withdrawal of water from the cell. The genotype which resists the withdrawal of water from the cell under stress is considered the desiccation tolerant genotype and can be recommended for drought prone areas. The genotypes IVTPM 3, IVTPM 6, IVTPM 1 and IVTPM 7 have been identified as desiccation tolerant genotypes indicating their suitability for cultivation in drought sensitive areas.

Table 1. Parameters for drought resistance

Genotypes	Membrane Thermostability (μmhos cm^{-1})	Desiccation tolerance (μmhos cm^{-1})	Leaf water Potential (MPa)
G_1 IVTPM 1	1.37	0.97	-0.38
G_2 IVTPM 2	2.01	1.19	-0.6
G_3 IVTPM 3	1.59	0.95	-0.9
G_4 IVTPM 4	1.48	1.90	-0.68
G_5 IVTPM 5	2.18	1.33	-0.3
G_6 IVTPM 6	1.19	0.97	-0.87
G_7 IVTPM 7	1.26	1.19	-0.29
SEM±	0.166	0.037	0.110
CD @ 5%	0.487	0.110	0.324

Leaf water potential

The water stress decreased leaf water potential, stomatal conductance, and rate of transpiration in flag leaves of pearl millet Balasubramanium and Maheswari (1989). The lowest leaf water potential due to water stress resulted in an increased leaf temperature Sandhu and Horton (1978). Turner *et al.* (1986) reported higher leaf photosynthesis at high leaf water potential, the decrease in photosynthetic rates with decrease in leaf water potential were similar in all species. There was a rapid decrease in the rate of net photosynthesis when the leaf water potential was -0.8 to -0.9 MPa. Ashraf *et al.* (2003) studied the decrease in leaf water potential and osmotic potential under water deficit. Leaf soluble sugar, soluble protein, and total free amino acid contents increased under water deficit. The drought stress decreased water content and water potential of the leaves and free water content in the plants while the content of bound water was increased slightly Wang *et al.* (2004). The stomatal conductance was correlated with leaf water potential and soil water potential. Stomata then play a critical role in regulating water flow and maintain water potential that physiological processes are not damaged Shah *et al*. (2010). The result indicated (Table 1) that the genotype IVTPM 7 possessed the maximum (-0.29) leaf water potential which is an important trait for controlling physiological mechanisms through enzymatic reactions. The enzymes remain active only under hydrated conditions. Genotype IVTPM 3 was associated with the lowest (-0.9) leaf water potential.

Relative water content and water saturation deficit

The RWC is an important trait for selection of genotypes against the drought conditions. The plants having higher RWC can withstand adverse environmental conditions. The water stress is known to decrease leaf water potential and RWC in different crops including pearl millet Balasubramanium *et al.* (1989). The plants under water stress accompanied by change in RWC indicating a higher or lower osmoregulation depending upon the magnitude of the decrease. Decreased (water potential) of the leaf under stress may be due to decreased availability /absorption and translocation of water from soil and roots and ultimately to leaves Moribona *et al.* (1992). The investigations revealed (Table 2) that the genotype IVTPM 5 (87.85%) was associated with the highest relative water content and lowest water saturation deficit (12.15%) which is a desirable character a

genotype should possess for drought affected areas. The economic yield (grain yield) was found to be strongly and positively correlated with RWC and the biomass of developing grains Ibrahim and Aldesuquy (2003). The impact of soil moisture deficit on carbon assimilation was found be severe even under mild stress due to the damage it causes to the photosynthetic machinery and the photo-inhibition due to decreasing leaf turgor Shah *et al.* (2010).

Table 2. Parameters for drought resistance

Genotypes	Relative water content (%)	Water Saturation Deficit (%)	Water use efficiency (μmol/mmol)	Leaf proline content (μmol/g)	Root shoot ratio
G1 IVTPM 1	80.76	19.23	5.35	0.91	0.24
G2 IVTPM 2	78.92	21.07	4.11	1.38	0.29
G3 IVTPM 3	67.68	32.31	2.36	0.42	0.17
G4 IVTPM 4	77.13	22.86	5.96	0.20	0.26
G5 IVTPM 5	87.85	12.15	4.39	0.19	0.15
G6 IVTPM 6	77.31	22.68	8.73	0.22	0.17
G7 IVTPM 7	76.05	23.94	8.12	1.74	0.22
SEM±	7.594	7.594	0.670	0.045	0.076
CD @ 5%	22.251	22.251	1.965	0.132	0.225

Water use efficiency

Water use efficiency has been proved to be an important trait particularly in adverse environmental conditions. Screening of genotypes for higher water use efficiency is a need of the day. The genotypes maintaining higher WUE have an efficient stomatal regulatory capacity Maroco *et al.* (1997). The efficient control of water loss through stomatal regulation was indicated by high instantaneous WUE. Measurement of WUE might be a useful trait for selecting genotypes with improved drought adaptation and biomass productivity under different environmental conditions Li (2000). The genotypes did not suffer due to moisture stress and attained high water use efficiency due to high productivity probably by allocation of greater proportion of assimilates to grains, thus to improve grain yield to crop in rainfed areas one must increase water passing through crop in transpiration, increase the water use efficiency and increase the proportion of dry matter allocation to grains Kumar *et al.* (2010). This study (Table 2) indicated that the genotypes IVTPM 6 (8.73) and IVTPM 7 (8.12) possessed higher water use efficiencies the trait desired in genotypes for cultivation in drought sensitive areas. It can contribute to productivity when water resources are scarce Babitha *et al.* (2006). The best way to conserve soil water is to select plant genotypes having higher WUE so that the transpiration water loss can be optimized. Such genotypes should also be able to tolerate drought stress Kannan *et al.* (2010). The genotype IVTPM 2 (4.11) indicated the lowest water use efficiency indicating its unsuitability for drought prone areas.

Leaf proline content

During the stress conditions proline amino acid accumulates in the plants causing stomatal closure which prevents further water loss Sumesh *et al*. (2008). An increase in proline content by water stress has been suggested as a test of resistance to water

stress Singh *et al*. (1974). The proline accumulation in water stress leaves might provide a source of respiratory energy to the recovering plant Ebercon (1976). It has been recorded that the genotypes IVTPM 7 (1.74) IVTPM 2 (1.38) and IVTPM 1 (0.91) were found to be associated with the higher proline contents over the remaining genotypes indicating their drought resistant characteristics. The proline accumulation increased with increasing stress level Singh and Singh (1983). An increase in proline during drought is beneficial in osmotic adjustment of plants. The proline started disappearing in the leaves with simultaneous increase in water potential when water stress was relieved showing that proline helps the plants to survive under stress by maintaining its water potential Narayan and Misra (1989 b). The proline accumulation under drought condition is a close indicator of drought resistance / tolerance capacity of plant Manabendra and Baruah, (1998).

Root shoot ratio

Acceleration of root growth under moisture stress has been observed. The increases observed in root weight under moisture stress indicate greater density of root or greater depths of root penetration, both of these are important morphological adaptations to moisture deficit and results in greater extraction of soil water (Hoogenboom *et al.* 1987). Narayan and Misra (1989 b) recorded deeper penetration of root under moisture stress, and concluded that depth of root penetration can provide a useful selection criterion for wheat breeding under drought stress. Root intensity (visible root length/ cm^2 viewing surface) gave an indication of distribution of total root length which could serve as an important selection criterion for screening cultivars for drought resistance. Results revealed (Table 2) that genotype IVTPM 2 (0.29) superseded rest of the genotypes for root shoot ratio which indicated its suitability for cultivation in drought prone areas. Higher root biomass is beneficial for extraction of water from deeper soil horizons due to greater root growth. On the other hand genotype IVTPM 5 was associated with minimum root shoot ratio.

Canopy temperature and air temperature

The attributes canopy temperature and air temperature are closely linked as they determine the magnitude of water escape from the plant. It the difference between canopy temperature and ambient temperature is greater, this is associated with higher water loss from the plant and vice-versa. The transpiration maintains the magnitude of temperature in the canopy. Higher water loss from the canopy leads to the canopy temperature depression resulting in cooling of the canopy and subsequently increasing the temperature of the air at the vicinity of the plant. However continuous transpiration may leads to the stomatal closure if plant is unable to meet out its transpiration demands. Fischer *et al*. (1998) noted the higher productivity of semi dwarf wheat cultivars to their greater canopy temperature depression. Present study (Table 3) showed that the genotype IVTPM 6 possessed the maximum air as well as canopy temperature which were associated with the reduction in the transpiration rate of the genotype. On the other hand IVTPM 7 possessed higher canopy and air temperature along with higher transpiration rate which indicated that the leaves were able to continue the transpirational demands despite of increasing in leaf temperature which is normally associated with stomatal closure.

