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Short Communication

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Nutrient management in niger

H.S. Patil*, M.R. Deshmukh and **A.R.G. Ranganatha**
Project Co-ordinating Unit (Sesame and Niger) ICAR
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482004 (MP)
*College of Agriculture, MPKV, Dhule 424 004 (Maharashtra)

Abstract

Niger [*Guizotia abyssinica* (Lf.) Cass] being a tropical and subtropical crop mainly grown in Orissa, Maharashtra, Madhya Pradesh, Karnataka and also in other states area mostly confined in degraded lands with resource poor farming. Though, niger is widely grown in poor and degraded soils with a very little attention. It has showed promising response to application of fertilizers, bio-fertilizers and organic manures at varying locations. Based on the review of the available literature pertaining to nutrient management throughout the country, it responded to application of 20 to 60 kg N, 30 to 67.5 kg P_2O_5, 10 to 30 kg K_2O, 15 to 40 kg S, 15 kg $ZnSO_4$/ha, 5 t FYM/ha and inoculation of *Azospirillum* or *Azotobacter* in seeds or soil depending upon the crop varieties and agroclimatic conditions.

रामतिल [*गुजोटिया एबीसीनिका* (एल.एफ.) कार] उष्णकटीबंधीय एवं समउष्णकटिबंधीय फसल है जो कि भारतवर्ष में मुख्यतः उडीसा, महाराष्ट्र, मध्यप्रदेश, कर्नाटक तथा अन्य प्रान्तों में बेकार (बिगर्ड भूमि में संसाधन विहिन खेती की स्थिती में होता है। यद्यपि रामतिल की फसल को बडे पैमाने पर बेकार (बिगडी हुयी) बंजर भूमियों अत्यंत कम लागत तथा आदानों के देते हुये ऊगायी जाती है। भिन्न-भिन्न शस्यजलवायु क्षेत्रों में रासायनिक उर्वरकों के, जैवउर्वरकों तथा कार्बनिक खादों के प्रयोग से फसल में लाभ होता पाया गया हैं। पोषण-प्रबंधन के ऊपर देश में उपलब्ध साहित्य एवं समीक्षा के आधार प रासायनिक उर्वरक यथा 20 से 60 किलोग्राम नत्रजन, 30 से 67.5 किलोग्राम स्फुर, 20 से 60 किलोग्राम पोटाश, 15 से 40 किलोग्राम सल्फर, 15 किलोग्राम जिंक सल्फेट प्रति हेक्टेयर के मानसे प्रयो करने एवं 5 टन गोबर की खाद/हेक्टेयर तथा जैव उर्वरकों र एजोस्पिरीलम एवं एजेटोबेक्टर द्वारा बीजों को उपचारित करना अथवा इन जैवउर्वरकों भूमिउपचार द्वारा फसलों की उन्नत किस्मों अथ शस्यजलवाय क्षेत्रों आधारित लाभ होना ज्ञात होता है।

Keywords: Nutrient management, NPK organic manures, integrated nutrient management and bio-fertilizers

Niger [*Guizotia abyssinica* (L.f.) Cass] is one of the oilseed crop, grown in India in about 4.48 lakh hectare. Orissa, Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh and Jharkhand are the leading states for cultivation of niger, while it also occupies a considerable area particularly in hilly regions of Rajasthan, Uttar Pradesh, Gujrat, Tamil Nadu, Assam and other north hills states. Its production is around 1.52 lakh tonnes annually. The acreage and production of niger always fluctuates depending on the rainfall pattern's of the growing regions, since it is grown as rainfed crop under resource poor and risk prone situations. Consequently, its productivity is also fluctuating depending on the prevailing weather conditions during the crop season. Generally, it is considered to be a poor man crop widely grown on poor lands of hilly regions led by tribal farmers. Mostly the traditional varieties are grown with least attention and no or limited use of fertilizers and other agro-chemicals owing to low crop yield. Research evidences have promised to step up its productivity to a great extent by growing improved crop varieties with the use of fertilizers. Niger is grown in heterogenous agro-climatic conditions, hence it responded variably to application of nutrients. These research achievements are critically reviewed in this paper to identify the appropriate nutrient management for improving the productivity of niger.

Effect of nitrogen fertilization

While summarizing the response of different niger lines to N application, Yantasath (1975) indicated that Indian lines of niger showed faster vegetative development with the application of N resulting in early maturity than Ethiopian lines. Bhattacharya (1973) also found significant increase in seed yield of niger due to N application upto 45 kg/ha on lateritic soils of West Bengal. With the agreement of these views, Bhosale and Patil (1977) recommended that application of 25 kg N/ha for optimum seed yield in laetrite soils of Dapoli, Konkan region of Maharashtra. But Singh et al. (1980) found its optimum

seed yield with 20 kg N/ha in sandy soil of Jabalpur (Madhya Pradesh). However, application of 40 kg N/ha in two equal splits first half as basal and rest by topdressing at one month old crop proved to be most effective to increase seed yields at Igatpuri, Maharashtra (Patil and Patil 1979; Patil and Patil 1981).

While analyzing the effect of N application on growth parameters of niger cv. Selection-71 as influenced by N application, Kachapur and Radder (1983a) recorded corresponding increase in total dry matter, leaf area, net assimilation rate, crop growth rate and relative growth rate markedly upto 50 kg N/ha at Raichur (Karnataka). Further, Kachapur and Radder (1983b) recorded maximum seed yield with 50 kg N/ha. On the contrary, Mishra et al. (1983) observed positive response of niger cv GA-24 to N application upto 20 kg N/ha only in acid clay loam soils of Semiliguda (Orissa).

According to Singh et al. (1986) a fertilizer dose of 40 kg N/ha was found optimum for seed yield of niger at Jabalpur (Madhya Pradesh) under rainfed conditions. With agreement to Singh et al. (1986) studies, Sahu et al. (1988) recorded higher seed yields upto 45 kg N/ha at Semiliguda (Orissa). Similarly, from Navsari, Gujrat, Trivedi et al. (1988) reported that nitrogen fertilization significantly increased the plant height, leaf area, leaf area index, dry matter/plant, number of capitula/plant and eventually stalk, seed and oil yield of niger with the corresponding increase in nitrogen level upto 40 kg N/ha. These results are in close conformity with the findings of Paikary et al. (1990) from Semiliguda (Orissa) and Singh et al. (1990) from Jabalpur (Madhya Pradesh) under rainfed conditions. Singh et al. (1991) further reported significant increase in seed yield of winter niger cv N-36 upto 60 kg N/ha under irrigated conditions in sandy loam soils at Jabalpur. Although application of 60 kg N/ha gave the highest seed yield at Navsari (Gujrat), the enhancement in seed and oil yield was significant only upto 40 kg N/ha (Trivedi and Ahlawat, 1991a&b and 1993). A nitrogen dose of 40 kg/ha has been reported to be optimum as well as economical for obtaining higher seed yield at Bhavanisagar, Orissa (Patro et al. 1996).

While reviewing the agronomy of niger cultivation in India, Getinet and Sharma (1996) emphasized that a dose of 20 kg N/ha was enough for this crop in Madhya Pradesh, Orissa and Bihar. However, Tiwari and Tomar (1997) found significant increase in seed and straw yields of niger up to 60 kg N/ha in soils of Tikamgarh (Madhya Pradesh). According to Padhi and Sahoo (1999) niger responded favourably up to 30 kg N/ha under varying dates of sowing at Udaigiri (Orissa). Patel (1999) also found better yield of niger with application of 30 kg N/ha. Also indicated that application of N in two splits i.e. half dose each as basal and topdressing at 30 DAS proved to be beneficial for higher yield of niger. Singh et al. (2002) found significant increase in seed and biological yield of niger upto 40 kg N/ha but stalk yield and harvest index showed significant increase only upto 20 kg N/ha at Faizabad (Uttar Pradesh). According to Bhadoria (2003) timely sown crop on onset of monsoon responded to N application upto 40 kg N/ha at Dahod (Gujrat). However, Patil et al. (2006) found positive effect of N application up to 60 kg N/ha at Dapoli (Maharashtra). On the contrary, Thakur et al. (2005) reported application of 20 kg N/ha optimum to niger at Chhindwara (Madhya Pradesh).

Based on the foregoing facts it could be concluded that niger responded significantly to varying rates depending on the soil types, crop varieties, irrigation and sowing season from throughout the country.

Effect of phosphorus fertilization

Being an oilseed crop, niger responded to application P-fertilizer invariably in different parts of the country. According to Bhattacharya (1973), increasing the rates of P-application increased seed yield upto 67.5 kg P_2O_5/ha on lateritic acid soils of West Bengal. However, Bhosale and Patil (1977) found response of niger upto 37 kg/ha only at Dapoli (Maharashtra). Similarly significant increase in seed yield of niger upto 40 kg P/ha was observed by Kachapur et al. (1979) from Raichur (Karnataka) and by Mishra et al. (1983) from Semiliguda (Orissa). Further, strongly emphasized that response of niger to P application was remarkable mainly in P deficient soils. Aggreing to these findings, Paikary et al. (1990) reported that phosphorus fertilization enhanced the seed yield of all niger varieties during kharif season in P deficient soils of Semiliguda (Orissa). However, phosphorus application had no effect on growth, yield attributes and seed and oil yield of niger in south Gujrat (Trivedi 1988, Trivedi and Ahlawat 1993). Significant increase in seed yield was observed upto 30 kg P_2O_5/ha from winter niger under irrigated condition at Jabalpur, Madhya Pradesh (Singh et al. (1991) and at Bilaspur, Chhattisgarh (Patel 1999).

It could be concluded from the foregoing points that response of niger to P application also varied like N application according to soil types, sowing season, crop varieties and irrigation.

Effect of combined use of N, P

It is noteworthy that a single element may not be enough to harvest good yield. The judicious combination of two

or more nutrients depending on the site-specific nutrient status of soil and demand of crop/varieties may have considerable role on growth and yield of crops.

Singh and Verma (1975) indicated that application of 20 kg N + 40 kg P_2O_5/ha gave higher seed yield than application of a single nutrient or combination of lesser dose of both at Jabalpur (Madhya Pradesh). Singh et al. (1990) also recorded that application of 20 kg N + 20 kg P_2O_5/ha proved to optimum dose for enhanced seed yield of winter season niger at Jabalpur (Madhya Pradesh). However, Paikary et al. (1997) found significantly higher seed yield from niger grown during pre-winter (rabi) than the other combinations at Semiliguda (Orissa). Combined use of all the major nutrients (N, P and K) has been tested and exhibited positive effects on growth, seed yields and economics of niger cultivation. Application of 40 kg N + 20 kg P_2O_5 + 10 kg K_2O/ha at Jorhat, Assam (Thakuria and Gogoi 1992) and 40 kg N + 20 kg P_2O_5 + 20 kg K_2O/ha at Chhindwara, Madhya Pradesh (Upadhyay and Paradkar 1992) was found to be optimum and remunerative fertilizer dose for niger under rainfed conditions. A fertilizer schedule of 30 kg N + 15 kg P_2O_5 + 15 kg K_2O/ha led to record the highest seed yield of niger in sandy loam soils of Gossaigaon, Assam (Paul et al. 1993).

According to Sharma and Kewat (1994) application of 40 kg N + 40 kg P_2O_5/ha significantly increased the seed yield of niger mainly due to improvement in yield attributes at Jabalpur (Mahdya Pradesh). Similar results have been reported by Thakur et al. (2000) from Chhindwara of the same state. However, Kulmi and Soni (1995) found that a dose of 30:30:15-N:P:K kg/ha was promising to harvest the maximum yield of niger in Sidhi district of Madhya Pradesh. Later on, Agrawal et al. (1996) emphasized that application of 40 kg N + 40 kg P_2O_5 + 20 kg K_2O/ha found to be optimum fertilizer dose for winter niger under irrigated condition at Jabalpur (Madhya Pradesh) mainly this results in improvement in number of capitulae/plant and seeds/capitulam. A fertilizer dose of 30 kg N+15 kg P_2O_5+15 kg K_2O/ha proved to be economically viable to increase niger yield under rainfed condition of north bank plains agro-climatic zone of Assam (Baishya and Thakur 1997).

Effect of combined use of N, P, K and S fertilization

Application of secondary nutrients particular S have been reported to be useful in niger cultivation. While summarizing the nutrient management work in niger at different locations of the country (DOR, 2002), balanced fertilization of 30 kg N + 30 kg P_2O_5 + 15 kg K_2O + 15 kg S/ha was found beneficial. Besides this application of 15 kg $ZnSO_4$/ha was also found promising in zinc deficient areas of the country. Nandini Devi et al. (2000) emphasized that application of 60:30:30:40-N:P:K:S kg/ha proved to be the best fertilizer application schedule for maximizing the seed and oil yield of niger in the lateritic belts of West Bengal.

From Igatpuri, Maharashtra, Patil et al. (2006) emphasized that the application of all major nutrients (40 kg N + 40 kg P_2O_5 + 20 kg K_2O/ha) along with 20 kg S/ha proved to be optimum dose for yield maximization of kharif niger under rainfed condition.

According to Patil and Ballal (1964) individual nutrients (N, P and K) application did not give any increase in the yield of seed and straw of niger at Poona (Maharahstra), but combined application of N with P was found to be effective in increasing the yield. This beneficial effect was still greater under balanced fertilization with N, P and K. The combined application of N and P was beneficial in increasing the oil output also.

Mamatha et al. (1994) reported that the oil content in niger seed decreased with increased nitrogen application, while it increased with phosphorus and sulphur application. The seed and oil yield was maximum with application of 40 kg N + 80 kg P_2O_5 and spraying of 25 ppm S/ha at Bangalore (Karnataka).

Effect of organic manures

In early reports application of 5 t FYM/ha significantly increased the seed yield of niger over no FYM at Igatpuri (Maharastra), particularly when sowing was done in rows and weeds were effectively controlled (Patil and Joshi 1978; Patil 1979). From the results of 3-years experimentation on niger at Dapoli (Maharashtra), Bhosale and Patil (1977) concluded that niger varieties viz., local Nagpur-5 and No.-123 gave the highest seed yield with application of 25 kg/ha each of N and P along with 4 t FYM/ha. According to Gentinet and Sharma (1996), a dose of 20 kg N + 40 kg P_2O_5 + 4 t FYM/ha was suitable for enhanced seed yield in Maharashtra. While application of 10 kg N + 20 kg P_2O_5 + 5 t FYM/ha proved to be an efficient nutrient management for this crop in Andhra Pradesh. From the results of multilocation studies on integrated nutrient management Jain et al. (1999) concluded that application of recommended dose of NPK through fertilizers in conjunction with 5 t FYM/ha gave the highest seed yield of niger at all the locations viz., Chhindwara (Madhya Pradesh), Igatpuri (Maharashtra), Semiliguda (Orissa) and Kanke (Jharkhand).

While compiling the results of INM in niger, an application of 20 kg N + 20 kg P_2O_5 + 4 t FYM/ha was found quite remunerative in Maharashtra state while 10 kg N + 20 kg P_2O_5 + 5 t FYM/ha in Andhra Pradesh and recommended NPK + 5 t FYM/ha was efficient INM for niger in Madhya Pradesh State as well as for Orissa (DOR 2002).

Use of bio-fertilizers

Halder et al. (1997) reported that seed inoculation with *Azotobactor* significantly gave higher seed yield of niger than un-inoculated one during rainy season at Semiliguda (Orissa). Like wise, Sawarkar (1997) found that soil inoculation of *Azospirillum* 2 kg/ha + 10 kg N/ha was appropriate for achieving higher seed yield of niger under rainfed conditions of Chhindwara (Madhya Pradesh).

The optimum dose of nitrogen application for niger crop indicates that application of 40 kg N/ha along with seed inoculation through *Azotobactor* at Semiliguda, Orissa and 10 kg N/ha with seed inoculation with *Azospirillum* at Chhindwara were appropriate low-cost nutrient management for most remunerative seed yield (DOR 2002).

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Genetic evaluation in rice hybrid for yield and yield attributing characters

Ajay Jaiswal, Ratnesh Singh, Yogesh Kumar and **Dhananjay Kathal***
Department of Genetics & Plant Breeding
Allahabad Agricultural Institute-Deemed University Allahabad 211 007 (UP)
*JNKVV, Jabalpur 482004 (MP)

Abstract

The present investigation consists of 23 rice hybrids provided by UPCAR Lucknow, during *kharif* 2007 at Allahabad Agricultural Institute-Deemed University, Allahabad. The experiment was conducted in RBD having three replications. The data were recorded on 16 characters to study the variability, heritability, genetic advance and correlation coefficient analysis. The significant mean sum of squares for the characters, viz., plant height, days to 50% flowering, number of tillers/hill, flag leaf width, number of spikelets/panicle, number of grains/panicle, test weight, biological yield/plot and grain yield/plot under study. It indicates that three is ample scope for selection of promising line from present gene pole for yield improvement. Based on the mean performance among 23 hybrids R 19, R 18, R 12 and R 06 were found to the best genotypes for grain yield/plot. High to moderate estimates of GCV and PCV were exhibited by grain yield/ plot, test weight and biological yield/plot indicating that these traits could be used as selection indices for crop improvement. Test weight, number of spikelets/panicle and biological yield per plot exhibited high values for heritability (broad sense) coupled with high genetic advance as percent of mean, suggesting pre dominance of additive gene action in the expression of these traits. Correlation coefficient analysis depicted that the entire yield contributing characters was positively correlated with grain per plot except spikelets fertility percentage.

प्रस्तुत अनुसंधान उत्तरप्रदेश कौसिल ऑफ एग्रीकल्चर द्वारा प्रदत्त 23 संकर धानों पर इलाहाबाद कृषि संस्थान-डीम्स विश्वविद्यालय खरीफ 2007 में संपन्न किया गया है। प्रयोग तीन पुनरावृत्तियो रेन्डमाइज ब्लाक डिजाइन में किया गया है। आंकडों का विश्लेषा 16 गुणों पर परिवर्तनशीलता, वंशागतित्व, आनुवांशिक प्रगति और सहसंबंध गुणांक की जांच के लिये किया गया है। पौधे की ऊँचाई 50 प्रतिशत पौधों की पुष्पन अवधि, कल्लों की संख्या प्रति पौध, ध्वज पर्ण की चौडाई, प्रति बाली स्पाइकलेट की संख्या, दानों की संख्य प्रति बाली, टेस्ट बेट, जैविक उपज प्रति प्लाट और दानों की उप प्रति प्लाट आदि गुणों के लिये औसत वर्गों का योग सिग्नीफिकेंट पाया गया। प्रस्तत विश्लेषण यह इंगित करता है वर्तमान जीन पोल द्वार आशाजनक लाईन के चुनाव द्वारा उपज वृद्धि के क्षेत्र में अत्याधिक संभावनायें है। 23 संकर धानों में से आर. 19, आर. 18, आर. 12, एवं आर. 06 औसत प्रर्दशन के आधार दानों की उपज प्रति प्ल सर्वश्रेष्ठ पाये गये।

Keywords: Variability, heritability, genetic advance, correlation coefficient

Rice (*Oryza sativa* L.) is a plant of Asian origin. The earliest record of rice in the world comes from Nons Nok Tha in Thailand where it dates back to 3500BC. Oryza sativa, the rice grown in Indian and South East Asia is first metioned in Neolithic Chirand in North Bihar (2000-1300 BC) and some other places (Randhawa et al. 1980). .

Globally rice is cultivated on 154 million hectares with annual production of around 600 million tons and average productivity of 3.9 tons/ha (Viraktamath 2007). The genetic classification of rice plant belongs to genus Oryza of family (Poaceae). The genus includes 24 species of which 22 are wild and two viz., *Oryza sativa* L. and *O. glaberriana* are cultivated. All species are cultivated in Asia, America, Australia and Europe continents. The basic number (n) of chromosomes of the genus *Oryza sativa* is 12 (2n=24). The cultivated varieties of *O. sativa* are grouped into three subspecies Indica, Japonica and Javanica. Indica are grown throughout the tropical and subtropical regions.

Variability in genotypes for yield and yield component traits forms the basic factor to be considered while making selection. Heritability along with genetic advance may provide a clearer picture for selection of a particular trait. Yield is a complex character which depends upon number of yield components. Knowledge about association of yield components with each other and with yield will be useful in its improvement. Correlation studies indicate the magnitude of association between any two characters. If the number of characters more, it is essential to measure their contribution with the observed correlation. Correlation studies forms the basic for determining selection index thereby helping the plant breeder for crop improvement.

The success of hybrid rice mainly depends on the availability of stable cytoplasmic genetic male sterile lines, effective restorer lines that combine well with CMS lines for yield and its component traits. In view of the above perspectives the present study was under taken to estimate genetic variability among hybrids; to identify the best hybrid and to find the character association for different yield and yield contributing characters.

Material and methods

The present study was conducted on 23 rice hybrids provided by UPCAR Lucknow, during *kharif*, 2007.The experiment was carried out at the Field experimentation Center, Department of Genetics and Plant Breeding, Allahabad Agricultural Institute-Deemed University, Allhabad during *kharif*-2007. The experiment was laid out in Randomized Block Design (RBD) with three replications comprising 23 hybrids. Allhabad is situated at an elevation of 98 metre above the sea level. It is situated at 25.87^{0}N latitude and 81.5^{0}E latitude. Allhabad is located in the south eastern part of U.P. and has s subtropical climate with extremes of summers and winters. During the summer season, the temperature reaches up to 46-48^{0}C. Seeds were sown in seed bed on 22-06-2007. The 28 days old seedlings were transplanted in the main field on July 20, 21 and 22-07-2007 for mid early, medium, medium short and early duration.

The recommended dose of fertilizers @ 200:60:60 kg per ha (NPK) was applied. The full dose of phosphorous and potassium and half dose of nitrogen was applied as basal dose at the time of transplanting. The rest of nitrogen were applied dose at the time of maximum tillering stage, i.e., 30 days after transplanting and between panicle initiation and boot leaf stage, i.e. 55 days after transplanting. Zinc was applied (25 kg/ha) to avoid Zinc deficiency. Crop was harvested on November 1, 4 and 6th 2007 at physiological maturity. Reading from five plants was averaged replication wise and the mean data was used for statistical analysis for 16 agronomical characters.

Results and Discussion

Estimates of heritability and genetic advance

The high estimates of heritability observed in test weight (99.5), number of tillers per hill (94.7), number of panicles per hill (93.2) and days to 50% flowering (70.8). Moderate estimates of heritability was recorded for number of spikelets per panicle (56.6), plant height (55.9), biological yield per plot (54.4), number of grains per panicle (47.5), grain yield per plot (41.2)), flag leaf width (35.7), panicle length (31.8) and grain yield per hill (30.5). The similar results were also reported by Patil et al. (2003); Kuldeep et al. (2004); Singh et al. (2005); Singh et al. (2007). Low heritability was recorded spikelets fertility (24.6), harvest index (19.8), flag leaf length (18.00) and biological yield per hill (11.8). In the present investigation heritability estimates were high test weight, number of tillers per hill and number of panicles per hill. The results are conformity with the findings of Manuel and Prasad (1993); Kuldeep et al. (2004); Shivani and Reddy (2000); Singh et al. (2007).

Genetic advance

The highest genetic advance was recorded for test weight (45.790), number of tillers per hill (31.584), grain yield per plot (30.432), biological yield per plot (23.155), number of spikelets per panicle (22.956), number of grains per panicle (20.965). Moderate amount of genetic advance was recorded for grain yield per hill (16.517), harvest index (10.751) and low genetic advance was observed for flag leaf width (9.769), plant height (9.672), days to 50% flowering (8.761), biological yield per hill, panicle length (6.275), flag leaf length (5.630), spikelet fertility (3.380) and number of panicles per hill (0.032).

Table 1. Estimates of genetic parameters for 16 characters in rice hybrids during kharif, 2007

Character	H (bs) %	GA	GA as % of mean
Plant height	55.9	10.516	09.672
Days to 50% flowering	70.8	09.400	08.761
Number of panicles per hill	93.2	00.006	0.032
Number of tillers per hill	94.7	06.845	31.584
Flag leaf length	18.0	01.869	05.630
Flag leaf width	35.7	00.145	09.769
Panicle length	31.8	01.646	06.275
Number of spikelets per panicle	56.6	47.697	22.956
Number of grains per panicle	47.5	36.905	20.965
Spikelet fertility	24.6	02.866	03.380
Grain yield per hill	30.5	05.587	16.517
Biological yield per hill	11.8	06.461	06.579
Test weight	99.5	09.054	45.790
Harvest index	19.8	03.901	10.751
Biological yield per plot	54.4	07.543	28.155
Grain yield per plot	41.2	02.523	30.432

Moderate heritability coupled with high genetic advance was registered for number of spikelate per panicle, number of grain yield per panicle, biological yield per plot and grain yield per plot. The similar results were also reported by Reddy et al. (1997). Moderate heritability coupled with low genetic advance was recorded for flag leaf width, plant height and panicle length, indicating

emphasis of non-additive gene action and greater environmental influence in the heritance of these traits.

Estimates of character association

Character association was studied with the help of correlation coefficient for all the characters both at phenotypic and genotypic level shown in (Table 2 and 3).

Phenotypic correlation coefficient (rp)

Character association of grain yield per plot with other characters

Grain yield per plot showed highly positive significant association with biological yield per plot (0.6984**), harvest index (0.5296**), number of spikelets per panicle (0.3872*) and number of grains per panicle (0.3745*). Non-significant but positive association with grain per per plot (1.0000), grain yield per hill (0.6048), test weight (0.3337), flag leaf length (0.3072), flag leaf width (0.2968), plant height (0.2687), number of panicles per hill (0.2659), number of tillers per hill (0.2291), panicle length (0.1489) and spikelet fertility (0.0207). The correlation of grain yield per plot showed negative non-significant association with days to 50% flowering (-0.0031) and biological yield per hill (-0.0839).

Character association among other characters

Plant height

Plant height showed highly significantly positive association with flag leaf width (0.4508*), flag leaf length (0.4508*) and number of grains per panicle (0.3676). It exhibited positive association with biological yield per plot (0.3421), grain yield per hill (0.3384), test weight (0.3157),

Table 2.1. Estimates of phenotypic correlation coefficients (rp) for 16 characters in 23 rice hybrids during kharif, 2007

Characters	Plant height	Days to 50% flowering	Number of panicle/hill	Number of tiller/hill	Flag leaf length	Flag leaf width	Panicle length	Number of spikelets
Plan height	1.0000	-0.0748	0.1422	0.1824	0.4508*	0.4698*	0.2841	0.3141
Days to 50% flowering		1.000	0.1600	0.0737	-0.2222	-0.1351	-0.3788	-0.3096
Number of panicle per hill			1.0000	0.5235**	0.2378	0.2969	0.0864	0.2375
Number of tiller per hill				1.0000	0.3513*	0.3614*	0.0438	0.2807
Flag leaf length					1.0000	0.2702	0.1099	0.2117
Flag leaf width						1.000	0.3205	0.4221*
Panicle length							1.0000	0.4167*
Number of spikelets								1.0000

*and** indicate significance at 5% and 1% respectively

Table 2.2. Estimates of phenotypic correlation coefficients (rp) for 16 characters in 23 rice hybrids during kharif, 2007

Characters	Number of grains/ panicle	Spikelets fertility	Grain yield/ hill	Biological yield/ hill	Test weight	Harvest index (%)	Biological yield/ plot	Grain yield/ plot
Plan height	0.3676*	0.2149	0.3384	0.2426	0.3157	0.0630	0.3421	0.2687
Days to 50% flowering	-0.3000	0.0039	-0.0569	0.2353	-0.1939	-0.2587	0.2145	-0.0031
Number of panicle per hill	0.1833	-0.1243	0.1520	0.0528	0.0630	-0.1108	0.2873	0.2659
Number of tiller per hill	0.2495	-0.0720	0.0396	0.0595	-0.1013	-0.0576	0.2613	0.2291
Flag leaf length	0.2105	-0.0089	0.1623	0.0212	0.2622	0.0759	0.2516	0.3072
Flag leaf width	0.3735*	-0.0054	0.3694*	0.2142	0.3561*	0.1133	0.2693	0.2968
Panicle length	0.4327*	0.1422	-0.0026	-0.1736	0.2406	0.0828	.0566	0.1489
Number of spikelets	0.9506**	0.0964	0.248	-0.1363	-0.1651	0.1393	0.3442*	0.3872*
Number of grains per panicle	1.0000	0.3879*	0.2636	-0.1071	-0.1351	0.1536	.03726*	0.3745*
Spikelets fertility		1.0000	0.0777	0.0759	0.0526	0.0342	0.1038	.0207
Grain yield per hill			1.0000	0.1921	0.3371	0.6297**	0.5661	0.6048
Biological yield per hill				1.0000	0.0879	-0.5039	-0.1195	-0.0839
Test weight					1.0000	0.3152	0.0629	0.3337
Harvest index						1.0000	0.4436**	0.5296**
Biological yield per plot							1.0000	0.6984**
Grain yield per plot								1.0000

*and** indicate significance at 5% and 1% respectively

Table 3.1. Estimates of genotypic correlation coefficients (rg) for 16 characters in 23 rice hybrids during kharif, 2007

Characters	Plant height	Days to 50% flowering	Number of panicle/hill	Number of tiller/hill	Flag leaf length	Flag leaf width	Panicle length	Number of spikelets
Plan height	1.0000	-0.0457	1.8758**	0.2208	0.1821	1.1335**	1.0876**	0.3203
Days to 50% flowering		1.000	57.7350**	0.1289	-0.2300	-0.0489	-0.3968	-0.3265
Number of panicle per hill			1.0000	5.3879**	4.5913**	0.1851	0.2176	23.6449**
Number of tiller per hill				1.0000	0.6842**	0.6156**	0.0743	0.3412
Flag leaf length					1.0000	0.8026**	1.2362**	0.5575**
Flag leaf width						1.000	0.8901**	0.7035**
Panicle length							1.0000	1.0593**
Number of spikelets								1.0000

*and** indicate significance at 5% and 1% respectively

Table 3.2. Estimates of genotypic correlation coefficients (rg) for 16 characters in 23 rice hybrids during kharif, 2007

Characters	Number of grains/ panicle	Spikelets fertility	Grain yield/ hill	Biological yield/ hill	Test weight	Harvest index (%)	Biological yield/ plot	Grain yield/ plot
Plan height	0.4279*	0.5148**	0.3638*	59.5312**	0.4163*	-0.1696	0.3316	0.2105
Days to 50% flowering	-0.3159	0.2028	-0.1359	6.60771**	-0.2267	-0.3507	0.4832**	0.0113
Number of panicle per hill	13.1372**	-3.9515	4.6958**	1.9855**	0.7043**	3.8240**	9.0974**	4.4092**
Number of tiller per hill	0.2950	-0.2930	0.0865	10.9314**	-0.1097	-0.1718	0.3227	0.4571*
Flag leaf length	0.5358**	-0.1935	0.1975	31.1433**	0.6073**	-0.7549	0.0738	0.6153**
Flag leaf width	0.6900**	-0.1565	0.1822	-0.1169	0.5788**	-0.0289	0.5394**	0.7147**
Panicle length	0.9760**	-52.80	0.3376	12.6211**	0.4436*	0.4795**	0.2317	0.6277**
Number of spikelets	0.9720**	-0.2684	-0.0155	-158.6081	-0.2158	-0.2396	0.3649**	0.2708
Number of Grains per panicle	1.0000	-0.0402	-0.0056	-65.8308	-0.1948	-0.3507	0.4973**	0.2943
Spikelets Fertility		1.0000	-0.1777	38.3936*	0.0956	-0.7087	0.4066*	-0.0626
Grain yield per hill			1.0000	4.6758**	0.5663**	0.70002**	0.7496**	0.6961**
Biological Yield per hill				1.0000	10.2136**	3.3829**	21.7136**	1.8354**
Test weight					1.0000	0.6912**	0.0826	0.5350**
Harvest index						1.0000	0.1422	0.2796
Biological Yield per plot							1.0000	0.7680**
Grain yield per plot								1.0000

*and** indicate significance at 5% and 1% respectively

number of spikelets per panicle (0.3141), panicle length (0.2841), biological yield per hill (0.2426), spikelet fertility (0.2149), number of tillers per hill (0.1824), number of panicles per hill (0.1422) and harvest index (0.0630). The correlation of plant height showed negative significant association with the days to 50% flowering (-0.0748).

Days to 50% flowering

Days to 50% flowering showed positive non-significant correlation with biological yield per hill (0.2353), biological yield per plot (0.2145), number of panicle per hill (0.1600) and number of tillers per hill (0.07737). The correlation of days to 50% flowering showed negative non-significant association with the panicle length (-0.3788), number of spikelets (-0.3096) number of grains per panicle (-0.3000), harvest index (-0.2587), flag leaf length (-0.2222), test weight (-0.1939), flag leaf width (-0.1351) and grain yield per hill (-0.0569).

Number of panicles per hill

Number of panicles per hill showed highly positive significant association with number of tillers per hill (0.5235**), whereas positive non-significant association was recorded for flag leaf width (0.2969), biological yield per plot (0.2873), flag leaf length (0.2378), number of spikelets (0.2375), number of grains per panicle (0.2833), grain yield per hill (0.1520), panicle length (0.0864), test weight (0.0630) and biological yield per hill (0.0528), whereas negative correlation non-significant association was recorded with spikelet fertility (-0.1243) and harvest index (-0.1108).

Number of tillers per hill

Number of tillers per hill showed highly positive significant association with flag leaf width (0.3614*) and flag leaf length (0.3513*), whereas positive significant association was recorded for number of spikelets (0.2807), biological

yield per plot (0.2873), number of grains per panicle (0.2495), biological yield per hill (0.0595), panicle length (0.0438) and grain yield per hill (0.0396). Negative correlation association was recorded for test weight (-0.1013), spikelet fertility (-0.0720) and harvest index (-0.0576).

Flag leaf length

Flag leaf length showed positive non-significant association with flag leaf width (0.2702) biological yield per plot test weight (0.2622), number of spikelet (0.2117), number of grains per panicle (0.2105), grain yield per hill (0.1623), panicle length (0.1099), harvest index(0.0759) and biological yield per hill (0.0212). It showed negative non-significant association with spikelet fertility (-0.0089).

Flag leaf width

Flag leaf width showed high degree of positive significant association with number of spikelet per panicle (0.42221*), number of grains per panicle (0.3735*), grain yield per hill (0.3694*) and test weight (0.3561*) while positive non-significant panicle length (0.3205), biological yield per plot (0.2693), biological yield per hill (0.2142) and harvest index (0.1133). Whereas flag leaf width showed negative non-significant association with spikelet fertility (-0.1736).

Panicle length

Panicle length showed high degree of positive significant association with number of grains per panicle (0.4327*) and number of spikelets pr panicle (0.4167*) while positive non- significant association with test weight (0.2406), spikelet fertility (0.1422), harvest index (0.0828) and biological yield per plot (0.0566). Whereas it exhibited negative non-significant association with biological yield per hill (-0.1736) and grain yield per hill (-0.0026)

Number of spikelets per panicle

Number of spikelets per panicle showed high degree of positive significant association with number of grains per panicle (0.4327*) and number of spikelets pr panicle (0.9506**) and biological yield per plot (0.3442*), whereas positive non-significant association with grain yield per hill (0.2636) and harvest index (0.1536), while non-significant association with test weight (-0.1651) and biological yield per hill (-0.1363)

Number of grains per panicle

Number of grains per panicle showed high degree of positive significant association with spikelet fertility (0.3897*), biological yield per plot (0.03726*). Whereas positive non-significant association with grain yield per hill (0.2636), harvest index (0.1536) and negative non-significant association with test weight (-0.135) and biological yield per hill (-0.1071)

Spikelet fertility (%)

Spikelet fertility (%) showed positive non-significant association with yield per plot (0.5661), biological yield per plot (0.0777), test weight (0.0526) and harvest index (0.0342)

Grain yield per hill

Grain yield per hill showed high degree of positive significant association with harvest index (0.6297**). Whereas positive non-significant association biological yield per plot (0.5661), test weight (0.3371) and biological yield per hill (0.1921)

Biological yield per hill

Biological yield per hill showed high degree of positive non-significant association with test weight (0.0879) and harvest index (-0.5039), biological yield per plot (-0.1195) was showed negative non-significant.

Test weight

Test weight showed degree of positive non-significant association with harvest index (0.3152) and biological yield (0.0629).

Harvest index

Harvest index showed high degree of positive significant association with biological yield per plot (0.4436).

Biological yield per plot

Biological yield per plot showed high degree of positive significant association with grain yield per plot (0.6984**).