Photosynthetic rate

The net photosynthesis and related gas exchange parameters have been suggested as early selection criteria to improve the efficiency of tree breeding Ceulemans *et al.* (1988). The photosynthesis rate accelerated with the increasing photon flux densities (PFD) Kumar *et al.* (1999). High yielding cultivars were found to be associated with a high rate of photosynthesis Ojima and Kawashima (1968). The yield obtained for any crop is a net result of photosynthetic productivity and its partition to the economic organs (sinks). The efficient genotypes will have an efficient photosynthetic productivity and also an efficient nutrient uptake in which genetic variation may exists Yuan Long Ping *et al.* (1988). The cultivars with moderate Pn and high LAI recorded

high canopy photosynthesis, dry matter production and high yield Murty *et al.* (1992).

The present study indicated (Table 3) that the genotypes IVTPM 6 (27.71) and IVTPM 7 (27.5) were associated with higher photosynthetic rates. Therefore in a breeding program for evolving the varieties having higher photosynthetic rates these genotypes may be utilized beneficially. On the other hand IVTPM 3 recorded the minimum photosynthetic rate which suggests that the photosynthetic efficiency of the genotype is required to be improved through plant breeding.

Table 3. Parameters for drought resistance

Genotypes	Canopy temperature (^{0}C)	Air temperature (^{0}C)	Photosynthetic rate (μmol/m^2/s)	Stomatal conductance (mol/m^2/s)	Transpiration rate (m mol/m^2/s)
G_1 IVTPM 1	29.01	29.15	17.78	0.51	3.34
G_2 IVTPM 2	28.69	29.09	15.59	0.69	3.81
G_3 IVTPM 3	28.66	29.01	9.02	0.68	3.80
G_4 IVTPM 4	28.88	29.15	21.02	0.60	3.53
G_5 IVTPM 5	29.21	29.44	11.24	0.32	2.60
G_6 IVTPM 6	29.44	29.53	27.71	0.41	3.21
G_7 IVTPM 7	29.38	29.53	27.05	0.46	3.52
SEM±	0.429	0.312	0.534	0.082	0.313
CD @5%	1.258	0.917	1.567	0.241	0.919

Stomatal conductance and Transpiration rate

The photosynthesis is largely dependent on stomatal regulation Hsiao (1973). The stomatal conductance is of atmost important when photosynthesis is concerned. Stomata play a pivotal role in controlling the balance between assimilation and transpiration Beadle *et al.* (1981). It is necessary to have higher plant conductance to achieve higher canopy photosynthesis which would lead to higher biological yield. High plant conductance rate not only enhances the, CO_2 exchange rate but also results in higher transpiration rate Farquhar and Sharkey (1982). The stomatal conductance controlled the photosynthetic rate in drying soil Kumar and Robinson (2003). By virtue of its effect on movement of carbon dioxide and water vapour across leaf affects transpiration, water balance and photosynthesis throughout the growing period Burman *et al.* (2011).

The present investigations revealed (Table 3) that the genotype IVTPM 2 possessed the maximum stomatal conductance (0.69 mol/m^2/sec) and transpiration rate (3.81 mmol/m^2/sec) as well. The higher stomatal conductance is indicative of higher transpiration from the leaf foliage which is beneficial trait as long as water availability is in abundance to meet out the transpirational demands of the plant. However if transpiration is still continued at a higher rate this may cause the water scarcity in the transpiring cells resulting in closure of stomata and subsequentaly the reduction in CO_2 assimilation in plants and declined photosynthesis. On the other hand IVTPM 5 was associated with the lowest stomatal conductance as well as transpiration rate. This trait may be utilized in a breeding program for evolving the genotypes of higher water retention capacity required under drought conditions.

2 Yield and yield components

Grain yield

Grain yield in cereals depends on number of cobs/ plant, number of grains/cob and thousand grain weight. It has been observed that if an attempt is made to increase one component, there is compensatory decrease in other component and yield remains more or less same suggesting that there is some mechanism operating in plant system which is acting as constraints in controlling the productivity.

The present study (Table 4 & 5) revealed that the genotype IVTPM 7 outyielded (37.60 g/plant and 5401.66 kg/ha) other genotypes owing to its highest no. of cobs/plant (5.30), highest cob length (32.00 cm) and no. of tillers/plant (5.33), a quite higher HI (36.52 %) biological yield (85.23 g/plant and 15341.4 kg/ha) which had reflected in its highest grain yield. IVTPM 5 was ranked second in yield performance (32.58 g/plant and 5146.66 kg/ha) due to its quite higher 1000 grain weight (7.06 g), number of cobs/ plant (4.99), cob length (28.5 cm) and number of tillers/plant (5.00) resulting in a quite higher grain yield. IVTPM 1 possessed the lowest grain yield (7.02 g/plant and 1755.83 kg/ha) due to poor magnitude of yield components. The highest no. of tillers/plant in IVTPM 4 (5.33), no. of grains/cob in IVTPM 3 (1277.66), biological yield in IVTPM 5 (104.43 g/plant and 18797.4 kg/ha) and HI in IVTPM 6 (40.86%) could not contribute to increase in the grain yield due to poor performance of other yield components. However these traits may be utilized in the breeding program.

Table 4. Yield and its components of pearl millet genotypes

Genotypes	Plant Height (cm)	Number of tillers per plant	Number of cobs per plant	Number of grains per cob	1000 grain wt (g)	Cob length Per (cm)
G1 IVTPM 1	225.0	4.33	5.18	744.44	6.46	22.00
G2 IVTPM 2	216.33	5.00	4.47	934.44	5.5	22.71
G3 IVTPM 3	225.0	5.00	4.59	1277.66	6.03	27.82
G4 IVTPM 4	221.0	5.33	2.10	1175.55	7.43	22.66
G5 IVTPM 5	216.33	5.00	4.99	744.22	7.06	28.5
G6 IVTPM 6	231.66	4.33	1.99	1198.88	6.03	21.66
G7 IVTPM 7	201.66	5.33	5.30	950.00	5.83	32.00
SEm±	1.377	0.366	0.362	59.433	0.624	0.825
CD at 5%	4.037	1.073	1.061	174.139	1.829	2.418

Biological yield

Biological yield refers to the total biomass of the plant including economic yield. It had direct effect on grain yield/plant (Singh *et al.* 2003). In the present study (Table 5) it was observed that genotype IVTPM 5 possessed the maximum biological yield (104.43 g/plant and 18797.4 kg/ha) over rest of the genotypes followed by IVTPM 3 (98.83 g/plant and 17790.0 kg/ha). It is recommended that these genotypes may be used for fodder purpose. On the other hand IVTPM 6 was associated with the minimum (55.63 g/plant and 10013.4 kg/ha) biological yield indicating the low magnitude of fodder production.

Harvest index

HI gives the ratio of economic yield to the biological yield and recognized as favourable in terms of

partitioning of photosynthates to organs having economic yield Donald and Hamblin (1976). It has been observed that the genotype IVTPM 6 was associated with the highest harvest index (40.86) over the remaining genotypes a trait which can be utilized in a breeding program for enhancing the mobilization efficiency of genotype. IVTPM 1 registered the minimum HI (12.63) which indicated that the translocation efficiency of the genotype is required to be improved.

Table 5. Yield and its components of pearl millet genotypes

Genotypes	Grain yield		Biological yield		Harvest index (%)
	(g/plant)	(kg/ha)	(g/plant)	(kg/ha)	
G1 IVTPM 1	7.02	1755.3	79.88	14378.4	12.63
G2 IVTPM 2	16.81	4203.3	73.98	13317.4	31.95
G3 IVTPM 3	26.97	4543.3	98.83	17790.0	25.85
G4 IVTPM 4	16.86	4215.3	64.13	11544.0	36.98
G5 IVTPM 5	32.58	5146.6	104.43	18797.4	28.95
G6 IVTPM 6	15.15	3787.5	55.63	10013.4	40.86
G7 IVTPM 7	37.60	5401.6	85.23	15341.4	36.52
SEm±	1.709	427.30	11.881	2138.81	5.641
CD at 5%	5.008	1252.0	34.813	6266.74	16.531

The investigations revealed that among drought resistant characteristics genotype IVTPM 7 possessed the maximum leaf water potential (-0.29 MPa) and leaf proline content (1.74μmol/g), genotype IVTPM 6 - the maximum membrane thermostability (1.19 μmhos cm^{-1} electrical conductivity), canopy temperature (29.44 ^{0}C), air temperature (29.53 ^{0}C), photosynthetic rate (27.71μmol/m^2/s), water use efficiency (8.73 μmol/m mol), IVTPM 3 - desiccation tolerance (0.95 μmhos cm-1) , IVTPM 2 - root shoot ratio (0.29), IVTPM 5 - lowest stomatal conductance (0.32 mol/m^2/s), transpiration rate (2.60 m mol/m^2/s), and highest relative water content (87.85 %) with lowest water saturation deficit (12.15 %), respectively. These traits are beneficial for developing the genotypes for drought prone areas. The genotype IVTPM 7 outyielded (37.60 g/plant and 5401.66 kg/ha) other genotypes owing to its highest no. of cobs/plant (5.30), highest cob length (32.00 cm) and no. of tillers/plant (5.33), a quite higher HI (36.52 %) and biological yield (85.23 g/plant and 15341.4 kg/ha) which had reflected in its highest grain yield. IVTPM 5 was ranked second in yield performance (32.58 g/plant and 5146.66 kg/ha) due to its quite higher 1000 grain weight (7.06 g), number of cobs/plant (4.99), cob length (28.5 cm) and number of tillers/plant (5.00) resulting in a quite higher grain yield.

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Propsoed Crop Zone of the State of Madhya Pradesh

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Abstract

After introduction of soybean crop in the state of Madhya Pradesh drastic changes have been occurred in the cropping pattern in all the districts except rice growing districts and therefore, it is planned to re-organized and redfine the earlier five crop zones using secondary data of area of different crops considering district as one unit. After analysis of the collected data the grouping of districts has been made and all the districts fall in one group on the basis of main kharif and rabi crops. After grouping of all the districts the six crop zones are proposed these are viz., Rice, Rice-Wheat, Soybean-Wheat, Soybean-Chickpea, Mustard/Wheat and Cotton- Wheat zones. The maximum net cropped area, gross cropped area and number of districts are confined to Soybean-Wheat crop zone and least in Cotton-Wheat crop zone. This clearly indicates that soybean in the kharif and wheat in the rabi season are the most important crops of the state of Madhya Pradesh and therefore, any policy decision regarding these crops.

Key words: Crop-zones, soybean, districts, Madhya Pradesh

Introduction

Madhya Pradesh basically an agriculture based state which was established in the year 1956 with 307.58 lakh ha land. The total cropped area of the state is 243.16 lakh ha out of which 132.06 lakh ha under Kharif and 111.10 lakh ha under rabi crops with cropping intensity of 158.6 percent.

Fig 1 Geographical map of the state of Madhya Pradesh

The state was divided into five crop zone nearly six decades ago. At that time Chhatisgarh was the part of the state with 28 distrcits. The five crop zone were:

1. Rice crop zone
2. Rice- Wheat crop zone
3. Wheat crop zone
4. Sorghum- wheat crop zone
5. Cotton- sorghum crop zone

Table 1 Representation of districts in various existing crop zone of Madhya Pradesh

Rice	Rice- wheat	Wheat	Sorghum- wheat	Cotton- Sorghum
Anuppur	Jabalpur	Bhopal	Ashok nagar	Badwani
Balaghat	Katni	Damoh	Betul	Burhanpur
Dindori	Panna	Guna	Bhind	Dewas
Mandla	Rewa	(Aron, Raghoghar and	Chatarpur	Dhar
Shahdol	Satna	Chachoda Tehsil)	Chindwara	Harda
Singroli	Seoni	Hoshangabad	Datia	Indore
Umaria	Sidhi	Narsighpur	Guna	Jhabua
		Raisen	(barring Aron, Raghoghar	Kahndwa
		Sagar	and Chachoda Tehsil)	Khargone
		Sehore	Gwalior	Mandsaur
		Vidisha	Murena	Neemuch
			Niwari	Rajgarh
			Shivpuri	Ratlam
			Tikamgarh	Shajapur
				Ujjain

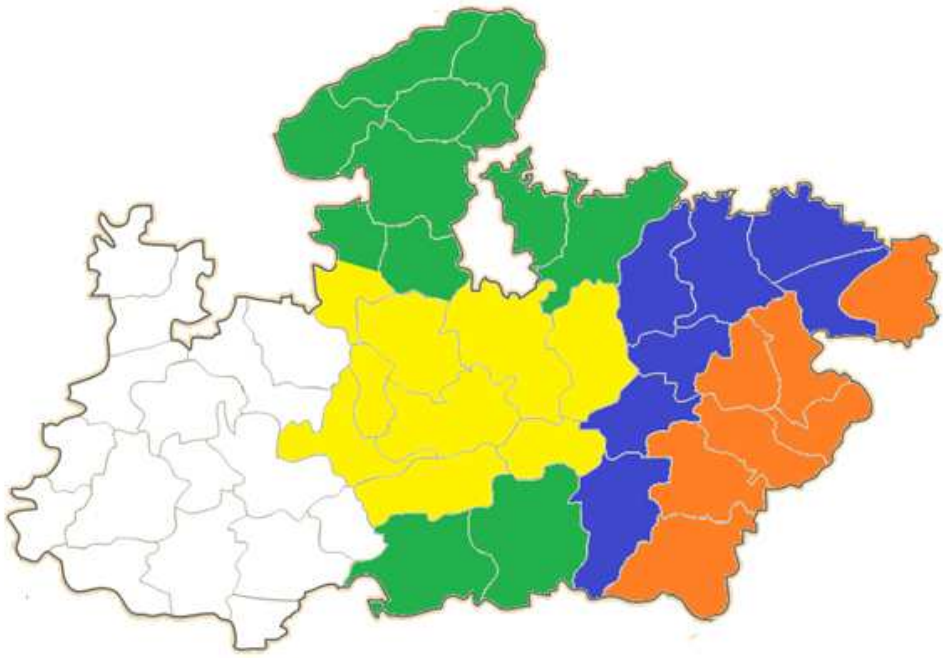

Fig 2: Exisitng crop zone of the state of Madhya Pradesh

In last six decades, the state of Madhya Pradesh has made many achievements in the field of agriculture due to policy decisions, development of new technologies, effective adoption of the technologies and meticulous efforts of farmers. It helped in food security and sovereignty. In last few years, 17.00 lakh ha land of the state has been converted from mono crop to double crop; 3.0 lakh ha from two crop to three crop and 10 lakh ha of non agricultural land to agricultural land in the state of Madhya Pradesh. The state has been established at the national level in the field of agriculture by producing highest quantity of pulses and oilseeds. The state is the highest producer of chickpea, garlic, guava, organic produce, soybean, tomato and urid bean; and second in coriander, mustard, orange, pigeonpea, vegetable pea and wheat. The state has been awarded continuously for six times with "Krishi Karman Award" at national level.

Material and Methods

After 60 years, the University has proposed new crop zones of the state based on the annual fluctuation in the area of important crops in the district. The average area of the crop in last three years was considered to redifne the crop zones, considering district as unit for groupin the districts in different proposed crop zones. Secondary data on area of different kharif and rabi crops were collected from website of Commissioner of Land Records and Settlement (www.landrecords.mp.gov.in)

Result and Discussion

Analysis of data shows that sorghum has loosed its importance in the state of Madhya Pradesh on the contrary soybean, and chickpea has achieved a large area whereas mustard has gained importance in specific area. The standard deviation of these crops in that area is also low.

The state of Madhya Pradesh has achieved top rank in production of soybean among oilseeds and chickpea among pulses at the national level. Given importance to these changes in the state of Madhya Pradesh following six crop zones are proposed that includes six crops with three new crops viz., soybean, chickpea and mustard and leaving sorghum. The distribution of districts in the proposed crop zone is given in table 2 and fig 3.