Genotype correlation coefficient (rg)

Character association of grain yield per plot with other characters

The genotype correlation studies grain yield per plot showed highly significant positive association with number of panicle per hill (4.4092**), biological yield per hill (1.8354**). Biological yield per plot (0.7680**), flag leaf width (0.7147**), grain yield per hill (0.6961**), panicle length (0.6277), flag leaf length (0.6153), test weight (0.5350**) and number of tillers per hill (0.4571*), whereas positive non-significant association with number of grains per panicle (0.2943), harvest index (0.2796), number of spikelets (0.2708), plant height (0.2105) and days to 50% flowering (0.0113).

Character association among other characters

Plant height

Plant height showed high degree of positive significant association with biological yield per hill (59.5312**), number of panicles per hill (1.8758**), flag leaf width (1.1335**), panicle length (1.0876**), spikelets fertility (0.5148**), number of grains per panicles (0.4279*) and test weight (0.4163*), whereas positive non-significant association with biological yield per plot (0.3316), number of spikelets (0.3203), number of tillers per hill (0.2208) and flag leaf length (0.1821). Plant height exhibited negative non-significant association with harvest index (-0.1696) and days to 50% flowering (-0.0457).

Days to 50% flowering

Days to 50% flowering showed high degree of positive significant association with number of panicles per hill (57.7350**), biological yield per hill (6.60771**) and biological yield per plot (0.4832**). Whereas positive non-significant association with spikelet fertility (0.2028), number of tillers per hill (0.2208). Negative non-significant association with panicle length (-0.3968), harvest index (-0.3507), number of spikelets per panicle (-0.3265), number of grains per panicle (-0.3159), flag leaf length (-0.2300), test weight (-0.2267), grain yield per hill (-0.1359) and flag leaf width (-0.0489). Low or high variabilities are due to the presence of negative and positive alleles for the character. High degree of positive correlation may be accounted to presence of either of positive or negative alleles for this character.

Number of panicles per hill

Number of panicles per hill showed highly significant positive association with number of spikelets per hill (23.6449**), number of grains per panicle (13.1372**), biological yield per plot (9.0974**), number of tillers per hill (5.3879**), flag leaf length (4.5913**), grain yield per hill (4.6958**), harvest index (3.8240**), biological yield epr hill (1.9855**) and test weight (0.7043**), while positive non-significant association with panicle length (0.2176), flage leaf width (0.1851), Negative non-significant association with spikelets fertility (-3.9515).

Number of tillers per hill

Number of tillers per hill showed high significant positive association with biological yield per hill (10.9314**), flag leaf length (0.6842**) and flag leaf width (0.6156**) whereas positive non-significant association with number of spikelets per panicle (0.3412), biological yield per plot (0.3227), number of grains per panicle (0.2950), grain yield per hill (0.0865) and panicle length (0.0743). Number of tillers per hill negative non-significant association with spikelets fertility (-0.2930), harvest index (-0.1718) and test weight (-0.1097).

Flag leaf length

Flag leaf length showed high degree of positive significant association with biological yield per hill (31.1433**), panicle length (1.2362**), flag leaf width (0.8026**), test weight (0.6073**), number of spikelets (0.5575**), number of grains per panicle (0.5358**). While positive non-significant association with grain yield per hill (0.1975) and biological yield per plot (0.0738), while negetive non-significant association with harvest index (-0.7549) and spikelets fertility (-0.1935).

Flag leaf width

Flag leaf width showed high degree of positive significant association with panicle length (0.8901**), number of spikelet per panicle (0.7035**), number of grains per panicle (0.6900**), test weight (0.5788**) and biological yield per plot (0.5394**) while positive non-significant association with grain yield per hill (0.1822), whereas negative non-significant association with spikelet fertility(-0.1565), biological yield per hill (-0.1169) and harvest index(-0.0289).

Panicle length

Panicle length showed high degree of positive significant association with number of yield per hill (12.6211**), number of spikelets (1.0593**), number of grains per panicle (0.9760**), harvest index (0.4795**) and test weight (0.4436*). While positive non- significant association with grain yield per hill (0.3376) and biological yield per plot (0.2317). Panicle length exhibited negative non-significant association with spikelet fertility (-52.80).

Number of spikelets per panicle

Number of spikelets per panicle showed high degree of positive significant association with number of grains per panicle (0.9720**), biological yield per plot (0.3749**), while negative non-significant association with biological yield per hill (-158.6081), spikelets fertility (-0.2684), harvest index (-0.2396), test weight (-0.2158) and grain yield per hill (-0.0155).

Number of grains per panicle

Number of grains per panicle showed high degree of positive significant association with biological yield per plot (0.4973**), while negative non-significant association with biological yield per hill (-65.8306), harvest index (-0.3507), test weight (-0.1948), spikelets fertility (-0.0402) and grain yield per hill (-0.0056).

Spikelet fertility (%)

Spikelet fertility (%) showed high degree positive significant association with biological yield per hill (38.3936*), biological yield per plot (0.4066*), while positive non-significant association with test weight (0.0956). Spikelet fertility exhibited negative non-significant association with harvest index (-0.7087) and grain yield per hill (-0.1777).

Grain yield per hill

Grain yield per hill showed high degree of positive significant association with yield per hill (4.6758**), harvest index (0.70002**), biological yield per plot (0.7496**) and test weight (0.5663**).

Biological yield per hill

Biological yield per hill showed high degree of positive non-significant association with biological yield per plot (21.7136**), test weight (10.2136**) and harvest index (3.3929**).

Test weight

Test weight showed high degree of positive significant association with harvest index (0.6912**) while positive non-significant association with biological yield per plot (0.0826).

Harvest index

Harvest index showed high degree of positive non-significant association with biological yield per plot (0.1428).

Biological yield per plot

Biological yield per plot showed high degree of positive significant association with grain yield per plot (0.7680**).

Conclusion

From the present study it may be concluded that on the basis of mean performance R 19, R 18 and R 06 were identified as promising rice hybrids for multiple traits out of the 23 rice hybrids. The characters, viz., grain yield, test weight, biological yield and number of tillers per hill may be used as selection indices for yield improvement in rice.

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Heritability and genetic advance for yield and related traits in *Cyamopsis tetragonoloba* (L.) Taub.

Ratnesh Singh, Prerna Singh, Ajay Jaiswal and **Yogesh Kumar**
Department of Plant Breeding & Genetics
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract

Thirty two clusterbean genotypes collected with a local check (HG 563) and were used to study their performance, heritability and genetic advance of yield and yield contributing characters. Characters like number of pods per plant, number of clusters per plant and number of branches per plant showed high heritability. Considerable high genetic advances in percentage of mean were number of pods per plant. The heritability estimates were high for the characters, days to maturity, number of pods per plant, number of clusters per plant and number of branches per plant. Number of branches per plant, number of pods per plant and number of clusters per plant has high values of heritability coupled with high genetic advance as per cent of mean indicating lesser influence of environment on these characters and prevalence of more additive gene action in their inheritance, hence, are amenable for simple selection. Low heritability with low genetic advance as per cent of mean was observed for plant population and days to 50% flowering.

कृषि महाविद्यालय ग्वालियर में वर्ष 2008 में 32 ग्वार प्रजातियां (लोकल चेक एच.जी. 563 के साथ) को एकत्र कर उनकी क्षम प्रदर्शन, वंशागतित्व एवं आनुवांशिक प्रगति हेतु उपज एवं उपज के लिये उत्तरदायी गुणों का मूल्यांकन किया गया। प्रति पौध फल्लियों संख्या, प्रति पौध गुच्छों की संख्या एवं प्रति पौध शाखाओं संख्याओं में उच्च वंशागतित्व पाया गया। प्रति पौध फलियों की संख्या में अपेक्षाकृत उच्च आनुवांशिक प्रगति उपस्थित थी। वंशागति संयोजन पकने की अवधि, प्रति पौध फलियों की संख्या, प्रति पौ गुच्छों की संख्या, एवं प्रति पौध शाखाओं की संख्या गुणों में दिखा। प्रति पौध शाखाओं की संख्या प्रति पौध फलियों की संख्या, एवं प्रति पौध गुच्छों की संख्या, गुणों में वंशागतित्व की अधिक मात्रा के साथ उच्च आनुवांशिक प्रगति भी देखी गयी जिससे पता चलता है कि गुण वातावरण से बहुत कम प्रभावित थे साथ ही इन गणों के वंशानुगत प्रसार में योगशील जीन क्रिया (additive gene action) का अधिक योगदान है। अतः उन गणों के आधार पर सरल वरण की प्रक्रि अपनायी जा सकती है। पौध संख्या एवं 50 प्रतिशत पुष्पन गुणों में वंशागतित्व एवं आनवांशिक प्रगति की कम मात्रा आंकलित की गयी।

Keywords: Genotype, heritability, genetic advance, additive gene action

Guar or cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] belonging to the family Fabaceae has been grown in India from ancient times for forage, vegetables and green manuring purpose. Its gum (content 20 to 30%) is used extensively by the paper, explosive, food, pharmaceutical, cosmetic, textile and oil industries around the world.

Guar also plays an important role in the agricultural economy. Being a legume, it is able to do relatively well under poor fertility condition. Its deep penetrating root system enables the plant to utilize the available limited moisture more efficiently. Thus, it is more suitable for rainfed farming. In India, it is grown in the North-Western states of the country viz., Rajasthan, Haryana, Gujrat, Punjab and parts of Uttar Pradesh, on nearly 21 lakh hectares with a production of about 6.78 lakh tonnes with an average productivity of 316 kg/ha.

In Madhya Pradesh, it is grown on a very limited scale. It is cultivated as pure crop in 11594 hectare and cultivated as a mixed crop in area 39121 hectares. About 80% area of the state is in Gird zone, which consists of Bhind, Morena, Guna, Shivpuri and Gwalior districts. It is known that yield is a polygenic character and is largely influenced by environment, whereas, yield components are governed by relatively less number of genes and are less sensitive to the environmental fluctuations. Thus the selection based on yield components has better chance of success. Therefore, the knowledge of direct and indirect influence of yield contributing characters is of prime importance to select high yielding genotypes. The correlation coefficient and path-coefficient analysis provide the information on the relative importance of various yield-contributing characters. Yield alone, cannot be a criterion for selection because of the low heritability and high

genotype x environmental interaction. Thus, for yield breeding the geneticstic have to simplify this complex situation and handle a number of related characters. Grain yields per plant as well as the components related to it i.e. number of pods per plant, number of seeds per pod and grain weight etc. are the effective components for selection. The effectiveness of components approach to selective breeding programme has been presented by several workers.

The knowledge of association of yield and its components are of immense value for breeder. Correlations arise from linkage or from developmental genetic interactions with or without purely phenotypic components.

The identification of physiological yield components and their inter-relationships decide the selection criterian to be practiced. In general, majority of yield components can be measured with much less error than yield per se. When these are closely correlated with yield, these are useful as an aid to improvement of yield. The main purpose of breeding programme is to improve the yield.

Material and methods

The experiment was laid down in a randomized block design with three replications. The material was planted on July 18, 2008. All recommended package of practices were followed during the conduct of experiment. The experimental material used in the present study comprised of thirty one genotypes (GR 1 to GR 31) with local check HG 563.

Estimation of heritability and genetic advance

Heritability

Heritability in per cent in broad sense was estimated by the following formula given by Singh and Choudhary (1977)

$$\text{Heritability } (h^2) = \frac{\text{Genotypic variance}}{\text{Phenotypic variance}} \times 100$$

Genetic advance

The estimates of expected genetic advance from selection, G(s), was obtained by the formula suggested by Robinson et al. (1949).

$$G(s) = k \times h^2 \times sp$$

where,

k = Selection differential in standard deviation units which is 2.06 for 5% selection intensity,
h^2 = Heritability in broad sense, and
sp = Phenotypic standard deviation

Results and Discussion

Heritability estimates

The estimates of broad sense heritability in percent are reported in Table 1. It is the ratio of genotypic variance to phenotypic variance. It is the heritable portion of phenotypic variance. It is a good index of the transmission of characters from parent to their offspring. Thus, it is an important selection parameter. The estimates of heritability ranged between 9.10 to 88.50 percent (Table 1).

The maximum heritability estimate of 88.50 per cent was recorded by days to maturity followed by the characters, number of pods per plant, number of clusters per plant and number of branches per plant recording 83.30, 80.70 and 77.50 per cent, respectively. Plant population registered the lowest heritability of 9.10 per cent.

Genetic advance

It is the improvement in the mean genotypic value of selected individuals over the parental population. It is an important selection parameter as it is a reliable measure of genetic improvement under selection for polygenic traits. Estimates of genetic advance help in understanding the type of gene action involved in the expression of various polygenic characters.

The highest estimate of genetic advance (21.57) was observed for number of pods per plant while the least estimate (0.19) was observed for seed yield per plant followed by 0.34 for length of pod, 0.37 for plant population, 0.50 for number of seeds per pod and 0.53 for 1000 seed weight.

Expected genetic advance as percent of mean was found the highest for number of branches per plant (37.69) followed by number of pods per plant (37.13) and number of clusters per plant (34.91) while the lowest estimate was observed for plant population (2.98) followed by days to 50% flowering (3.10), number of seeds per

Table 1. Mean, range, coefficient of variation and heritability of different characters

Characters	Range	Grand mean	PCV	GCV	Heritability (%)	Genetic advance	Genetic advance as % of mean
Plant population	10.22-14.66	12.40	15.90	4.79	9.10	0.37	2.98
Days to 50% flowering	38.00-43.00	40.34	4.32	2.55	34.70	1.25	3.10
Plant height (cm)	49.00-88.47	70.40	16.75	12.50	55.70	13.54	19.23
Number of branches/plant	3.27-8.27	5.89	23.62	20.79	77.50	2.22	37.69
Number of clusters/plant	8.07-20.07	15.01	21.00	18.87	80.70	5.24	34.91
Number of pods/plant	30.47-76.40	58.10	21.63	19.75	83.30	21.57	37.13
Length of pod (cm)	4.13-5.20	4.70	8.62	5.53	41.20	0.34	7.23
Number of seeds/pod	7.27-8.73	8.19	5.77	4.15	51.70	0.50	6.11
Days to maturity	105-129	118.40	3.83	3.61	88.50	8.27	6.98
1000 seed weight (g)	2.62-3.89	3.38	13.14	9.97	57.50	0.53	15.68
Seed yield/plant (g)	1.52-2.06	1.87	9.40	6.78	52.10	0.19	10.16

pod (6.11), days to maturity (6.98) and length of pod (7.23). The characters viz., plant height (19.23), 1000 seed weight (15.68) and seed yield per plant (10.16) exhibited moderate estimate of expected genetic advance as percent of mean.

Selection based on the particular character will be effective when its heritability estimates is high. Burton (1952) suggested that genotypic coefficient of variability together with heritability estimates gave picture on genetic advance to be expected from a selection. The high heritability (b.s.) was observed for days to maturity followed by number of pods per plant, number of clusters per plant and number of branches per plant. Such high heritability estimates has been reported for days to maturity (Singh et al. 2003; Choudhary et al. 2004b; Mahla and Kumar 2006; Singh et al. 2005a), number of pods per plant (Gipson and Balakrishnan 1990; Singh et al. 2001; Chaudhary et al. 2003; Choudhary et al. 2004b; Saini et al. 2005; Singh et al. 2005a; Singh et al. 2005b; Mahla and Kumar 2006; Anandhi and Oommen 2007), number of clusters per plant (Chaudhary et al. 2003; Choudhary et al. 2004b; Saini et al. 2005; Singh et al. 2005a; Singh et al. 2005b; Anandhi and Oommen 2007) and number of branches per plant (Gipson and Balakrishnan 1990; Singh et al. 2001; Singh et al. 2003; Choudhary et al. 2004b; Saini et al. 2005; Singh et al. 2005a; Singh et al. 2005b; Buttar et al. 2008). Apart from showing high heritability estimates the characters number of branches per plant, number of clusters per plant and number of pods per plant showed high GCV estimates thereby pointing to the improvement of these characters through simple mass selection.

Since heritability estimates are influenced by environment, genetic material and also other factors hence their utility will be restricted. Thus, heritability values coupled with genetic advance would be more reliable and useful in formulating selection criteria. Johnson et al. (1956) stated that the resultant effect of selection, the genetic advance should be given weightage along with heritability. According to this yardstick, number of branches per plant, number of clusters per plant and number of pods per plant have high value of heritability coupled with high genetic advance as per cent of mean indicating lesser influence of environment on these characters and prevalence of more additive gene action in their inheritance, hence, are amenable for simple selection. Singh et al. 2001; Chaudhary et al. 2003; Saini et al. 2005; Singh et al. 2005a; Singh et al. 2005b; Choudhary and Shrimali 2006; Anandhi and Oommen 2007 also observed high heritability with high genetic advance for number of branches per plant, number of clusters per plant and number of pods per plant.

High heritability coupled with low genetic advance as per cent of mean was recorded for days to maturity indicating less influence of environment but prevalence of non-additive gene action for which simple selection will be less effective.

Moderate heritability with low genetic advance for length of pod and number of seeds per pod indicated less variability and non-additive gene action, hence, less amenable for selection.

Moderate heritability with moderate genetic advance was recorded for plant height, 1000 seed weight seed yield per plant revealing lesser influence of environment but governed by non-additive and additive gene action. Hence, limited improvement is expected through selection in later generations.

Other characters viz., plant population and days to 50% flowering, which had low values for heritability

and genetic advance, may not respond favourably to selection.

From the foregone discussion, it can be concluded that higher GCV, PCV, heritability and genetic advance as per cent of mean were observed for number of branches per plant, number of clusters per plant and number of pods per plant indicating the prevalence of additive gene action in control of these characters and simple selection may be effective to improve these characters.

Conclusion

1. The heritability estimates were high for the characters, days to maturity, number of pods per plant, number of clusters per plant and number of branches per plant.
2. Number of branches per plant, number of pods per plant and number of clusters per plant has high values of heritability coupled with high genetic advance as per cent of mean indicating lesser influence of environment on these characters and prevalence of more additive gene action in their inheritance, hence, are amenable for simple selection. Low heritability with low genetic advance as per cent of mean was observed for plant population and days to 50% flowering.

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Relative performance of newly developed promising genotypes of niger [*Guizotia abyssinica* (L.f.) Cass] under varying nitrogen levels

H.S. Patil and **M.R. Deshmukh***
College of Agriculture, Dhule (MS)
*AICRP on Sesame & Niger
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482004 (MP)

Abstract

Results of the field experiments conducted on niger in shallow soil of Igatpuri during rainy seasons for 3 years under rainfed conditions revealed that IGPN-9628-a newly developed genotype out yielded among all genotypes tested closely followed by IGPN-9610. All genotypes responded to application of N upto 60 kg/ha, but application of 30 kg N/ha was found to be optimum with regard to seed yield, oil yield and profits.

आंचलिक अनुसंधान केन्द्र, ईगतपुर (महराष्ट्र) की हल्की भूमि में खरीफ मौसम में वर्षा आधारित दशाओं के अंतर्ग लगातार 3 वर्षों तक किये गये प्रक्षेत्र परिणामों के द्वारा यह ज्ञात हुआ की नव-वि जिनोटाईप आई.जी.पी.एन.-9628 द्वारा सबसे अधिक उपज दर्ज होना पाया गया जो की जिनोटाईप 9610 द्वारा दर्ज की गई उपज के समीप थी। परीक्षण के अंतर्गत जाँचें गये सभी जिनोटाईप नत्रजन की 60 किलोग्राम प्रति हेक्टेयर के मान से प्रयोग करने तक लाभान्वित हुं किन्तु 30 किलोग्राम नत्रजन/हेक्टेयर के मान से प्रयोग करना अधिक बीज एवं तेल की उपज तथा लाभ लेने हेत उपयक्त प्रतित हआ है।

Keywords: Niger, genotypes, nitrogen levels

Niger [*Guizotia abyssinica* (L.f.) Cass] is an important rainy season oilseed crop in Maharashtra, which is mostly grown under rainfed production system by using traditional varieties particularly in marginal and degraded lands with a very little attention for plant-nutrition. Consequently, its productivity is very low (315 kg/ha) in the state from a considerable area (54 thousand hectare). Recently, several high yielding genotypes have been developed, which have ability to enhance their productivity to a considerable extent with the application of adequate quantity of fertilizers particularly nitrogenous one. In lacking of authentic information, the present investigation has been undertaken to evaluate the relative seed yield performance of newly developed promising genotypes under varying levels of nitrogen application.

Material and methods

Field experiments were carried out in shallow soils during rainy seasons of 2002-03 to 2004-05 at CBF farm, Igatpuri (MS) under rainfed conditions. The soils of the experimental field was neutral in reaction (6.9 pH) with low organic carbon (0.22%) contents and analyzing in low available N (180 kg) and in medium available P (32 kg) and available K (375 kg) contents. The rainfall was 2099, 2975 and 4260 mm. during the crop seasons in three consecutive years. Twenty treatments consisted with 5 genotypes (No.71, GA-10, IGPN-9628, IGPN-9610 and IGP-70) and 4 nitrogen levels (15, 30, 45 and 60 kg N/ha) were tested in FRBD with 3 replications. The sowing of all genotypes was done immediately after the onset of monsoon with 30 cm x 10 cm planting geometry in 5.00 m x 3.60 m size plots. A uniform dose of 40 kg P_2O_5 /ha and 20 kg K_2O/ha was given to all plots. Half dose of N as per treatments alongwith full quantity of P & K fertilizer were applied as basal and rest half N was top dressed on one month old crop after completing the weeding. Harvesting of crop was done at maturity and then seed yields were recorded after threshing of harvested produce. Oil yields were also determined on the basis of oil contents of seeds. Finally, economics was worked out in terms of cost of cultivation, gross monetary returns (GMR), net monetary returns (NMR) and benefit-cost ratio for each treatment.

Results and Discussion

Performance of genotypes

On the basis of mean data over the years, the genotypes significantly differed for their seed yields every year (Table 1). Newly developed genotype IGNP-9628 out yielded among all, but variations were not significant with

Table 1. Mean seed and oil yields and economics of different genotypes of niger under varying nitrogen levels

Treatments	Seed yield (kg/ha)				Oil yield (kg/ha)				Cost of cultivation (Rs/ha)	Gross monetary returns (Rs/ha)	Net monetary returns (Rs/ha)	B:C ratio
	2002	2003	2004	Mean	2002-03	2003-04	2004-05	Mean				
Genotypes												
No.-71	400	392	338	377	165	164	165	165	3775	7163	3328	1.89
GA-10	385	396	398	393	149	153	154	152	3775	7467	3692	1.97
IGPN-9628	458	459	466	461	193	193	197	194	3775	8759	4984	2.32
IGPN-9610	439	422	409	423	181	174	169	175	3775	8037	4262	2.12
IGP-76	415	428	443	429	167	176	181	175	3775	8151	4376	2.15
CD (P=0.05)	37	38	23	15	-	-	-	-	-	-	-	-
Nitrogen levels												
15 kg N/ha	357	369	370	365	136	141	142	140	3550	6935	3385	1.95
30 kg N/ha	436	432	437	435	170	170	170	170	3700	8265	4565	2.23
45 kg N/ha	440	436	436	437	173	172	171	172	3850	8303	4453	2.15
60 kg N/ha	443	441	443	444	174	174	175	174	4000	8436	4436	2.10
CD (P=0.05)	33	34	21	13	-	-	-	-	-	-	-	-

Cost of seeds is Rs 19/kg

other newly developed genotype IGPN-9610 during first two years (2001-02 to 2002-03). Other 3 varieties (No-71, GA-10 and IGP-76) proved to be less yielder than the 2 newly developed genotypes. Among 3 varieties, IGP-76 produced higher seed yield followed by GA-10 and No.-71 in descending order, but variations were significant with No.-71 only during the year 2004-05 and mean yield for the 3 years. These variations in seed yield among the genotypes may be due to their variation in genetic yield potential. Oil yield is directly related with seed yield and oil content of seeds. Consequently, IGPN-9628 genotype excelled in oil yield too among all genotypes tested followed by IGPN-9610, IGP-76, GA-10 and No.-71 mainly following the trend of seed yields. While comparing the economics, genotype IGPN-9628 was more remunerative in terms of GMR, NMR and B:C ratio than other genotypes and varieties. The cost of cultivation of all genotypes was almost comparable, but monetary values of the produce of different genotypes varied by maintaining the trend of yielding ability of genotypes.

Effect of nitrogen levels

All genotypes significantly responded to increasing levels of N application upto 60 kg/ha, but variations did not reach to the level of significance beyond 30 kg N/ha (Table 1). The seed yield was 365 kg/ha with 15 kg N/ha which increased to 435, 437 and 444 kg/ha with the application of 30, 45 and 60 kg N/ha, respectively. Those results are in close conformity with the findings of several workiers (Padhi and Sahoo, 1999; Patel 1999; Singh et al. 1991; Patil et al. 2006). The oil yields also increased as 140, 170, 172 and 174 kg/ha, due to application of 15, 30, 45 and 60 kg N/ha, respectively mainly due to increase in seed yield. With regard to economics, the GMR and NMR correspondingly increased with the increasing rates of N application upto the highest level, but the margin of increase in monetary values showed declining trend beyond application of 30 kg N/ha. Thus it reflected the highest B:C ratio with 30 kg N/ha which reduced gradually with further increase in each level of N application. If an indicated that net profit over each rupee of investment on N application above 30 kg N/ha was not remunerative.

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Influence of sowing dates and time of fertilizer application on nutrient uptake in soybean crop for Malawa region of Madhya Pradesh

S.K. Jha, A.K. Sharma and **A.K. Jha***
Department of Agronomy, College of Agriculture, Indore
RVSKVV, Gwalior 474001 (MP)
*JNKVV, Jabalpur 482004 (MP)

Abstract

The present investigation was conducted during *kharif* 2007 and 2008 at College of Agriculture, Indore with the objective study the nutrient uptake of soybean influenced by sowing dates and time of fertilizer application for Malawa region of Madhya Pradesh. The maximum (115.76 in seed, 25.75 in straw kg/ha) N uptake was recorded in treatment last week of June (25th June). In fertilizer applications 100% RDF at sowing time + 30 kg N/ha at flowering maximum uptake of nutrient N, P and K.

कृषि महाविद्यालय इंदौर (म.प्र.) के काली दोमट मिट्टी वाले अनुसंधान प्रक्षेत्र में बुवाई की तिथि एवं उर्वरकों का छिडकाव के सम सोयाबीन द्वारा पोषक तत्वों के अवशोषण के उद्देश्य से सन 2007 एवं 2008 के खरीफ वर्षों में प्रयोगस किये गये। इस प्रयोग में तीन बुवाई की तिथि एवं चार उर्वरकों का छिडकाव करने के तरीके को स्पिलिट प्लाट डिजाइन के अंतर्गत तीन बार दोहराया गया। प्राप्त परिणामों से यह पाया गया कि बुवाई तिथि 25 जून एवं उर्वरक 100% अनुसंशित मात्रा को बुवाई के समय + 30 कि.ग्रा. नत्रजन फूलन के समय देने पर अधिक मात्रा में नत्रजन, फास्फोरस एवं पोटाश का अवशोषण हुआ।

Keywords: Soybean, Date of sowing and fertilizer application

Soybean has good adaptability in wide range of soil and climate. In Madhya Pradesh, it occupies an area of about 39.5 lac ha with a production of about 25.7 lac tones. The productivity of soybean in Madhya Pradesh is 1106 kg/ha as compared to global productivity is 2206 kg/ha. The major area covered by the states of Madhya Pradesh is 70%. The reason for the low productivity of the crop could be ascribed to a number of factors that are related to quality of seed and biotic stress. Among these factors adoption of improvement agro-technology including application and nutrient management is one of the major problem resulting in low productivity.

Ability of soybean plant for symbiotic N-fixation also gets reduced at seed development stage, whereas the requirement of N at seed development stage remains more and if added at this stage, it significantly improve the seed yield and quality of soybean (Khan et al. 2004).

Material and methods

The present investigation was conducted during kharif 2007 at College of Agriculture, Indore. The soil of the experimental site was clay with pH 7.50, electrical conductivity 0.23 dsm^{-1} and organic carbon content 0.45%. The quantities of available N, P_2O_5 and K_2O were 124.06, 15.06 and 261.36 kg/ha, respectively. A field experiment was consisted of 3 main treatments date of sowing viz., D_1-last week of June (25th June), D_2-first week of July (5th July, D_3-second week of July (15th July) and 4 sub treatment, time of fertilizer application viz., T_1-at sowing time (RDF i.e. 20 kg N+60 kg P_2O_5+20 kg K_2O/ha), T_2-25th days after sowing (RDF i.e. 20 kg N+60kg P_2O_5+20 kg K_2O/ha), T_3-10th days before sowing (RDF i.e. 20 kg N+60 kg P_2O_5+20 kg K_2O/ha), T_4-100% RDF at sowing time + 30 kg N/ha at flowering replicated 3 times in split plot design (SPD). As per treatment the seed of soybean cv. JS 93-05 were used with seed rate of 80 kg/ha was kept for sowing. Calculated quantities of fertilizers as per treatments were applied. The individual plot was given the weighted quantities of fertilizers to pro-vide 20 kg N, 60 kg P_2O_5 and 20 kg K_2O/ha, through IFFCO, Urea, SSP, respectively. The data was analyzed by method of analysis of variance as described by Panse and Sukhatme (1985). Nutrient content in seed and straw (kg/ha) determined by oven dried ground seed and straw samples weighed 0.2 and 0.5 g, respectively and were digested in di acid mixture of H_2SO_4 and $HCLO_4$ (9:1) for nutrient (N, P and K) estimation. After digestion, a known volume was made with distilled water and stored in well washed bottles after filtration through whatman filter paper No. 42. Nitrogen content in digested plant material was determined by Nesslers reagent method (Lindner 1944). Phosphorus and potassium content were determined by vanadomolybdo phosphoric acid yellow color method ((Jacksan 1973) and

Table 1. Nutrients uptake in seeds influenced by date of sowing and time of fertilizer application in soybean

	Nutrients uptake (kg/ha)								
	N uptake			P uptake			K uptake		
Treatments	2007	2008	Mean	2007	2008	Mean	2007	2008	Mean
D_1-25th June	116.3	115.0	115.76	4.04	4.65	4.34	41.36	43.83	42.59
D_2-5th July	116.1	114.0	115.05	4.31	4.33	4.32	42.56	42.78	42.67
D_3-15 July	104.7	109	106.89	3.84	4.30	4.07	43.67	41.74	42.70
SEm±	1.49	0.15	0.81	0.06	0.03	0.04	0.39	0.091	0.24
CD at 5%	5.87	0.58	3.22	0.23	0.14	0.18	1.56	0.357	0.95
T_1-at sowing	119.3	115	117.37	4.07	4.43	4.25	43.02	43.1	43.05
T_2-25 days after sowing	108.2	105	106.61	3.92	4.40	4.16	40.45	41.22	40.83
T_3-10 days before sowing	115.7	113	114.11	4.09	4.43	4.26	44.7	42.34	43.52
T_4-(T_2+30 kg N/ha at flowering stage)	120.9	117	119.18	4.17	4.45	4.31	45.47	44.46	44.96
SEm±	2.91	0.09	1.5	0.28	0.013	0.14	1.09	0.095	0.59
CD at 5%	8.65	0.28	4.46	NS	NS	NS	3.25	0.283	1.76

flame photometric method Khanna et al. (1971) respectively.

Uptake of each nutrient (N, P and K) was computed as follows:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{\% nutrient content in seed/straw x yield (kg/ha)}}{100}$$

Results and Discussion

Nitrogen uptake

The mean N uptake (kg/ha.) was significantly affect with different sowing dates (Table 1 and 2). The maximum (115.76 in seed, 25.75 in straw kg/ha) N uptake was recorded in treatment D_1 and the minimum (106.89 in seed, 22.5 in straw kg/ha) N uptake was recorded in treatment D3. As regards the time of fertilizer application the maximum (119.18 seed and 26.00 in straw kg/ha) N content was recorded in treatment T_4 and the minimum (106.61 in seed and 22.60 in straw kg/ha) N uptake was recorded in treatment T_2.

Phosphorus uptake

The mean P_2O_5 uptake (kg/ha) was significantly affect with different sowing dates (Table 1 and 2). The maximum (4.34 in seed and 2.81 in straw kg/ha) P_2O_5 uptake was recorded in treatment D_1 and the minimum (4.07 in seed and 2.56 in straw kg/ha) P_2O_5 uptake was recorded in treatment D_3.

Table 2. Nutrients uptake in straw influenced by date of sowing and time of fertilizer application in soybean

	Nutrients uptake (kg/ha)								
	N uptake			P uptake			K uptake		
Treatments	2007	2008	Mean	2007	2008	Mean	2007	2008	Mean
D_1-25th June	26.57	24.9	25.75	2.94	2.671	2.81	43.89	47.78	45.83
D_2-5th July	27.34	24	25.66	2.98	2.637	2.81	52.49	46.03	49.26
D_3- 5 July	22.28	22.9	22.58	2.51	2.609	2.56	51.65	44.82	48.24
SEm±	0.38	0.12	0.25	0.07	0.008	0.04	0.41	0.055	0.23
CD at 5%	0.15	0.49	0.32	0.28	0.033	0.16	1.63	0.214	0.92
T_1-at sowing	25.99	25	25.47	3.01	2.648	2.83	50.38	46.87	48.63
T_2-25 days after sowing	23.73	21.5	22.60	2.76	2.614	2.69	45.26	43.63	44.44
T_3-10 days before sowing	25.71	24.1	24.88	2.78	2.631	2.71	50.61	45.6	48.11
T_4-(T_2+30 kg N/ha at flowering stage)	26.73	25.3	26.00	2.69	2.662	2.68	51.13	48.75	49.94
SEm±	0.39	0.15	0.27	0.13	0.007	0.07	0.82	0.113	0.47
CD at 5%	1.17	0.44	0.81	N.S.	N.S.	0.00	2.44	0.336	1.39

As regards time of fertilizer application, interaction between sowing time and time of fertilizer applications was found non -significant

Potassium uptake

The mean K_2O uptake (kg/ha.) was significantly affect with different sowing dates (Table 1 and 2). The maximum 42.59 in seed and 45.83 in straw kg/ha K_2O uptake was recorded in treatment D_1 and the minimum (41.73 in seed and 44.82 in straw kg/ha) K_2O content was recorded in treatment D3

As regards Time of fertilizer application the maximum (44.96 in seed and 49.94 in straw kg/ha) K_2O uptake was recorded in treatment T_4 but the T_1 was found significantly at par in K_2O content and the minimum (40.83 in seed and 44.44 in straw kg/ha) K_2O uptake was recorded in treatment T_2.

Interaction between sowing time and time of fertilizer applications was found non-significant.

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Nutrient uptake influenced by different tillage and sowing management under rice-wheat cropping system

A.K. Jha, M.L. Kewat, S.K. Vishwakarma and **S.K. Jha***
Department of Agronomy
Jawaharlal Nehru Krishi Vishwa Vidalaya, Jabalpur 482 004 (MP)
*RVSKVV, Gwalior 474001 (MP)

Abstract

Investigations were carried out during 2007-08 to 2008-09 at Jabalpur, Madhya Pradesh to evaluate the tillage and sowing management on nutrient uptake of rice - wheat cropping system. Four tillage and sowing methods for each crop components (direct seeding in dry fields, direct seeding of sprouted seeds in puddled field by drum seeder, manual transplanting, and mechanical transplanting) in rice var. Kranti; and (conventional till sowing, zero till sowing, strip till sowing and bed planting) for wheat cv. GW-273 were tested in strip plot design with 3 replications. Direct seeded rice removed significantly maximum quantity of N (230.26 kg/ha) and K ((201.12 kg/ha)) among all tillage and sowing methods of rice but p uptake was not significant. The strip till sowing of wheat removed significantly the highest quantity of N (234.70 kg/ha), P (46.19 kg/ha) and K (201.67 kg/ha) than other tillage and sowing of wheat.

ज.ने.कृ.वि.वि., जबलपुर (म.प्र.) के बलुई दोमट मिट्टी वाले अनुसंधान प्रक्षेत्र में, धान-गेहूँ फसल प्रणाली पर सिंचित कृषि परिस्थितिकी में दोनों फसलों को क्रम से उगाने के लिये प्रभावी प्रक्षेत्र औजारों द्वारा भू-परिष्करण एवं बुआई करते समय पोषक तत्वों का अवशोषण के उद्देश्य से सन 2007-08 और 2008-09 के दौरान दो वर्षों तक प्रयोग किये गये। प्रत्येक फसल के लिये चार भू-परिष्करण एवं बुवाई विधियाँ जैसे धान की क्रांति प्रजाति के लिये (सूखे खेत में धान की सीधी बोनी, मचौआ केत में अंकुरित धान के बीज की ड्रम सीडर से सीधी बोनी, आदमी द्वारा रोपाई और मशीन द्वारा रोपाई) तथा गेहूँ की जी.डब्ल्यू.-273 प्रजाति के लिये (प्रचलित जुताई द्वारा बोनी, बिना जुताई के बोना स्ट्रीप टिल बोनी और ऊँचे कुड की बोनी) को स्ट्रिप प्लाट डिजाइन के अंतर्गत तीन बार दोहराया गया। विभिन्न विधि द्वारा बोई गयी धान में सूख खेत में धान की सीधी बुवाई द्वारा भूमि से अधिक मात्रा में नत्रजन (230.26 कि.ग्रा./हे.) एवं पोटाश 201.12 कि.ग्रा./हे. अवशोषित हुआ जबकि फास्फोरस के अवशोषण पर कोई भी प्रभाव नहीं हुआ। गेहूँ में स्ट्रीप टिल बोनी के द्वारा अधिक मात्रा में नत्रजन (234.70 कि.ग्रा./हे.) एवं पोटाश 201.67 कि.ग्रा./हे.) भूमि से पौधों में अवशोषित हुआ।

Keywords: Tillage and sowing methods, rice-wheat cropping system, nutrient uptake

Rice-wheat system is a predominant cropping system is of the Indo-Gangetic plains, where rice traditionally grown by transplanting 3-5 weeks old seedlings into puddled fields. Continued puddling over decades has led to deterioration in soil physical properties through structural breakdown of soil aggregates and capillary pores and clay dispersion. Puddling forms a compacted layer that restricts the percolation of water, causing temporary waterlogging, and restricts root penetration and growth for succeeding crops after rice (Gill et al. 2006).

It is therefore important that alternative methods that are more water efficient and nutrient uptake by the both crops. Therefore, present experiment was conducted to develop appropriate rice establishment technique to enhance the availability of nutrients and uptake.

Material and methods

The field experiment were carried out at Krishi Nagar Research Farm, J.N. Krishi Vishwa Vidayalya, Jabalpur, (MP) during 2007-08 to 2008-09. The soil of the experimental field was sandy clay loam in texture and neutral in reaction (7.4) and low in organic contents (0.68%) and analyzing medium in available N (250 kg/ha), P (12.5 kg/ha) and medium in available K (308 kg/ha) contents. Sixteen treatments consisted with 4 tillage and planting management for both crop components under rice-wheat system were tested in strip plot design with 3 replications. Tillage and sowing methods were P_1-direct drilling in dry field, P_2-direct seeding of sprouted seeds through drum seeder in puddled field, P_3-manual transplanting and P_4-transplanting through self propelled transplanter (SPT) for rice var. Kranti and T_1-conventional tillage sowing, T_2-zero till sowing, T_3-strip till sowing and T_4-bed planting for wheat cv. GW-273. Sowing of rice viz., direct drilling in dry field before onset monsoon (P_1), sowing

in nursery to get seedlings for transplanting (P_3 and P_4) and soaking of seeds to obtain sprouted seeds under (P_2) was done on the same day. The seed rate 100 kg/ha for direct seeding in dry field and 50 kg/ha for direct seeding of sprouted seeds through drum seeder in puddled field where as 30 kg seeds/ha was use only for both manual transplanting and transplanting through self propelled transplanter. A uniform dose (120 kg N + 60 kg P_2O_5 + 40 kg K_2O/ha) of fertilizers was applied to both crops along with other agronomic practices were as per state recommendation. The sample of seeds and plants (excluding of roots) were taken at the time of harvest of each crop components in both the years and then they were allowed to dry in an oven till to reach the constant weight. After this, these samples were grinded into fine powder with the help of mortar and pistal. After this, N, P and K contents of these samples were analysed by Nessler's reagent colorimetric method (Linder 1944) for nitrogen, Ammonium vanadomolybdo phosphoric acid yellow colour method (Jackson 1973) for phosphorus and flame photometer method (Khanna et al. 1971) for potassium, respectively. The values of NPK contents for grains and straw were recorded treatment wise and then N, P and K uptakes were determined for grain and straw yields of each treatment. The total uptake of these nutrients was recorded by summation of uptake by grain and straw for each treatment separately. The values of total N, P and K uptake by individual crop and cropping system as a whole was determined to compare the effect of treatments.

Results and Discussion

Nutrient uptake

Rice

Nitrogen uptake

The average N-uptake by rice significantly varied due to direct effect of different methods of sowing/planting of rice. Based on 2 years mean data, the value was maximum (126.97 kg/ha) with direct seeding in dry fields-P_1 followed by direct seeding of sprouted seeds by drum seeder-P_2 (123.24 kg/ha) , transplanting by SPT-P_4 (122.38 kg/ha) and transplanting of seedlings manually-P_3 (121.83 kg/ha). But differences among P_2, P_3 and P_4 were not significant. The average N-uptake by rice did not vary due to the indirect influence of the treatments applied in succeeding wheat crop grown during the previous year. The interactions were not found significant for this study.

Phosphorus uptake

The mean P-uptake of rice did not vary due to the direct effect of tillage and sowing methods of rice as well as in direct effect of tillage and sowing to methods of wheat. The P uptake ranged from 22.38 to 23.59 kg/ha and 22.22 to 22.44 kg/ha due to the effect of various tillage and sowing methods practiced in rice and wheat crops grown in a sequence, respectively. The interactions were also not significant for this study.

Potassium uptake

Different tillage and sowing packages of rice did not exhibit significant variation on mean K-uptake by rice. It is evident from the data that direct seeded rice-P_1 had maximum K uptake (144.24 kg/ha) followed by direct seeding by drum seeder-P_2 (140.50 kg/ha), manual transplanting-P_3 (139.56 kg/ha) and transplanting by SPT-P_4 (139.54 kg/ha) . The average K-uptake did not vary due to the indirect influence of the treatments applied in succeeding crop grown during the previous year. The interactions were not found significant.

Wheat

Nitrogen uptake

The average N uptake by wheat did not differ due to indirect effect of different tillage and sowing methods of rice. Numerically, maximum N uptake (103.29 kg/ha) was recorded under direct seeded rice-P_1 among all sowing methods of rice. The N-uptake reduced as 101.01, 100.65 and 100.4 kg/ha due to P_3, P_4 and P_2, respectively. The average N-uptake was significantly minimum (93.34 kg/ha) with bed planting-T_4 among different tillage and sowing methods of wheat, while it was maximum (111.14 kg/ha) under strip till sowing-T_3 which significantly reduced as 101.71 and 99.27 kg/ha with conventional till sowing-T_1 and zero till sowing-T_2, respectively. All interactions were found to be not significant for this study for both years.

Phosphorus uptake

Different tillage and sowing methods of rice did not cause significant variations on P-uptake during both years. It varied from 19.85 to 21.01 kg/ha among all 4 tillage and sowing methods of rice. Among the sowing methods of wheat, the average P-uptake was significantly maximum

Table 1. Average total N, P, K uptake by rice under different tillage and sowing methods of crops under rice-wheat system

		Uptake of nutrients (kg/ha)								
		N			P			K		
Treatments		2007-08	2008-09	Mean	2007-08	2008-09	Mean	2007-08	2008-09	Mean
Tillage and sowing methods of rice										
Direct seeding	(P_1)	130.90	123.04	126.97	24.72	22.47	23.59	147.85	140.64	144.24
Seeding of sprouted seeds	(P_2)	129.00	117.48	123.24	23.96	21.19	22.57	144.61	136.39	140.50
Manual transplanting	(P_3)	127.22	116.44	121.83	23.71	21.05	22.38	143.89	135.24	139.56
Transplanting by SPT	(P_4)	126.81	117.96	122.38	24.45	21.69	23.07	143.23	135.86	139.54
SEm±		0.83	1.20	1.31	0.63	0.75	0.76	0.93	0.85	1.1
CD at 5%		2.45	4.80	3.95	NS	NS	NS	NS	NS	NS
Tillage and sowing methods of wheat										
Conventional till sowing	(T_1)	129.22	119.55	124.38	23.9	20.99	22.44	144.24	136.26	140.25
Zero till sowing	(T_2)	127.86	117.82	122.84	23.94	20.67	22.30	143.32	135.42	139.37
Strip till sowing	(T_3)	127.86	119.27	123.56	23.89	20.90	22.39	143.56	135.41	139.48
Bed planting	(T_4)	127.41	119.33	123.37	23.70	20.74	22.22	143.24	135.38	139.31
SEm±		0.81	0.73	0.80	0.43	0.36	0.42	0.61	0.45	0.6
CD at 5%		NS	NS	NS	NS	NS	NS	NS	NS	NS

(23.8 kg/ha) with strip till sowing-T_3. The P-uptake was 21.89 kg/ha with conventional till sowing-T_1 which was at par to zero till sowing-T_2 (20.62 kg/ha). The P-uptake was significantly minimum with bed planting-T_4 (15.99 kg/ha). The interactions were found to be not significant for this study in both the years.

Potassium uptake

The mean K uptake ranged from 55.86 to 56.88 kg/ha, which did not vary with each other to the residual effect of different tillage and sowing methods of rice in both years. But, it significantly varied due to direct effect of different tillage and sowing methods of wheat. It was maximum (62.19 kg/ha) with strip till sowing-T_3 which significantly reduced with conventional till sowing-T_1 (57.92 kg/ha), zero till sowing-T_2 (55.83 kg/ha) and bed planting-T_4 (51.92 kg/ha). The interactions were found to be not significant for this study for both the years.

Table 2. Average total N, P, K uptake by wheat under different tillage and sowing methods of crops under rice-wheat system

		Uptake of nutrients (kg/ha)								
		N			P			K		
Treatments		2007-08	2008-09	Mean	2007-08	2008-09	Mean	2007-08	2008-09	Mean
Tillage and sowing methods of rice										
Direct seeding	(P_1)	97.31	109.27	103.29	19.14	20.56	19.85	55.23	58.54	56.88
Seeding of sprouted seeds	(P_2)	97.40	103.48	100.44	19.86	21.14	20.5	54.34	57.39	55.86
Manual transplanting	(P_3)	99.87	102.16	101.01	21.48	20.54	21.01	55.46	58.39	56.92
Transplanting by SPT	(P_4)	95.50	105.80	100.65	20.01	21.36	20.68	54.26	57.86	56.06
SEm±		1.82	1.96	1.81	0.93	1.84	0.93	0.81	0.92	0.84
CD at 5%		NS	NS	NS	NS	NS	NS	NS	NS	NS
Tillage and sowing methods of wheat										
Conventional till sowing	(T_1)	97.41	106.01	101.71	21.14	21.89	21.51	56.46	59.38	57.92
Zero till sowing	(T_2)	94.81	103.74	99.27	19.12	20.62	19.87	54.34	57.32	55.83
Strip till sowing	(T_3)	108.72	113.57	111.14	23.24	24.36	23.8	59.56	64.82	62.19
Bed planting	(T_4)	88.74	97.95	93.34	15.13	16.86	15.99	50.42	53.43	51.92
SEm±		2.32	2.61	2.43	1.30	1.22	1.24	1.84	1.12	1.62
CD at 5%		7.91	8.4	7.2	3.56	3.45	3.46	6.35	4.63	5.20

Table 3. Average total N, P, K uptake by rice-wheat cropping system under different tillage and sowing methods

		Uptake of nutrients (kg/ha)								
		N			P			K		
Treatments		2007-08	2008-09	Mean	2007-08	2008-09	Mean	2007-08	2008-09	Mean
Tillage and sowing methods of rice										
Direct seeding	(P_1)	228.21	232.31	230.26	43.86	43.03	43.44	203.08	199.18	201.12
Seeding of sprouted seeds	(P_2)	226.40	220.96	223.68	43.82	42.33	43.07	198.95	193.76	196.36
Manual transplanting	(P_3)	227.09	218.60	222.84	44.25	41.59	43.39	199.35	193.63	196.48
Transplanting by SPT	(P4)	222.31	223.76	223.03	44.46	43.05	43.05	197.49	193.72	195.60
SEm±		1.02	3.21	1.08	0.91	1.83	0.94	0.83	0.94	0.86
CD at 5%		4.43	8.36	3.06	NS	NS	NS	NS	NS	NS
Tillage and sowing methods of wheat										
Conventional till sowing	(T_1)	226.63	225.56	226.09	45.04	42.88	43.95	200.7	195.64	198.17
Zero till sowing	(T_2)	222.67	221.56	222.11	43.06	41.29	42.17	197.66	192.74	195.20
Strip till sowing	(T_3)	236.58	232.84	234.70	47.13	45.26	46.19	203.12	200.23	201.67
Bed planting	(T_4)	216.15	217.28	216.71	38.83	37.6	38.21	193.66	188.81	191.23
SEm±		2.30	2.62	2.41	1.31	1.01	1.21	1.08	1.09	1.60
CD at 5%		6.90	6.46	7.25	3.56	3.03	3.82	5.44	5.16	4.26

Rice-wheat cropping system

Nitrogen uptake

The total uptake of N by cropping system as a whole significantly varied due to different treatments in both years of investigation. Based on 2-year data, DSR-P_1, removed significantly maximum quantity of N (230.26 kg/ha) among all tillage and sowing methods of rice (Sharma et al. 2006). Direct seeding of sprouted seeds in wet lands-P_2 was next in order with the removal of 223.68 kg N/ha, which was at par to those removed by transplanting through SPT-P_4 (230.03 kg/ha) and manual transplanting-P_3 (222.84 kg/ha).

Different tillage and sowing methods of wheat also significantly varied the uptake of N by entire rice-wheat system. The strip till sowing of wheat-T_3 removed significantly the highest quantity of N (234.70 kg/ha) among all sowing methods of wheat. The conventional till sowing-T_1 of wheat stood with the N uptake of 226.09 kg/ha, which was at par to those removed by zero till sowing-T_1 (222.11 kg/ha) and bed planting-T_4 (216.71 kg/ha).

Phosphorus uptake

The total P-uptake by entire cropping system did not significantly varied during both the years due to different tillage and sowing methods of rice. Based upon the mean data of both years, it ranged between 43.05 to 43.44 kg P/ha due to the effect of various sowing methods of rice. But P-uptake significantly varied due to different sowing methods of wheat in both years of investigation almost in the same pattern. Two years mean data that uptake was maximum (46.19 kg/ha) with T_3-strip till sowing among all sowing methods except to conventional till sowing-T_1 (43.95 kg/ha), which was at par to zero till sowing-T_2 (42.17 kg/ha), while bed planting-T_4 of wheat removed the lowest quantity of P (38.21 kg/ha).

Potassium uptake

The K uptake of entire cropping system differed significantly due to different sowing methods of rice and wheat in both years. Based on 2-year data, DSR-P_1 significantly removed the highest quantity of K (201.12 kg/ha) through the both crops of entire rice-wheat system among all sowing methods of rich. The other three sowing methods stood in descending as P_3-manual transplanting (196.48), direct seeding through drum seeder in wet land-P_2 (196.17 kg/ha) and transplanting by SPT-P_4 (195.60 kg/ha) and these were at par with each other with regard to K uptake.

The uptake of K by entire cropping sequence, was maximum with strip till sowing (201.67 kg/ha), among all the sowing methods of wheat except to conventional till sowing-T_1 (198.17 kg/ha). The next best treatment with regard to K-uptake was zero till sowing-T_2 with K-uptake of 195.20 kg which was at par to T_1 as well as bed planting-T_4 (191.23 kg/ha).

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Halogenation - a cost effective method for enhancing longevity of soybean seeds

Subrata Sharma, Sathrupa Rao and **J.P. Lakhani**
Seed Technology Research Unit
Department of Plant Breeding & Genetics
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract

Freshly harvested and processed soybean seeds of varieties JS 335 and JS 90-41 were dried to safe moisture limits (8%) and treated with different doses of halogenation mixture to identify and standardize the suitable dose that can effectively enhance the longevity of soybean seeds. Results indicate that 2 g. halogenation mixture/kg seed was suitable for enhancing the germination and vigour of soybean seeds for longer duration (15 months), hence can be used for long term storage of soybean seed.

सोयाबीन किस्म जे.एस. 335 व जे.एस. 90-41 के नवीन पैदावार फसल को छाँव में सुरक्षित भंडारण नमी 8%) तक सुखाकर इन्हें विभिन्न मात्रा के हैलोजिनीकरण चूर्ण द्वारा उपचारित किया ता उपयोक्त मात्रा का हैलोजिनीकरण चूर्ण का मानकीकरण किया जा सके जो सोयाबीन बीज के भंडारण में बीज की आयु वृद्धि करे। दो ग्राम हैलोजिनीकरण चूर्ण प्रति किलोग्राम सोयाबीन बीज में मिलाकर उनकी अंकुरण क्षमता व ओज को अधिक समय तक (15 महिने) बढाये रखने में सहायक पाया गया अतः दीर्घकालीन सोयाबीन भंडारण में इसका उपयोग कर बीजों को अधिक समय तक सरक्षित रखा जा सकता हैं।

Keywords: Halogenation, germination %, vigor index

The seed is a miniature living material. Almost all of our reliance on plant production depends ultimately on the germinability of their seeds. While, much of the harvested seed is utilized for consumption, the material to be replanted is stored until the next sowing season. Additionally, long term storage of the gene pool is required for conservation, breweding and improvement purposes. This can be attained by maintaining 'dry seeds' under suitable storage conditions.

In the recent past years, fluctuation in climate during seed development is another factor that is deleterious to the life of seed. Our farmers are facing grave and recurring problems in storage and maintaining seed vigor and viability sometimes even for a single crop season.

Practically, though ageing of seed cannot be stopped totally, it can however, be reduced by adopting suitable methods for storage technologies. But, these methods are very expensive and call for an effective storage technology feasible for large scale adoption at a reasonable cost. This urges the need to understand the deterioration process in seed. Basu (1976) proposed the concept of free radical production as the basic source of seed deterioration. A number of crop seeds given hydration treatment with water or very dilute solution of anti-oxidant chemical has been effective in controlling physiological deterioration (Dharmalingam and Basu 1989/1990) upto a certain extent. But this method did not gain adoption by farmers and producers in large scale due to the complication and labour involved in the treatment.

Thus, the need arises for a pre-storage seed treatment that can be followed up along with routine storage operation and easy to handle. The presently developed dry dressing halogenation treatment (Dharmalingam 1982) has a more practical and effective approach in enhancing seed longevity. Keeping this in view the present trial has been taken up in soybean to assess the effective dose of halogenation mixture required for enhancing the shelf life of soybean seeds in bulk storage.

Material and methods

Considering the multifold advantages of halogenation treatment , the present investigation was taken up in two varieties of soybean JS 335 and JS 90-41. Soon after harvest, the seeds of both the varieties were shade dried to bring down their moisture content to 8% (safe storage moisture limit) prior to storage. The seeds were then treated with different doses of halogen mixture as mentioned

below and stored in hermetically sealed containers (poly-lined gunny bags) for storage. The halogenation mixture was prepared by mixing Calcium carbonate and bleaching powder in the ratio 1:1. The treatments are as mentioned below:

Varieties: V_1-JS 335, V_2-JS 90-41

Treatments: T_1-Control; T_2-2g halogenation mixture/kg seed; T_3-3g halogenation mixture/kg seed; T_4-Thiram @ 0.25%; T_5-2g halogenation mixture + 0.25% thiram/kg seed. T_6-3g halogenation mixture + 0.25% thiram/kg seed.

After processing and drying to safe moisture limit, the seeds were packed and kept undisturbed in the store till next sowing season (6 months). After that the seeds were removed from each container at bimonthly intervals and tested for the parameters (i) Laboratory germination; (ii) Seed moisture content; (iii) Vigor Index (germination % x seedling dry weight).

Results and Discussion

The laboratory observations were recorded after six months of storage with onset of monsoon and thereafter at bimonthly intervals to estimate their storage seed moisture, germinability and vigor index.

The seed moisture remained within safe limits during the entire storage period. Although the seed moisture increased slightly during the rainy season, yet it did not exceed the mean standards recommended for safe seed storage (8-10%). The seeds had been stored in poly-lined gunny bag which, being moisture impervious offered a protective covering to the seeds within. Hence, the seeds were not affected much by the external environmental moisture during storage and had less fluctuation in seed moisture during entire storage duration.

The seed germination % remained above MSCS (minimum seed certification standards) in all the treatments initially and after six months of storage and it dropped below MSCS in control at eleven months of storage. Bewley and Black (1994) reported loss of membrane integrity to lead to leaching out of sugars and amino acids as a reason for seed deterioration. The mitochondria of deteriorated seeds of soybean take up 10-40% more oxygen than those of fresh seeds, but, the amount of ATP produced is much less than that of fresh seeds. The seed germination % and vigor index remained above MSCS for maximum duration (15 months) in T_2 (2g halogenation mixture/kg seed followed by T4 (Thiram @ 0.25% treated seed). The reason may be that the halogens are readily vaporized at room temperature and taken up by the unsaturated fatty acid component of the seed causing stability and extending seed longevity. The germination % dropped by increasing the dose of halogenation mixture in T_3. The seed germination and vigor index decreased gradually with period of storage. The higher germination and longevity of halogenated seeds could be probably due to their reduced physiological deterioration by stabilization of the unsaturated fatty acid component of the lipo-protein in the cell membrane and also reduced lipid peroxidation and free redical reaction (Pal and Basu 1988). Further, the halogens possess microbial (Ravichandran and Dharmalingam 1994) and insecticidal (Vasantha 1995, Malarkodi et al. 2000) properties that offer protection against storage pathogen and pest, thus controlling seed deterioration to a greater extent. Similar has been reported by Dharmalingam and Malarkodi (2002).

Overall, the varieties, treatments and period of storage had significant impact on seed moisture, seed germination % and vigor index. The effect of varieties on treatments (interaction VxT) and months (VxM) was significant during the entire storage period. Interaction TxM (treatment x month) was significant for seed germination % and vigor index. Hence, it could be concluded that dry halogenation of soybean seed @ 2 g. halogenation mixture/kg can safely retain germinability an vigor till next sowing season.

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Table 1. Effect of halogenation on longevity of soybean seeds

Parameter Months of storage	7	9	11	13	15	17	7	9	11	13	15	17	7	9	11	13	15	17
V_1T_1	8.90	9.40	8.82	8.22	7.87	8.32	81.0	74.0	60.5	53.5	42.0	37.0	73.29	61.18	50.34	34.63	24.59	18.85
$V1T_2$	8.67	9.37	8.25	8.12	7.85	8.27	88.5	84.0	82.0	79.5	78.0	69.5	80.10	74.65	70.05	67.99	51.50	44.61
V_1T_3	8.75	9.50	8.80	8.05	8.10	8.45	87.5	85.0	75.5	72.5	69.5	67.0	74.38	69.20	89.05	60.41	45.36	39.97
V_1T_4	8.95	9.17	8.55	8.22	8.02	8.10	83.0	80.5	78.0	75.0	74.5	64.0	70.54	66.05	64.43	63.30	48.08	38.48
V_1T_5	8.95	9.47	8.47	8.42	7.82	8.12	90.0	85.5	79.5	77.0	71.5	64.5	72.21	69.49	66.65	58.45	46.23	40.34
V_1T_6	9.05	9.22	8.20	8.12	8.20	8.27	90.5	81.0	78.5	72.5	70.5	64.5	79.80	68.20	58.75	53.71	42.81	30.17
V_2T1	9.10	9.40	8.47	8.20	8.10	8.35	80.5	78.0	67.5	52.0	49.5	34.0	78.55	48.29	53.59	32.79	24.95	14.29
V_2T_2	8.85	9.40	8.47	8.35	8.17	8.47	88.0	83.5	81.0	79.0	76.0	68.0	73.47	70.36	66.54	66.00	58.58	42.70
V_2T_3	9.00	9.37	8.35	8.30	8.10	8.27	90.5	86.0	82.0	76.5	71.5	66.0	68.72	58.23	58.77	55.94	45.03	35.04
V_2T_4	9.40	9.82	8.10	8.50	7.87	8.25	86.0	81.5	78.5	74.0	72.5	64.0	66.82	65.08	59.90	57.08	47.03	39.79
V_2T_5	8.97	9.27	8.15	8.30	8.07	8.37	85.5	80.0	76.0	69.0	64.0	62.0	70.40	66.65	55.13	52.68	39.29	27.52
V_2T_6	9.15	9.15	8.52	8.30	7.97	8.15	86.5	79.0	75.5	74.5	71.0	58.5	73.03	62.08	56.46	49.88	44.91	21.32
CD																		
Variety (V)		NS			11.5				2.46									
Treatment (T)		0.05			1.39				1.39									
V x T		0.08			1.96				1.96									
M		0.05			1.13				1.51									
V x M		0.07			1.61				2.13									
T x M		NS			2.78				3.70									

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Effect of various pre-harvest treatments on yield, quality and shelf-life of aonla fruits

Sharad Bisen, P.K. Jain and **R.S. Thakur***
Department of Horticulture
*Department of Food Science & Technology
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract

Pre-harvest application of calcium nitrate (0, 1.0, 1.5, 2.0%) and urea (0, 1.0, 2.0%) were given as spray before harvest on aonla cv. Narendra Aonla 7. In all 12 treatments were evaluated to asses their effect on yield, quality and shelf-life of aonla fruits. It was concluded that the fruit diameter, fruit fresh weight, fruit volume, specific gravity, stone weight and pulp-stone ratio, moisture content, total soluble solids, acidity, ascorbic acid, total sugar and yield were significantly increased with the use of chemicals. The solution of two per cent calcium nitrate in combination with two per cent urea was found as the most effective pre-harvest treatment for increasing the shelf-life of the aonla.

आंवला (किस्म नरेन्द्र आंवला 7) के पौधों पर तडाई पर्व कैल्शियम नाईटेट (0%, 1.0%, 1.5%, 2.0%) एवं (0%, 1%, 2%) यूरिया का विभिन्न सान्द्राताओं में छिडकाव किया गया। सभी 12 उपचारों को उपज, गुणवत्ता एवं भंडारण क्षमता पर उनके प्रभाव को निर्धारित करने के लिये मूल्यांकन किया गया. परिणाम स्वरुप रासायनों के प्रयोग से फलों के भौतिकीय गुणों, जैव रासायनिक गुणों में वृद्धि पायी गयी इन रासायनों में 2 प्रतिशत कैल्शियम नाइटेट एवं 2 प्रतिशत यरिया के घोलका छिडकाव भंडारण के लिये अच्छे पाये गये।

Keywords: Foliar application, shelf life, urea, calcium nitrate

Aonla (*Emblica officinalis* G.) also known as Indian goose berry, belongs to the family Euphorbiaceae, is a minor sub-tropical deciduous fruit crop with medicinal value. It is grown across the country in an area of 50,000 ha producing 2.25 lakh tons annually along with average productivity of 4.05 T/ha (Pathak et al. 2002). Aonla is one of the most nutritious fruit, second richest source of Vitamin 'C' and has high content of tannin, which has antioxidant property, rich in pectin and could be used for preparing murraba, pickles and candy (Nath and Sharma 1998).

Material and methods

The investigation was carried out on aonla Narendra Aonla 7 at experimental orchard station and P.G. laboratory of the section of Horticulture, College of Agriculture Indore, Madhya Pradesh during 2006-2007. The plants were maintained with uniform cultural operations throughout the experimentation. Nine year old plants of aonla uniform in vigor and productivity were selected as experimental material to find out the response of foliar application of calcium nitrate and urea on yield, quality and shelf life of aonla fruits. The first spray of urea at different level was done on 30th Sept. 2006 and second spray of calcium nitrate on 30th Dec, 2006 with all its level. The fruits were harvested on 15th Jan, 2006 at the appropriate physiological maturity. The cultivar given to following treatments: calcium nitrate and urea were sprayed in 12 treatment combination C_0+N_0, C_0+N_1, C_0+N_2, C_1+N_0, C_1+N_1, C_1+N_2, C_2+N_0 , C_2+N_1, C_2+N_2, C_3+N_0, C_3+N_1, C_3+N_2 as Calcium Nitrate (0, 1, 1.5, 2 %) and Urea (0, 1, 2%). The treatments were completely randomized and the physical characters were studied that include fruit diameter, fruit weight, fruit volume, specific gravity of fruit, stone weight, pulp-stone ratio, physiological loss in weight (PLW) and yield. The chemical composition of aonla fruits with respect to moisture content, total soluble solids (TSS), total sugar, titrable acidity, ascorbic acid and calcium content contents were determined by (AOAC 1980) by taking the samples from extracted juice of fruits. The analysis of variance for the design of experiment i.e. RBD was carried out according to the procedure outlined by Panse and Sukhatme (1985). The significance of difference among treatment means was tested by "F" test.

Results and Discussion

The maximum fruit diameter and fresh fruit weight was

Table 1. Effect of various pre-harvest treatments on physical characters on Aonla

Treatments	Fruit diameter (cm)	Fruit fresh weight (g)	Fruit volume (cc)	Specific gravity (g/cc)	Stone weight (g)	Pulp-stone ratio	Yield (kg/ha)
T_1 (C_0+N_0)	4.50	46.42	48.37	1.02	1.74	18.97	3968
T_2 (C_0+N_1)	4.87	49.50	49.87	1.15	2.00	17.57	4498
T_3 (C_0+N_2)	4.97	50.70	52.00	1.21	2.13	16.78	4528
T_4 (C_1+N_0)	4.82	47.65	49.02	1.04	2.08	17.43	5201
T_5 (C_1+N_1)	5.00	48.63	51.77	1.18	2.16	16.70	5223
T_6 (C_1+N_2)	5.18	51.03	52.57	1.24	2.31	15.58	5240
T_7 (C_2+N_0)	5.08	48.17	53.13	1.04	2.14	16.72	5365
T_8 (C_2+N_1)	5.47	49.37	51.60	1.13	2.40	15.81	6830
T_9 (C_2+N_2)	5.65	51.57	51.10	1.25	2.46	15.74	7956
T_{10} (C_3+N_0)	5.17	50.87	52.80	1.07	2.18	17.21	7576
T_{11} (C_3+N_1)	5.40	52.43	53.77	1.16	2.34	16.22	8557
T_{12} (C_3+N_2)	5.67	56.45	55.45	1.28	2.46	15.15	8982
SE(m)±	0.091	1.23	0.279	0.016	0.175	0.573	134.4
CD at 5%	0.25	3.41	0.77	0.04	0.49	1.59	372

recorded with the foliar application of T_{12} followed by use of T_9. Fruit volume was found significant at treatment T_{12} over control. The second and third highest fruit volume was noticed by application of T_{11} and T_7. The reason for increase in fruit diameter made due to the availability of nitrogen through calcium nitrate or urea might be attributed for efficient movement, absorption and consequently more luxuriant vegetative growth in the initial stage which influenced more activity of metabolism in plant and attributed in better development of fruit. These findings were in conformity with the findings of Singh et al. (2004) and Joon et al. (1984).

The maximum specific gravity was recorded with the foliar application of T_{12}. The specific gravity of fruit was not found to be influenced significantly by different treatments. It might be due to increase in the weight and volume of fruit in the same proportions under different treatments. These results are in agreement with the findings of Singh et al. (2004); Saule and Harding (1958); Pathak (1965); Pandey et al. (1990); Singh et al. (1993).

In this investigation the significantly highest pulp-stone ratio was recorded with the foliar application of T_1 followed by use of T_2 and T_4. These results are in closed conformity with the findings of Singh et al. (2004); Singh et al. (1993).

The increase in fruit yield is possibly due to the direct or indirect involvement of nutrients which provide more metabolites for the growth and development of fruits by increase in metabolic activities. These activities improve their size, weight and volume; and thus ultimately increased the total yield of fruits. The fruit yield was recorded maximum with the spray of T_{12}, which was found statistically at par with the application of T_{11} and significant effect was recorded under all the treatments over control (water spray). These findings match with observations of earlier workers thiourea improved the yield of ber (Yadav et al. 1999).

Maximum moisture content was recorded with the foliar application of T6 followed by use of T_3. The lowest moisture content was recorded with the use of T_1.

In present study significantly highest accumulation of total soluble solids in aonla fruits was found with spray of T_{12} (10.58 ^{0}B) followed by T_9 (10.52 ^{0}B). There was no significant variation in T_{12}, T_9 and T_6 and thus found at par with each other. By the application of 2 per cent urea TSS was highest at all level of calcium nitrate. Similarly, with the use of 2 per cent calcium nitrate result maximum total soluble solids as compared to all levels of urea. Increase in TSS of fruit pulp by foliar application of urea might be due to the availability of more assimilates as a result of nitrogen availability to fruit trees (Bhati and Yadav 2003). Similarly, Singh et al. (2004) presented result that foliar feeding of urea at 1.0 per cent and 2.0 per cent increases TSS in aonla fruit. Yadav et al. (2002) recorded the 1 per cent calcium nitrate increases TSS in aonla fruit. Singh (1987) observed that TSS content was highest with foliar spraying of 25 per cent urea on Allahabad safeda (Arora and Singh 1970).

The used different treatments significantly influenced the acidity per cent in aonla fruits. Treatment T_{12} (2.42%) was found significantly effective over control. The corresponding increase in acidity might be due to increase in availability of more nitrogen to the fruit trees which is the constituents of various energy sources like

Table 2. Effect of various pre-harvest treatments on biochemical characters on Aonla

Treatments	Moisture content (%)	Total soluble solids (^{0}Brix)	Acidity (%)	Ascorbic acid (mg/100 g)	Total sugar (%)	Calcium content (mg/100 g)
T_1 (C_0+N_0)	66.43	8.57	2.04	504	4.86	755
T_2 (C_0+N1)	70.37	9.45	2.15	519	5.21	786
T_3 (C_0+N_2)	72.57	10.05	2.30	555	5.39	815
T_4 (C_1+N_0)	68.10	9.57	2.18	524	5.14	779
T_5 (C_1+N_1)	71.80	9.80	2.32	548	5.32	809
T_6 (C_1+N_2)	73.30	10.37	2.39	559	5.52	818
T_7 (C_2+N_0)	68.33	9.63	2.21	544	5.31	801
T_8 (C_2+N_1)	70.40	9.90	2.31	565	5.42	815
T_9 (C_2+N_2)	71.77	10.52	2.41	580	5.46	822
T_{10} (C_3+N_0)	68.70	9.72	2.25	563	5.39	816
T_{11} (C_3+N_1)	69.60	10.18	2.32	577	5.48	830
T_{12} (C_3+N_2)	70.77	10.58	2.42	588	5.75	846
SE(m)±	0.524	0.104	0.033	3.91	0.067	3.10
CD at 5%	1.45	0.29	0.09	10.84	0.19	8.59

amino acids and amino-sugars. The similar findings were also reported by Yadav et al. (2002) found that 1 per cent calcium nitrate increases total acidity in aonla fruit. Singh et al. (2004) presented result that foliar feeding of urea at 1.0 per cent and 2.0 per cent increases acidity in aonla fruit.

The ascorbic acid content significantly influenced by the spraying of different treatments. It was highest for the foliar application of T_{12} (588 mg/100g) followed by T_9 (580). The increased ascorbic acid content of fruit juice might be associated with the catalytic activity enzyme and co- enzyme which, are represented ascorbic acid and synthesized. These findings are in agreement with the findings of Yadav et al. (2002) who found that 1 per cent calcium nitrate increases ascorbic acid in aonla fruit. Singh et al. (2004) presented result that foliar feeding of urea at 1.0 per cent and 2.0 per cent increases ascorbic acid in aonla fruit.

The maximum total sugar was recorded with the foliar application of T_{12} (5.75%) followed by T_6 (5.52%). This might be associated with higher translocation of food and minerals from other parts of the plant towards the developing fruit that are active metabolic site. The spray of these chemicals increased the availability of nutrients needed in photosynthesis which ultimately lead into the accumulation of carbohydrates and attributed to increase in total sugar. This increase in total sugars might be associated with transformation of pectic substances, starch, hemicellulose and other polysaccharides into soluble sugar. Jutamanee et al. (2001) concluded that the calcium nitrate in the water-soluble form increases the sugar content of fruit. Yadav et al. (2002) found that 1 per cent calcium nitrate increases total sugar in aonla fruit.

The most effective treatment for calcium content in fruits was T_{12} (846 mg/100 g) followed by T_{11} (830 mg/100 g). Similarly the increase in calcium content in aonla fruit by direct application of calcium to the fruit was found the most effective method by Conway et al. (2002) and Lanauskas et al. (2001) investigated the effect of calcium fertilizer sprays on apple trees, they found the most significant effect of calcium fertilizers on fruit calcium content. When fertilizers were applied sevenfold, fruit calcium increased by 50-120 mg/kg of dry fruit weight in comparison with control.