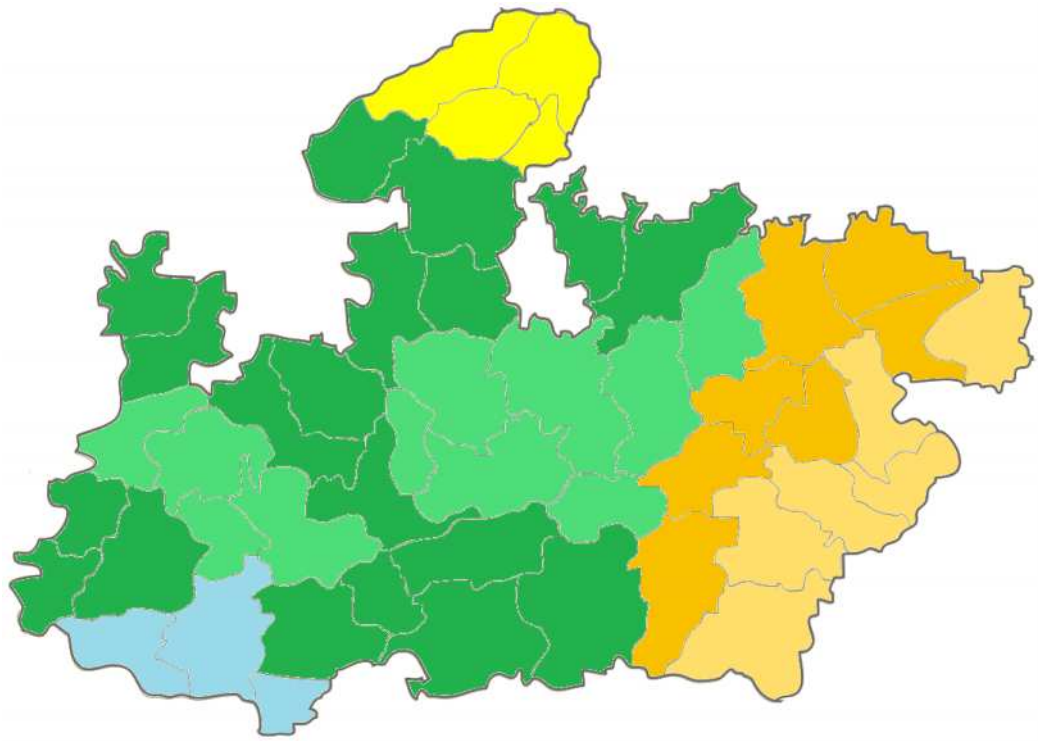

Fig 3 Proposed crop zone of the State of Madhya Pradesh

Table 2 Prospoed crop zones of the State of Madhya Pradesh

Districts	Rice	Rice-wheat	Soybean-Wheat	Soybean-Chickpea	Mustard-wheat	Cotton – wheat
Distrcit	Anuppur Balaghat Dindori Mandla Shahdol Singroli	Jabalpur Katni Rewa Satna Seoni Sidhi Umaria	Alirajpur Ashok nagar Betul Chatarpur Chindwara Dhar Guna Harda Hoshangabad Jhabua Khandwa Mandsaur Neemuch Niwari Raisen Rajgarh Sehore Shajapur Sheopur Shivpuri Tikamgarh	Agar malwa Bhopal Damoh Dewas Indore Narsighpur Panna Ratlam Sagar Ujjain Vidisha	Bhind Datia Gwalior Murena	Badwani Burhanpur Khargoan
Number of districts	06	07	20	11	4	3
Net Cropped area (lakh ha)	11.87	18.58	61.88	37.67	10.24	7.33
Gross cropped area (lakh ha)	15.78	27.14	100.78	64.51	13.6	10.05

Rice crop zone: It consists of six districts (Fig-4) located at the eastern part of the state viz., Anuppur, Balaghat, Dindori, Mandla, Shahdol and Singroli (Table 3). Out of net cropped area of 11.87 lakh ha of the zone rice is cultivated in 7.31 lakh ha (63%) in the kharif season. In the zone the maximum area of rice rice is 95% in Balaghat district and it is minimum (28%) is in Singrouli district. Wheat is the main rabi crop of this zone but the area is not more than 20% in any district. On an average it is 18% for the districts of rice zone. All these districts were also representing the previous Rice zone. The area under this crop zone is low due to high area under forest. The soil of the zone is mainly black to mixed red. The average rainfall of the zone is 1400-1600 mm.

Table 3 Cropping pattern of Rice crop zone of Madhya Pradesh (lakh ha)

Districts	Net cropped area	Gross cropped area	Major Kharif crops		Major Rabi crops	
			Rice	Maize	Wheat	lentil
Balaghat	2.72	3.44	2.62 (96)	-	-	-
Mandla	2.22	3.19	1.32 (60)	-	0.45 (20)	0.21(09)
Dindori	2.00	2.89	0.82 (41)	-	0.32 (16)	0.36 (18)
Shahdol	1.73	2.08	1.08 (63)	-	0.28 (16)	-
Singrouli	1.66	2.26	0.47 (28)	0.25 (15)	0.34 (20)	0.14 (08)
Anuppur	1.54	1.92	1.00 (65)	-	-	0.15 (10)
Total	11.87	15.78	7.31 (63)	0.25	1.39 (18)	0.86

(Figures in parentheses shows percentage to netsown area)

Fig 4 Rice Crop Zone of Madhya Pradesh

Rice-Wheat crop zone: Under this crop zone there are seven districts (Fig-5) of the state where after rice in kharif wheat is cultivated in rabi season intensively. The net cropped area of this crop zone is 18.58 lakh ha (Table 4). In this zone rice is grown over 52% of net cropped area in Jabalpur and Rewa districts and it was grown in minimum area in Seoii district (11%). The other crops grown in this area in the kharif season are maize, soybean, black gram, and sorghum. In rabi mainly wheat is grown in this crop zone. The percentage of wheat area to net cropped area is maximum in Jabalpur district (53%) and it is minimum in Umaria district (29%). In this zone the rice is grown over 7.07 lakh ha (38%) and 8.08 lakh ha (44%) is under wheat. The second important crop of rabi season is chickpea with maximum coverage of area in Satna district (21%) and minimum in Umaria district (7%) to the net sown area of this crop zone. The soils of this zone are mixed red and yellow (Rewa and Satna districts) and medium deep black soils confined to Jabalpur, Katni, Umaria, and Sidhi districts. The average annual rainfall of this zone is in the range of 1200 to 1400 mm.

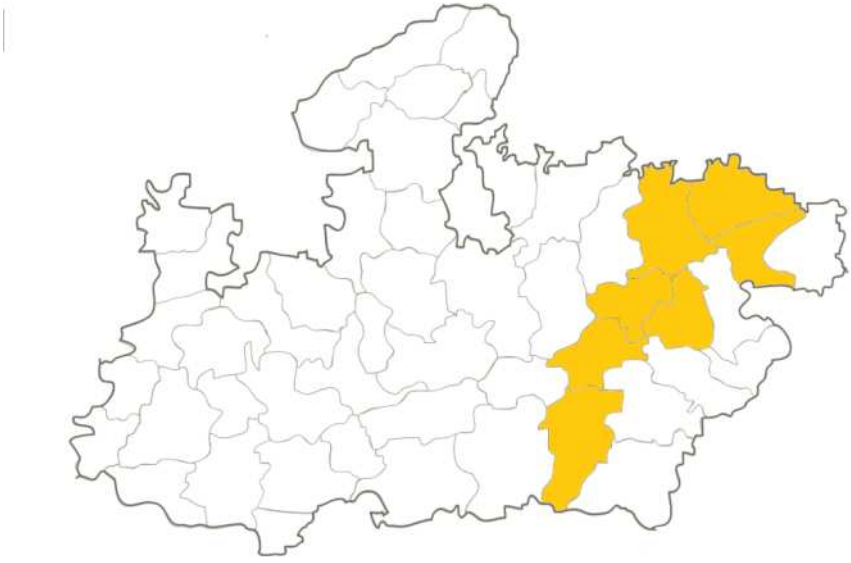

Fig 5 Rice- Wheat Crop Zone of Madhya Pradesh

Table 4 Cropping pattern of Rice-Wheat crop zone of Madhya Pradesh

(lakh ha)