The per cent physiological loss in weight (PLW) was an important parameter in maintaining the flesh freshness of the fruit. All the treatment showed a decreasing trend PLW when it proceeds from control to treated fruits in all successive days of storage. The higher weight loss of untreated fruits is due to increased storage breakdown associated with higher respiratory rate as compared to calcium treated fruits. The highest shelf-life on the basis of physiological weight loss was recorded with the foliar application of T_{12} 15 days after harvest followed by T_7 and T_4. The lowest shelf-life was recorded with the use of T_1. Carpita et al. (2000) observed calcium is an important element in the composition of the plant cell wall contributing to farm ionic links between negatively charged polysaccharides, particularly the pectin fraction is believed to be the most important cell wall component to impart firmness to the plant tissue, and in particular

Table 3. Physiological loss in weight (PLW %) of aonla as influenced by foliar application of different levels of calcium nitrate and urea

Treatments	5 days	10 days	15 days
T_1 (C_0+N_0)	3.54	5.97	9.16
T_2 (C_0+N_1)	3.67	6.10	8.70
T_3 (C_0+N_2)	3.66	5.81	8.65
T_4 (C_1+N_0)	3.65	5.84	5.65
T_5 (C1+N_1)	3.62	5.72	8.54
T_6 (C_1+N_2)	3.60	5.99	5.56
T_7 (C_2+N_0)	3.58	5.94	9.13
T_8 (C_2+N_1)	3.69	6.10	8.70
T_9 (C_2+N_2)	3.51	5.99	8.67
T_{10} (C_3+N_0)	3.36	5.63	8.52
T_{11} (C_3+N_1)	3.34	5.66	8.45
T_{12} (C_3+N_2)	3.18	5.30	5.19
SE(m)±	0.034	0.109	0.842
CD at 5%	0.097	0.312	2.406

when pectin forms a tight polymeric network. Kumar et al. (2004) found that the percent physiological loss in weight (PLW) was an important parameter in maintaining the flesh freshness of the fruit. Faust (1978) reported that the higher weight loss of untreated fruits is due to increased storage breakdown associated with higher respiratory rate as compared to calcium treated fruits. Singh et al. (1987) concluded that the calcium nitrate as treatments had been reported to reduce the PLW by maintaining flesh firmness and retarding the rate of transpiration through fruit surface in guava. Nath et al. (1992) concluded that the calcium nitrate as treatments had been reported to reduce the PLW by maintaining flesh firmness and retarding the rate of transpiration through fruit surface in aonla.

It was concluded that the fruit diameter, fruit fresh weight, fruit volume, specific gravity, stone weight and pulp-stone ratio, moisture content, total soluble solids, acidity, ascorbic acid, total sugar and yield were significantly improved at two per cent concentration of urea.

Pre-harvest treatment of two per cent calcium nitrate was adjudicated as the most effective concentration, helped in increasing the fruit diameter, fruit fresh weight, fruit volume, specific gravity, stone weight , moisture content, total soluble solids, acidity, ascorbic acid, total sugar, yield and pulp-stone ratio in the aonla fruit. The two per cent calcium nitrate in combination with two per cent urea solution was found as the most effective pre-harvest treatment helped in increasing the shelf life of the aonla fruits after fourteen days of storage and the PLW at ambient temperature of storage was significantly minimum than untreated fruits.

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Effect of paclobutrazol on growth and yield of mango

V.K. Singh*, A.K. Singh, Deepak Rathi and **K.C. Shukla**
College of Agriculture, Tikamgarh, JNKVV, Jabalpur (MP)
*Regional Agricultural Research Station, Rajori
Sher-E-Kashmir Univ of Agricultural Sciences & Technology (J&K)

Abstract

An experiment was carried out to study the effect of paclobutrazol on growth and yield of Mango in factorial Randomized Block design replicated thrice Interaction between cultivars and paclobutrazol showed significant differences for percent increase in shoot length and internodal length which were significantly lower with the combination of Langra x 7.5 g paclobutrazol, closely followed by Dashehari x 7.5 g paclobutrazol. The highest values for shoot length and internodal length were recorded in Chausa x control. The higher fruit yield per tree was recorded in the combination of Dashehari x 5.0 g paclobutrazol closely followed by Langra x 5.0, 7.5 and 2.5g paclobutrazol. The lower fruit yield per tree was recorded in the combination of Dashehari x control and Langra x control.

यह अध्ययन आम की विभिन्न प्रजातियों की फल उत्पादन तथा विकास पर पेक्लोब्यूटाजॉल का प्रभाव देखने हेतु किया गया। इस प्रयोग के परिणाम यह प्रदर्शित करते हैं कि पेक्लोब्यूटाजॉल 7.0 ग्राम आम की सभी प्रजातियों में शाखा लम्बाई तथा पर्व संधि की लम्बाई कम करने में सार्थक प्रभाव दर्शाता है। आम प्रजाति दशहरी व पेक्लोब्यूटाजॉल 5.0 ग्राम संयोजन में उच्चतम फल उत्पादन प्राप्त हुआ. जबकि निम्नतम फल उत्पादन दशहरी व नियंत्रण प्रखण्ड द्वारा प्राप्त हुआ।

Keywords: Paclobutrazol, mango cultivars, growth and yield

Mango (*Mangifera indica* L.) the most luscious fruit has been recognized as the 'King of Fruits' in India long back. India ranks first in area and production of mango in the world (Shikamany and Sudha 2004).

Vegetative and reproductive growth are antagonistic to each other, mango produces more vegetative growth than reproductive growth. It remains vegetative for longer periods. Vegetative growth utilizes much of the photosynthesis soon after their synthesis and will not allow their accumulation which is vital for flowering. It was conceived that by inhibiting the vegetative growth, the accumulation of carbohydrates can be achieved and this makes the tree more conducive for flowering (Babu and Jyothi 2004).

Paclobutrazol belongs to triazoles, a group of growth retardants. PBZ is broad spectrum plant growth retardants. In trade it is called with different names, cultar, sadabahar, parlay, clipper etc. PBZ is an inhibitor of gibberellins synthesis and thus said to be anti-gibberellins. PBZ is well known as a promoter of flowering.

Material and methods

The experiment was carried out in factorial randomized block design replicated at the main experiment station, Department of Agricultural Sciences, Banaras Hindu University, Varanasi. The experiments were conducted on mango cultivars Dashehari, Langra and Chausa. Which are the most popular varieties among north Indian mango cultivars and exhibit alternate bearing behaviour.

Application of different doses of paclobutrazol viz., 2.5, 5.0 and 7.5 gm per canopy diameter along with control was done. Paclobutrazol was applied once in a year i.e. 15th Sept. 2000 and 2001 in soil around the tree canopy spread, in the next year half dose was applied in view that the PBZ possesses 50 percent residual effect after one year of its application in the soil/plant. The following parameters viz. length, total number of fruit/tree and yield were recorded at harvest.

Results and Discussion

Significantly less increase in shoot length was observed in cultivar Langra (2.06%) which was similar to Dashehari (2.32%). The higher shoot length was noted in Chausa (2.91%). Among various doses of paclobutrazol, lower increase in shoot length was recorded in 7.5 gm paclobutrazol (0.86%) followed by 5.0g paclobutrazol (1.87%). Highest increase in shoot length was recorded in control (4.48%). Interaction also showed lowest

Table 1. Effect of paclobutrazol on growth and yield of different varieties of mango

Particulars	Length of shoot 2000	Length of shoot 2001	% increase	Internodal length 15 Sept.	Internodal length 15 July	% increase	No. of fruits/plant	fruit yield/ tree (kg)
V_1 Dashehari	11.91	12.185	2.32	2.74	2.85	3.77	418.6	101.03
V_2 Langra	10.89	11.135	2.265	2.67	2.785	4.245	367.45	97.78
V_3 Chausa	10.16	10.45	2.91	2.57	2.69	4.82	331.33	94.84
SEm±	0.2	0.19	0.05	0.01	0.03	0.10	7.86	2.00
CD at 5%	0.59	0.57	0.14	0.04	0.09	0.32	23.04	5.88
T_0 control	10.57	11.04	4.48	2.63	2.85	8.29	285.11	78.04
T_1paclobutrazol 2.5 g/tree	10.50	10.79	2.78	2.69	2.73	3.91	377.84	98.37
T_2 paclobutrazol 5.0 g/tree	11.02	11.74	1.87	2.66	2.73	2.88	431.34	112.65
T_3 paclobutrazol 7.5 g/tree	10.84	11.44	0.85	2.63	2.69	2.03	416.75	102.95
SEm±	0.23	0.22	0.05	0.01	0.03	0.12	9.07	2.31
CD at 5%	0.68	0.655	0.16	0.044	0.11	0.365	26.6	6.79
V_1xT_0 Dashehari x control	11.51	11.96	3.9	2.65	2.86	7.94	300.32	78.82
V_1xT_1 Dashehari x 2.5 g paclobutrazol	11.80	12.11	2.62	2.81	2.89	2.98	433.60	102.50
V_1xT_2 Dashehari x 5.0 g paclobutrazol	12.01	12.22	1.74	2.73	2.80	2.38	493.93	117.11
V_1xT_3 Dashehari x 7.5 g paclobutrazol	12.30	12.43	1.01	2.72	2.77	2.01	447.15	105.7
V_2xT_0 langra x control	10.28	10.74	4.47	2.60	2.81	8.05	276.06	74.20
V_2xT_1 langra x 2.5 g paclobutrazol	10.13	10.34	2.11	2.68	2.79	4.10	385.21	102.44
V_2xT_2 langra x 5.0 g paclobutrazol	11.32	12.03	1.73	2.66	2.74	3.00	409.10	108.8
V_2xT_3 langra x 7.5 g paclobutrazol	11.33	11.42	0.74	2.67	2.71	1.49	399.41	105.67
V_3xT_0 Chausa x control	9.93	10.44	5.08	2.65	2.89	8.87	278.95	81.08
V_2xT_1 Chausa x 2.5 g paclobutrazol	9.56	9.86	3.62	2.60	2.72	4.60	314.70	90.17
V_3xT_2 Chausa 5.0 g paclobutrazol	10.74	10.97	2.13	2.59	2.67	3.28	390.98	112.02
V_3xT_3 Chausa x 7.5 g paclobutrazol	10.39	10.47	0.81	2.52	2.58	2.58	340.70	97.48
SEm±	NS	NS	0.09	0.02	NS	0.21	15.71	NS
CD at 5%	NS	NS	0.28	0.06	NS	0.63	46.08	NS

increase in shoot length of Langra x 7.5g paclobutrazol (0.74%) which was similar with Chausa x 7.5 g paclobutrazol (0.81%) and Dashehari x 7.5 g paclobutrazol (1.01%). The lowest increase in shoot length with paclobutrazol seems to be due to restricted cell elongation caused by reduction or blocking of the gibberellins bio-synthesis. The minimum length of terminal shoot (9.49 cm) was recorded in soil application of cultar at 5 g a.i./plant which was closely followed by soil application of cultar at 10 g a.i./tree in mango (Singh and Singh 2003).

Among the cultivar lowest internodal length of 3.77 per cent was recorded with Dashehari followed by langra 4.24% while it was highest 4.82% in chausa. Paclobutrazol 5.0 g dose reduce the internodal length 2.88% significantly while in case of combination 7.5 g x langra recorded the lowest internodal length 1.49% which is confirmed by the findings of Kulkarni (1988) they found that paclobutrazol reduced the internodal length by 53-90 per cent in mango.

Significantly highest number of fruits per plant and number of fruit yield per tree was recorded in dashehari 419 and 101 kg followed by langra 367 and 97 kg while these two attributes recorded were least with chausa 331 and 95 kg respectively. Application of paclobutrazol reveled that 5.0 g paclobutrazol recorded that highest number of fruits per plant and fruit yield per tree of 431 and 113 kg per tree respectively where as these were lowest in control 285 and 78 kg per tree respectively. Interaction of paclobutrazol and mango cultivars indicated that maximum fruits per tree was produced by combination Dashehari x paclobutrazol 5.0 g (494) closely followed by chausa x 7.5 g paclobutrazol (447) while it was recorded lowest with the combination of langra x control. 276 fruits per tree. The findings are in agreement with Kumar (1999) in mango. Although the numerical value for interaction was non significant but the fruit yield per tree was highest (117.11 kg) with the combination of dashehari x 5.0 g paclobutrazol. It is apparent from the results that paclobutrazol 5.0 g performed better in combination with variety Dashehari over rest of the dose and variety of mango.

It is concluded that the 7.5 g paclobutrazol is the best combination to reduce shoot length and internodal length while to harvest higher fruit per tree and fruit yield per tree 5.0 g paclobutrazol proved to be the best concentration over rest of the treatment.

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Genetic variability, heritability and genetic advance in Indian bean [*Lablab purpureus* (L.) sweet]

K.K. Gupta, T.R. Sharma and **Rajani Tomar**
Directorate of Extension
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract

Phenotypic and genotypic coefficient of variation, heritability with expected genetic advance of Indian bean were calculated using 18 treatments viz., 16 genotypes and 2 checks in Randomized Complete Block Design (RCBD) using three replications. High phenotypic coefficient of variation was observed for pod yield per plant (41.98%), pod yield quintal per hectare (32.82%), pod weight (41.64%), pod girth (39.59%), number of pods per cluster (32.06%) and pod breadth (27.89%). However, low phenotypic coefficient of variation was observed for the characters protein percent (11.91%), number of seeds per pod (16.46%), test weight (17.15%), days to first picking (20.55%) and number of flowers per cluster (20.57%). Moderate to high heritability with high genetic advance as percentage of mean was observed for characters like days to first flowering, days to 50% flowering, number of flowers per cluster, days to first picking, pod breadth, weight of pod, test weight, pod yield per hectare. The findings revealed that these characters were controlled by additive gene effect and consequently has less environmental effect thus could be improved through direct selection.

फिनोटिपिक और जीनोटिपिक विभिन्नता गुणांक एवं व
हेरिटेबिल्टी सम की एडवांस संततियों की 18 उपचारों के साथ गणना
हेतु रेन्डोमाजड कम्लीट ब्लाक डिजाइन का तीन अनुकरण में उपयोग
किया गया। उच्च विभिन्नता का गणांक फली उपज/पौधा (41.95%),
फली उपज/ हेक्टेयर 32.82%), फली वजन 41.64%), फली
परिध (39.59%), फली संख्या/गुच्छा 32.06%), और फली
चौडाई (27.89%) में उच्च फिनोटाइप गणांक प्राप्त हुआ। जब
प्रोटीन 11.91%) दाने/फली 16.46%), दानों का व
(17.15%), प्रथम तुडाई के दिन 20.55%) एवं फल/क्लस्ट
(20.57%) में फिनोटाइप गुणांक में कमी देखी गई। प्रथम फल
आना, 50 प्रतिशत पुष्पन, फल प्रति गुच्छा, प्रथम तुडाई दिव, फल
की चौडाई, फली वजन, दानों का भार एवं उपज प्रति हेक्टेयर में मध्यम
से उच्च हेरिटेबिल्टी के साथ उच्च एडीटिव एडवांस का औसत प्रतिशत
देखा गया। इससे परिलक्षित होता है कि एडीठिर जीन का प्रभाव होता
है परन्तु वातावरण का प्रभाव उक्त लक्षणों पर सधार प्रक्रिया के नियंत्रण
में उतना नहीं होता है।

Keyword: Phenotypic and genotypic coefficient of variation, heritability, genotypes

Lablab bean [*Lablab purpureus* (L.) sweet] commonly known as sem is an important vegetable grown in India and is very nutritive vegetable grown for fresh consumption as well as dry seeds are used as pulse. It can be grown easily under different agro climatic conditions due to its wide adoptability. Uttar Pradesh, Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, Haryana and West Bengal are the major sem growing states. It is therefore, necessary to select variety having desired pod quality with high yield potential. Genetic improvement of any crop depends on the nature extend of genetic variability and also on magnitude and interrelationship of phenotypic and genotypic variation in yield and yield attributing characteristics. A wide range of variability exists in pod shape, size and colour and other agronomic characters in lablab bean. Information on nature and magnitude on variability present in a population is a pre-requisite for starting a systematic breeding programme. Identification of superior genotypes among the existing germplasm becomes imperative for promoting production per unit area of the crop. Heritability is an index of transmissibility of a character from parents to their off springs. But, heritability alone does not give true picture of genetic improvement through selection, therefore, study of Genetic advance coupled with heritability are more useful in predicting the resultant effect of selection. The present investigation was undertaken to assess the genetic variability, heritability and genetic advance.

Material and methods

The experiment was conducted at Vegetable Research Farm (22^0 49' and 20^0 80' North latitude and 78^0 21' and

80^0 58' East latitude), Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.), during 2009-10. The soil of the experimental field was sandy loam with low organic carbon (0.55) slightly saline pH, low available nitrogen (220 kg/ha) and phosphorus (9.60 kg/ha) and high potassium (820 kg/ha). The average annual rainfall is 1350 mm mostly received during June to October; average maximum temperature reaches up to 46^0C and minimum 6.8^0C with average annual relative humidity 74%. The experiment was laid out in Randomized Complete Block Design (RCBD) using three replications and 18 treatments (16 genotypes + 2 checks). Sowing of lablab bean was done on 16th July 2009 at a spacing 30 cm between plants and 60 cm between the row with 12 pants in a row and 5 rows in a plot. The net plot size was 3.6 x 3 m^2 and net experimental area was 311 sq m. A basal fertilizer dose of 60:40:40 kg/ha (NPK) in each plot was applied. Recommended cultural practices and plant protection measures were followed. Observations were recorded from five randomly selected plants on twenty one quantitative phenological, growth and yield and two quality parameters. Observations were also recorded on incidence of pest and diseases. Phenotypic and genotypic coefficient of variation (expressed in %) were calculated by using the formula given by Burton (1952), heritability by the formula given by Hanson et al. (1956) and expected genetic advance was calculated by using the method suggested by Johnson et al. (1955) at 5% selection intensity.

Results and Discussion

Analysis of variance for different characters under study revealed that the treatment effects were highly significant suggesting existence of high genetic variability in the population (Table 1 and Table 2). The phenotypic coefficient of variation (PCV) were slightly higher than their corresponding genotypic coefficient of variation (GCV) due to environmental influence. Comparatively high value of phenotypic coefficients of variation were observed for pod yield per plant (41.98%), pod yield quintal per hectare (32.82%), pod weight (41.64%), pod girth (39.59%), number of pods per cluster (32.06%) and pod breadth (27.89%). These results indicate that genotypes under study may offer scope for improvement through selection for the characters those show high genotypic as well as phenotypic coefficient of variation. Similar results were reported by Pan et al. (2004); Lal et al. (2005); Rai et al. (2008). However, low phenotypic coefficient of variation was observed for the characters protein percent (11.91%), number of seeds per pod (16.46%), test weight (17.15%), days to first picking (20.55%) and number of flowers per cluster (20.57%). Contrary to the above result, low values were reported by Singh et al. (1984); Chand (1999) for pod breadth, pods per cluster and pod yield per plant. High heritability was recorded for pod yield quintal per hectare (99.5%), days to first flowering (99.5%), days to 50% flowering (99.4), pod weight (99.1%), days to first picking (95.8%), test weight (89.9%), number of flowers per cluster (88.3%) pod breadth (87.3%) where as moderate values were noted for pod girth (60.0%), length of pod (54.5%) However, lower value of heritability was observed for number of pods per cluster (41.9%) pod yield per plant (41.2%), pod yield per plot (39.6%) incidence of fruit borer and incidence of bean mosaic virus (22.4%). The results are supported by the findings of Desai et al. (1996). High heritability was recorded for number of pods

Table 1. Analysis of variance for seventeen characters in eighteen Indian bean genotypes

Source of variation	d.f	Days to 1st flowering	Days to 50% flowering	Number of flower per clusters	Number of pod per cluster	Days to first pod harvest	Pod length (cm)	Pod breadth (cm)	Pod girth (cm)
Replication	2	0.427	0.015	4.408	0.896	0.019	0.170	0.056	0.006
Treatment	17	1934.890	2223.475	76.258	12.668	1952.097	17.203	1.203	9.218
Error	34	3.078	3.873	3.219	4.000	4.136	3.738	0.056	1.672
F-cal		628.58**	574.15**	23.69**	3.16**	471.96**	4.60**	21.66**	5.51**
CD		2.91	3.27	2.98	3.32	3.37	3.21	0.39	2.15

Cont...

Source of variation	d.f.	Protein percent	Test weight (g)	Number of seed/ pod	20 pod weight (g)	Pod yield/ plant (g)	Pod yield/ plot (kg)	Pod yield (q/ha)	Incidence of bean mosaic virus	Incidence of fruit borer
Replication	2	0.277	0.933	0.045	0.241	316.167	1.536	0.964	1.796	20.444
Treatment	17	27.856	100.037	0.901	14403.887	136461.23	127.326	11495.810	185.910	63.984
Error	34	0.397	3.605	0.627	41.280	11744.754	42.877	2.694	99.404	34.138
F-cal		70.20**	27.75**	1.43	348.93**	3.10**	2.96**	4266.79**	1.87	1.87
C.D		1.05	3.15		10.66	179.82	10.87	2.72		

**Significant at 5% level of significance

Table 2. Variability and genetic parameters for seventeen characters in Indian bean genotypes

Characters	PCV (%)	GCV (%)	Heritability (%)	Genetic advance (as a % of mean)
Days to 1st flowering	26.95	26.88	99.5	55.25
Days to 50% flowering	26.17	26.10	99.4	53.64
Number of flower per clusters	20.57	19.34	88.3	37.44
Number of pod per cluster	32.06	20.76	41.9	27.70
Days to 1st pod harvest	20.55	20.49	99.3	42.07
Pod length (cm)	25.50	18.84	54.5	28.66
Pod breadth (cm)	27.89	26.06	87.3	50.18
Pod girth (cm)	39.59	30.68	60.0	48.99
Protein percent	11.91	11.66	95.8	23.51
Test weight (g)	17.15	16.26	89.9	31.78
Number of seeds per pod	16.46	5.87	12.7	4.31
20 Pod weight (g)	41.64	41.46	99.1	85.05
Pod yield per plant (g)	41.98	26.95	41.2	35.65
Pod yield per plot (kg)	41.93	26.40	39.6	34.24
Pod yield (q/ha)	32.82	32.81	99.5	67.57
Incidence of bean mosaic virus	33.43	15.85	22.4	15.48
Incidence of fruit borer	38.36	18.22	22.5	17.83

per cluster and weight of pods by Ali et al. (2005); Lal et al. (2007). Similar result were reported for the characters days to first flowering and days to 50% flowering by Santosh et al. (2002); Eswaran et al. (2007). Moderate heritability was noted for pod girth and length of pod. As regard to the length of pod, moderate heritability was also observed by Tukadiya et al. (2006), where as high heritability for the length of pod was reported by Raffi and Nath (2004); Sheela et al. (2006), which is contrary to the results of this study. Pod girth showed moderate heritability and similar results were observed by Tukadiya et al. (2006); Nimbarkar et al. (2002), while Mishra and Das (1991) observed high heritability for pod length. Moderate to high heritability with high genetic advance as percentage of mean was observed for characters like days to first flowering, days to 50% flowering, number of flowers per cluster, days to first picking, pod breadth, weight of pod, test weight, pod yield per hectare. This indicates that these characters were controlled by additive gene effects and consequently with less environmental effect which could be improved through direct selection. These results are in agreement with Raffi and Nath (2004); Rai et al. (2008). Pod length, girth of pod and protein percent showed high heritability with low genetic advance indicated that there is a non additive gene effect present for these traits. Similar inferences were drawn by Nimbarkar et al. (2002). The findings revealed that these characters were controlled by additive gene effect and consequently has less environmental effect thus could be improved through direct selection.

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Effect of time and species on bud union and survivability in citrus

K.S. Kirad, Swati Barche*, Sevono** and **A.K. Sharma***
Farmers Welfare & Agriculture Development, Tikamgarh 472001
*Jawaharlal Nehru Krishi Vishwa Vidyalaya, College of Agriculture
Tikamgarh 472 001 (MP)
**Allahabad Agricultural Institute Deemed University, Allahabad 211 007 (UP)

Abstract

The present investigation was carried out with Four varieties of citrus namely Lime, Lemon, Kinnow and Grapefruit budded on Karnakhatta rootstock in first, second and last week of November. Among all the species Lemon budded in the first week of November was found significantly superior with higher success of budding (95.56%), minimum days taken for bud sprouting (14.00) and maximum sprout length (7.37 cm) sprout girth (8.03 mm), number of leaves per plant (14.08), number of branches per plant (1.85) leaf length (5.17 cm), leaf width (2.27 cm). Whereas minimum success was recorded in Kinnow (60%) with maximum sprout length (2.58 cm), sprout girth (3.78 mm), number of leaves per plant (5.04), number of branches per plant (1.00), leaf length (1.12 cm), leaf width (0.56 cm) and maximum days taken for bud sprouting (31.87) budded in the last week of November. Economically Grapefruit budded in the first week of November was found more superior than Kinnow budded in the last week of November.

नींबू वंशीय प्रणतियों का नंवबर माह में किलकायन की समय उपयुक्तता जानने के लिये प्रचलित मूलवृंत करना खड्डा पर सफल रोपण के लिये शोध किया गया। जिसमें महानींबू का नंवबर के प्रथम सप्ता कलिकायन सर्वाधिक सफल रहा, जबकि किन्नों प्रजाति के समय बढने पर (नंवबर के अंतिम सप्ताह) कलिकायन पर प्रतिकल प्रभाव पडा।

Keywords: Lime, Lemon, Kinnow, Grapefruit

Citrus is the third most important fruit crop after mango and banana with an area of O.71mha and a production of 5.99 million tones. Indian Horticulture Data Base, (2005). In India citrus is commercially propagated by T-budding and its success percentage is 65-70 for large scale multiplication. The major limiting factor for success in budding is self incompatibility. In Uttar Pradesh most widely used rootstock is Rough Lemon followed by Karnakhatta for most of the scions. Compatibility problem and early die-back within 10 years was observed w hen sweet orange and certain grapefruit cultivars were budded on Karnakhatta rootstock (Kumar 1999). When blood red was budded over Cleopatra, Mosambi over Rough lemon, Grapefruit and Lime over Karnakhatta showed smooth bud union with high yield and good quality fruits after 30 years (Harish et al. 2000). Keeping in view the above fact the present investigation was conducted to find out the suitable time and species for successful budding.

Material and methods

The present experiment was conducted during 2007- 2008, in the Department of Horticulture, Allahabad Agriculture Institute-Deemed University, Allahabad. The experiment was laid out in 3x4 factor factorial with T-budding method on four varieties i.e. lime, lemon, Kinnow and grapefruit with twelve treatments and each replicated thrice. The treatments were allocated randomly in each replication. The rootstock used was Karna khatta (*Citrus karna*) budded in three different times first week of November, Second week of November, Last week of November. One year old healthy seedlings with pencil thickness and 25-30 cm in height were used as rootstock. Well swollen, unsprouted and dormant scion buds of current season growth were taken from mature, 8-10 year old tree of Citrus cultivar Grapefruit, Lemon, Kinnow and Lime. From the root stock plants all leaves, sprouts and thorns were removed just above the point of operation site. First a vertical cut of about 2.5-3 cm long is made in the bark of the stock, at 20 cm height from ground level and then another horizontal cut below vertical cut were made. (T-cut). Then the flaps are carefully lifted without injuring tissue by budding knife. After that, inserted bud shield of 2.5 cm without a slice of wood and wrapped tightly with polythene sheet both at the upper and lower ends, leaving buds uncovered. Removed polythene tying after the bud take on the stock. The emerging shoot below an above the bud union were removed from time to time so that the growth of sprouted buds accelerated. The data were recorded from 40th day after budding to 70th days after budding and statistically analyzed by the method given by Panse and Sukhatme (1976).

Results and Discussion

The budding success differs significantly due to different species and time of budding (Table 1). Maximum success of budding (98.67%) was observed in the first week of November which was followed by second week of November (78.33%). Among the species, lemon was found significantly superior (95.56%) over other species like Lemon (82.22%), grape fruit (80.0%) and Kinnow (57.78%). The interaction lemon species budded in the first week of November gave 100% budding success, which was closely followed by same species budded in the second week of November. (93.33%) and it was statistically at par with Lemon budded in the last week of November (93.33%). This might be due to availability of better scion stock and active sap flow in Lemon tissue. However, the least budding success (53.33%) was obtained in the Kinnow budded in the last week of November. It might be due to low temperature and humidity which may restrict the flowing of sap in tissues. These findings are in close conformity with the results of Bhullar et al. (1980) in Citrus species and Dimri (1999) in Lemon.

The data pertaining to the number of days taken for bud sprouting of inserted citrus buds (Table 1) revealed that minimum number of days taken for bud sprouting was recorded in the first week of November (18.90) and maximum days was taken in the last week of November (24.09). Among the species, Lemon taken 14 days for bud sprouting while other species like lime (15.83), Kinnow (31.87) and Grape fruit (22.71) were taken for bud sprouting. The effect of time and species on the number of days taken for bud sprouting was recorded. The minimum number of days taken for bud sprouting was observed in lemon (13.30) budded in the first week of November followed by Lemon budded in second (13.73) week of November. Grapefruit budded in the last week (30.64) of November and Kinnow budded in the first week (30.64), second week (30.64) was statistically at par whereas maximum success was recorded in the last week (34.33) of November in Kinnow. Good sap flow in Lemon compared to other cultivars might be the factors that favoured early callusing and perforation at the bud union. Similar findings have also been reported by Patel et al. (2003); Anuja et al. (2004). Maximum length (5.35 cm) of sprouts was obtained in the first week of November, whereas minimum length of sprout (4.14 cm) was recorded in the last week of November. Among species Lemon showed maximum sprout length (7.37 cm) followed by Lime (5.12 cm), Grapefruit (3.63 cm) and minimum in

Table 1. Effect of time, species and their interaction on bud union of citrus

Treatment Time	Success of budding (%)	Days taken for sprouting	Sprout length (cm)	Sprout girth (mm)	No of leaves per plant	No of branches per plant	Leaf length (cm)	Leaf width (cm)
T1	81.67	18.90	5.35	6.29	10.07	1.43	3.50	1.65
T2	78.33	20.33	4.54	5.69	8.06	1.26	2.91	1.36
T3	76.67	24.90	4.14	5.03	7.70	1.22	2.28	1.20
CD at 0.05	1.03	0.38	0.14	0.24	0.28	0.11	0.16	0.07
Species								
S1	82.22	15.83	5.12	6.01	8.84	1.22	3.44	1.54
S2	95.56	14.00	7.37	8.04	14.08	1.85	5.17	2.27
S3	57.78	31.87	2.59	3.72	5.04	1.04	1.12	0.56
S4	80.00	22.71	3.63	4.91	6.62	1.10	1.86	1.23
	1.18	0.43	0.16	0.27	0.33	0.12	0.18	0.08
Time x Species								
T1S1	86.67	15.12	5.67	6.40	9.42	1.33	4.07	1.68
T1S2	100.00	13.30	8.87	9.07	16.97	2.22	6.51	2.92
T1S3	60.00	30.64	2.78	4.30	5.55	1.07	1.17	0.58
T1S4	80.00	16.44	4.08	5.40	8.34	1.11	2.27	1.42
T2S1	80.00	15.89	5.15	6.00	8.74	1.22	3.67	1.49
T2S2	93.33	13.73	6.84	8.24	13.19	1.66	4.79	1.98
T2S3	60.00	30.64	2.69	3.53	4.82	1.05	1.17	0.56
T2S4	80.00	21.05	3.47	5.00	5.90	1.11	2.00	1.40
T3S1	80.00	16.4	4.54	5.63	8.33	1.11	2.59	1.45
T3S2	93.33	14.98	6.38	6.80	12.07	1.66	4.20	1.92
T3S3	53.33	34.33	2.31	3.33	4.73	1.00	1.02	0.55
T3S4	80.00	30.64	3.33	4.33	5.63	1.09	1.30	0.88
CD at 0.05	2.05	0.75	0.28	0.47	0.57	0.21	0.31	0.14

Table 2. Benefit cost ratio

Particular	Quantity	Cost price (Rs)	Selling price	Gross return (Rs)	Net benefit (Rs)	Benefit cost ratio
Lime (First week November)	10000	14868.00	Rs 8/grafted plant	80000	65132	5.380683
Lemon (First week November)	10000	14868.00	Rs 8/grafted plant	80000	65132	5.380683
Kinnow (First week November)	10000	14868.00	Rs 10/grafted plant	100000	85132	6.725854
Grapefruit (First week November)	10000	14868.00	Rs 12/grafted plant	120000	105132	8.071025
Lime (Second week November	10000	14868.00	Rs 7/grafted plant	70000	55132	4.708097
Lemon (Second week November)	10000	14868.00	Rs 7/grafted plant	70000	55132	4.708097
Kinnow (Second week November)	10000	14868.00	Rs 9/grafted plant	90000	85132	6.053268
Grapefruit (Second week November)	10000	14868.00	Rs 11/grafted plant	110000	75132	7.398439
Lime (Third week November)	10000	14868.00	Rs 6.50/grafted plant	65000	50132	5.380683
Lemon (Last week November)	10000	14868.00	Rs 6.50/grafted plant	65000	50132	4.371805
Kinnow (Last week November)	10000	14868.00	Rs 8/grafted plant	80000	65132	4.371805
Grapefruit (Last week November)	10000	14868.00	Rs 10/grafted plant	100000	85132	6.725854

Kinnow (2.59 cm). Lemon budded (8.87 cm) in the first week of November showed maximum sprout length followed by Lemon budded in second (6.84 cm) week of November and minimum sprout length was recorded in the last week (2.31 cm) of November in Kinnow.Maximum sprout length in Lemon may be due to its vigorous growth character and minimum sprout length in Kinnow is might be due to dwarfing character of the variety. Similar results were obtained by Aulakh (1998); Gagan et al. (2005). Sprout girth of different cultivars were found to differ significantly .The maximum sprout girth was noticed in first week of November (6.29 mm) followed by second week (5.69 mm) and minimum in the last week of November (5.03 mm). Lemon showed maximum sprout girth (8.04 mm) followed by Lime (6.01 mm), Grapefruit (4.91 mm) and minimum sprout girth in Kinnow (3.72 mm). The interaction of time and species was recorded maximum sprout girth in Lemon (9.09 mm) budded in the first week of November followed by Lemon budded in second (8.24 mm) week of November whereas minimum sprout girth was recorded in the last week (3.33 mm) of November in Kinnow. The maximum sprout girth obtained in the first week of November might be due to the congenial temperature and humidity for the early growth and minimum sprout girth in the third week of November might be because of the start of winter season. Similar results have been reported by Patel et al. (2003).

The data presented in Table 1 indicated that Lemon produced the maximum number of leaves per plant (14.08), while Kinnow bear the minimum (5.04). Maximum number of leaves bear in the first week of November (10.07), and last week of November having the minimum (7.70). Lemon (16.97) budded in the first week of November gave maximum number of leaves per plant, whereas minimum number of leaves was recorded in the last week (4.73) of November in Kinnow. It is might be due to maximum sprout length in Lemon and minimum sprout length in Kinnow. These findings are in consonance with the results of Patel et al. (2003).

Among the different species budded, Lemon (2.22) produced better response followed by Lime (1.22) and minimum in Kinnow (1.04) in increasing the number of branches per plant. However, the maximum number of branches was recorded in the first week of November (1.43), followed by second (1.26) week of November and minimum number of branches in the third week of November (1.22). Lemon (2.22) budded in the first week of November showed maximum number of branches. Lemon budded in second (1.66) week of November was statistically at par with Lemon budded in last week of November (1.66). Lime (1.33) budded in the first week of November were statistically at par with Lime budded in the second (1.22). Lime budded in the last (1.11) week of November, and Grapefruit budded in the first (1.11), second week (1.11) and last week of November. And minimum success was recorded in the last week (1.00) of November in Kinnow. Anuja et al. (2004) reported highest number of branches in Aonla.

There was significant difference in leaf length and width of budded citrus species.

The maximum leaf length (3.50 cm) and leaf width (1.65 cm) was obtained in the first week of November followed by second week (1.26 cm), (1.36 cm). However minimum length of leaf (2.28 cm) and leaf width (1.20 cm) was recorded in the last week of November. Among the species, Lemon showed maximum leaf length (5.17 cm) and leaf width (2.27 cm) and minimum in Kinnow (1.12 cm) and (0.56 cm) respectively. Lemon budded (6.51 cm) in the first week of November showed maximum leaf

length and leaf width (2.92 cm). Kinnow budded in the first week (1.17 cm) was statistically at par with Kinnow budded in second week (1.17 cm) whereas minimum leaf length (1.30 cm) and leaf width (0.55 cm) was recorded in the last week of November in Kinnow.