Districts	Net cropped area	Gross cropped area	Major Kharif crops		Major Rabi crops	
			Rice	Other	Wheat	Chickpea
Seoni	3.94	5.70	1.71 (44)	0.64 Maize (16)	1.54 (39)	0.39 (10)
Rewa	3.59	5.16	1.25 (35)	0.49 Soy (14)	1.57 (44)	0.52 (15)
Satna	3.51	5.20	0.94 (27)	0.67 Soy (19)	1.62 (46)	0.74 (21)
Jabalpur	2.72	4.36	0.95 (35)	0.29 Black gram (11)	1.43 (53)	0.51 (19)
Katni	2.13	3.03	1.10 (52)	-	1.04 (47)	0.38 (18)
Sidhi	1.67	2.30	0.68 (41)	0.10 Sorghum (06)	0.59 (35)	0.18 (11)
Umariya	1.02	1.39	0.41 (41)	0.09 Maize (09)	0.29 (29)	0.07 (07)
Total	18.58	27.14	7.07 (38)	2.28 (12)	8.08 (44)	2.79 (15)

(Figures in parentheses shows percentage to netsown area)

Soybean-wheat crop zone: This is the largest crop zone of the state consisting of nineteen districts (Fig-6). The net cropped area of this crop zone is 65.32 lakh ha and soybean is grown over 33.90 lakh ha (53%) in kharif season and during rabi season the wheat is grown over 29.60 lakh ha (45%) area (Table-5). Previously this zone was deginated as sorghum and wheat crop zone. But presently soybean and wheat are the important crops of this zone. In Harda, Shajapur and Mandsaur the soybean crop is grown over 93, 89 and 80 per cent of the net cropped area respectively. The other kharif crops grown in this crop zone are sesame in Chhatarpur & Tikamgarh districts, cotton in Dhar and Khandwa districts, and black gram, rice etc are the other kharif crops which are grown in this crop zone with acreage of 07 to 27 per cent.

In Chhindwara and Jhabua districts of this zone maize crops is grown over 41 and 34 per cent of the net cropped area respectively. During rabi wheat is a major crop. The wheat is grown over 88 and 83 per cent of the net cropped areas in Hoshangabad and Harda districts respectively. The highest variability measured as coefficient of variation was found to be highest in Rajgarh district (40.50%) for the area allocation under wheat during the period of last nine years. In this crop zone in sixteen districts chickpea is second important crop during the rabi season with less than 20 per cent of the coefficient of variation revealing that this crop is more stable as compared to wheat during rabi season. The soils of this crop zone are generally deep light black soils (Dhar, Shivpuri, Rajgarh, Sehore, Mandsaur, Guna, Hoshangabad, Alirajpur, Khandwa, Shajapur, Jhabua, Harda and Neemuch districts) on the other hand in Chhatarpur, Tikamgarh and Ashoknagar the soils are mixed red to black and in Chhindwara and Betul districts the soils are medium black and shallow in nature. The average annual rainfall for Chhindwara and Sehore district is ranged between 1200 to 1400 mm; in, Chhatarpur, Tikamgarh, Ashocknagar, Rajgarh, Betul, Guna, Shajapur and Harda districts the average annual raninfall ranged between 1000 to 1200 mm while in remaining districts average annual rainfall is in the range of 800 to 1000 mm.

Table 5 Cropping pattern of Soybean-Wheat crop zone of Madhya Pradesh

(lakh ha)

Districts	Net cropped area	Gross cropped area	Major Kharif crops		Major Rabi crops	
			Soybean	Other	Wheat	Chickpea
Chhindwara	5.09	7.22	1.00 (20)	2.09 Maize (41)	1.50 [16] (30)	0.44
Dhar	5.01	8.20	2.99 (60)	0.92 Cotton (18)	2.24 [18] (45)	0.67
Shivpuri	4.50	6.89	1.85 (41)	0.34 Black gram (08)	1.84 [19] (40)	0.53
Rajgarh	4.40	7.95	3.55 (81)	0.35 Maize (08)	2.07 [41] (47)	0.65
Raisen	4.32	6.95	1.24 (29)	1.11 Rice (26)	2.50 [15] (58)	1.07
Betul	4.20	6.03	2.53 (59)	0.53 Maize (12)	1.38 [11] (32)	0.32
Chhatarpur	4.10	6.09	0.95 (23)	0.84 Sesame (21)	1.66 [17] (40)	0.60
Sehore	3.97	7.61	3.03 (76)	-	2.56 [16] (64)	0.79
Mandsaur	3.56	6.12	2.85 (80)	0.23 Maize (07)	1.00 [27] (28)	0.37
Guna	3.39	5.54	2.60 (77)	-	1.35 [20] (40)	0.64
Hoshangabad	3.10	6.29	0.96 (31)	0.89 Rice (28)	2.75 [08] (88)	0.18
Ashoknagar	3.08	5.01	1.52 (49)	0.67 Black gram (22)	1.51 [15] (49)	0.83
Khandwa	3.03	4.55	2.05 (68)	0.45 Cotton (15)	1.18 [22] (39)	01.7
Shajapur	2.80	5.00	2.50 (89)	-	1.29 [22] (46)	0.41
Tikamgarh	2.69	4.30	1.07 (40)	0.32 Sesame (12)	1.31[27] (49)	0.11
Jhabua	1.89	2.45	0.65 (35)	0.64 Maize (34)	0.40 [27] (21)	0.11
Harda	1.86	3.63	1.73 (93)	-	1.54 [09] (83)	0.23
Neemuch	1.83	3.10	1.38 (75)	0.19 Maize (11)	0.46 [19] (25)	-
Alirajpur	1.70	2.11	0.21 (13)	0.54 Black gram (29)	0.20 [17] (12)	-
Sheopur	1.68	2.69	0.48 (29)	0.25 Rice (15)	0.86 [25] (52)	0.08
Total	65.32	107.73	34.33 (53)	10.36 (16)	29.60 (45)	9.73 (15)

(Figures in parentheses shows percentage to netsown area and figures in [ ] shows the coefficient of variation)

Fig 6 Soybean- Wheat Crop Zone of Madhya Pradesh

Soybean-Chickpea Crop Zone: This crop zone covers twelve districts of the state (Fig-7) covering an area of 37.67 lakh ha (Table 6). In this crop zone soybean is grown over 24.43 lakh ha (65%) in the kharif season and chickpea is grown over 9.97 lakh ha (25%) during the rabi season. In Ujjain 95 per cent of the kharif cropped area is under soybean, similarly for Indore, Dewas, and Agar the area under soybean was 92, 87, and 81 per cent respectively. During rabi chickpea is a stable crop because the coefficient of variation indicating stability index is below 30 per cent. The wheat is important crop of this crop zone but instability in area under wheat is higher (>30%) as compared to chickpea. In Narsinghpur district sugarcane become the important crop and as per old classification of crop zone this districts was confined to Sorghum-wheat crop zone. The soils of this crop zone are deep medium black. The average annual rainfall in Damoh and Narsinghpur districts is between the range of 1200 to 1400 mm; in districts of Sagar, Vidisha, Dewas and Panna the annual average rainfall is between the range of 1000 to 1200 mm and in remaining districts the rainfall is in the range of 800 to 1000 mm.

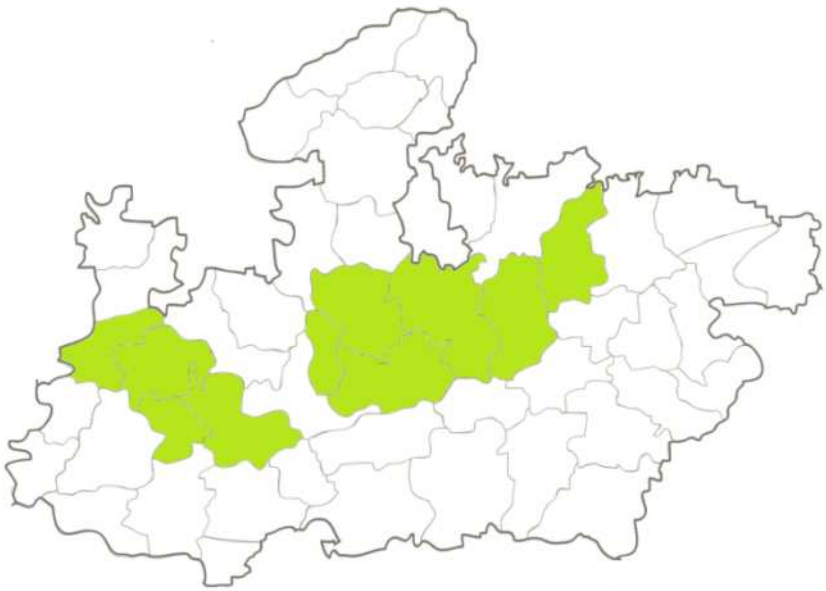

Fig 7 Soybean- Chickpea Crop Zone of Madhya Pradesh

Table 6: Cropping pattern of Soybean-Chickpea crop zone of Madhya Pradesh

(lakh ha)

Districts	Net cropped area	Gross cropped area	Major Kharif crops		Major Rabi crops	
			Soybean	Other	Wheat	Chickpea
Sagar	5.47	9.10	3.54 (65)	0.55 Urid bean (10)	2.44 (45)	1.43 [12] (26)
Vidisha	5.33	9.46	3.53 (63)	0.89 Urid bean (17)	3.07 (53)	1.31 [20] (25)
Ujjain	5.05	9.04	4.73 (95)	-	2.47 (49)	1.07 [29] (21)
Damoh	3.18	5.48	0.92 (29)	0.67 rice (21)	0.95 (30)	1.59 [17] (50)
Narsinghpur	3.10	4.82	0.54 (17)	0.60 S. Cane (23)	1.03 (33)	0.83 [18] (27)
Indore	2.52	4.68	2.32 (92)	-	1.19 (47)	0.63 [17] (25)
Bhopal	1.31	2.34	0.96 (64)	-	0.90 (59)	0.21 [22] (14)
Dewas	4.04	7.40	3.50 (87)	-	1.82 (45)	1.29 [12] (32)
Agar	1.74	2.88	1.44 (81)	0.08 Maize (06)	0.39 (22)	0.27 [28] (15)
Panna	2.57	3.83	0.63 (25)	0.32 Sesame (12)	0.76 (30)	1.83 [09] (33)
Ratlam	3.36	5.48	2.50 (74)	0.35 Maize (10)	1.14 (34)	0.51 [18] (15)
Total	37.67	64.51	24.43 (65)	3.46 (09)	16.16 (43)	9.97 (25)

(Figures in parentheses shows percentage to netsown area and figures in [ ] shows the coefficient of variation)

Mustard-wheat crop zone:

The total net cropped area of this crop zone is 10.24 lakh ha (Table 7). This zone is consists of four districts (Fig-8) viz., BHind, Moorena, Gwalior and Datia. The cropped area during kharif season in Bhind, Gwalior and Datia districts are negligible. In Morena district permillet is grown over 42 per cent of net cropped area and in Gwalior district rice is grown over 27 per cent of the net cropped area. During rabi season mustard is well established crop of this zone. The total area under mustard in this zone is 3.52 lakh ha. The percentage of area under mustard to net cropped area during rabi season was highest in Moorena and Bhind (43%), followed by Gwalior (23%), and Datia (17%). During Rabi season wheat is grown over an area of 5.07 lakh ha. The percentage coverage under wheat was highest for Datia (70%), followed by Gwalior (54%), and moorena (45%). The soils of this crop zone are mainly Alluvial with annual average rainfall of less than 800 mm.

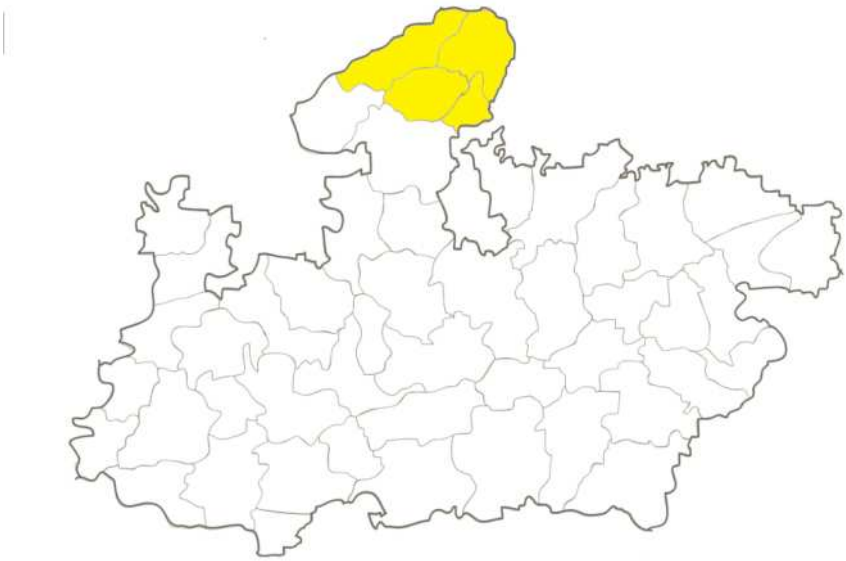

Fig 8 Mustard-wheat Crop Zone of Madhya Pradesh

Table 7: Cropping pattern of Mustard-wheat crop zone of Madhya Pradesh

(lakh ha)

Districts	Net cropped area	Gross cropped area	Major Kharif crops		Major Rabi crops	
			Pearlmillet	Seasme	Wheat	Mustard
Bhind	3.39	4.04	0.38 (11)	0.27 (08)	1.27 (38)	1.53 (45)
Moorena	2.70	3.97	1.14 (42)	-	1.22 (45)	1.16 (43)
Gwalior	2.08	2.79	0.16 Rice (27)	0.09 (04)	1.13 (54)	0.48 (23)
Datia	2.07	2.80	0.16 (08)	0.31 (15)	1.45 (70)	0.35 (17)
Total	10.24	13.60	2.33 (23)	0.67 (07)	5.07 (50)	3.52 (34)

(Figures in parentheses shows percentage to netsown area)

Cotton-Wheat crop zone:

The cotton is well established crop of this zone since last six decades and grown over an area of 3 lakh ha (Table 8). This zone is consisting of Khargone, Khandwa and Burahanpur districts (Fig-9) with 10.24 lakh ha of net cropped area. In Khargone (49%), Burahnpur (38%) and Badwani (29%) are the main cotton growing area of the state. The other important crops during kharif season are soybean and maize and these crops are grown over 16 to 21 per cent of the net cropped area of the zone respectively. During rabi season the wheat is an important crop and cultivated over 2.0 lakh ha area. These districts are in western part of the Madhya Pradesh and cotton and wheat is well established crops in the cropping pattern. Soils of this zone are deep medium black in nature and annual average rainfall is in the range of 800-1000 mm.

Fig 9 Cotton-wheat Crop Zone of Madhya Pradesh

Table 8: Cropping pattern of Cotton-wheta crop zone of Madhya Pradesh

(lakh ha)

Districts	Net cropped area	Gross cropped area	Major Kharif crops		Major Rabi crops	
			Cotton	Other	Wheat	Chickpea
Khargone	4.00	5.81	1.96 (49)	0.64 Soybean (16)	1.45 (36)	0.25 (06)
Badwani	2.30	2.97	0.66 (29)	0.48 Maize (21)	0.48 (21)	-
Burahnpur	1.03	1.27	0.38 (38)	0.21 Soybean (21)	0.10 (10)	-
Total	7.33	10.05	3.00 (41)	1.33 (18)	2.03 (28)	0.25 (03)

(Figures in parentheses shows percentage to netsown area)

In the proposed crop zones the maximum area is under Soybean-Wheat crop zone (65.32 lakh ha) with maximum number of districts (19). Under soybean -chickpea crop zone the area was 37.67 lakh ha with coverage of eleven districts. In rice-wheat crop zone the area is only 18.58 lakh ha with seven districts while in rice crop zone there are six districts with coverage of area of 11.87 lakh ha. Under mustard-wheat crop zone and cotton-wheat zone the net cropped area was 10.24 lakh ha and 7.33 lakh ha with four and three districts respectively.

The wheat crop is cultivated over 63 lakh ha area in Madhya Pradesh and main wheat producing area

(43.10%) is confined to soybean-wheat crop zone (Table 9). This crop is dominating crop in five crop zones out of six deginated crop zones. Soybean crop is grown over 62 lakh ha area and mainly confined to soybean -wheat and soybean chickpea crop zones. The chickpea is cultivated over 23 lakh ha area and only soybean-chickpea crop zone accounts for 44 per cent of the chickpea area. The rice is grown over 21 lakh ha area and about 70 per cent of the rice area is confined to rice and rice -wheat crop zones. The 57 per cent of the mustrard area is confined to four districts of the northern part of the state and 56 per cent of the cotton area is confined to three districts of western part of the state.