Economics of different citrus species budded in three different times are given in Table 2. The highest net return Rs 105132 and B: CR 1:8.1 was recorded in Grapefruit budded in the first week of November and minimum net return Rs 50132 and B: CR 1:4.4 was recorded in Lemon budded in the third week of November. Budding of Lemon on Karnakhatta rootstock in the first week of November was found superior than other species and time. Economically Grapefruit budded in the first week of November was found superior to other species.

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Response of growth retardants on growth, development and yield of Okra cv. Parbahani Kranti

Swati Barche, K.S. Kirad*, A.K. Sharma and **P.K. Mishra**
Jawahar Lal Nehru Krishi Vishwa Vidyalaya
Campus-College of Agriculture, Tikamgarh 472 001 (MP)
*Farmers Welfare & Agriculture Development, Tikamgarh 472 001 (MP)

Abstract

Okra (*Abelmoschus esculentus* L.) is a delicious, nutritive and excellent fruit vegetable used against goiter. High temperature and high humidity resulting more vegetative growth as compares to reproductive growth. Growth retardant suppresses the vegetative growth and promotes reproductive traits. An investigation was conducted at JNKVV Campus-College of Agriculture, Tikamgarh during 2007-2008 and 2008-2009 to find out the response of growth retardants on vegetative, reproductive and economic traits of Okra. Observations were recorded on various traits and concluded that the plant height was retarded most in CCC @ 1500 ppm seed+foliar treatment while number of leaves, branches per plant, number of tender immature fruits, fresh and dry weight, length and diameter of tender fruit, yield and maximum benefit cost ratio were higher in CCC @ 1000 ppm seed+foliar treatment.

भिंडी की प्रजाति परभनी क्रांति पर वृद्धि नियामकों की विभिन्न सान्द्रता को विभिन्न विधियों के द्वारा प्रयोग करने पर पाया गया कि पौधे की न्यूनतम ऊँचाई सी.सी.सी. 1500 पी.पी.एम. मात्रा बीज + पर्णीय उपचार में पायी गयी जबकि पत्तियों की संख्या, प्रति पौधा शाखाओं की संख्या अपरिपक्व मुलायम फलों की संख्या व तुडाई उपरांत ताजा भार, शुष्क भार, फलों की लंबाई व व्यास, उपज व अधिकतम लाभ लागत अनुपात सी.सी.सी. 1000 पी.पी.एम. बीज + पर्णिय उपचार में पाया गया।

Keywords: Plant growth regulators, growth, yield attributes, benefit cost ratio

Okra [*Abelmoschus esculentus* (L.) Moench] in an important fruit vegetable. Plant growth regulators prove beneficial for augmentation of physico-biochemical processes. Yield potential of okra can be improved with the adoption of scientific cultivation technology including use of growth retardant. Growth retardants help in efficient utilization of metabolites play vital role in the regulation of plant system, formation of pods, seeds, etc. in the plant. Among the various growth substances 2-Chloroethyl trimethyl ammonium chloride (CCC) and 6-Benzyladenine (BA) or aminopurine are very promising . The growth retardant interact with gibberellins or IAA Oxidase or lower the levels of diffusible auxin and hereby suppress vegetative growth (Helevy et al. 1965). Application of CCC retarded plant growth induced formation of branches, produced more number of fruits per plant, more seeds per fruit and thereby resulted in ultimate higher yields. (Patel and Singh 1989). CCC application causes retardation in plant height by reducing internodal length which is favorable situation for accommodating more plant population per hectare. Considering the importance of okra tender immature fruits as vegetable the present project was undertaken to determine the effective concentration of growth retardants application method and their interaction effect on growth, development yield and the best economic treatment.

Material and methods

The experiment was carried out during 2008 in Vegetable Crop Cafeteria, Research Farm, College of Agriculture, Tikamgarh in previously cultivated Soybean as kharif and Berseem as rabi .Parbhani Kranti cultivar was used as experimental material. After harvested Rabi crop, the field was properly ploughed and pulverized by discing and harrowing. Thereafter, field was leveled properly Soil profile was sandy clay loam with low nitrogen content. Soil samples were collected up to a depth of 30 cm with the help of auger before sowing. All the soil samples were mixed to prepare a composite sample, which was then air-dried. Sieved through a 2 mm sieve and finally working samples were made for physical and chemical analysis. Two days before final cultivation, pre-emergence chemical weed control was with Tok E-25 (5L/ha) for all plots. During the season three hoeing were done. All plots were irrigated eight times. Insecticide for control of White Fly at 10 days interval was sprayed.

After preparing plot in Randomized Block Design (Factorial arrangement) the recommended dose of well rotten FYM @ 10 tones/hectare was incorporated 20 days before sowing. Nitrogen was applied @ 120 kg/ha by urea in three equal splits. The first dose of nitrogen was applied one day before sowing along with full recommended dose of phosphorus @ 50 kg/ha and potash @ 50 kg/ha in the forms of single super phosphate and muriate of potash, respectively. The second and third dose of nitrogen was given 30 and 40 DAS respectively by top dressing. Growth retardants stock solution of known concentration was prepared first before use Chemicals were dissolved in minimum volume of alcohol and than mixed with distilled water to make a stock solution by dilution. The solution of required concentrations were than prepared from the stock solution of required concentrations were than prepared from the stock solution by dilution.

There are three types of treatments:

(I) Growth retardants (BA and CCC)
(II) Different concentration of BA and CCC.
Low concentration 50 ppm BA and 500 ppm CCC
Medium concentration 75 ppm BA and 1000 ppm CCC
High concentration 100 ppm BA and 1600 ppm CCC
(III) Methods of application of growth retardants
Seed treatment (M_1)
Foliar treatment (M_2)
Seed+foliar treatment (M_3)

Seed treatment (M_1) was done 24 hours before prior to sowing. Required quantity of okra seeds was soaked in the solution of AB and CCC at different concentrations as per treatment for 24 hours. Thereafter seeds were taken out from the respective solutions and allowed to dry under shad till complete moisture was removed from the surface of the seeds. Thereafter, seeds were treated with Thiram @ 2.5 g seeds/kg seeds. Foliar spray (M_2) of different concentrations of growth retardants was done at 3rd leaf stage or 25 days after sowing. Seed + foliar treatment (M_3) method, seeds were treated in different concentration of BA and CCC solution for 24 hours before sowing. The same plants were then sprayed with the same solution at 3rd leaf stage or 25 DAS. At the time of sowing, carbofuran (Furadaon 3G @ 30 kg/ha) added in the soil. Treated seeds were dibbed per hill at the distance of 0.45 m, in the plot of 8.50 sqm in the first week of July. Various growth and development yield attributes were observed and analyzed statistically.

Results and Discussion

Growth retardant, concentration and application method was found to be significant. The highest germination percentage was recorded under CCC medium concentration as applied as seed + foliar treatment (91.99%) followed by CCC medium concentration applied

Table 1. Response of Plant growth regulators on growth traits

Treatment	Germination (%)	Plant height (cm)	No. of leaves per plant	No. of branches per plant
T_1-BA @ 50 ppm+seed treatment	88.36	106.26	18.46	1.67
T_2-BA @ 50 ppm+foliar treatment	88.65	105.31	19.65	1.83
T_3-BA @ 50 ppm+seed and foliar treatment	90.38	106.40	19.17	1.76
T_4-BA @ 75ppm+seed treatment	88.67	105.81	20.15	2.03
T_5-BA @ 75 ppm+foliar treatment	90.41	104.91	21.75	2.74
T_6-BA @ 75 ppm+seed and foliar treatment	90.35	105..26	20.47	1.86
T_7-BA @ 100 ppm+seed treatment	88.61	104.62	21.27	2.66
T_8-BA @ 100 ppm+foliar treatment	90.38	103.54	22.37	3.12
T_9-BA @ 100 ppm+seed and foliar treatment	89.42	105.23	19.17	1.69
T_{10}-Cycocel @ 500 ppm+seed treatment	88.76	104.62	20.16	1.82
T_{11}-Cycocel @ 500 ppm+foliar treatment	89.43	103.54	21.24	2.36
T_{12}-Cycocel @ 500 ppm+seed and foliar treatment	91.92	102.27	21.17	1.94
T_{13}-Cycocel @ 1000 ppm+seed treatment	88.77	101.42	22.23	2.84
T_{14}-Cycocel @ 1000 ppm+foliar treatment	91.99	99.37	23.87	3.36
T_{15}-Cycocel @ 1000 ppm+seed and foliar treatment	91.52	101.32	22.13	2.64
T_{16}-Cycocel @ 1500 ppm+seed treatment	88.70	100.81	23.34	2.31
T_{17}-Cycocel @ 1500 ppm+foliar treatment	91.86	98.26	24.43	3.65
T_{18}-Cycocel @ 1500 ppm+seed and foliar treatment	91.86	98.26	24.42	3.65
SEm±	0.031	0.460	0.012	0.010
CD at 5%	0.090	1.320	0.034	0.031

Table 2. Response of plant growth regulators on reproductive characters

Treatment	Days to 50% flowering	Duration of reproductive phase (days)	No. of tender immature fruits/plat	L x D of tender (L) immature fruits (cm)	Diameter (cm)	Fresh wt. of tender immature/plant (g)	Dry wt. of tender immature fruits/plant (g)	Yield of tender immature fruits/ha (q/ha)	No. of mature fruit/plant
T_1	44.28	31.61	16.92	9.76	1.35	280.24	40.74	119.93	9.52
T_2	44.17	32.28	17.19	10.03	1.42	285.04	42.42	126.49	10.08
T_3	42.32	33.88	17.74	10.12	1.45	290.05	44.15	133.83	10.76
T_4	43.84	31.85	17.12	10.07	1.38	284.33	48.72	143.17	10.53
T_5	43.04	32.97	18.50	10.47	1.46	295.03	52.71	150.87	11.28
T_6	42.11	33.84	19.27	11.21	1.47	300.13	57.24	158.56	12.25
T_7	42.36	33.51	18.66	10.27	1.56	289.71	42.12	130.65	9.86
T_8	42.32	34.06	19.18	11.16	1.64	295.37	47.53	138.35	10.17
T_9	41.66	35.50	20.38	11.03	1.74	310.03	52.22	145.63	11.43
T_{10}	44.27	32.13	17.15	9.82	1.44	281.72	41.32	126.87	9.91
T_{11}	43.77	33.87	18.71	10.83	1.45	286.58	49.56	134.12	10.64
T_{12}	42.36	34.27	19.18	11.14	1.46	292.36	64.88	141.49	11.77
T_{13}	42.97	34.55	21.88	11.26	1.74	310.31	64.36	163.62	12.35
T_{14}	41.52	35.33	22.15	11.54	1.77	315.65	69.12	164.06	13.46
T_{15}	40.83	36.26	23.67	13.18	1.84	322.02	72.76	188.78	14.15
T_{16}	42.97	35.27	19.75	10.18	1.62	306.85	54.93	151.59	11.16
T_{17}	41.75	36.18	20.62	11.26	1.73	308.45	58.77	159.40	12.21
T_{18}	40.28	37.15	21.47	12.48	1.83	311.16	62.53	171.25	13.38
SEm±	0.072	0.088	0.016	0.020	0.016	0.007	0.013	0.020	0.014
CD at 5%	0.211	0.252	0.047	0.058	0.047	0.022	0.039	0.058	0.043

as seed treatment (91.92 percent) at 15 days after sowing (Table 1). Minimum germination percent was found under BA low concentration + seed treatment (88.36%) at 15 days after sowing. Highest germination percent by CCC application was similar to those reported by EL-Beheidi (1980) and Mangal et al. (1988) .The data on plant height (cm), number of leaves per plant, number of branches per plant were recorded at 45 days after first flower formation as influenced by growth retardants, concentrations and methods of application are presented in Table 1. The smallest plant height (98.26 cm) was recorded under CCC x higher concentration x seed + foliar treatment interaction, followed by CCC x medium concentration x seed + foliar treatment interaction (99.37 cm). The longest plant (106.40 cm) was recorded under BA x medium concentration x seed treatment interaction. The reduction in plant height was due to antigiberellic effect of CCC. Similar finding was in accordance with the findings of Mehrotra et al. (1970), Gowda and Goda (1983) and Rathore and Patel (1996) in okra. Maximum number of leaves (24.43) per plant was recorded under CCC x higher concentration x seed + foliar treatment interaction, followed by CCC x medium concentration x seed + foliar treatment interaction (23.87 leaves per plant), while the minimum number of leaves per plant was recorded under BA x low concentration x seed treatment interaction (18.46). This was in agreement with the results of Abdul et al. (1985) in okra. The maximum number of branches per plant (3.65) was recorded under CCC x higher concentration x seed + foliar treatment interaction, followed by CCC x medium concentration x seed + foliar treatment (3.36), while the least number of branches per plant (1.67) was recorded under BA x low concentration x seed treatment interaction. Increased branch number may be due to reason of CCC increases root to shoot ratio. This was in close conformity with the findings of Arora et.al. (1990). The present findings indicate that BA @ 50 and 75ppm as seed treatment was not effective in altering the vegetative growth of okra.

The interaction between growth retardants, concentrations and application methods had significant effect on reproductive characters of okra (Table 2). The minimum days taken to 50% flowering (40.25) was recorded under CCC x higher concentration x seed + foliar treatment interaction, folioed by CCC x medium concentration x seed + foliar treatment (40.83). The maximum days taken to 50% flowering was recorded under BA x low concentration x seed treatment interaction (44.28 days). Earliness due to CCC application was also reported in tomato by Umesha et al. (1991). The maximum duration of reproductive phase (37.15 days) was recorded under CCC medium concentration x seed + foliar treatment interaction (36.86 days), while minimum duration of reproductive phase was recorded under BA low concentration (31.61 days). These results are in quite agreement with the results reported by Zayed et al. (1985). The maximum number of tender immature fruits per plant (23.67) was recorded under CCC x medium concentration x seed + foliar treatment interaction followed by CCC x

Table 3. Benefit cost ratio

Treatment	Common expenditure (Rs/ha)	Treatment cost (Rs/ha)	Total input cost (Rs/ha)	Immature gross income (Rs/ha)	Fruit net return (Rs/ha)	Production C:B:Ratio
Control	18331.79	0.00	18331.79	108770.00	90438.21	1:59:3
BA 50 ppm	18331.79	1786.70	20118.49	133830.00	113711.51	1:6:65
BA 75 ppm	18331.79	2680.05	21011.84	158560.00	137548.16	1:7:54
BA 100 ppm	18331.79	3573.40	21905.19	145630.00	123724.81	1:6:64
CCC 500 ppm	18331.79	2900.00	21330.69	141490.00	120159.81	1:6:63
CCC 1000 ppm	18331.79	5018.00	23349.79	188780.00	165430.21	1:8:08
CCC 1500 ppm foliar application	18331.79	7996.00	26327.79	171250.00	144922.21	1:1:52

higher concentration x seed + foliar treatment interaction (22.15). Minimum number of the tender immature fruits per plant was recorded under BA x low concentration x seed treatment interaction (16.92). Similar results were also reported by Arora et al. (1990). Maximum length and diameter (13.18 and 1.84) was recorded under CCC x medium concentration x seed + foliar treatments interaction, followed by CCC higher concentration x seed + foliar treatment interaction (12.48 and 1.83 cm), while the minimum length and diameter (9.76 and 1.35 cm) was recorded under BA x low concentration x low concentration x seed treatment interaction. This increase in fruit length and diameter due to CCC was also reported by Gowda et al. (1992).Maximum fresh weight of tender immature fruit per plant was recorded (322.0 g) under CCC x medium concentration x seed + foliar treatment interaction, followed by CCC x medium concentration x foliar treatment interaction (315.65 g), while minimum fresh weight of fruit per plant was recorded under BA x low concentration + seed treatment interaction (280.24 g). The increase in fresh weight of tender immature first due to CCC application is in confirmation with the finding of Gowda et al. (1992) in okra. The highest dry weight of tender immature fruit per plant was recorded (72.76 g) under CCC x medium concentration x seed + foliar treatment interaction (69.12 g). The lowest dry weight of tender immature fruit per plant was recorded under BA x low concentration x seed treatment interaction (40.74 g).

That the maximum net return for immature fruit production (Rs. 165430.21) was obtained under CCC @ 1000 ppm seed + foliar treatment, followed by CCC @ 1500 ppm seed + foliar treatment (Rs. 144922.21). The best cost benefit ration for immature fruit production 1:80 was obtained under CCC @ 1000 ppm seed + foliar treatment (Table 3). The poorest cost: benefit ratio (1:5:93) was obtained under control. The variation in net returns and cost: benefit ratio might be due to the difference in the yield was price of growth retardants.

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Efficacy and economics of some new insecticides and plant products against the infestation of okra shoot and fruit borer (*Earias vittella* Fab)

Amit Kumar Sharma, Swati Barche and **P.K. Mishra**
Jawahar Lal Nehru Krishi Vishwa Vidyalaya
College of Agriculture
Tikamgarh 472 001 (MP)

Abstract

Field experiment was conducted during summer 2008 to test field efficacy of Cartap hydrochloride, Ethofenprox, and botanicals (Neem oil and Karanj oil) against the infestation of shoot and fruit borer *Earies vitella* Fab.in okra crop. Application of Cartap hydrochloride (0.1%) was found significantly superior with highest healthy fruit yield of 31.96 q/ha. Cartap hydrochloride (0.5%) and Ethofenprox (0.01% and 0.02%) were the next better treatment with health fruit yield of 26.52, 26.21 and 24.72 q/ha respectively. Neem oil is the next better option (22.87 q/ha) although it is inferior to lower doses of Cartap hydrochloride and Ethofenprox.

भिंडी के तना व फल भेदक के प्रकोप को नियंत्रित करने के लिये प्रयोग किये गये नये कीटनाशकों व पादप उत्पादों की सर्वाधिक उपयुक्तता व आर्थिक लाभ कारटेप हाइडोक्लोराइड (0.11) के साथ पायी गयी।

Keywords: *Earies vitella*, infestation, insecticides, botanicals shoot and fruit damage

Shoot and fruit borer, *Earies vitella* Fab. (Lepidoptera; Noctuidae), is an important pest of okra, *Ablemoschus esculentus* (Linn.) Moench. Krishnaiah (1977) observed 7.6 q/ha of yield losses by this pest. Many insecticides have been tested in the past and found effective like fenvalerate (0.1%) and Thiocarb (0.15%) (Dhamdhere et al. 1984). Most of the chemical insecticide are toxic to many insects, may results in a complete destruction of biological control agents (Pathak and Rathore 1981). The control of this pest is difficult due to its concealed nature, so the farmers often use insecticides indiscriminately. Therefore some new and safer insecticides with greater efficacy are much needed for testing viz., cartap hydrochloride and ethofenprox. In recent years application of botanicals has assumed a special place in strategy of IPM. Bhatnagar and Kandaswamy (1993) found neemrich 20EC at 0.1% exhibited 50.1percent antifeedent activity against larvae of *E. vittella*. Pachori et al. (2006) also found neem gold @ 10 ml next better treatment after endosulfan 35 EC (0.07%). Very few attempts have been made to determine effectiveness of botanicals against major pests of okra under field condition. Thus present study is put forth to test the bio efficacy of botanicals and some newer chemical insecticides for the effective management of *E. vitella* in okra.

Material and methods

The experiment was conducted at vegetable crop cafeteria Tikamgarh, using randomized block design, during the summer season of 2008. The Plot size was 3x2 m. The okra crop was sown in the second week of April. All agronomical practices were adopted The treatment consisted of spraying the crop twice with Cartap hydrochloride (0.05%and 0.1%), Ethofenprox (0.01% and 0.02%), Neem oil (1.0%), Karanj (*Pongamia pinnata* L.) oil (1.0%) and untreated control .The first spray was applied at the flowering stage (45 days old), using hand compression sprayer . the second spray was given 10 days after first one . Number and weight of healthy and damaged fruits were recorded 3, 7, 10 days after the first and second sprays. The data were subjected to analysis of variance after angular transformation at 5% level of significance. The cost benefit ratio was calculated considering the existing market prize of okra (Rs.2000/ qt.) during the period.

Results and discussion

Fruit damage

The damage by the pest was recorded in each picking. On average basis Cartap hydrochloride (0.1%) and Ethofenprox (0.2%) were found to be most effective with lowest infestation by *E. vitella*. Lower doses of both the insecticide were at par and equally effective. Present investigation is in conformity with the earlier work of

Table 1. Effect of different insecticides against shoot and fruit borer on okra

Treatments	Dose per ha	Formulation (%)	Fruit damage percentage (mean of three replication)						
				Post treatment observation					
				Days after 1st spray			Days after 2nd spray		
			Pre treatment observation	3	7	10	3	7	10
Cartap hydrochloride 50 SP	0.5 kg	0.05	32.12 (34.17)	6.88 (15.93)	7.46 (10.44)	5.27 (12.81)	7.73 (15.30)	7.71 (15.90)	7.22 (15.46)
Cartap hydrochloride 50 SP	1.0 kg	0.10	27.85 (31.82)	7.46 (15.25)	4.37 (11.73)	4.37 (11.73)	4.00 (11.30)	5.11 (13.12)	3.21 (8.20)
Ethofenprox 10 EC	0.5	0.01	33.13 (35.09)	6.64 (11.99)	8.68 (17.06)	10.57 (18.87)	8.34 (16.58)	10.14 (18.36)	10.99 (19.17)
Ethofenprox 10 EC	1.0	0.02	34.44 (35.60)	4.21 (9.34)	6.92 (15.08)	6.55 (14.67)	5.96 (13.86)	7.84 (16.3)	6.96 (15.22)
Neem oil 1.0%	5.0	1.0	36.06 (36.83)	12.08 (19.67)	13.20 (20.86)	11.32. (19.42)	15.03 (22.72)	17.66 (24.73)	13.13 (20.87()
Karanj oil 1.0%	5.0	1.0	25.28 (30.08)	23.23 (28.23)	18.13 (25.18)	17.16 (24.22)	18.40 (25.04)	22.40 (28.15)	19.85 (26.34)
Untreated control	-	-	27.42 (31.42)	35.43 (36.43)	28.95 (32.48)	41.82 (40.10)	32.42 (31.28)	28.68 (32.34)	30.95 (33.70)
SEd	-	-	-	5.93	3.82	3.66	2.63	2.07	3.52
CD at 5%	-	-	NS	12.89	8.32	7.97	5.73	4.55	7.67

Sharma and Shukla (2003). Next option, Neem oil was at par with lower doses of Cartap hydrochloride and Ethofenprox. Neem oil has been reported to be the effective insecticide by several workers. Rao et al. (1991) recorded 54.1% increase in yield of okra fruits yield over control plot's yield, by 1.0% spray of neem oil. Sardana and Kumar (1990) also showed that weekly application of 2% neem oil controlled *Earias vitella* effectively on okra. De and Haque (1992) also recorded 11.7% infested fruits by Achook in kharif okra. Neem oil, in the present experiment, was rated after doth the doses of Ethofenprox and Cartap hydrochloride. Karanj oil (1.0%) was found least effective and slightly better than untreated control. Highest fruit infestation, ranging between 27.42 and 41.82% was observed in untreated control.

Healthy fruit yield

Significantly higher healthy fruit yield (31.96) among all the treatments was registered in Cartap hydrochloride (0.1%). Cartap hydrochloride (0.05%) and Ethofenprox (0.02%) were at par and registered 26.52 and 26.21 q/ha healthy fruits respectively. Yield in other insecticidal treatments ranged between 18.51 and 24.72 q/ha. Significantly lowest yield was recorded in untreated control.

Benefit cost ratio

Highest benefit cost ratio 1:12.73 and 1:12.38 was observed in Cartap hydrochloride (0.05%) and (0.1%) treatment respectively followed by the ratio of 1:11.43 in Ethofenprox (0.01%) and 1:7.86 in Ethofenprox (0.02%) treatment. Lowest ratio of 1:1.36 was registered in Karanj oil treatment while it is 1:4.73 in case of Neem oil (1.0%).

Cartap hydrochloride (0.1%) treatment gave the highest yield in the present investigation while Sosamma

Table 2. Economics of different insecticides against shoot and fruit borer on okra

Insecticides	Average yield of healthy fruit (q/ha)	Increase in yield of healthy fruits over control (q/ha)	Quantity of insecticide used for two sprays	Total cost	Net return (Rs)	Benefit cost ratio
Cartap hydrochloride 50 SP (0.1%)	26.52	8.6	1.0 kg	1252	15948	1:12.73
Cartap hydrochloride 50 SP (0.05%)	31.96	14.4	2.0 kg	2152	26648	1:12.38
Ethofenprox 10 EC (0.01%)	24.72	7.16	1.0 l.	1152	13168	1:11.43
Ethofenprox 10 EC (0.02%)	26.21	8.65	2.0 l.	1952	15348	1:7.86
Neem oil 1.0% (1.0%)	22.87	5.31	5.0 kg	1852	8768	1:4.73
Karanj oil 1.0% (1.0%)	18.51	0.95	5.0 kg	802	1098	1:1.36
Untreated control	17.56	-	-	-	-	-

et al. (1996) reported Cartap hydrochloride to be least effective in comparison with fenvalrate and others. Ethofenprox at both the doses (higher and lower) was found effective in terms of lowest infestation and higher healthy fruit yield. Clement and David (1988) also found Ethofenprox to be most effective treatment against *E. vitella* in summer okra. Karanj oil (1.0%) was found least effective as compared to all the insecticidal treatments while Neem oil (1.0%), in present investigation was found inferior to both the doses of Ethofenprox and Cartap hydrochloride, although Neem oil was reported to be the most effective insecticide by several workers (Bhatnagar and Kandasamy 1993; Rao et al. 1991; Sardana and Kumar 1990; De and Haque 1992). It was clear that neem products (and also the *Pongamia* oil) cannot be ammatch to conventional and new insecticides in giving desired relief against Earias incidence (Singh et al. 1984; Appaya, 1990). However, in combination treatments, neem products like neem oil can be encouraging and they should find a place in the spray schedule to lessen the dependence on conventional insecticides, thus overcoming several side effects such as flareup of secondary pests, pest resurgence and harmful residues (Rao et al. 1991)

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Seasonal activity of major insect pest species of paddy in relation to weather factors in central India

Amit Kumar Sharma and **S.M. Vaishampayan**
Jawaharlal Nehru Krishi Vishwa Vidyalaya
College of Agriculture, Tikamgarh 472 001 (MP)

Abstract

Field experiment was conducted at research farm during *kharif* 2002 and 2003 at Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur. Standard design of light trap (Model SM-01) was used to collect valuable information on seasonal activity of four major insect pest species of paddy namely white backed plant hopper, rice leaf folder, army worm grass hopper (complex) and to find out its relationship with weather parameters. Seasonal activity indicated that major activity period was confined between August to December in case of *Sogatella furcifera* H., *Cnaphalocrocis medinalis* Gen and *Mythimna separata* W. except Grass hopper (complex), which is active round the year with two monthly peaks during August and September. Three to four peaks were observed in case of *S. furcifera*, *C. medinalis* which indicates competition of 3 generations during main cropping season while highest weekly peaks were observed during third week of September and November in case of *Mythimna separata*. Consistently very high collection of these species in trap catches associated with their higher infestation in field during 2003 compared to 2002. This indicated that higher rainfall, lower mean maximum temperature and higher relative humidity were very favorable weather factors for development of these pest species in the year 2003.

वर्ष 2003 में अधिक वर्षा, कम तापमान तथा उच्च सापेक्षिक द्रिता के कारण सफेद फुदका, पत्ती मोडक कीट एवं फौजी कीट अगस्त सितंबर माह में अधिक प्रकोप पाया गया जबकि टिड्डे की सक्रिय उपरोक्त महिनों के साथ-साथ परे वर्ष भर देखी गयी।

Keywords: Light trap catches, paddy, seasonal activity, weather parameters

Seasonal activities of insect pest species can be monitored very effectively through trap catches. In recent years use of light trap occupied an important place in entomological studies all over the world for survey, detection and control of insect pest population. All though much work has been done on use of light trap against pest of pulses, but very little information is available on pests of paddy in central India (Mahakaushal region of M.P.). Different workers have used the light trap against pests of rice crop in different states including Tamil Nadu (Ramkrishnan et al. 1994) and West Bengal (Sarkar and Gayan 1992). Under Indian conditions, though paddy is attracted by a wide range of insect pests as compared to any other single crop but not much information is available on the incidence and population build up of rice pests under varying agro-climatic conditions. The losses in paddy crop are very high in Jabalpur district due to various insect pests viz., *Sogatella furcifera* H., *Cnaphalocrosis medinalis* Gen., *Mythimna separata* W., Grass hopper (complex) as major pest species and *Nephotettix virescens* Dist., *Leptocorisa varicornis Dicladispa armigera* O., *Tryporyza incertulas* W., *Nilaparvata lugens* S. and *Melanitis ismene* C. as minor (Dubey 1970). Hence an urgent need was felt to study the use of light trap as IPM tool in paddy crop. The present study is conducted to collect valuable information on seasonal activity of four major insect pest species namely white backed plant hopper, rice leaf folder, army worm grass hopper (complex) insect pest species of paddy and to find out its relationship with weather parameters.

Material and methods

Field experiment was conducted at research farm during *kharif* 2002 and 2003 at Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur. Standard design of light trap (Model SM-01) by using 80 watt mercury vabour lamp, was operated through out July to December during both the crop seasons i.e. 2002 and 2003. Daily records of pest population are collected.

Trap catch obtained during every night, is an unbiased sample which represents relative activity of night flying insects active in neighborhood of the trap which is as per rough estimate is about 100 m radius around trap. The daily trap catches were converted to weekly totals and mean per day catch per week (Weakly means/day)

Table 1a. Seasonal activity of major insect pest species of paddy collected in light trap during main activity season (*kharif* 2002)

Month	Total trap catch/month (30 days collection)			
	Sogatella furcifera	*Cnaphalocrocis medinalis*	*Mythimna separata*	Grass hopper (complex)
July	0	0	0	155
August	420	115	10	293
September	425	177	103	93
October	1236	331	193	101
November	804	499	317	10
December	357	205	75	1
Total catch of a season	3242	1327	698	643

Table 1b. Seasonal activity of major insect pest species of paddy collected in light trap during main activity season (*kharif* 2003)

Month	Total trap catch/month (30 days collection)			
	Sogatella furcifera	*Cnaphalocrocis medinalis*	*Mythimna separata*	Grass hopper (complex)
July	0	0	0	218
August	1182	464	31	573
September	9033	7336	554	719
October	25176	14937	327	272
November	41568	6533	553	86
December	2726	229	105	34
Total catch of a season	79685	29499	1570	1902

where worked out. Division of weeks is based on calendar days i.e. I week (1st to 7th day), II week (8th to 15th day), III week (16th to 23rd day) and IV week (24th to 30th/31st day)

Daily weather data namely rainfall, maximum temperature and relative humidity were collected from JNKVV Agro metrological observatory for the years 2002 and 2003, which is situated within one kilometer radius from the experimental field. The collected weather data has been checked for its quality before utilizing in this study. Weekly and monthly means are calculated from the daily weather values.

Results and Discussion

Three insect pest species namely white backed plant hopper (*Sogatella furcifera* H.), rice leaf folder (*Cnaphalcrocis medinalis* Gen.), arry worm (*Mythimna separate* W.) and grass hopper (complex ie-*Trilophidia cristata* and *Gastrimargus transversus*) were identified as most important pests of paddy in this region because they occurred in significantly high numbers in trap catches as well as in field also. Species wise weekly as well as monthly results of both years (Main activity season *kharif*) are described below:

White backed plant hopper [*Sogatella furcifera* (Harvath)]

Main activity season (kharif 2002)

It is a major pest of paddy in this region. Pest appears in second week of August and activity continues up to December. The highest monthly catch was observed in October (1236) hoppers followed by November (804 hoppers) (Table 1A) and highest weekly peak was observed in the first week of November and population declines thereafter (Fig. 1) .

Main activity season (*kharif* 2003)

Pest appeared in second week of August. Major activity period was August to November there was a distinct rise in population in multiple proportion every month up to highest monthly peak in November (41,658 hopper) (Table 1B) . Highest weekly peak was observed in third week of November with 15, 568 hoppers (Fig. 1). Population curve revealed the presence of 3 to 4 peaks of catches, each successive peak being followed by gap of 15 to 20 days which coincides approximately with one life cycle period, suggesting completion of three generations during main season.

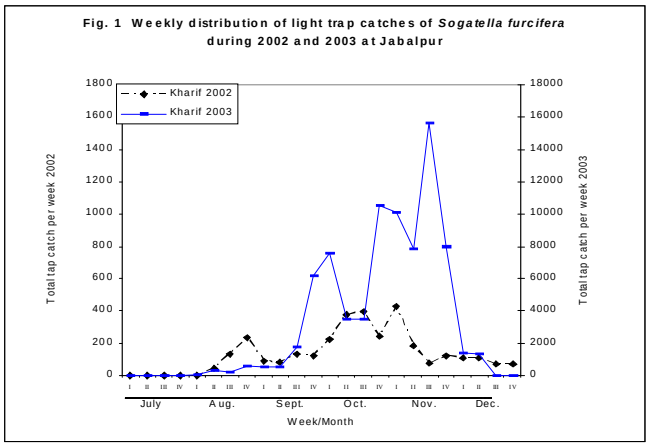


Fig. 1 Weekly distribution of light trap catches of *Sogatella furcifera* during 2002 and 2003 at Jabalpur

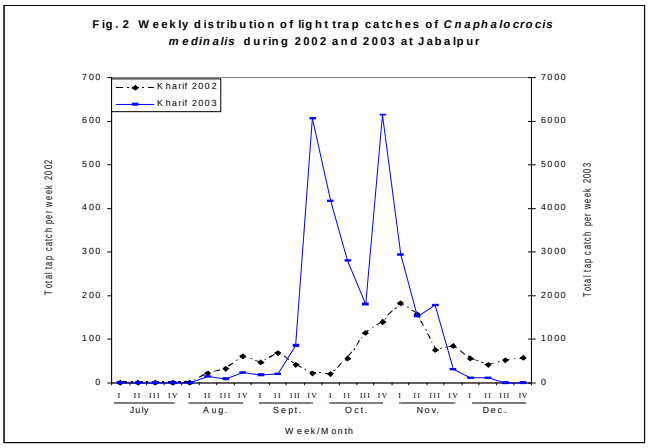


Fig. 2 Weekly distribution of light trap catches of *Cnaphalocrocis medinalis* during 2002 and 2003 at Jabalpur

Observations made by Kerketta et al. (1990) also showed that *Sogatella furcifera* and *Nilaparvata lugens* were active from September to December in trap catches in Chattisgarh. Qudeer et al. (1990) also reported that activity of major paddy pests including *Sogatella furcifera* reached its peak in August-September in Karnal, Hariyana. While according to Ammer et al. (1978) Delphacids are most abundant in October and November.

Rice leaf folder [*Cnaphalocrocis medinalis* (Guenee)]

Main season activity (*kharif* 2002)

It is a major pest of paddy in Jabalpur and also in other parts of central India. The pest first appears in second week of August and remains active up to December. The highest monthly peak was observed in November, 499 months (Table 1A) while the highest weekly peak was recorded in first week of November (182 moths) (Fig. 2).

Main season activity (*kharif* 2003)

First appearance of pest was recorded in second week of August (144 moths). Major activity period was August to December. From August to October there was distinct rice in population in multiple proportions, every month, reaching to its highest monthly peak in October (14,937 moths) (Table 1A). Highest weekly peaks were recorded during fourth week of September (6,076 moths) and October (6,144 moths) (Fig. 2). Population then significantly declined during November (6,533 moths) and December (229 moths).

The present findings are in accordance with findings of HarinKhere et al. (1998) who also reported the appearance of rice leaf folder in second week of August and major peaks were reported during September and October in Balaghat (M.P.). Similar observations were made by Manisegaram and Letchoumanane (2001) who reported major activity in August and September population curve shows three peaks and the gap (25 to 35 days) between these peaks is coincided with one life cycle period of the pest which indicates the possibility of completion of three generation during main activity season. Similar observations were reported by Chang and Wu (1999) in Tiwan who reported that rice leaf folder complete 3 generation during each crop season.

Army worm [*Mythimna separata* (WIK.)]

Main season activity (*kharif* 2002)

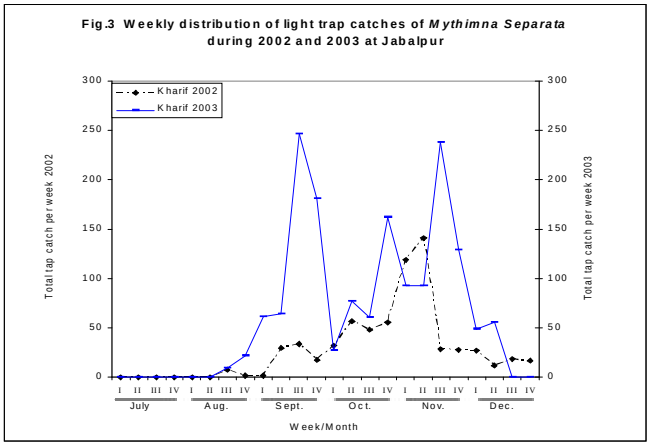
The pest first appeared in the second week of August and reached to its highest monthly peak in November (317 moths) (Table 1 A)with highest weekly peak during first and second week of November (119 and 141moths respectively) (Fig 3).

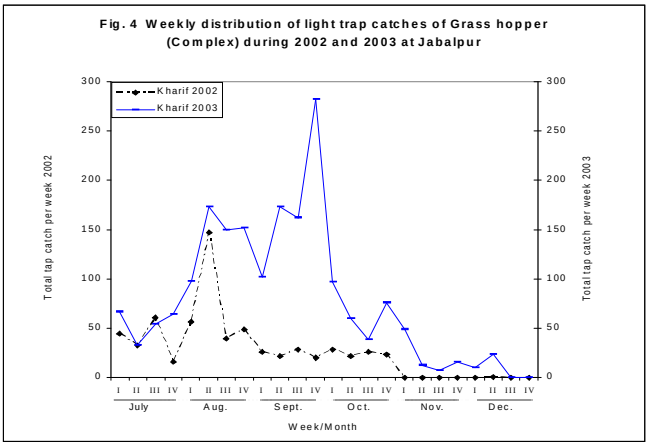
Main season activity (*kharif* 2003)

The pest was totally absent during July (Table 1B). The pest first appeared in third week of August (9 moths). Major activity period was August to December. Population raised sharply in September (554 moths) with slight fall in October, it again reached to its peak in November (553 moths). Highest weekly peaks were observed in third week of September (247 moths) and November (238 moths). Population than declined in December (105 moths). The four distinct peaks in population curve (Fig. 3) suggest completion of four generation during *kharif*.

Pest population in relation to weather parameters

Comparative activity of four pest species in relation to weather factors was studied by analysis of total monthly





catches in two different years i.e. 2002 and 2003, respectively

Results clearly revealed a distinct difference in the activity of all four pest species in both years. Year 2002 was a season of low activity while the activity of all the four most important species was distinctly much higher during 2003 crop season i.e. crop season of 2003 was most favorable for the activity of pest species.

White backed plant hopper [*Sogatella furcifera* (Harwath)]

Data indicated (Table 2) that activity in crop season was extremely higher (76,959 hoppers) about 27 times higher as compared to 2002 trap catch (2,885 hoppers).

Rice leaf folder [*Cnaphalocrocis medinalis* (Gunee)]

Trap catches in 2003 crop season (29,970 moths) was 26 times higher compared to 2002 trap catch (1,122 hoppers).

Army worm [*Mythimna separata* (Wlk.)]

The difference in trap catch of this pest was more than double. Trap catch in 2003 was 1465 moths while it was 623 moths in 2002 crop season.

Analysis of three weather parameters namely rainfall, temperature (Maximum) and humidity indicate (Table 2) prevalence of higher rainfall during July (248.8 mm), September (537.7 mm) and October (72.5 mm), lower mean maximum temperature during August (29.0^{0}C), September (28.3^{0}C) and October (29.3^{0}C) and distinctly higher humidity in September (94%) and October (93%) in the crop season of the year 2003. Apparently, these environmental conditions seem to be highly favorable for the development of *Sogatella furcifera* and *Cnaphalocrocis medinalis*, while it was moderately favorable in case of *Mythimna separata* and Grass hopper (complex).

Koul et al. (1999) observed a significant positive correlation of *C. medinalis* population levels with rain fall and frequency of rainy days. Taoling et. al. (1997) reported that monthly rainfall over 90 mm in November or December is favorable for out break of white backed plant hopper and serious drought in crop season inhibit the out break. Singh et. al. (2007) reported that insect pests of rice attained peak during warm and humid months of August and September in Panjab.

Results on seasonal activity indicated that major activity period was confined between August to December

Table 2. Monthly catches of four major pest species of paddy and weather parameters at Jabalpur

	Sogatella furcifera		*Cnaphalocrocis medinalis*		*Mythimna seporata*		Grass hopper (complex)		Weather parameters: Rainfall (mm)		Maximum temperature (^{0}C)		Relative humidity (%)	
Month/year	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
August	420	1182	115	464	10	31	293	573	745.6	532.6	29.5	29.0	91	92
September	425	9033	177	7336	103	554	93	719	239.3	537.7	30.6	28.3	88	94
October	1236	25176	331	14937	193	327	101	272	21.0	72.5	32.2	29.2	86	93
November	804	41568	499	6533	317	553	0	86	0.00	17.4	31.2	26.8	78	89
Total/mean	2,885	76,959	1,122	29,970	623	1,465	487	1,650	1005.9	1160.2	30.9	28.3	86	92

in case of *Sogatella furcifera*, *Cnaphalocrocis medinalis* and *Mythimna separata* except Graass hopper (complex), which is active round the year with two monthly peaks during August and September. Three to four peaks were observed in case of *S. furcifera*, *C. medinalis* which indicates competition of 3 generations during main cropping season while highest weekly peaks were observed during third week of September and November in care of *Mythimna seporata*. Consistently very high collection of these species in trap catches associated with their higher infestation in field during 2003 compared to 2002. This indicated that higher rainfall (1160.2 mm.), lower mean maximum temperature (28.3^{0}C) and higher relative humidity (92%) were very favorable weather factors for development of there pest species in the year 2003.

This information further strengthened the importance of light trap in monitoring the pest activity and its scope as IPM tool in the management against major pest species of rice in central India.

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Variability among two anastomosis groups of *Rhizoctonia solani* causing aerial blight of soybean

Rahul Singh and **R.K. Varma**
Department of Pant Pathology
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract

To determine the suitable media, pH and temperature for the growth and sporulation of two anastomosis group of *R. solani* six media, six pH and four temperatures were used. Richard Synthetic medium was best for mycelial growth and Czapek's Dox agar medium for sclerotial production for I(A) group. For I(B) group all the six medium were best for mycelial growth, where as Richard Synthetic agar medium was found best for sclerotial production. Out of six pH tested I(A) could grow from pH 5.0 to 8.0. Whereas I(B) group could grow from pH 6.0 to 9.0 and pH 7.0 was found best for mycelial growth and sclerotial production of IA and IB. Temperature required for the growth on PDA for I(A) group ranged between 20 C to 35 C, however 25 C found best for mycelial growth and 20 C for sclerotial production. I(B) group could grow between 20 C to 35 C, 25 C found best for mycelial growth as well as sclerotial production but no sclerotial formed at 35 C.

सोयाबीन में राइजोक्टोनिया अंगमारी के कारक राइजोक्टोनि सोलेनाई के दो समूहो 1(A) और 1(B) के तन्तु और स्क्लेरोशिय उत्पादन लिये उचित मीडिया पी.एच. एवं तापक्रम के आंकलन के लिये प्रयोगशाला में अध्ययन किया गया। राइजोक्टोनिया सोलेनाइ समूह 1(A) के तन्त के लिये रिर्चाडस मीडिया. पी.एच 5.0 से 8.0 और तापक्रम 20-35 से. उत्तम पाया गया। इसी के स्क्लैरोशिया उत्पादन हेत जेपैक्साडाक्स अगर मीडिया. पी.एच. 5.0 से 9.0 एवं 20-35 डि.से. (25 से) उत्तम रहा। समूह 1(B) के तन्तु के लिये सभी छः मीडिया पी.एच. 6.0 से 9.0 एवं 20-30 डि.से. तापक्रम उचित र स्क्लेरोशिया उत्पादन हेत रिर्चाडस मीडिया. पी.एच. 7.0 एवं तापक्रम 25 डि.से. सबसे उत्तम पाया गया. जबकि 35 डि.से. पर स्क्लैरोशिया का उत्पादन ही नहीं हआ।

Keywords: Soybean, aerial blight, *R. solani*, anastomosis, variability

Soybean [*Glycine max* (L.) Merrill] is an important oil yielding crop with a steady increase in world wide production at global level. Over the past decade productivity trend of soybean indicates that the impressive yields achieved are not sustained due to biotic and biotic factors in Madhya Pradesh. The crop suffers from many diseases including yellow mosaic disease (Mungbean yellow mosaic virus), charcoal rot (*Rhizoctonia bataticola=Macrophomina phaseolina*), collar rot (*Sclerotium rolsfii*), root rot and aerial blight (*Rhizoctonia solani*). The foliar blight (RAB) was described by Jullius Kuhn on potato in 1858. Rhizoctonia aerial blight has been reported to cause epiphytotics in soybean throughout the world (Jones and Belmar 1989; Yang et al. 1990; Liu and Sinclair 1992; Muyolo et al. 1993; Embrapa 1999). RAB is found throughout the tropics and subtropics and observations suggest that pod and foliage losses were upto 70 per cent. Rhizoctonia aerial blight in caused by two intraspecific, morphologically distinct groups of *Rhizoctonia solani* in India, one producing macro and another micro sclerotia (Jones and Belmar 1989). The sexual stage of *Rhizoctonia solani* i.e. *Thanatephorus cucumeris* was first observed (Prilleux and Delacroiz 1891).

Material and methods

A laboratory experiment was carried out in the Department of Plant Pathology College of Agriculture Jabalpur during 2006 and 2007.

Media

Mycelial growth and sclerotial production of *R. solani* [*Macrophomina phaseolina* (Tassi) Goid] was studied on the following six media: Richard Synthetic agar medium (RSA), Czapek,s Dox agar medium (CDA), Soybean Hi-veg media (SHM), Rose Bengal agar medium (RBA), Host Decoction agar medium (HDA) and V-8 juice agar medium. Media were sterilized in an autoclave and 15 to 17 ml of luke warm medium was poured into each sterilized Petri plate. Seven mm of disk from a seven days old

culture of R. solani were cut, one disc was placed in the center of each plate. These were incubated at 25 C Colony growth was measured and cultural characters were noted every 24 hr till full growth. For determining sclerotial production the plates were incubated at 25 C for 10 day. Number of sclerotia produced per plate was counted. The experiment was repeated 3 times.

Hydrogen Ion concentration

Six pH levels (5.0, 6.0, 7.0, 8.0 9.0 and 10.0) were used to study the influence of pH on the growth and production of mycelium and sclerotia of the test fungus. A 7 mm disc was cut from seven days old culture and placed in the centre of Petri plates containing PDA. The plates were incubated at 25 C. Colony growth was measured at alternate days. Number of sclerotia formed per plate was recorded after 10 days of incubation at 25 C.

Preparation of buffers

Five buffers with pH 5.0, 6.0, 7.0 8.0, 9.0 and 10.0 were prepared. Adjustment of pH was done by Elico pH meter using sodium citrate buffer. To obtain pH 5.0, 9.70 ml of 0.1m citric acid was added to 10.30 ml of 0.2m dibasic sodium phosphate. To obtain pH 6.0, 7.37 ml of 0.1m citric acid was added to 12.63 ml of 0.2m dibasic sodium phosphate. To obtain pH 7.0, 3.56 ml of 0.1m citric acid was added to 16.95 ml of 0.2m dibasic sodium phosphate. To obtain pH 8.0, 0.55 ml of 0.1m citric acid was added to 19.45 ml of 0.2 m dibasic sodium phosphate. Similarly 9.0 and 10.0 pH will be prepared. The prepared buffers were rechecked and adjusted by pH meter.

Temperature

To determine the range and optimum temperature required for mycelial growth and sclerotial production. Petri plates containing potato dextrose agar medium were used. Poured Petri plates were incubated at 20 C, 25 C, 30 C and 35 C. The plates were exposed to artificial fluorescent light (2x40 W) for 6 hr and mycelial growth was recorded after 24, 48, 72 and 96 hr of inoculation. Sclerotial count was made after 10 days of incubation. Each treatment were replicated 6 times

Results and Discussion

Six media viz., Richard Synthetic agar medium, Czapek's Dox ager medium, Rose Bengal, agar medium, Host Decoction agar medium, and V_8 juice agar medium, and Soybean Hi-Veg medium. Four temperature (20 C, 25 C, 30 C and 35 C) and six levels of pH (5.0, 6.0, 7.0, 8.0, 9.0 and 10.0) were evaluated for mycelial growth and sclerotial

Table 1. Effect of different media on mycelial growth sclerotia production of isolates of *Rhizoctonia solani* I(A) group

Media	Radial growth (mm) after (hr) 24	48	Colony character	No. of sclerotia/plate
Richard Synthetic Agar (RSA)	24.58	90.00	White cottony with variable size of sclerotia with black in colour	111
Czapek's Dox Agar (CDA)	21.09	90.00	Scanty white cottony with distributed sclerotia	34
Soybean Hi-Veg media (SHM)	22.91	90.00	White thread, dense at centre	00
Rose Bengal Agar (RBA)	14.00	90.00	White thread with distributed sclerotia few matured with large no. of immature	47 (Mature)
Host Decoction agar (HDA)	19.75	90.00	White thread, sclerotia at margin abundant mature and immature sclerotia	105
V-8 Juice agar (V-8 JA)	15.33	90.00	Dense white thread like slightly thin at centre and dense at peripheral	05
Potato Dextrose Agar, PDA (control)	12.16	90.00		54

	SEm±	CD at 5%
Media (M)	1.013094	2.944580
Days (D)	0.541521	1.573944
M × D	1.432732	4.164265

Table 2. Effect of different media on mycelial growth and sclerotia production of isolates of *Rhizoctonia solani* I(B) group

Media	Radial growth (mm) after (hr) 24	48	72	Colony character	No. of sclerotia/ 7 mm disc.
Richard synthetic agar (RSA)	24.33	90.00	90.00	Dense dark brown scleriotial production in cluster	408
Czapek's Dox agar (CDA)	25.00	90.00	90.00	Dense dark brown	295
Soybean Hi-Veg media (SHM)	25.00	90.00	90.00	White colour thin at centre dense at margin	-
Rose Bengal agar (RBA)	25.00	90.00	90.00	Thin at centre, dense at peripheral	140
Host Decoction agar (HDA)	25.00	90.00	90.00	Dense light pink growth with abundant sclerotia	191
V-8 Juice agar (V-8 JA)	24.91	90.00	90.00	Dense white (pink tented)	-
Potato Dextrose Agar, PDA (control)	15.33	22.50	90.00		200

	SEm±	CD at 5%
Media (M)	0.361132	1.049611
Days (D)	0.193028	0.561041
M × D	0.570705	1.484375

production of two anastomosis group IA and IB of *Rhizoctonia solani* causing aerial blight of soybean.

Effect of media

Mycelial growth and sclerotial production of *R. solani* was studied on the following six media: Richard Synthetic agar medium (RSA), Czapek's Dox agar medium (CDA), Soybean Hi-Veg media (SHM), Rose Bengal agar medium (RBA), Host Decoction agar medium (HDA) and V-8 Juice agar medium.

The mycelial growth of *R. solani* I(A) after 24 hr was maximum (24.58 mm) in Richard Synthetic agar medium and minimum (14.00 mm) in Rose Bengal agar medium. Complete growth (90.00 mm) was recorded after 48 hrs in all the six medium tested (Table 1). Number of sclerotia/plate was maximum (111/plate) in Czapek's Dox

Table 3. Effect of different pH on mycelial growth sclerotia production of isolates of *Rhizoctonia solani* I(A) group

pH	Radial growth (mm) after (hr) 24	48	72	Colony character	No. of sclerotia/plate
5.0	8.16	18.00	90.00	Central portion pure white but scanty thread like mycelium at peripheral. Few sclerotia at peripheral	03
6.0	10.41	20.66	90.00	White concentric growth with few mature and immaturesclerotia	13
7.0	14.66	24.08	90.00	Thick white concentric growth with few mature and immature sclerotia	60
8.0	9.83	19.25	90.00	Thick white concentric growth with few mature sclerotia and scanty at peripheral	17
9.0	-	-		No growth	-
10.0	-	-		No growth	-

(-) - No growth

	SEm±	CD 5%
pH (P)	0.371248	1.066818
Days (D)	0.262514	0.754354
P × D	0.643021	1.847782

Table 4. Effect of different pH on mycelial growth sclerotia production of isolates of *Rhizoctonia solani* I(B) group

pH	Radial growth (mm) after (hr) 24	48	72	Colony character	No. of sclerotia/7mm disc
5.0	-	-	-	No growth	-
6.0	12.25	19.83	90.00	White cottony type	34
7.0	14.66	25.00	90.00	Pinkish at centre	200
8.0	10.75	21.75	90.00	Scanty white	28
9.0	9.50	18.00	38.75	Dense white with wavy margin	-
10.0	-	-	-		-

(-) - No growth

	SEm±	CD 5%
pH (P)	0.371248	1.066818
Days (D)	0.262514	0.754354
P × D	0.643021	1.847782

agar medium, followed by Host Decoction agar medium (105/plate). No sclerotia formed in Soybean Hi-Veg medium and only few sclerotia formed (05/plate) in V-8 Juice agar medium. White mycelium growth was recorded in all the six medium.

The mycelial growth of *R. solani* I(B) after 24 hr was maximum (25 mm) in following four medium Czapek's Dox agar medium, Soybean Hi-Veg medium, Rose Bengal agar and Host Decoction agar medium and minimum of (24.3 mm) in V-8 Juice agar medium (Table 2). Complete growths (90.00 mm) were recorded after 48 hr in all the six medium tested. Number of sclerotia/plate was maximum (408/plate) in Richard Synthetic agar medium followed by (295/plate) in Czapek's Dox agar medium. No sclerotia formed in Soybean Hi-Veg medium and V-8 juice agar medium. Dense in RSA, CDA, HDA, and V-8 JA and thin growth in SHM and RBA was recorded.

Effect of hydrogen ion concentration

Six pH levels (5.0, 6.0, 7.0, 8.0 9.0 and 10.0) were used to study the influence of pH on growth and production of mycelium and sclerotia. The data presented in Table 3 Indicates that mycelial growth after 24 hr was maximum (14.66 mm) in pH 7.0 and minimum (8.16 mm) in pH 5.0. Complete growths (90.00 mm) were recorded after 72 hr in pH 5.0, 6.0, 7.0 and 8.0 Number of sclerotia/plate was maximum (60/plate) in pH 7.0 followed by pH 8.0 (17/plate). No growth was seen in pH 9.0 and 10.0. Pure white scanty in pH 5.0, white concentric in pH 6.0, Thick white concentric growth in pH 7.0 and 8.0 were recorded.

The mycelial growth after 24 hr was maximum (14.66 mm) in pH 7.0 and minimum (10.75 mm) in pH 8.0. Complete growth (90.00 mm) was recorded after 72 hr in pH 6.0, 7.0 and 8.0 (Table 4). Number of sclerotia/ plate was maximum (200/plate) in pH 7.0 followed by pH 6.0 (34/plate). In pH 9.0 after 72 hr. the maximum growth 38.75 was recorded and growth was found restricted even after 7 days of incubation. No growth occurred in pH. 5.0 and 10.0. white cottony in pH 6.0, pinkish centre in pH 7.0 and scanty white growth recorded in pH 8.0 and dense white growth recorded in pH 8.0

Effect of temperature

To determine the range and optimum temperature for

Table 5. Effect of different temperature on mycelial growth and sclerotia production of isolates of *Rhizoctonia solani* I(A) group

Temp. (C)	Radial growth (mm) after (hr) 24	48	72	96	Colony character	No of sclerotia/plate
20	5.00	14.25	90.00	90.00	Spars growth, distributed sclerotia	80
25	12.16	90.00	90.00	90.00	Thin white sclerotia at margin	54
30	7.25	18.33	90.00	90.00	White, few sclerotia at margin	35
35	6.33	16.41	24.00	90.00	Dense white sclerotia at margin, undeveloped	40 (Immature)

	SEm±	CD 5%
Temperature(T)	0.37697	1.088624
Days(D)	0.37697	1.088624
T×D	0.75395	2.177248

Table 6. Effect of different temperature on mycelial growth and sclerotial production of isolates of *Rhizoctonia solani* I(B) group

Temp. (C)	Radial growth (mm) after (hr) 24	48	72	96	Colony character	No of sclerotia/plate
20	5.50	20.16	90.00	90.00	Scanty, but dense at peripheral	168
25	15.33	22.50	90.00	90.00	Dense, pinkish white, sclerotia reddish dark brown	200
30	7.33	19.50	90.00	90.00	Dense white, immature sclerotia	150
35	5.75	16.16	24.75	90.00	Pinkish white, fluffy growth with no sclerotia	-

(-) - No growth

	SEm±	CD 5%
Temperature (T)	0.37549	1.084331
Days (D)	0.37549	1.084331
T × D	0.75098	2.168663

mycelial growth and sclerotial production Petri plates were incubated at 20 C, 25 C, 30 C and 35 C.

The mycelial growth after 24 hrs was maximum (12.16 mm) at 25 C and minimum of (5.00 mm) at 20 C. Complete growth (90.00 mm) was recorded after 24 hr at 25 C and 72 hrs at 20 C and 30 C (Table 5). It is clear from data that growth at 35 C was initially very slow and take 96 hrs to reach complete growth (90.00 mm), number of sclerotia/plate was maximum (80/plate) recorded at 20 C followed by 54 sclerotia/plate. Dense white growth recorded at 30 C and 35 C whereas thin, white and spars growth observed at 25 C and 20 C

The mycelial growth after 24 hr was maximum (15.33 mm) at 25 C and minimum of 5.50 mm at 20 C. Complete growth (90 mm) was recorded after 72 hr at 20 C, 25 C and 30 C (Table 6). It was clear from data that growth at 35 C was initially very slow and took 96 hr to reach complete growth (90.00 mm). Number of sclerotia/plant was maximum (200/plate) recorded at 25 C followed by 168 sclerotia/plate at 20 C. No sclerotia were produced at 35 C. Dense, white was recorded at 25 C, 30 C and 35 C whereas growth was scanty at 20 C.

Out of six media tested, Richard synthetic agar medium was best for mycelial growth and Czapeks Dox agar medium for sclerotial production of I(A) group, whereas I(B) group could grow in all six medium but Richard synthetic agar medium was found best for sclerotial production. Only work of Carling et al. (1994) who reported that anastomosis group 2 fruited on 1.5% water agar and 2% V-8 juice agar. The variation in result is might be due to difference in anastomosis group. In the present investigation I(A) and I(B) group were used. Therefore this study is the first report in this aspect.

Six pH were tested in which I(A) could grow from pH 5.0 to 8.0 and I(B) group could grow from pH 6.0 to 9.0 and pH 7.0 found best for mycelial growth and sclerotial production of I(A) and I(B) group. Literature pertinent to this aspect was not available, therefore this study is first report in this aspect.

Temperature required for the growth on PDA of I(A) and I(B) ranged between 20 C to 35 C, however 25 C found best for mycelial growth for both the group but 20 C was found best for sclerotia production for I(A) group and 25 C for I(B) group. Similar findings have been reported by Fenille et al. (2002); Grosch et al. (2004). Literature relating to study of temperature and age on the susceptibility information is lacking therefore the observation seems to be the first report.

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Process optimization and evaluation of quality of Indian papaya cultivars for higher recovery of fruit pulp

S.P. Tripathi, S.S. Shukla* and **Brijlata Dubey****
Krishi Vigyan Kendra Mandsore, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya Gwalior (MP)
*Department of Food Science & Technology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (MP)
**Govt.M.H.College of Home Science & Science for Women, Rani Durgavati Vishwa Vidyalaya, Jabalpur (MP)

Abstract

The physical properties, chemical composition and processing quality of 6 papaya cultivars have been evaluated and optimized. The effect of machine variable viz. speed of machine (S_1,S_2) and feed rate (T_1,T_2,T_3) for higher recovery of papaya pulp shows the maximum pulp recovery at treatment combination of S_1T_3 i.e. 480 rpm and 12 minutes for Badwani, Washington and Taiwan varieties, However it was found the lowest at treatment combination of S_2T_1 i.e. 620 rpm and 4 minutes respectively. Among the three varieties the highest pulp recovery was observed in case of Washington variety. The results reveals that treatment means has got significant difference on pulp recovery for both varieties. The protein and carbohydrate content were observed maximum in Coimbatore 1 cultivar while the Badwani and Washington variety content maximum crude fibre and fat. The mineral nutrients content were found to be Calcium 9.48-14.72, Phosphorus 4.26-7.65, Iron 0.36-0.61 and Potassium 0.38-0.64 mg/100g.

पपीते की विभिन्न प्रजातियों की भौतिक, रासायनिक एवं प्रसंस्करण गुणवत्ता का मूल्यांकन एवं स्थाईत्व किया गया। पपीते के पल्प के उच्च मात्रा हेतु मशीन वेरियबल जैसे मशीन की स्पीड (एस.-1, एस.-2) एवं फीडरेट (टी.-1, टी.-2, टी.-3) का प्रभाव दर्शाते हैं। किस बडवानी, वाशिंगटन एवं ताइवान किस्मों में टीटमेन्ट समूह एस. 1 टी.-1 480 आर.पी.एम. एवं 12 मिनट पर उच्च पल्प की मात्रा प्राप्त हुई जबकि टीटमेन्ट समूह एस.-2 टी.-1 620 आर.पी.एम. एवं 8 मिनट में यह निम्न थी तीनों किस्मों के बीच वाशिंगटन किस्म के पपीते के पल्प में अधिकतम रिकवरी प्राप्त हुई। अध्ययन का प्रतिफल बताता हैं कि पल्प की रिकवरी पर टीटमेन्ट अध्ययन में सार्थक अंतर कोयम्बटूर-1 किस्म में प्रोटीन एवं कार्बोहाईडेट की मात्रा अधिक एवं बडवानी व वाशिंगटन किस्म में क्रूड फाइवर एवं तेल की कम मात्रा देखी गयी। मिनिरल की न्यूटिटन्ट जैसे कैल्सियम 9.48-14.72, फास्फोरस 4.26-7.65, लोह 0.36-0.61, एवं पोटेशियम 0.38-0.64 मि.ग्रा./100 ग्रा. प्राप्त किये गये।

Keywords: Papaya pulp recovery, papaya cultivars quality

Papaya (*Carica papaya* L.) belongs to the family Caricaceae. In India, it is cultivate with an annual production of 9.05 lakh tonnes. Papaya is called as "Karpaga Viruksha" since the various parts of the tree are used either for human consumption, animals feed, raw material for many agro-based food industries etc.The composition and sensory quality of papaya cultivated in Madhya Pradesh i.e. Badwani, Honeydew, Selon and Golden delicious shows that fruits of these varieties are very attractive with good appearance and colour. The pulp colour is saffron yellow and has good flavor and good sugar/acid ratio; hence can be used for processing of export quality products.

Couple of years back several varieties of papaya have been released. However, the systematic information on composition and optimum processing parameters for pulp recovery and pulp quality is not available for these varieties under investigation. Therefore the varieties are not used by processors. In view of the above facts the present investigation has been undertaken to study the physical properties and chemical compositions of different varieties of ripen papaya fruits and to standardize the machine (pulper) variables for higher recovery of papaya pulp.

Material and methods

The fresh unripe fruits of papaya cultivars viz., Badwani red, Badwani yellow, Honey Dew, Coimbatore 1, Taiwan and Washington were obtained from Horticulture Department, Jabalpur. The fruits were dry-cleaned and wrapped in brown paper and placed in corrugated boxes in dark for 4-5 days for ripening using carbide (CaC_2) ampoules. The ripened fruits were unwrapped, cleaned and exposed to air to bring them to ambient temperature for further analysis. The physical properties viz., peel (%), seed (%), pulp (%), pulp/peel ratio and colour of flesh of

Table 1. Physical properties of different cultivars of ripen papaya fruits

Cultivars	Pulp %	Peel %	Pulp/peel ratio	Flesh colour	Fruit shape
Badwani red	85.4	11.6	7.36	Red	Oblong
Badwani yellow	85.6	11.6	7.38	Yellow	Oblong
Coimbatore 1	86.2	11.8	7.31	Orange	Oblong
Honey dew	87.0	10.7	8.13	Orange	Long to oblong
Taiwan	84.2	12.2	6.90	Yellow red	Oblong
Washington	83.0	12.5	6.64	Yellow red	Oval to oblong

*The value is average of three replications

ripened papaya fruits were evaluated according to standard procedure as described by Ranganna (1991); Parwar (1999). Proximate composition determination in terms of moisture, protein, fat, total ash and carbohydrate contents in fresh fruits were determined by methods as given in AOAC (1984). The important minerals, like calcium, iron, phosphorus and potassium in papaya fruits were estimated by method as described by Black (1965). The Total soluble solids content of papaya fruit pulp and juice were determined by using hand refractometer (0-32 ^{0}Brix, ERMA, New Delhi) and the values were corrected to 20^{0}C, according to the procedure described by Ranganna (1991). To standardize papaya pulper machine (Plate 1, Make-Berry & Co. New Delhi) variables for maximum pulp recovery, the experiment were planned in Factorial Design with two factors each at three levels. The machine variables were feeding time (T_1, T_2 and T_3 at 4, 8 and 12 minutes) and Speed of pulper machine (R_1, R_2 at 480 and 620 rpm) respectively . The quantity of papaya to be fed in pulper was fixed at 10 kg for each experiment. The observations for total pulp recovery and weight loss were recorded using electronic balance (TS 2005, DHAUS Corporation, USA). The fruits were cleaned and washed under running tap water. The ripened fruits were pealed and cut into longitudinal section in two equal parts. The seeds and fibrous parts in side the cavity of fruits were removed. The fruits were further cut in to suitable small pieces. Now the pulper was fixed with fine sieves and it was operated at predetermined speed and feed rate. The small papaya pieces were poured into the pulper. After a recorded time the pulper was stopped and pulp was recovered. The fresh pulp was pasteurized at 80oC and hot filled in to 5kg glass jar container. The container was sealed with wax and stored at room temperature for further analysis work.

Results and Discussion

The freshly procured raw papaya fruits were ripened and stored at room temperature to determine the physical properties. The peel percent and pulp yield are important factors that determine the processing quality of papaya. It varied from 10.7 to 12.5 and 83.0 to 87.0 per cent among the six cultivars under investigation as shown in Table 1. The ripened fruits of Badwani red variety had attractive red colour of flesh. However, Honey Dew variety which is sweetest in taste possessed orange colour. The varieties viz., Badwani yellow, Taiwan and Washington possessed yellowish flesh colour. The fruit shape of almost all cultivars ranged from oblong to oval shape. To substantiate the present findings, the information on physical attributes of papaya cultivars is quite meager. However, present finding can be confirmed with reported values by Pal et al. (1980a); Pal et al. (1980b); Singh and Singh (1998).

The proximate composition of ripened papaya fruit (Table 2) indicates a wide variation among the cultivars with regard to protein, carbohydrate and mineral nutrients composition. The moisture, carbohydrate, protein, fat, and crude fibre, varied from 88.5 to 90.0, 8.0 to 11.3, 0.35 to 0.62, 0.15 to 0.18 and 1.29 to 2.13 per cent respectively. The maximum amount of protein and carbohydrate content

Table 2. Proximate composition (% of edible portion) of different cultivars of papaya fruits (ripen)

	Percent				
Cultivars	Moisture	Carbohydrate	Protein	Fat	Crude fibre
Badwani red	89.5	10.8	0.53	0.15	2.13
Badwani yellow	88.5	10.0	0.51	0.16	2.13
Coimbatore 1	88.6	11.3	0.62	0.16	1.78
Honey dew	90.0	9.4	0.60	0.17	1.65
Taiwan	89.1	8.9	0.35	0.16	1.29
Washington	89.8	8.0	0.40	0.18	2.00

Value (g/100 g edible portion)

Table 3. Mineral nutrients composition (mg/100 g of edible oil portion) of different cultivars of papaya fruits (ripen)

Cultivars	% mg				
	Calcium	Phosphorus	Iron	Potassium	Ash
Badwani red	13.00	5.06	0.58	0.60	0.57
Badwani yellow	13.05	5.06	0.58	0.61	0.74
Coimbatore1	12.83	5.01	0.50	0.55	0.63
Honey dew	13.85	4.26	0.42	0.46	0.60
Taiwan	9.48	4.39	0.36	0.38	0.65
Washington	12.11	7.65	0.61	0.64	0.58

was observed in Coimbatore 1 cultivar. The Badwani and Washington variety contained maximum amount of crude fibre and fat content respectively. The findings of mineral composition of papaya cultivars (Table 3) indicate that papaya cultivars were rich source from calcium. The range of important mineral nutrients in papaya was calcium 9.48 to 13.85, phosphorus 4.26 to 7.65, iron 0.36 to 0.61 and potassium 0.38 to 0.64 mg/100 g. The papaya fruits are vital source of life saving nutrients and minerals. The wide varietal variation as regards for composition and quality of papaya fruits (raw and ripened) has been reported by many workers. The present findings could be substantiated with the reported values of Giri et al. (1980); Pal et al. (1980); Gopalan et al. (1981).

The papaya cultivars grown in central part of Madhya Pradesh had a wide variation in chemical composition and physical properties that also influences the textural properties viz., firmness, weight and volume of papaya fruits, which finally influences the recovery of fruit pulp. To undertake studies on recovery of fruit pulp the pulper was fed with 15 kg of peeled papaya slice of Badwani, Taiwan and Washington variety of papaya and operated at predetermined treatment combinations. The effects of machine variables speed (rpm) and feed time (min) on pulp recovery are presented in Table 4, 5 and 6. The results revealed that in case of Badwani variety average quantity of pulp observed inside and outside of pulper were to be 0.975 to 1.309 kg and 13.109 to 13.624 kg respectively. The maximum pulp recovery (97.33%) was observed at treatment combination of R1T3 i.e. 480 rpm and 12 min. The pulp loss of 2.67 to 3.88 per cent was assessed in different treatment combination.

Table 4. Standardization of machine (pulper) variables for higher pulp recovery from Badwani variety of papaya

Treatments	Papaya peeled slices (kg)	Weight of fine pulp(kg) Inside pulper	Outside pulper	Total pulp recovery (kg)	Loss of pulp in pulper (kg)	Pulp recovery (%)	Pulp loss (%)
R_1T_1	15	1.156	13.422	14.578	0.422	97.19	2.81
R_1T_2	15	0.990	13.593	14.583	0.417	97.22	2.78
R_1T_3	15	0.975	13.624	14.599	0.401	97.33	2.67
R_2T_1	15	1.309	13.109	14.418	0.582	96.12	3.88
R_2T_2	15	1.250	13.232	14.482	0.518	96.55	3.45
R_2T_3	15	1.116	13.447	14.563	0.437	97.09	2.91

Table 5. Standardization of machine (pulper) variables for higher pulp recovery from Taiwan variety of papaya

Treatments	Papaya peeled slices (kg)	Weight of fine pulp(kg) Inside pulper	Outside pulper	Total pulp recovery (kg)	Loss of pulp in pulper (kg)	Pulp recovery (%)	Pulp loss (%)
R_1T_1	15	1.250	13.352	14.602	0.398	97.35	2.65
R_1T_2	15	0.208	13.411	14.619	0.381	97.46	2.54
R_1T_3	15	1.110	13.527	14.637	0.363	97.58	2.42
R_2T_1	15	1.440	13.996	14.436	0.564	96.24	3.76
R_2T_2	15	1.356	13.144	14.500	0.500	96.67	3.33
R_2T_3	15	1.096	13.469	14.565	0.435	97.10	2.90

Table 6. Standardization of machine (pulper) variables for higher pulp recovery from Washington variety of papaya

Treatments	Papaya peeled slices (kg)	Weight of fine pulp(kg) Inside pulper	Outside pulper	Total pulp recovery (kg)	Loss of pulp in pulper (kg)	Pulp recovery (%)	Pulp loss (%)
R_1T_1	15	1.438	13.097	14.535	0.465	96.90	3.10
R_1T_2	15	1.366	13.189	14.555	0.445	97.03	2.97
R_1T_3	15	1.056	13.585	14.641	0.359	97.61	2.39
R_2T_1	15	1.589	12.713	14.302	0.698	95.35	4.65
R_2T_2	15	1.554	17.813	14.367	0.633	95.78	4.22
R_2T_3	15	1.405	13.016	14.421	0.579	96.14	3.86

The pulp recovery varied from 96.24 to 97.58 per cent among the various treatment combinations and pulp losses were 2.42 to 3.76 per cent. The treatment combination of R_1T_3 (480 rpm x 12 min) was found to be the best for maximum recovery of papaya pulp. Effect of feeding time and speed of the pulper had significant effect on the pulp recovery of Washington cultivar of papaya (Table 5). The maximum (97.61%) and minimum (95.35%), pulp recovery was observed at treatment No. 3 i.e. R_1T_3 (480 rpm x 12 min) and treatment No. 4 (620 rpm x 4 min) respectively. The loss of pulp during operation of pulper was 2.39 to 4.65 per cent among six treatment combinations. The attribute of recovery of pulp of particular variety using pulper is the phenomenon of fruit texture quality. Avery meager information is available in the literature regarding pulp yield characteristics of papaya fruit. However, the findings of present investigation can be confirmed from the reported value by Parwar (1999); Diwan (2000).