Table 9: The crop wise coverage of cultivated area in different crop zones

(lakh ha)

Districts	Net cropped area	Gross cropped area	Major Kharif crops		Major Rabi crops	
			Cotton	Other	Wheat	Chickpea
Khargone	4.00	5.81	1.96 (49)	0.64 Soybean (16)	1.45 (36)	0.25 (06)
Badwani	2.30	2.97	0.66 (29)	0.48 Maize (21)	0.48 (21)	-
Burahnpur	1.03	1.27	0.38 (38)	0.21 Soybean (21)	0.10 (10)	-
Total	7.33	10.05	3.00 (41)	1.33 (18)	2.03 (28)	0.25 (03)

The higheast acreage of rice is confined to Balaghat district (2.62 lakh ha) which account for 96 per cent of the net cropped area of the district. The Vidisha districts stands first with respect to area under wheat with coverage of 3.07 lakh ha, which accounts for 73 per cent of the net cropped area of the districts. In soybean crop, Ujjain districts stand on the top with 4.73 lakh ha of area which accounts for 95 per cent of the net cropped area of the districts. For chickpea, Panna districts are on the top with area allocation of 1.83 lakh ha, which accounts for 33 per cent of the net cropped area of the districts. Bhind district is on the top with respect to mustard production allocating an area of 1.3 lakh ha which is 45 per cent of the net cropped area of the district. Cotton is mainly grown in Nimad region of the state and Khargone is the major cotton growing district with area allocation of 1.96 lakh ha which accounts for 49 per cent of the net cropped area.

After 55 years of the agricultural development in Madhya Pradesh the new proposed crop zones will be useful for policy makers for formulation of cropped based agricultural development policies. This will also be helpful in research in deciding research priorities of different Zonal and regional research stations. For Krishi Vigyan Kendra the proposed crop zones will be helpful in the planning of dissimination of cropped based technologies through demonstration and tranings and this will be more helpful in planning for crop diversification in different districts of the state for enhancing farmers' income. For secondary agriculture the proposed crop zones will be guiding tool for district wise planning and identification of product based growth centers. For preparation of contingent crop plan this deginated crop zones will be helpful in preparation of mitigating strategies in the scenario of climate change.

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An investigation on flavonoids content in some new soybean varieties influenced by enhancement processing

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Abstract

Soybean seeds contain the most important pharmaceutical compounds flavonoids in the range from 545-700mg/100g and have medicinal importance for human health which is affected by agricultural practices and cultivars. Total flavonoids are available in detoxified full fat soy flour as supplementary form which acts as health beneficial phytochemicals dietary. Processed soybean enhanced the total flavonoids content from 7.97 to 67.72% significantly in soybean seeds ranged from 600-965mg/100g respectably. Wherever in sprouted seeds total flavonoids contents decreased significantly. Autoclaved seeds T_3 treatment cooking for 30min full fat soy flour applicable in diet as functional food supplement.

Keywords: Flavonoids, Thermal Processing Soybean, Functional Food.

Soybean (*Glycine max* (L.) Merrill.) legume crop is known as miracle golden bean has relatively high protein content (40%) and good quality (20%) oils with adequate amount of carbohydrates (30%). Pharmaceutical value of full fat soy flour can be increased by processing technology. Processed full fat soy flour can be used for protein fortification programmers as source of good quality proteins supplemented soyfoods. Antinutritional phytochemical trypsin inhibitors and lypoxygenase in soybean seeds mainly contains in the 11S globulins and 7S globulins proteins (*Ogawa et al., 1993*). Various processing methods have been used to increase the utilization as food of soybean. Several limiting chemicals in the soybean seeds inactivated through cooking process (*Astwood et al., 1996*). Insufficient cooking at low temperature may not completely detoxify the soybean seeds (*Franz, 1991*). Thermal processing improves the nutritional value of soybean by reducing trypsin inhibitor activity with increase availability of proteins (*Liener, 1989*). Intake of soybean flavonoids in the daily diet lowers the risks of certain radical related pathophysiology which has antimicrobial potential, antioxidant and antimutaganic activities (*Duthie et al., 2000*). Generally FDA recommended soybean proteins (25g per day) which contain 100mg isoflavones contents for adult which can affect the level of such phenol compounds by processing. Naturally occurring phenolic compounds like total flavonoids have health promoting properties because these secondary metabolites work as ROS-scavenging. Few studies carried out on effect of autoclaved temperature with time of cooking interval as well as sprouting process for total flavonoids contents level in soybean seeds. The aim of this study was to determine of total flavonoids contents in improved cultivars of soybean and effect of autoclave temperature with interval of processing time as well as hydroponic sprouted seeds.

Materials and Method

Seeds of five popular soybean cultivars as JS20-29 (V_1), JS20-34 (V_2), JS97-52 (V_3), JS93-05 (V_4) and JS95-60 (V_5) were collected from Soybean

Research Unit (BSP), JNKVV, Jabalpur (M.P.). Treatments: T0 control, T1 autoclaved for 10min at 121^0C±1 on 15 psi pressure, T2 autoclaved for 20min at 121^0C ±1 on 15 psi pressure, T3 autoclaved for 30min at 121^0C±1 on 15 psi pressure and T4 BOD sprouted seeds at 25^0C ±2 for period 96 hrs.

Determination of total flavonoids

The total flavonoids of extracts were assayed according to the method described by Chang *et al*. (2002).The 500mg of each sample was kept in 95% ethanol for 24hr than filtered and volume made up 25 ml with 80% ethanol. The aliquot 0.5 ml sample of extract was mixed with 1.5 ml of 95% ethanol than after 5min 0.1ml of 10% aluminum chloride were added and standing for 5 min prior mixed with 0.1 ml of 1M potassium acetate and 2.5 ml of distilled water. The tubes were incubated at room temperature for 30 min and absorbances of the solution were determined at 415 nm by UV-Spectrophotometer. The calibration curve was established using quercitin (0.2-1.0 mg/ml) as the standard sample, with the help R^2= 0.9998 correlation coefficient. Results of total flavonoids content in the soybean seeds extracts are expressed as milligram / 100g dry weight. The Dunnett's t test was used for multifactor comparison in between the four treatments as triplicates mean value for among five cultivars seeds. The table value 3.02 recommended at 8 degree of freedom were calculated as statistical significant.

Results and Discussion

With regard to the total flavonoids content cultivars V_4 seeds exhibited the highest level (701.29 mg/100g) of total flavonoids followed by cultivar V1 (621.80 mg/100g) and V5 (591.42mg/100g) (Lee *et al*., 2008 ; Lee *et al.*, 2010). The treatment T1 increased significantly of total flavonoids in varieties V1 (639.70 mg/100g), V2(574.35mg/100g) and V3(640.95mg/100g) compared to control. However, treatment T2 and T3 improved highly significant amount of total flavonoids among the cultivars as compared with control but T3 treatment is superior than others which seems to be most important for pharmaceutical utility because of the total flavonoids content having highest in this treatment (Fig.1).The hydroponic sprouted seeds treatment T4 reduces significantly all the five cultivars seeds. The confidence interval level range at high temperature for 30 min autoclaved seeds, variety V2 improved at least 354.331 to 374.009 mg/100g of total flavonoids content rather than variety V4 (253.714 to 274.026mg/ 100g) and variety V5 increased at least 334.975 to 343.425 mg/100g of total flavonoids content respectively. Natural phytochemical total flavonoids content significantly increased in processed seeds of soybean, which which added the pharmaceutical, medicinal and nutritional value. The significantly improvement computed as increased or decreased percentages of d value for treatments performance to all varieties is given in (Fig.2.) Treatment T1 in autoclaved seeds the flavonoids contents increased from 2.88 to 17.56% with respect to control accepts cultivar V5. For treatment T2 autoclaved seeds in all five varieties total flavonoids contents increases from 4.95 to 38.24% respectively. For treatment T3 autoclaved cooked seeds were found superior in all five varieties increases from 7.97 to 67.72% with respect to control. However, treatment T4 sprouted seeds in all five cultivars decreased from 3.96 to 22.84% respectively.

Total flavonoids content is most heat stable at high temperature under high pressure in moist steam which reduces oxidative stress assay in cancer, heart and brain diseases. Treatment T3 with 30 min cooking time at 1200C autoclaved seeds were found superior in total flavonoids content rather than other treatments and leached out others total phenolics compounds which might be toxic in soybean seeds.