The fruit juice processing industries uses conventional methods to produce fruit pulp; the positive economy will takes place when the product will be produced at the competitive cost on proposed optimized conditions. From above findings it could be concluded that the papaya cultivars grown in Madhya Pradesh are very nutritious and can be processed easily for production of fruit pulp. This attempt of utilization of available surplus ripened papaya fruit for value added product could certainly help the nation in the way of minimizing the harvest and post harvest losses and technological development.

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Effect of cold sterilization on quality attributes of mushrooms stored at low temperature

Alpana Singh, R.S. Thakur, S. Gautam*, A. Wasnikar** and **Reena Deshmukh**
Department of Food Science & Technology
**Department of Plant Pathology
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur 482004 (MP)
*Food Technology Division, Bhabha Atomic Research Centre, Mumbai 400 085

Abstract

Changes in quality characteristics of mushrooms i.e. *Agaricus bisporus* and *A. bitorquis* as influenced by cold sterilization (gamma radiation) along with low temperature storage were studied. Mushrooms packed with LDPE film (100 guage) could be stored up to 10-15 days at 5^{0}C with the maximum retention of mushroom quality characteristics such as sensorial attributes (colour, appearance, texture), Instrumental colour (L*,a*,b* values), physical parameters (cap opening, stipe length, cap diameter), physiological weight loss as compared to unirradiated mushroom kept control and stored for 5 days under same condition. *A. bisporus* retained good colour, appearance and texture up to 12th day when irradiated with 1.5 kGy radiation dose whereas *A. bitorquis* treated with 2.0 kGy radiation dose remained acceptable up to 24th day as compared to control (5th day). Irradiated mushrooms showed significant effect on Hunter colour values. PLW was reduced in irradiated mushrooms during storage as compared to control. Cap diameter and stipe length of A. Spp. remain unchanged irrespective of radiation doses during storage. The cap remained unopened up to 9th day and partially opened on 12th day of storage in irradiated samples of both the varieties as compared to non irradiated samples (cap opened on 6th day). It can be concluded that gamma radiation treatment in combination with low temperature storage was found suitable for shelf-life extension and maintenance of mushroom quality.

शीत निजर्मीकरण (गामा विकिरण) का निम्न तापक्रम पर भंडारि (ऐगेरिकस बाईस्पोरस व ऐगेरिकस बाईटार्क्विस) की विभिन्न गुणवत्ता पर प्रभाव का अध्ययन किया गया। अनुसंधान के दौरान विभिन्न गुणों जैसे सेंसरी (रंग रुप, टेक्चर), इन्स्ट्रुमेन्टल रंग L*,a*,b* मान), फिजिकल (डंठल की लंबाई, छतरी का डायमीटर, छतरी का खुलना) एवं फिजियोलाजिकल वेट लास के अध्ययन में पाया गया कि निम्न घनत्व वाली पालीइथाईलीन पैकेट 100 गेज) में मशरुम 5^{0}C पर 10-15 दिनों के लिये संरक्षित किये जा सकते हैं। 1.5 kGy विकिरण मात्रा द्वारा विकरित ऐगेरिकस बाईस्पोरस का रंग, रुप व टेक्चर 12 दिनों तक एवं ए. बाईटार्क्विस (20 kGy विकिरण मात्रा द्वारा विकरित) 24 दिनों तक जबकि कंटोल मशरुम सिर्फ 5 तक ही सही अवस्था में पाये गये। गामा विकिरण का हंटर रंग मान पर भी अनुरुप प्रभाव देखा गया। कंटोल मशरुम की तुलना में विकिरित फिजियोलाजिकल वेट लास कम पाया गया। डंठल की लंबाई व छत्तरी के डायमीटर पर भंडारण के दौरान इन प्रयोगों का कोई प्रभाव नह हुआ। विकिरित मशरुम की दोनों प्रजातियों की छत्तरी ९ दिन तक नहीं खुली एवं 12 दिन में आंशिक रुप से खुली जबकि कंटोल मशरुम की छत्तरी 5 दिन में पूण रुप से खुली देखी गयी। निष्कर्षतः यह कहा जा सकता है कि गामा विकिरण व निम्न तापक्रम पर भंडारण संयुक्त रुप से मशरुम की गुणवत्ता को बनाये रखते हये उसकी भंडारण अवधि को बढाने में साहयक सिद्ध हये है।

Keywords: Cold sterilization, gamma radiation, sensory attributes, physiological weight loss, Hunter colour values

Mushrooms are nutritionally rich in proteins, vitamins and minerals (Prakash and Tejaswini 1991; Ghosh et al.1990) and physiologically an important potential source of biologically active compounds of medicinal value. India produces about 50,000 tonnes of fresh mushroom annually, a major portion of which is exported, as the mushroom industry is growing at a faster rate (Suman and Sharma 2005). Mushrooms are extremely perishable results in various physiological and morphological changes after harvest like browning, loss of moisture and texture which make them unacceptable for consumption. Therefore, scientific maintenance of their quality is at present an important urge that shall enhance not only their quality but shall also increase their shelf life. Post harvest handling practices helps in enhancing the availability of quality mushrooms to the consumers. Use of gamma radiation to retain the freshness, preventing senescence, microbial decontamination has recently taken an important place as cold sterilization. Irradiation

Table 1. Sensory attributes of *Agaricus bisporus* during storage (9 point hedonic scale)

Radiation doses	Parameters	Storage days						
		0	3	6	9	12	15	18
Control	C & A	9	7.5	6.4	D			
	T	9	7.3	6.3	D			
1.0 kGy	C & A	9	8.5	8.3	8	7.2	6.8	D
	T	9	8.4	8.1	7.9	7	6.5	D
1.5 kGy	C & A	9	8.8	8.5	8.3	8.1	7.2	
	T	9	8.7	8.4	8.2	8	7.1	
2.0 kGy	C & A	9	8.4	8.1	7.8	7	6.5	D
	T	9	8.2	8	7.7	6.8	6.4	D

C & A-colour and appearance; T-texture; D-discarded

processing slows down the rate of metabolism and inactivates the enzymes and extending the shelf life. Food irradiation has safe, technically and economically feasible applications. It has been legally permitted in India and regulation is in place for its commercialization and marketing of irradiated foods (Bawa and Vibhakara 2002). Therefore the present study is being conducted with the objective to evaluate various quality parameters of mushroom as affected by gamma radiation.

Material and methods

Freshly harvested mushrooms free from visual blotches were collected from College of Agriculture, JNKVV, Jabalpur and were promptly placed in refrigerator before packing as they are required to be precooled immediately after harvest to check the deteriorative changes. Collected samples were packed in LDPE bags (100 gauge), irradiated with 0, 1.0, 1.5, 2.0 kGy radiation doses in radiation chamber using cobalt-60 source of gamma radiation and stored at 5^0C. Sensory attributes were judged by a panel of 10 experts by using 9 point Hedonic scale (Amerine et al. 1965). Colour reflectance of mushroom was measured as Hunter colour values where L is a measure of lightness on a scale ranging from 0 (black) to 100 (white), + a- redness and + b- yellowness (Hunter 1975). Physiological weight loss was measured by weighing the stored samples at 3 day intervals. The cap opening was visually monitored. A total rupture of the veil exposing the dark gills was considered as the complete cap opening as against partial opening when the rupture of veil did not show the gills. The stipe length and cap diameter was measured using a millimeter scale.

Results and Discussion

Significant difference was observed in the acceptability of unirradiated and irradiated mushrooms during storage (Table 1, 2). Low doses of gamma radiation reduce the loss of colour, appearance and texture. *A bisporus* retained good colour, appearance and texture up to 12 days when irradiated with 1.5 kGy radiation dose where as *A. bitorquis* treated with 2.0 kGy radiation dose retained these parameters up to 24 days as compared to 5 days in control. The irradiated mushroom showed less brown discoloration compared to non-irradiated control. The

Table 2. Sensory attributes of *Agaricus bitorquis* during storage (9 point hedonic scale)

Radiation doses	Parameters	Storage days								
		0	3	6	9	12	15	18	21	24
Control	C & A	9	8.1	7.3	D					
	T	9	8	7.1	D					
1.0 kGy	C & A	9	8.6	8.3	8.1	7.8	7.4	7.1	7	6.9
	T	9	8.7	8.4	8	7.7	7.3	7	6.9	6.8
1.5 kGy	C & A	9	8.8	8.5	8.3	8.1	7.8	7.6	7.3	7.1
	T	9	8.7	8.6	8.4	8.2	7.9	7.5	7.2	7
2.0 kGy	C & A	9	8.9	8.7	8.5	8.2	8	7.8	7.6	7.3
	T	9	8.8	8.6	8.4	8.1	7.9	7.7	7.5	7.2

C & A-colour and appearance; T-texture; D-discarded

Table 3. Hunter colour analysis of *A. bisporus* during storage (L*, a*, b* values)

Treatments	Colour parameters	Storage days 0	3	6	9	12	15
Control	L*	73.5	77.6	72.15	70.69	68.58	66.48
	a*	1.44	2.94	5.06	5.3	5.52	5.75
	b*	14.74	17.54	20.69	21.19	21.21	21.23
1.0 kGy	L*	57.1	83.13	83.76	80.84	72.84	64.84
	a*	1.99	3.61	3.45	4	3.56	3.13
	b*	14.76	18.3	17.62	18.37	17.43	16.5
1.5 kGy	L*	69.46	74.6	66.28	71.63	72.34	73.06
	a*	2.78	4.1	3.56	5.73	4.32	2.91
	b*	18.86	18.39	18.1	19.44	17.61	15.79
2.0 kGy	L*	72.2	71.69	73.13	70.53	68.7	66.91
	a*	1.42	3.33	3.78	4.35	4.74	5.13
	b*	11.41	18.47	18.76	19.22	18.88	18.54

scores reported by judges regarding sensory attributes showed that maximum scores after 15 days of storage as retained under 1.5-2.0 kGy gamma radiation without any objectionable changes in colour, appearance, and texture might be due to decreased enzymatic activities which is responsible for deterioration.

All the irradiated mushrooms showed significant effect on hunter colour values (Table 3, 4). It was also evidenced by the sensory studies. The lightness in the irradiated mushroom was more than unirradiated samples at the end of storage. Lightness decreases gradually, while the redness and yellowness of unirradiated mushroom increased during storage. Delayed colour change in irradiated mushroom could be due to decreased metabolic process responsible for degradation of stored mushrooms. This may be due to reduced activity of

Table 4. Hunter colour analysis of *A. bitorquis* during storage (L*, a*, b* values)

Treatments	Colour parameters	Storage days 0	3	6	9	12	15	18	21	24
Control	L*	66.29	66.5	64.55	63.69	61.19	60.11	60.82	59.94	62.21
	a*	2.84	4.22	4.42	4.63	4.85	4.99	5.08	5.33	7.09
	b*	15.53	18	18.13	18.5	17.95	18.1	18.47	19.43	26.35
1.0 kGy	L*	72.4	69.94	70.08	70.15	70.16	68.44	67.53	66.43	68.3
	a*	2.69	3.49	3.51	3.72	3.63	3.42	3.15	3.03	5.05
	b*	16.46	17.12	17.3	17.83	17.82	16.55	15.04	15.75	20.03
1.5 kGy	L*	72.21	54.47	54.3	54.97	51.84	51.9	52	52.21	60.91
	a*	4.02	8.46	7.91	7.8	8	8.1	8.21	8.25	8.67
	b*	17.36	21.99	20.18	19.4	21.75	21.81	20.08	20.99	19.48
2.0 kGy	L*	73.68	64.17	65.93	69.2	68.5	68.11	67.82	67.2	68.5
	a*	2.93	4.16	4.2	4.27	4.72	9.9	4.1	4.21	4.68
	b*	18.95	18.65	18.55	18.5	19.02	19.04	19	19.02	19.12

Table 5. Physiological weight loss (%) of *A. bisporus* during storage

Radiation doses	Storage days 0	3	6	9	12	15
Control	0	1.4	3.29	3.99	4.45	6.98
1.0 kGy	0	1.07	1.23	1.62	2.21	3.68
1.5 kGy	0	0.92	1.18	1.87	1.87	2.3
2.0 kGy	0	1.03	1.48	1.81	2.36	3.8

Table 6. Physiological weight loss (%) of *A. bitorquis* during storage

Radiation doses	Storage days								
	0	3	6	9	12	15	18	21	24
Control	0	0.65	1.25	1.91	4.2	4.8	5.6	9.9	14.2
1.0 kGy	0	1.85	2.74	3.53	6.38	5.1	5.71	9.35	12.99
1.5 kGy	0	3.64	3.74	4.32	5.69	6.35	6.84	7.92	8.97
2.0 kGy	0	2.43	2.99	3.6	5.25	6.2	6.75	7.41	8.07

polyphenol oxidase enzyme responsible for causing browning in mushrooms (Skou et al. 1974). Storing mushrooms at low temperature could also inhibit colour deterioration due to controlled enzyme activity and microbial deterioration. As observed in this study, Beaulieu et al. (1992) have earlier reported that irradiated mushrooms undergoes less browning compared to non-irradiated samples during a prolonged storage.

The entire irradiated mushrooms had lower PLW during storage as compared to unirradiated samples (Table 5, 6). The LDPE film reduces moisture loss and restricts movement of gases and the moisture. This inturn results into considerable reduction in respiration rate and transpiration loss of water. Weight loss in mushrooms occurs due to moisture lost by diffusion through the film and loss of carbon due to respiration. Patel et al. (1988) observed weight loss in mushrooms even when they were stored at 97% RH. The weight loss was within the 8.0% range reported for golden white and 6.7% for off white strain stored 9 days at 12^{0}C (Schmidt 1977). Similar weight loss (12.9% and 5.4% after 2 and 10 days, respectively) was also reported by Anouni (1991) at 12^{0}C.

The increase in button diameter and stipe length during storage did not show a noticeable difference between non-irradiated and irradiated samples (Table 7, 8). The caps remained unopened up to 9th day and partially opened on 12th day of storage in irradiated samples of both the varieties as compared to non irradiated mushrooms (Cap opened on 6th day). Irradiation along with low storage temperature was found to have a synergistic effect on the self life extension of mushrooms (Staden 1965; Langerak 1972). Treatment with gamma radiation was found to inhibit the physiological growth of mushroom as reflected by the measurement of physical parameters of the stored irradiated and non-irradiated samples. These findings are similar to those of Wahid (1980); Markakis et al. (1972). Irradiation can potentially delay the physiological process of maturation i.e. development of cap, stalk, gill and spore. It also reduces the water loss, colour, texture and delays the quality losses.

The quality parameters of mushroom indicated that the irradiated mushroom retained all the quality attributes required for its acceptability. The present study suggested that a gamma radiation dose of 1.5-2.0 kGy in conjunction with storage at 5^{0}C would be an effective tool for extending the shelf life of commercially produced button

Table 7. Physical parameters of *A. bisporus* during storage

Treatments	Storage days					
	0	3	6	9	12	15
Cap diameter (cm)						
Control	5.8	5.8	5.8	5.5	5.5	5.5
1.0 kGy	6.2	6	6	6	6	6
1.5 kGy	6.5	6.5	6.5	6.5	6.5	6.5
2.0 kGy	6	6	6	6	6	6
Stipe length (cm)						
Control	2.4	2.4	2.4	2.4	2.4	2.4
1.0 kGy	2.2	2.2	2.2	2.2	2.2	2.2
1.5 kGy	2.5	2.5	2.5	2.5	2.5	2.5
2.0 kGy	1.6	1.6	1.6	1.6	1.6	1.6
Cap opening						
Control	unopened	unopened	Opened			
1.0 kGy	unopened	unopened	unopened	Slightly opened	Opened	
1.5 kGy	unopened	unopened	unopened	unopened	Slightly opened	Slightly opened
2.0 kGy	unopened	unopened	unopened	Slightly opened	Opened	

Table 8. Physical parameters of *A. bitorquis* during storage

Treatments	Storage days					
	0	3	6	9	12	18
Cap diameter (cm)						
Control	4.2	4.2	4.2	4.2	4.2	4.2
1.0 kGy	4	4	4	4	4	4
1.5 kGy	4.5	4.5	4.5	4.5	4.5	4.5
2.0 kGy	4.1	4.1	4.1	4.1	4.1	4.1
Stipe length (cm)						
Control	1.6	1.6	1.6	1.6	1.6	1.6
1.0 kGy	2	2	2	2	2	2
1.5 kGy	2	2	2	2	2	2
2.0 kGy	2.5	2.5	2.5	2.5	2.5	2.5
Cap opening						
Control	unopened	unopened	Opened			
1.0 kGy	unopened	unopened	unopened	Slightly opened	Opened	
1.5 kGy	unopened	unopened	unopened	Slightly opened	Opened	Opened
2.0 kGy	unopened	unopened	unopened	Unopened	Slightly opened	Slightly opened

mushroom up to a period of 10-15 days facilitating its market distribution and sale in the country. This technique of preservation could be used by the mushroom growers for storage as well as for better economic returns particularly during peak harvesting seasons, also by the traders for both domestic markets as well as for export trade.

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Resource use efficiency of soybean production in Raisen district of Madhya Pradesh

R.M. Sahu, R.S. Raghuwanshi, Roshni Tiwari and **D. Dhakar**
Department of Agricultural Economics & Farm Management
Jawaharlal Neheru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract
The study was undertaken to estimate the resource use efficiency of soybean production in Raisen district of Madhya Pradesh. The primary data has been collected from sixty farmers of Bari block of Raisen district in the year 2007-08. it is observed from the analysis of data that an average soybean growers found to be use their all the resources efficiently except plant protection. The farm category wise analysis showed that an average small farmer has only found to be used their seed (0.975**) resource efficiently while large farmers has efficiently used all the resources except seed (-0.796*). The fitted Cobb-Douglas production function found to be good fit as it explained 79 to 97 percent efficiency of resources of soybean production.

Hindi

Keywords:

In the wake of modernization of agriculture, the endeavour is to increase productivity, profitability, adaptability, stability and sustainability of the farm business for the efficient utilization of farm resources. Soybean [*Glycine max* (L)] is a miracle crop because of having high quality protein and edible oil. It is triple beneficiary crop, which contains 18 to 20 percent edible oil, 45 percent high quality protein and high level of essential amino acids. Soybean is an eco-friendly crop in the sense it fixes 25-30 kg nitrogen/ha in the soil, which leads to reduce use of chemical fertilizers as a source of nitrogen for following crop (Sharma et al.).

Soybean cultivation in the world is mainly confined to USA, Brazil, China, Argentina, European Union, Paraguay and India. India is the fifth largest soybean producing country in the world which occupied 9.62 million ha. area with 9.31 million metric tones production and 967 kg/ha productivity (Kharif 2008-09). In Madhya Pradesh which is known as soybean state because it covered 54.79 percent of the soybean crop area of the country having 1st rank. It occupied 52.99 lakh ha area, 55.08 lakh metric tones production with 1040 kg/ha productivity (kharif 2008-09). However the productivity levels have been observed to be low because of low level of input use as well as the inefficient use of available resources.

Methodology

The study was confined to Raisen district of Madhya Pradesh in the year 2007-08. The district comprises of 7 blocks viz., Sanchi, Gairatganj, Begamganj, Udaypura, Silwani, Goharganj and Bari. Out of them Bari block was selected purposively for study which covers highest area under soybean.

Five villages were selected from block on the basis of highest area under soybean viz., Khargon, Singhpur, Batera, Bhondia, Chheend, The farmers from each village were categories into 3 size groups i.e. small (up to 2.00 ha), medium (2.01 to 4 ha) and large size (above 4.01 ha). From each category 20 farmers were selected randomly, thus the total numbers of farmers were 60 for detail investigation. The primary data were collected from selected farmers through personal interview by survey method using pretested interview schedules.

The Cobb Douglas production function (Heady and Dillon) was used for estimating the resources used in soybean production.

Table 1. Resource use efficiency of soybean production in Raisen district

Farm size	No. of respondent	Constant (a)	Production variable (Rs/ha)						R^2
			Seed X_1	Human labour X_2	Bullock labour X_3	Machine labour X_4	Manure and fertilizer X_5	Plant protection measures X_6	
Small	20	0.984 (0.330)	0.975** (0.168)	-2.129 (0.069)	-1.644 (0.004)	-4.305 (0.131)	0.150* (0.052)	2.810 (0.005)	0.97
Medium	20	2.203 (0.581)	0.268 (0.194)	7.086* (0.33)	-4.423 (0.006)	0.300* (0.127)	8.660 (0.060)	-6.570 (0.006)	0.79
Large	20	2.213 (0.401)	-0.796* (0.281)	0.119* (0.042)	1.267 (0.007)	0.762** (0.251)	0.132 (0.208)	0.645** (0.192)	0.94
Average	60	1.07 (0.188)	0.395** (0.132)	7.641* (0.031)	3.255 (0.004)	0.49** (0.125)	5.740 (0.057)	-2.880 (0.005)	0.96

*Significant at 0.05 level of probability, **Significant at 0.01 level of probability

$$Y = a X_1^{b1} . X_2^{b2} . X_3^{b3} . X_4^{b4} . X_5^{b5} . X_6^{b6}$$

where

Y = Dependent variable (Gross income Rs./ha)
A = Constant
X1 = Seed (Rs/ha)
X2 = Human labour (Rs/ha)
X3 = Bullock labour (Rs/ha)
X4 = Machine labour (Rs/ha)
X5 = Manures & fertilizer (Rs/ha)
X6 = Plant protection (Rs/ha)
b_1-b_6 = Regression coefficient of respective resource used

Results and Discussion

The R^2 value for average production was 0.96 which indicate that function was best fit and able to explain the variable to the extant of 96%. The values of coefficient of seed (0.395), human labour (7.641) and machine labour (0.49) were observed positive and highly significant. The value of plant protection coefficient (-2.88) was negative and non significant, revealed that the plant protection resources used in excessively by the cultivator.

The estimation of resource use efficiency revealed that seed resource was positive and highly significant and had value 0.975 for the small size of holding. Manure & fertilizer had also significant regression coefficient (0.146). The coefficient of human labour (-2.129), bullock labour (-1.644) and machine labour (-4.305) were found negative and non significant, shows that the resources were used in excess. The seed and manure and fertilizers were important and play significant role in soybean production in small size farms. In this case R^2 value was 0.97.

The power function analysis revealed the R^2 of 0.785 which indicate that the production function is best fit for medium size of holdings. The resource use efficiency analysis shows that human labour and machine labour were positive, significant and have values of 7.086 and 0.30. The bullock labour (-4.423) and plant protection (-6.565) resources found negative and non significant, which showed bullock and plant protection resources used in excess. It is found that for medium size of holdings seed and machine labour resources had significant contribution for production of soybean.

The power function analysis revealed the R^2 of 0.941 which shows function was good fit for large size of holdings. The aggregate elasticity was 2.129 shows the return to scale is increasing order. The coefficients of machine labour and plant protection resources were positive and highly significant had values 0.762 and 0.646 respectively, for human labour it was also found positive and higher significant. Seed was found negative and highly significant coefficient showed seed used in excessively by the cultivators.

It can be concluded from above discussion that human labour and machine labour was significant for medium, large and average size of holdings, but it was not for small size of holdings. Seed was significant for small, but it was not for large size of holding. The fertilizer was significant for only small size of holdings. Plant protection was significant only for large size of holdings, but it was excess used at overall level. Bullock labour was found non significant for all categories.

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Economics of production performance of maize in tribal area of Madhya Pradesh

Deepak Rathi, P.K. Awasthi* and **V.K. Singh**
College of Agriculture, Tikamgarh
*JNKVV, Jabalpur (MP)

Abstract

The present study was undertaken to examine the extent of adoption pattern of new maize technology and their impact on yield, reduction in cost of production, resource use efficiency. The probable constraints have been analyzed on the basis of primary data collected from the 100 maize growers selected from tribal Shahdol district during 2005-06. Simple tabular analyses such as cost and returns analysis, resource use efficiency, technological adoption index were used to analyze the data. The study revealed that in the light of growing demand of maize due to its commercial and industrial orientation, its improvement in terms of production and productivity assumes greater importance as growth in the past has faltered. For achieving competitive advantage for maize vis-à-vis paddy crop enhancing the productivity thereby lowering the unit cost has to be considered and incorporated into the R&D programmes. Presence of aflatoxin in maize may cause serious health hazards and take alarming proportions in the wake of growing realization of sanitary and phyto-sanitary dimensions under the WTO regions. Ensuring good quality and desired cultivars backed up with financial assistance to the poor farmers be accorded top priority for the resource scarce regions.

वर्तमान अनुसंधान शहडोल जिले 2005-06 में चयनित मक्का उपजाने वाले किसानों पर किया गया जिसके अन्तर्गत उनके द्वा अपनायी जाने वाली नई तकनीकों के अंगीकरण से उपज पर प्रभाव. उत्पादन लागत की कमी. संसाधन उपयोग क्षमता तथा संभा व्यवधानों का अध्ययन किया गया। इस हेतु लाभ-लागत विश्लेषण संसाधन उपयोग क्षमता तकनीकी अंगीकरण सूचकांक तकनीकी का उपयोगकिया गया। वर्तमान अध्ययन से पता चलता है कि मक्का की व्यवसायिक एवं औद्योगिक उपयोग की वजह से मक्का की बढती हुई मांग से उत्पादन व उत्पादकता में बढोत्तरी करने का महत्व बढा है। मक्का से धान की तुलना में ज्यादा लाभ देने हेतु मक्का उत्पादकता को बढाने तथा प्रति इकाई लागत को कम करने का उपाय अनुसंधान व विकास कार्यक्रम के अंतर्गत लिया जाना चाहियें। विश्व व्यापार संगठन के अंतर्गत सेनेटरी एवं फाइटों सेनेटरी पहल को ध्यान में रखते हये मक्का के अंतर्गत विद्यामान रसायन एफ्लाटॉक्सिन ज कि स्वास्थ्य की दृष्टि से हानिकारक है. एक गंभीर समस्या है। अच्छे गुणों से युक्त व वांछित किस्म की उपलब्धता तथा छोटे व ग किसानों को आर्थिक सहायता पहँचाने हेत विशेष कार्यक्रम चल जाने चाहिये।

Keywords: Adoption, Technology, impact, reduction in cost, resource use efficiency, policy perspectives

Resource allocation and income distribution happen to be the byword of economic science. Productivity, profitability, adaptability, stability and sustainability are the important parameters of agricultural technology, which are highly variable according to farm size. Increasing productivity is possible provided the farmers use right amount and proportion of various production resources. Increasing efficiency of resource use through appropriate allocation not only increased the productivity but also profitability in the farms (Awasthi and Rathi 2002).

Maize has a great worldwide significance due to its diversified uses. Being grown in more than 0.85 million hectares of land in Madhya Pradesh, it is the third important food grain crop after wheat and rice. Maize is not grown only to meet human dietary needs of millions of poor population of the State. Therefore, the crop deserves special attention on its front. The State harvests about 2 t/ha against Karnataka, Andhra Pradesh, Bihar harvesting more than 3 t/ha. Shahdol is one of the potential maize producing tribal district in the State producing more than 10.38 thousand metric tones from 12 thousand hectares with an average yield of 865 kg/ha in the year 2007-08. Therefore the major concern is the low yield of this crop. Against this backdrop, the present study was undertaken to analyze the adoption pattern of new technologies and their impact on maize yield, reduction in cost of production and resource use efficiency in tribal areas of the State.

Methodology

The study pertains to the traditional maize growing tribal districts of the Madhya Pradesh namely Shahdol. The

extent of adoption of new maize technology, its impact on yields, costs and resource use efficiency have been analyzed on the basis of primary data collected from the 100 maize growers representing Small (47), Medium (29) and Large (24) categories during 2005-06. The cross sectional data from the sample holdings were collected with the help of pre tested schedules. The data were analyzed using suitable classification, tabulation, technological adoption index, semi-log production function, average and percentage.

Technology adoption index (TAI)

The TAI has been computed by using the formula

$$TAI_i = \frac{1}{5}\left[\frac{AH_i}{CA_i} + \frac{NA_i}{NR_i} + \frac{PA_i}{PR_i} + \frac{KA_i}{KR_i} + \frac{IA_i}{IR_i}\right] \times \frac{CA_i}{GCA_i} \times 100$$

where,

i = 1,2, ……..n (farmers)
TAI_i = Technology adoption index of ith farmer
AH_i = Area under modern maize varieties (ha)
CA_i = Total area of maize (ha)
NA_i = Quantity of Nitrogen applied for maize (kg)
NR_i = Recommended dose of Nitrogen of maize crop (kg)
PA_i = Quantity of Phosphorous applied for maize (kg)
PR_i = Recommended dose of Phosphorous of maize crop (kg)
KA_i = Quantity of Potash applied for maize (kg)
KR_i = Recommended dose of Potash of maize crop (kg)
IA_i = Actual number of irrigation applied
IR_i = Recommended number of irrigation
GCA_i = Gross cropped area of the ith farmer (ha)

Results and Discussion

Technology and adoption

Though there are many public as well as private organizations involved in the development of composite and or hybrid varieties of maize, the presence was not visible in the farmers field. The high yielding varieties grown at district Shahdol by the respondents were Hi Shell, Hy 4640, PAC 9714.

Adoption of HYV is only one aspect for achieving higher yields. Besides, there are other factors, which influence the yield per unit area of any crop. Adoption of new maize technology means using the entire package of practices for cultivation of improved variety of maize. An adoption index was calculated for individual farmer (Table 1).

Overall 18 per cent of the sample respondents adopted recommended technology at low level as against 29 per cent adopted technology at moderate level. More than half of the respondents adopted technologies at high level. It was found that overall highest no. of respondents were in high adoption range (53.00%) irrespective of size group followed by one-fourth of the large farmers to more than one-thirds of medium farmers adopted moderate level of recommended maize technologies (29.00%) leaving the balance (18.00%) fall under low rate of adoption.

Impact of technology

Maize yield

It is expected that with the adoption of improved production technologies, the efficiency would improve. Improvement in yield and reduction in unit cost of production of the crop is the most common impact indicator to measure the efficiency at farm level. It was found that the maize yield had increased significantly with the adoption of composite/hybrid variety of maize in all the categories of farms.

Large farmers had a unique advantage in maize production harvesting around 4 tones grain per hectare with hybrid varieties. Small and medium farmers are harvesting 3.74 and 3.78 t/ha respectively. Respondents who grow traditional/local varieties harvested 1.4 to 1.69 t/ha in different farm size. In other words, irrespective of farm size, all farmers harvested better maize yield with hybrid varieties. Secondly, there was no significant

Table 1. Distribution of sample farmers across different adoption level (in per cent)

Adoption level	Size group			Overall
	Small	Medium	Large	
Low adoption (upto 33%)	08 (17.00)	04 (14.00)	06 (25.00)	18 (100.00)
Moderate adoption (33-66%)	13 (28.00)	10 (34.00)	06 (25.00)	29 (100.00)
High adoption (67% and above)	26 (55.00)	15 (52.00)	12 (50.00)	53 (100.00)
Total	47 (100.00)	29 (100.00)	24 (100.00)	100 (100.00)

Figures in parenthesis indicate percent to total farmers in respective size

Table 2. Grain yield of maize crop realized by sample farmers (t/ha)

Cultivar	Size group			Overall
	Small	Medium	Large	
Traditional	1.54	1.69	1.48	1.54
Composite	2.55	2.93	2.71	2.72
Hybrid	3.74	3.78	3.90	3.83

difference in the maize yield due to farm size and small farmers were also harvesting as much maize grain as medium/large farmers. This showed that smallholdings were not inefficient in terms of productivity per hectare.

Reduction in cost of production

Improvement in yield is only one aspect of depicting the impact of improved technologies. In general, the improved technologies push the frontier by utilizing either more inputs or utilizing the resources more efficiently. In case of maize crop, it was clear that increase in yield due to the composite/ hybrid variety had not free of cost, the cost of cultivation with these varieties had increased considerably in all categories of farmers. For example, the farmers who spent nearly Rs 5600 on cultivating one hectare of traditional variety of maize had to spent Rs 8600 and Rs 10550 to cultivate the composite and hybrid maize, respectively. Expenditure on fertilizer, irrigation, plant protection resources and seeds mainly contributed to the additional cost of cultivation.

The concept of efficiency is however suggests that the objectives of technological improvement should be shift from more production to more efficient production. This implies a focus on lowering the cost of production per unit of output. Output per hectare is a partial measure of efficiency, which was useful when increasing production from limited resource was the primary objective of research. But, now under the liberalized economic scenario, the focus was on comparative production was an appropriate efficiency indicator. Against this backdrop, it may be observed that, though cost of cultivation per hectare increases with the adoption of improved cultivars, it will be economically viable propositions to grow these cultivars provided they give proportionally higher yields. This strengthened with a perusal of Table 3, which gives the real picture of economic viability and thus the justification for adoption of improved cultivars of maize crop. There was appreciable reduction in the cost of maize production by adopting improved cultivars in all the categories of farms. Radha and choudhary (2004) also reported similar findings in their study.

Table 3. Reduction in cost of production due to adoption of improved cultivars

Cultivar	Size group			Overall
	Small	Medium	Large	
Cost of Production (Rs/q)				
Traditional	366	345	371	365
Composite	356	310	299	316
Hybrid	277	286	270	276
Reduction in cost of production (%)				
Due to composite	-2.73	-10.14	-19.40	-13.42
Due to hybrid	-24.30	-17.10	-27.20	-24.40

It was observed that with the composite variety, the cost of production had come down by 2.73 to 19.40 per cent in comparison to traditional variety. With hybrid variety the cost of production had declined by 17.10 to 27.20 per cent in comparison to local variety by the farmers. The result calls for higher emphasis to boost the adoption of improved variety by the farmers.

Efficiency of inputs used

Farmers were found to have limited resources and their objective was to maximize farm returns from the available resources. To operate the farm business at the economic optimum level, they had to make some adjustments in the allocation of their resources. The question that arises is whether the farmer belonging to different size groups respond equally to the economic opportunities and make rational use of resources. How does the resource use efficiency behave with the size of farms ? With this aspect in mind, semi-log production function were fitted to

Table 4. Regression analysis of resource use on sample farm

Particular	Size group			Overall
	Small	Medium	Large	
Human labour	0.00014***	0.00008**	0.00017***	0.00014***
	(0.00002)	(0.00004)	(0.00002)	(0.00001)
Farm power	0.00004**	0.00004	0.00005	0.00003
	(0.00002)	(0.00003)	(0.00003)	(0.00002)
Fertilizer	0.00167***	0.00420***	0.00357***	0.00341***
	(0.00043)	(0.00064)	(0.00043)	(0.00028)
Irrigation	-0.03387	0.02000	0.10900	0.09590***
	(0.05447)	(0.08100)	(0.06254)	(0.03754)
Adoption	0.00748***	-0.00160	0.00088	0.00053
	(0.00155)	(0.00160)	(0.00113)	(0.00078)
Plant protection	0.00033	0.00004	-0.00021	0.00016
	(0.00039)	(0.00062)	(0.00039)	(0.00028)
R^2	0.9086	0.7040	0.8421	0.8421

Figures in parenthesis show standard error of the respective regression coefficient

Table 5. Resource use efficiency of the sample farm

Farm inputs	Input price (Rs/unit)	Small		Medium		Large		Overall	
		MVP	R	MVP	R	MVP	R	MVP	R
Labour	110.85	1.58	<1	0.86	<1	1.84	<1	1.57	<1
Fertilizer	15.16	18.85	>1	47.95	>1	38.65	>1	38.18	>1
Irrigation	614.95	-	-	-	-	-	-	1073.9	>1

establish the input-output relations with output of maize as the dependent variable and human labour, farm power, fertilizer, irrigation, adoption index and plant protection measures adopted as the independent variable.