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Table1: Total flavonoids content of soybean cultivars and effect of processing treatments mg/100g

Cul/Tr	$\bar{Y}$ -	$\bar{Y}0$	d value	't' value	S^2	SEd	SEm	CD%	Confidence interval level		
V1T1	639.70	-621.80	17.900	2.399	83.457	7.459	5.274	17.230	-4.626	to	40.426
V1T2	652.60	-621.80	30.800	4.129	83.457	7.459	5.274	17.230	8.274	to	53.326
V1T3	671.33	-621.80	49.530	6.640	83.457	7.459	5.274	17.230	27.004	to	72.056
V1T4	497.36	-621.80	-124.440	16.683	83.457	7.459	5.274	17.230	-146.966	to	-101.914
V2T1	574.35	-537.73	36.620	11.240	15.527	3.258	2.304	7.527	26.781	to	46.459
V2T2	630.96	-537.73	93.230	28.610	15.527	3.258	2.304	7.527	83.391	to	103.069
V2T3	901.90	-537.73	364.170	111.758	15.527	3.258	2.304	7.527	354.331	to	374.009
V2T4	439.92	-537.73	-97.810	30.015	15.527	3.258	2.304	7.527	-107.649	to	-87.971
V3T1	640.95	-545.22	95.730	41.376	8.028	2.313	1.635	5.344	88.745	to	102.715
V3T2	753.74	-545.22	208.520	90.128	8.028	2.313	1.635	5.344	201.535	to	215.505
V3T3	720.86	-545.22	175.640	75.916	8.028	2.313	1.635	5.344	168.655	to	182.625
V3T4	523.58	-545.22	-21.640	9.355	8.028	2.313	1.635	5.344	-28.625	to	-14.655
V4T1	705.46	-701.29	4.170	1.237	16.967	3.363	2.378	7.769	-5.986	to	14.326
V4T2	727.10	-701.29	25.810	7.672	16.967	3.363	2.378	7.769	15.654	to	35.966
V4T3	965.16	-701.29	263.870	78.457	16.967	3.363	2.378	7.769	253.714	to	274.026
V4T4	541.06	-701.29	-160.230	47.644	16.967	3.363	2.378	7.769	-170.386	to	-150.074
V5T1	524.83	-591.42	-66.590	47.590	2.936	1.399	0.989	3.231	-70.815	to	-62.365
V5T2	650.10	-591.42	58.680	41.945	2.936	1.399	0.989	3.231	54.455	to	62.905
V5T3	930.62	-591.42	339.200	242.448	2.936	1.399	0.989	3.231	334.975	to	343.425
V5T4	530.65	-591.42	-60.770	43.432	2.936	1.399	0.989	3.231	-64.995	to	-56.545

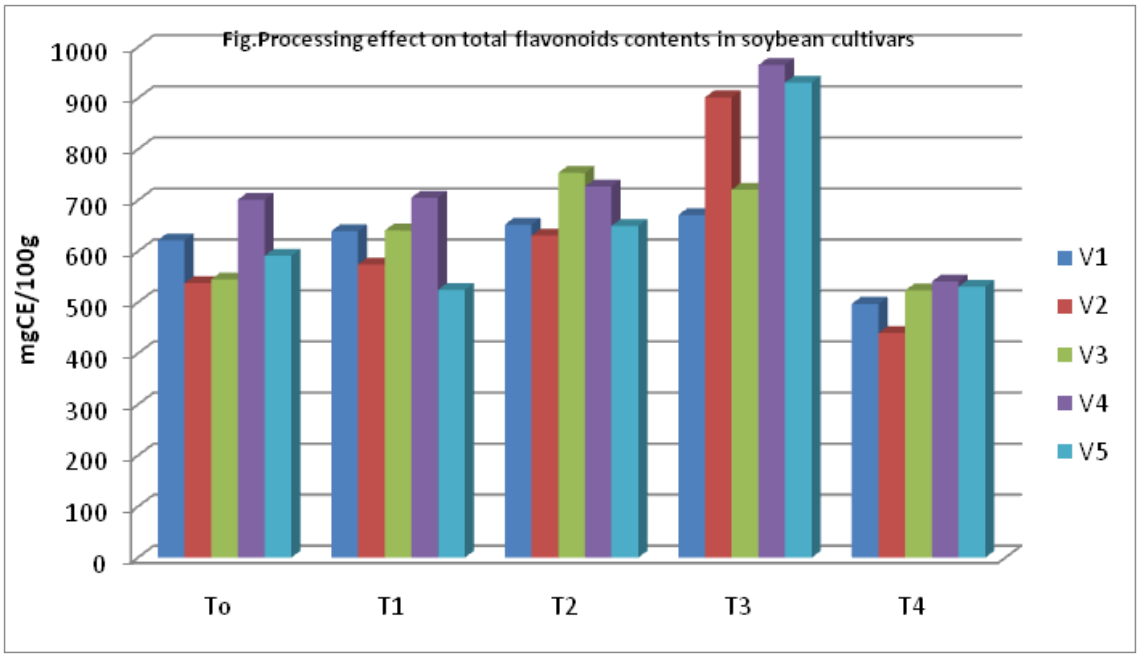
Fig.Processing effect on total flavonoids contents in soybean cultivars
mgCE/100g
1000
900
800
700
600
500
400
300
200
100
0
To
T1
T2
T3
T4
V1
V2
V3
V4
V5

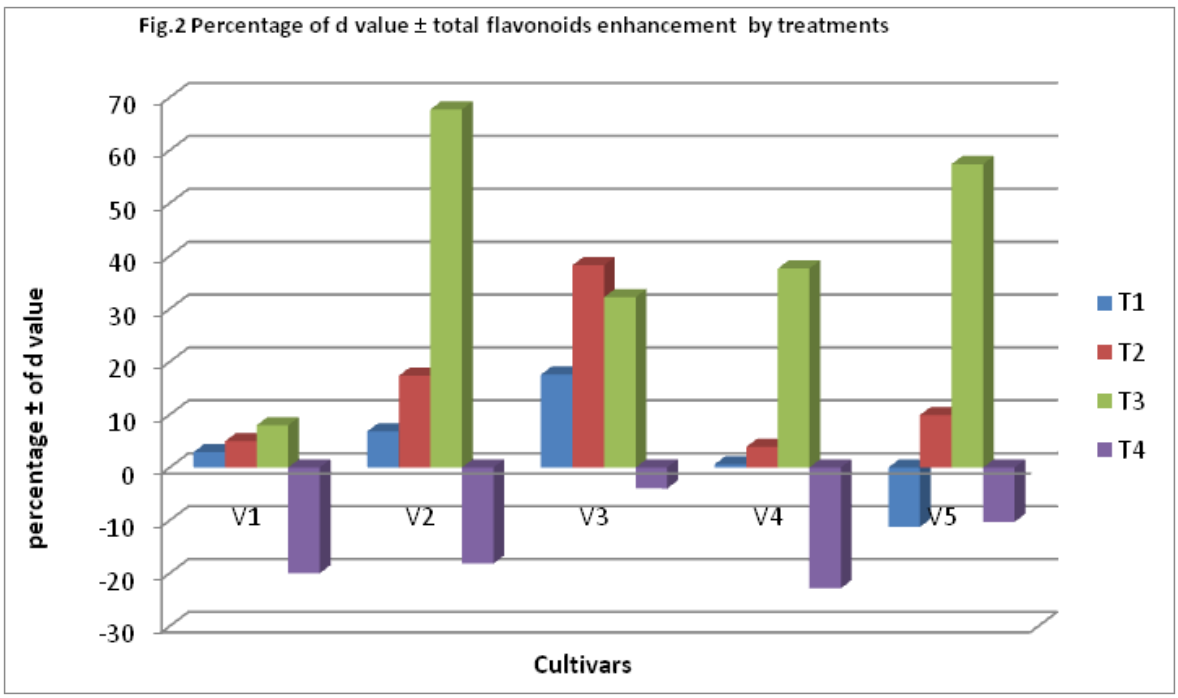
Fig.2 Percentage of d value ± total flavonoids enhancement by treatments
percentage ± of d value
70
60
50
40
30
20
10
0
-10
-20
-30
V1
V2
V3
V4
V5
Cultivars
T1
T2
T3
T4

STATEMENT OF OWNERSHIP
FORM IV
(See Rule 8)

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I, Dhirendra Khare, hereby declare that the particulars given above are true to the best of my knowledge and belief.

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