The coefficients of human labour, fertilizer, an irrigation were found to have positive and highly significant impact, where as farm power, adoption index and use of plant protection measures were having positive, though non-significant impact on the output of the crop. All these variables together accounted for around 84 per cent variation in the output of maize on sample farms (Table 4).

The size-group wise analysis indicated that human labour and fertilizer had a significant effect on output in the case of large farmers. However, the impact of use of chemicals as plant protection measures was negative, though non-significant. The impact of rest of the variables was found to be non-significant. All these six variables together explained 91 per cent of the variation in output. In case of small farms, human labour, farm power, fertiliser and adoption index had highly significant positive impact on the output of the crop. The use of plant protection measures contributed positively, though non-significant to the yield of maize crop. All these variables could explain around 91 percent of the variation in the model. In contrast to this, the model explained only around 70 per cent of the variation in the case of medium farmers. Human labour and fertilizer consumption were the only two variables, which were found to be significantly affecting the output of the crop in this category of the farms. Satapathy et al. (2002) also noted similar response of added inputs in maize production in their study.

Resource use efficiency

The marginal value products of various inputs and their ratio to their respective prices were calculated only for the significant factors for each size of farm (Table 5).

It was found that human labour had been over utilized, while fertilizers and irrigation had been under utilised and the marginal value product of these factors was higher than unity. This indicates that these two inputs were being used at sub-optimal levels.

Policy perspectives

Technological advancement in maize has favoured mostly the commercial oriented large farmers, neglecting a large proportion of subsistence, small and marginal farmers. The tools of biotechnology for the development of new maize traits, suitable for cultivation to all the categories of farmers under varying production environments are regarded as the most suited option

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Impact assessment of national agricultural insurance scheme on stabilizing farm income in Nimar Valley of Madhya Pradesh

Deepak Rathi, P.K. Awasthi* and **V.K. Singh**
College of Agriculture, Tikamgarh
*JNKVV, Jabalpur (MP)

Abstract

The present study was undertaken to measure impact of National Agricultural Insurance Scheme (NAIS) on level of technology adoption and stabilization of farm income as well determine the operational and administrative constraints faced by farmers and implementing agency. The study revealed that NAIS provides good opportunities for farmers to deal with the risk in agriculture. There seems to be an increasing acceptance to the scheme due to consecutive failure of monsoon. With the technological development in cotton farmers opted this crop to augment their family income and employment. Consequently more than half of the gross cultivated area was put under cotton by sample farms. Actual yield of cotton (1904 kg/ha) was more than double than the thresholds yield (832 kg/ha). Thus, no compensation claim was given to the insured farmers by the NAIS implementing agency. NAIS did not yield any impact on adoption of non-conventional production technology and stabilization of farm income. Due to high risk and capital intensive cotton technologies farmers adopted production technology moderately. The gap in actual yield and expected yield of cotton was much wider on large farm. Higher premium rate and delay in settlement of claims and lack of technically trained staffs were the major problems reported by the farmers. Seasonal crop weather watch survey on regular basis needed to be conducted for proper implementation of the NAIS.

वर्तमान अध्ययन राष्ट्रीय कृषि बीमा योजना का किसानों द्वारा अपनायी जाने वाली तकनीक, व प्रक्षेत्र आय के स्थिरीकरण पर प्रभाव जानने हेतु किया गया। साथ ही साथ इस योजना को प्रभावी ढंग से ला करने हेतु किसानों व लागू करने वाली एजेन्सी को आने कठिनाईयों का अध्ययन किया गया। अध्ययन से पता चलता है कि मानसून की असफलता, जोखिम प्रबंध की वजह से किसानों द्वा इसे अपनाया जा रहा है। पारिवारिक आय तथा रोजगार बढाने की दृष्टि से किसानों ने कपास फसल को अपनाया जिसमे कि अधिकतम जोखिम र पँजी की आवश्यकता होती है। इसमें नमूना किसानों द्वारा प्राप्त उपज 1904 किलो प्रति हेक्टेयर पायी गयी। जो कि न्यनत अनुमानित उपज 832 किलो प्रति हेक्टेयर से दो गुना अधिक थी जिसमें कि राष्ट्रीय कृषि बीमा योजना के अंतर्गत कोई दावा राशि नहीं दी गयी। बीमा के दावों के निराकरण में देरी तथा बीमा की किस्त की अधिक दर एवं तकनीकी रुप से कम शिक्षित कर्मचारी आदि प्रमुख समस्यायें किसानों के द्वारा बतलायी गयी। मौसम के अनुसार फसल मौसम सर्वेक्षण को लगातार कराया जाा आवश्यक है। जिससे राष्ट्रीय कृषि बीमा योजना को प्रभावी ढंग से लाग किया जा सके।

Keywords: Adoption index, income stabilization, cropping pattern, insurance

Risk and uncertainties are twin dangers, which hamper agricultural production and bring about instability in rural economy of the State. Inadequate and uneven rainfall, hail-storm, incidence of insect pests and diseases etc. are important factors which causes considerable losses in agricultural production. Farmers and nature are the opposite players in crop production (Awasthi et al. 1987). Khargone is an important cotton growing district of Madhya Pradesh accounting alone 31% of total cotton production in the State. Cotton production level fluctuated widely due to the climatic changes, thus farmers loose considerable amount of farm income.

In order to cope up these risks arising due to insured causes, Government of India introduced new insurance scheme called National Agricultural Insurance Scheme from rabi 1999-2000 season in place of old comprehensive crop insurance scheme which was implemented in rabi 1985. It provides coverage to all food crops, oilseeds, horticultural/ commercial crops and livestock. Keeping this in view an attempt has been made in present study to examine the impact of NAIS on adoption of crop production technology, productivity level, stability on farm income and identification of the bottlenecks in smoothly functioning of the scheme.

Methodology

The study was confined to Kasrawad block of Khargone district of Madhya Pradesh. The objective function of the

study was to evaluate the impact of NAIS on production level and stabilization of farm income and identification of problems hindering popularity and implementation of the scheme. For micro-level study of the NAIS impact, the cross section data were generated from the selected 45 beneficiaries respondents by personal interview using survey method. The collected data were analyzed in the light of stated objectives by using suitable classification, tabulation, technology adoption index and B-C approach etc.

Technology Adoption Index

$$TAI_i = \frac{1}{5}\left(\frac{AH_i}{CA_i} + \frac{NA_i}{NR_i} + \frac{PA_i}{PR_i} + \frac{KA_i}{KR_i} + \frac{IA_i}{IR_i}\right) \times \frac{CA_i}{GCA_i} \times 100$$

where,

i = 1,2, ……..n (farmers)
TAI_i = Technology adoption index of ith farmer
AH_i = Area under modern maize varieties (ha)
CA_i = Total area of maize (ha)
NA_i = Quantity of Nitrogen applied for maize (kg)
NR_i = Recommended dose of Nitrogen of maize crop (kg)
PA_i = Quantity of Phosphorous applied for maize (kg)
PR_i = Recommended dose of Phosphorous of maize crop (kg)
KA_i = Quantity of Potash applied for maize (kg)
KR_i = Recommended dose of Potash of maize crop (kg)
IA_i = Actual number of irrigation applied
IR_i = Recommended number of irrigation
GCA_i = Gross cropped area of the ith farmer (ha)

Results and Discussion

Cropping pattern

The area under kharif crops was higher than that under rabi crops, irrespective of the size of holdings because of profitability and favourable market conditions (Table 1). Cotton was the main crop of kharif season and wheat during rabi season grown by sample farmers. In general, the per cent area allocated under various crops on different size of holding did not show glaring difference.

- The farmers have preference for kharif crops over rabi crops.
- Crop production is land oriented established an extensive farming system based on low intensity of inputs used and low productivity levels.
- Cropping intensity was higher on small farm followed by large farm and medium farm irrespective of sample categories. The highest cropping intensity among small holding for the obvious reason of proper and controlled management of farm. (Table 1)

Area under cotton

Macro level study of the selected 45 cotton growers clearly suggested that with the technological development of cotton, farmers opted this crop to augment their family income and employment. Small farmers allocated more acreage to this crop in comparison to other farm size. It varied from 47 to 53 per cent among all the categories.

Table 1. Cropping pattern on sample farm (in ha)

Season/crops	Size groups Small	Medium	Large	Overall
Kharif				
Cotton	0.95 (32)	1.79 (29)	3.40 (29)	6.14 (29)
Chilies	0.27 (09)	0.61 (10)	0.96 (08)	1.84 (09)
Soybean	0.36 (12)	0.75 (12)	1.60 (14)	2.69 (13)
Others	0.17 (05)	0.55 (08)	0.90 (08)	1.64 (08)
Sub-total	1.75 (58)	3.70 (60)	6.86 (59)	12.31 (59)
Rabi				
Wheat	1.10 (35)	2.27 (36)	4.32 (37)	7.69 (37)
Gram	0.09 (03)	0.10 (02)	0.10 (01)	0.29 (02)
Other	0.07 (02)	0.18 (03)	0.35 (04)	0.60 (03)
Sub-total	1.26 (42)	2.50 (40)	4.77 (46)	8.53 (41)
Total cropped area	3.01	6.20	11.65	20.84
Cropping intensity (%)	172	167	169	169

Table 2. Threshold and actual productivity of cotton in Kasrawad block (2005-06)

Crop	Block	Threshold yield (kg/ha)	Actual yield (kg/ha)	Shortfall (-) excess (+) in yield (kg/ha)	Percent shortfall
Cotton	Kasrawad	832	1904	+1072	+56.30

Thus, half of the cultivated areas were put under cotton. This could be due to the fact that small farmers grow this crop for sale purpose.

Threshold and actual yield

The data on threshold yield and actual yield of cotton as per crop cutting experiments were recorded from the office of the Agricultural Insurance Company of India Ltd., Bhopal (M.P.) during the year 2005-06 for Kasrawad block (Table 2). The table inferred that the actual yield (1904 kg/ha) of cotton on sample farm was found to be higher than the threshold yield (832 kg/ha) and excess in yield of cotton was 1072 kg/ha (+ 56.30%) was observed. It may be noted from Table 2 that actual yield of cotton on sample farm was higher than the threshold yield, consequently none of the sample farmers got any compensation claim from the NAIS implementing agency during the year 2006-07.

Adoption Index

Technological adoption index at overall level was to the extent of 70.35 per cent. Similarly, 27 to 33 per cent of sample farmers adopted technologies at moderate level while about three-fourth were adopted more than recommended technology in cotton production (Table 3).

On size group wise, about one fourth of small farmers adopted recommended technology at moderate level and rest were adopted at high level. Two-third to three fourth sample farmers represented medium and large farm respectively were adopted recommended technology at high level accounted more than 66%. Thus, majority of the sample farmers adopted recommended technology at high rate and none of them taken under the low adoption rate.

Table 3. Adoption of recommended technology on sample farm

Size group	Adoption level			
	Low (up to 33%)	Moderate (33-66%)	High (67% and above)	Adoption index (%)
Small	0	04 (26.67)	11 (73.33)	70
Medium	0	05 (33.33)	10 (66.67)	71
Large	0	04 (26.67)	11 (73.33)	70
Overall	0	13 (28.90)	11 (71.10)	70

Table 4. Income stabilization due to NAIS

Particular	Size group			
	Small	Medium	Large	Overall
Yield (q)	17.99	17.23	18.19	17.80
Price (Rs/q)	2080	2105	2085	2090
Gross income	37419	36269	37926	37204
Total cost	28998	29558	30148	29568
Net income over				
Operational cost	12774	11170	13281	12408
Total cost	8421	6711	8928	8020
Total cost+Premium	7430	5719	7936	7028
Net income	7430	5719	7936	7028
Benefit-cost ratio	1.29	1.23	1.26	1.26

Income stabilization

Cotton covered 48 per cent of the total cropped area on sample farm and on an average required Rs 29568/ha to produce this crop. The gross income was Rs 37204 and the net income over total cost including premium paid was Rs 7028/ha. The benefit-cost ratio was 1.26 in case of small farms, it was to the extent of 1.29 followed by large farm (1.26) and medium farm (1.23). it was found that no distinct difference was incurred between different farm sizes. Thus NAIS did not yield any beneficial impact on farm economy in the study area. Amarender et al. (2004); Bisari et al. (2002); Kalavakonda et al. (2005) also found similar results.

Table 5. Problems reported by the beneficiaries

Problems reported	Size group Small	Medium	Large
High premium rate	15	15	15
Delay in settlement in claims	15	15	15
Banks charged interest even settlement of claims	09	07	08
Premium as additional burden	02	05	03

Problems reported

Beneficiaries farmers

Higher premium rate and delay in settlement of claims was major problems reported by sample farmers. The banks also charged interest on the premium up to the period of settlement of claims followed by premium is an additional burden and therefore farmers do not want to avail this facility.

Implementing agencies

Curtailment of staff on account of Voluntary Retirement Scheme in commercial banks finds it difficult to complete all the formalities for bringing loanee farmers under the purview of the NAIS. The implementing agencies with frequencies of 60% show that due to delay in settlement of the claims, farmers were unwilling to join the scheme in the next year crop season was the major problems reported by 78 per cent of the officers of the implementing agencies.

The officers of the commercial bank complained that the settlement of the claims was earlier in co-operative as compared to commercial banks. The non-lonee farmers are not interested in the scheme. Lack of trained human resource in agricultural field resulted poor implementation of the scheme and delay in claim settlement for timely settlement of claims and enhancing farmers awareness towards the NAIS students passed post graduation in Agricultural economics should be deputed in all districts of the State.

NAIS provides good opportunities for farmers to deal with risk in agriculture. There seems to be increasing acceptance to the scheme in recent years due to consecutive failure of monsoon. Seasonal crop weather watch survey on regular basis, need to be conducted for proper implementation of the NAIS. The present scheme required an increase in premium and a reduction in the range of risks covered. It is suggested to prepare block wise commercial crop statistics for the State from collecting the data from Patwari records of revenue circle because such crops can be included under the purview of the scheme with higher premium rates. The defined unit area for paying indemnity should be a village or group of villages as against tahsil/block is being considered at present.

Table 6. Problems reported by the implementing agencies (N=19)

Problems	Number	Per cent
Farmers shows their unwillingness to join the scheme	12	60.00
Insufficient staff	14	78.00
Due to high premium rate farmers are reluctant to insure crops	10	56.00
Farmers inclined co-operative sector for borrowing	08	44.00
Non-loanee farmers are not interested in this scheme	16	89.00

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An assessment of rainfall and temperature variability in Madhya Pradesh

U.P.S. Bhadauria and **Sanjay Jain**
Department of Physics & Agrometeorology
College of Agricultural Engineering
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract

Rainfall pattern and temperatures mainly decides the crop planning in rainfed areas. Amount, distribution and intensity of rainfall mainly determine the choice of particular crop variety/species. The interrelated dynamics of climate is going to be alerted for availability of ground water mainly received from precipitation especially important for rainfed crops. Model predictions of future scenario indicated that there will be an increase in rainfall, temperatures and an overall decrease in number of rainy days over a major part of the country. Looking to the above, analysis for rainfall and temperatures of three districts viz. Jabalpur, Indore and Gwalior of Madhya Pradesh was done using available past weather data. The trend analysis for rainfall of three districts of Madhya Pradesh showed decreased trend in Gwalior and Indore district. All the months of winter season also showed decreasing trend of rainfall. Analysis of historical data of annual mean maximum temperature shows decreasing trend at Gwalior and an increasing trend at Indore and Jabalpur while mean minimum temperature data indicate highest variability in Jabalpur district and lowest in Indore district while annual mean temperature does not sowed any appreciable change in Gwalior district.

वर्षा आधारित क्षेत्रों में फसल कार्य योजना के निर्धारण में वर्षा एव तापमान प्रमुख कारक हैं फसल एवं उसकी प्रजाति का चुनाव वर्षा की मात्रा, वितरण एवं तीव्रता पर निर्भर करता है। मौसम के विभिन्न घटकों के अध्ययन भूजल स्तर की उपलब्धता के साथ-साथ वर्षा आधारित क्षेत्रों की विभिन्न फसलो के लिये महत्वपूर्ण है। भविष्य में माडलिंग के अध्ययन के द्वारा भी देश के विभिन्न भागों में वर्षा एवं तापमान में वृद्धि एवं वर्षा दिनों में कमी होने की संभावना दर्शायी गयी है। इन तथ्यें को ध्यान में रखते हुये मध्यप्रदेश के प्रमुख जिलों जबलपुर, इंदौर एवं ग्वालियर के विगत वर्षों के ऐतिहासिक आँकडों का विश्लेषण किय गया। इंदौर एवं ग्वालियर जिलों में वर्षा का घटता हुआ क्रम पाया गया जबकि शरद ऋतु के सभी महीनों में भी वर्षा का घटता हुआ क्रम देखा गया। वार्षिक औसत अधिकतम तापमान के आँकडों के विश्लेषण द्वारा ग्वालियर जिले में तापमान का घटता क्रम तथा इंदौर एवं जबलपुर में बढता क्रम देखने को मिला। जबलपुर जिले में न्यूनतम तापमान के आँकडों में सर्वाधिक विविधता तथा इंदौर जिले में न्यूनतम विभिन्नता थी जबकि ग्वालियर जिले के न्यनतम तापमान के आँकडों में सार्थक परिवर्तन प्राप्त नहीं हुआ।

Keywords: Maximum, minimum temperature, rainfall, variability

Agricultural production is very much dependent upon environmental variables and is also an important agent of environmental change. Hence it is critical to examine the possible consequences of global warming on agricultural sustainability and food security. The climate sensitivity of agriculture is uncertain, as there is regional variation of rainfall, temperature, crops and cropping system, soil and management practices (Kriplani 2003). The inter-annual variation in temperature and precipitation may enhance the crop losses if the predicted climate change increases the climate variability (Dixit et al. 2005). Different crops responded differently as the global warming will have a complex impact. Assessment on potential impact of climate change on agricultural productivity indicates greater vulnerability of food productivity in tropical region certainly suffer from yield losses compared to those in temperate regions. The fourth assessment report of the IPCC shows that the climate may be warm globally by 1.80C to 5.80C in the next 100 years. Over the Indian region, it may be restricted to 1.40C±30C in the 2020 (IPCC 2001). Madhya Pradesh comprised of nine agroclimatic zones with great diversity of climate and cropping pattern. During monsoon season the major crops are rice, soybean whereas, in winter season wheat and chickpea crops are cultivated as rainfed and mustard is also sown in large area in rainfed conditions. It was also noticed that monsoon rainfall does not follow any definite trend in all India scale. Besides, this state experiences wider range of both maximum and minimum temperature. Despite increasing grain yield through green revolution, the agricultural scenario of the rainfed area is still highly

dependent on rainfall and rainfall distribution pattern (Mukharjee and Banerjee 2009). Hence, study of rainfall and its variability is important for agricultural production and management. As the cropping pattern of any region is solely governed by both rainfall and temperature distributions the study was carried out to find out the trend in rainfall and temperature in the widely distributed zones viz. Gwalior, Indore and Jabalpur.

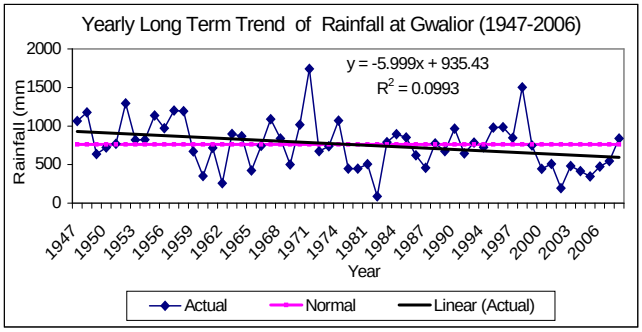
Material and methods

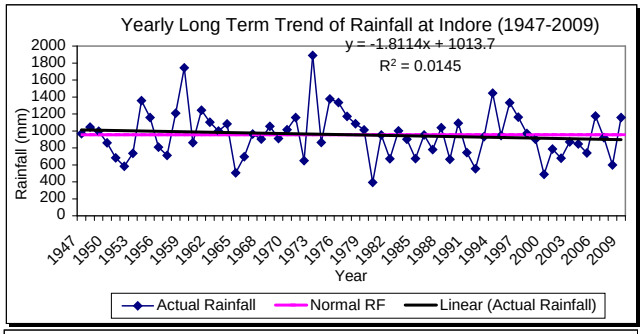
Historical weather data recorded at meteorological observatory of College of Agriculture, Gwalior and Indore of Rajamata Scindia Krishi Vishwa Vidyalaya and College of Agricultural Engineering, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur were collected and analyzed in present study which is representative of climatology of Madhya Pradesh. Daily data of rainfall and maximum and minimum temperature for the period of 1947 to 2009 from (as per availability from different stations) was analyzed to determine the trend on yearly average basis (Venkateswarlu and Shankar 2008). The climate of the study area was analyzed by calculating Mean, Standard Deviation (SD) and Coefficient of Variation (CV) as per suggested by Sahu 2008.

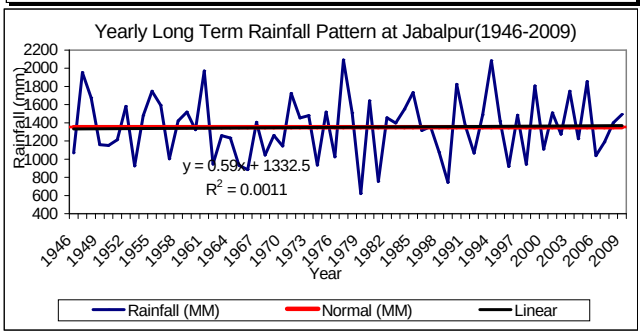
Results and Discussion

Analysis of rainfall for annual variability

The trend analysis for rainfall of three districts of Madhya Pradesh showed that in Gwalior district a decreasing trend of rainfall was observed in all the months of monsoon season except September (Table 1). In winter decreasing trend showed in December and January whereas increasing trend in October and November. In the Indore district the trend was decreasing except September month of monsoon season, whereas in winter all the months showed decreasing trend except November. Rainfall in Jabalpur district showed increasing trends during monsoon season except August. The highest rainfall (2092.6 mm.) was recorded for Jabalpur during the year 1979 followed by Indore (1879.6 mm.) during the year







1980 and Gwalior (1740.9 mm) during the year of 1971. The variation was very high for Gwalior district (CV-41.5%, SD-315.9) and registered lower variability at Jabalpur (CV-24.9% and SD-336.7) while Indore station also showed considerable amount of variability (CV-9.3% and SD-279.8).

Analysis of annual variability for temperature

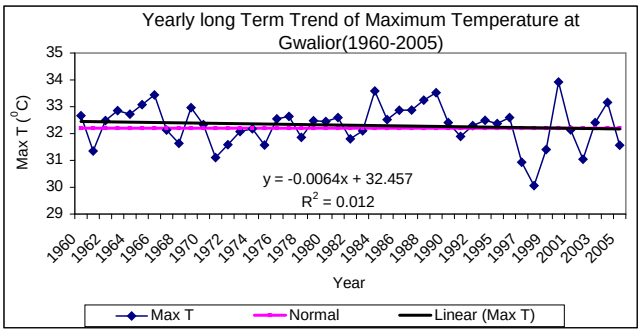
Analysis of temperature data of annual mean maximum temperature shows decreasing trend at Gwalior and an increasing trend at Indore and Jabalpur. Long term data of minimum temperature showed decreasing trend in

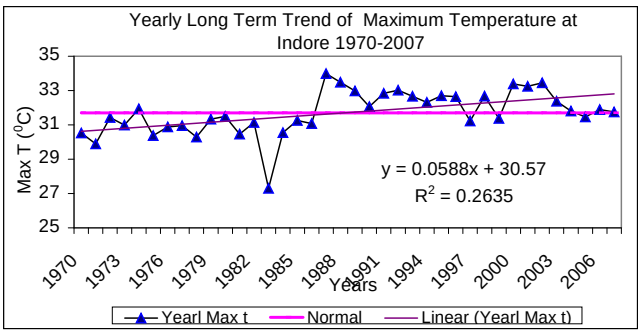
Table 1. Annual rainfall variability in Madhya Pradesh

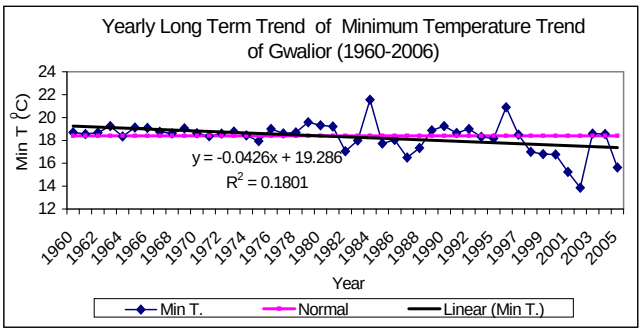
Weather parameters	Mean	Median	SD	CV%	Values Highest	Values Lowest
Jabalpur	1351.7	1383.6	336.7	24.9	2092.6 (1979)	620.2 (1977)
Gwalior	761.5	749.2	315.9	46.5	1740.9 (1971)	41.4 (1882)
Indore	954.8	948.6	279.8	29.3	1889.6 (1980)	392.4 (1973)

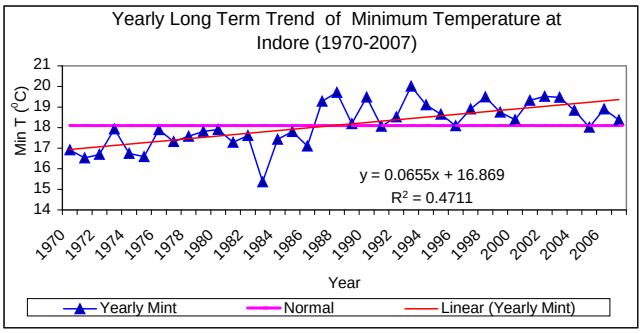
Table 2. Annual maximum temperature variability in Madhya Pradesh

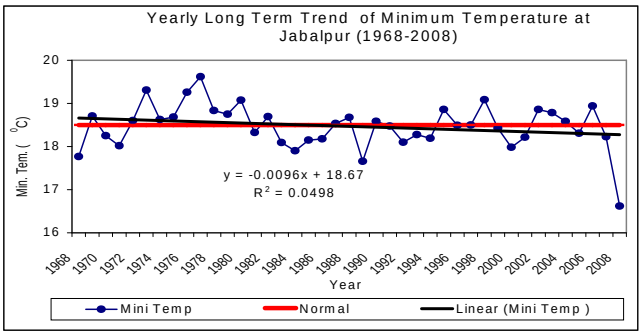
Weather parameters	Mean	Median	SD	CV%	Values Highest	Values Lowest
Jabalpur	31.5	31.5	0.6	1.9	44.9 (1971)	26.9 (2009)
Gwalior	32.3	32.4	0.8	2.4	46.9 (1998)	30.1 (2000)
Indore	31.7	31.6	1.3	4.0	43.9 (1983)	27.3 (1987)











Gwalior and Jabalpur and Indore district indicated an increasing trend. The highest value of maximum temperature was observed for Gwalior (46.9^{0}C) in the year of 1998 followed by Jabalpur (44.9^{0}C) in the year of 1971 and Indore (43.9^{0}C) in the year of 1983 (Table 2). The variability in maximum temperature was highest in Indore district (CV-4.0% and SD-1.3) and lowest in Jabalpur district (CV-1.9% and SD-0.6). Data of minimum temperature indicated highest variability in Jabalpur district (CV-37.9% and SD-7.0) followed by Gwalior district (CV-7.2% and SD-1.3) and Indore district (CV-5.8% and SD-1.1) while annual mean temperature does not sowed any appreciable change during study period (Table 3).

Conclusion

With changes in precipitation and temperature, considerable efforts would be required to deal with climate-related impacts in agriculture in Madhya Pradesh. As

Table 3. Annual minimum temperature variability in Madhya Pradesh

Weather parameters	Mean	Median	SD	CV%	Values Highest	Values Lowest
Jabalpur	18.5	18.5	7.0	37.9	19.6 (1977)	2.1 (2008)
Gwalior	18.3	18.6	1.3	7.2	21.6 (2002)	1.4 (2009)
Indore	18.1	18.1	1.1	5.8	20.0 (1983)	3.2 (2008)

the rainfall pattern is shifting, the date of sowing of paddy and soybean during *kharif* may also be shifted to over come with changing scenario. Genetically diversified crops and species-rich ecosystems have greater potential of adaptation to climate change. The selection of crops and cultivars with tolerance to abiotic stresses e.g. high/low temperature and excessive moisture resistant may helpful for sustainable crop production in changing environment.

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Investigations on physical and engineering properties of rice variety Sugandha-3 grain at Jabalpur, Madhya Pradesh

V.K. Tiwari
Department of Post Harvest Process & Food Engineering
Faculty of Agricultural Engineering
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract

Rice is the staple food for more than 70% of the population in the world. Physical and engineering properties, moisture content of paddy and milling machine parameters plays important role in the recovery of head rice. The study of physical and engineering properties of Rice cv. Pusa Sugandha-3 was conducted in JNKVV, Jabalpur. The average length, width and thickness of rice were found to be 11.2, 2.27 and 1.8 mm, respectively. The geometric mean diameter ranged from 35.10 to 44.65 mm^2. The puerility was 35.72%, the aspect ratio was 0.19. Thousand grain weight of paddy was 26.42 gram. The true density, bulk density and porosity were 900 kgm^{-3}, 500 kgm^{-3} and 44%, respectively. The angle of repose of paddy was 30.76^0. A study on milling characteristics was also carried out. The head rice recovery was 71.59 (zero percent milling), 40.39 38.65, 33.52, 31 and 30.70% and broken percentages were 2.88, 25.86, 29.20, 34.10, 35.91 and 36.4%, respectively for corresponding time of milling. The head rice recovery decreases and broken percentage increases with time of milling.

विश्व के अधिकांश के व्यक्ति खाने में चावल का म
से उपयोग करते हैं । धान से चावल की प्राप्ति
भौतिक, अभियांत्रिक, नमी प्रतिशत एवं धान दरने की
प्रकार की मशीनों का काफी प्रभाव पडता है । धान
सुगन्धा-३ व्हेरायटी के भौतिक गुणों
जवाहरलाल नेहरू कषि विश्वविद्यालय में किया गया । धान
औसत लंब 11.2, चौडा 2.27 एवं मो 1.8
मिलीमीटर पायी गयी । धान के एक हचार दानों का औसत व
26.42 ग्राम पाया गया । धान का कुल घनत्व 500, वास्तविक घनत्व
900 किलोग्राम प्रति घन मीटर एवं पोर 44 प्रतिश
पायी गयी । धान के ढेर का कं 30 डिग्री मापा गया । ध
को विभिन्न समय अन्तर 30, 60, 90, 100 एवं 120
सेकेन्ड तक दरने पर औसतन साबुत चावल ब 40, 39,
34, 31 एवं 30 प्रतिशत टटा चावल क्रमश 3, 26, 29, 34, 35,
36 प्रतिशत प्राप्त हुआ । दराई का समय बढने
चावलकी मात्रा क्रमशः घटती गयी जबकि टटे चावल की
क्रमशः बढती गयी

Keywords: Rice grain, engineering properties, Sugandha 3 variety

The post harvest operation varies from region to region. Paddy was earlier milled by hand and foot pounding, chakkies resulting in higher percentage of broken rice with lesser recovery of head rice. With the advent of time milling is being carried out by modern equipments including. Dehusking by rubber roll sheller and polishing by cone/friction polisher (Mohapatra and Bal 2007). The speed of rubber rolls, the clearance and the alignment of the cone and crib are the important parameters for deciding head rice recovery (Mohapatra and Bal 2004).

Material and methods

The rice variety Sugandha-3 was selected for the study of engineering properties. The effect of time of milling on the rice (head rice, broken and total yield) and cooking quality was investigated.

Instrumentation

The standard AOAC method was used to determine the moisture content. The lab model rice milling machine was employed for determination of influence of different time of milling on head rice, broken and total yield.

Test milling

The laboratory model rice mill machinery under test was thoroughly cleared to remove residual paddy, brown rice,

husk, broken rice. The preliminary trail run also helped to make calibration for adequate operation of sheller and polisher. The sample of 140 g. of each variety was fed in lab model rice milling machine. The process was repeated for each variety three times.

Physical properties of paddy

The study of following physical properties including. Length, width, thickness, length breath ratio, size, sphericity, volume and engineering properties including. Angle of repose, husk content, bulk density, true density and porosity was investigated.

Length Breath ratio

The ratio was investigated as per the method described by (Mohsenin1986) Size is of great importance for analysis of behavior of grain during handling, processing, storage and designing the machinery using following expression.

Size = (length x width x thickness)$^{1/3}$

Size = (L x W x T)$^{1/3}$

Sphericity

The sphericity the length, width and thickness of the grain was measured and was determined.

$$\text{Sphericity} = \frac{(LWT)^{1/3}}{L}$$

Angle of repose

The Angle of repose was determined by method given by Tabatabaeefar (2003). Angle of repose is important factor in design of conveyor and storage structure.

Angle of repose = $\tan^{-1}$ (2h/D)

where,

h = the height of pile

D = the base (diameter)

Bulk density

The bulk density was measured as per formula

$$\text{Bulk density} = \frac{\text{Mass}}{\text{Volume}}$$

True density

The true density was measured as per formula

$$\text{True density} = \frac{\text{Mass}}{\text{Total solid volume}}$$

Results and Discussion

Engineering properties

The average length, width and thickness were found to be 11.2, 2.27 and 1.8 mm respectively. The importance

Table 1. Some physical properties of rice

Property	No. of observation	Mean value	Standard deviation	Min. value	Max. value
Length (mm)	10	11.20	0.73	10.06	12.45
Width (mm)	10	2.27	0.12	2.01	2.44
Thickness (mm)	10	1.80	0.12	1.59	1.99
Sphericity (%)	10	35.72	0.02	28.40	34.40
Volume (mm^3)	10	12.57	1.07	9.34	15.06
Bulk density (kg/m^3)	3	500	1.00	499	501
True density (kg/m^3)	3	900	1.00	800	1000
Porosity (%)	3	44	1.52	42	45
Thousand grains wt (g)	3	26.42	0.59	25.99	27.1
Angle of repose (degree)	3	30.76	1.19	32.11	28.9

Table 2. Effect of milling on head rice recovery

Time of milling (second)	Head rice %
0	71.59
30	40.39
60	38.65
90	33.52
120	31.06
150	30.70

of these and other characteristics axial dimension in determining aperture size and other parameter are very important in machine design (Mahmood et al. 2003).

Thousand grain weight of the paddy variety ranged was up to 26.42 g. This parameter is a useful index to "milling outturn" in measuring the relative amount of dockage or foreign material in a given lot of paddy. Similar concept was given by Ehsanullah et al. (2000).

The true density, bulk density and porosity were 900kb m^{-3}, 500 kg^{-3} and 44% respectively. This characteristic can be used to design separation or cleaning process for grain since lighter fraction will float. Similar concept was given by Mehdi Ghasemi Varnamkhasti (2007) in IR-36 variety of paddy.

Effect of time of milling on head rice recovery

The test weight of Sughandha-3 variety was 19 grams, maximum length of kernel is 8.50 has thick husk (25.53%). Before milling the husk was removed by hand pounding to know the solid material in the variety. The milling was conducted for 30, 60, 90, 120; 150 second by laboratory model 6702 Rice Miller (MC Gill Type) friction type. The variation is up to ten percent. Initially when brown rice sample were milled for 30, 60, 90 seconds the head rice recovery decreases. The recovery was 40.39, 38.65 and 33.52% respectively. Thus the decrease head rice recovery was about seven percent. That the rate o

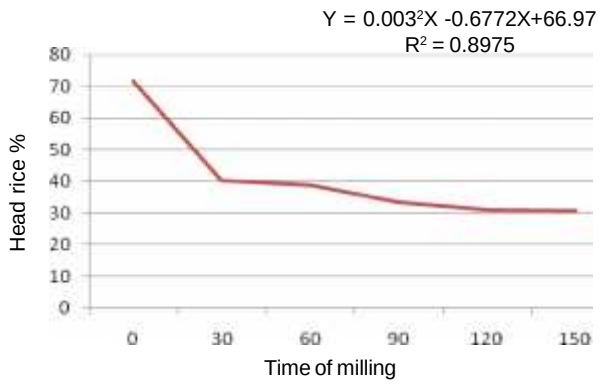

Fig 1. Effect of milling on head rice recovery

decreased was very fast for another set of milling when milled for 90, 120 and 150 second. The recovery of head rice decreases as with time of milling. In this set the rate of decrease was only three percent.

$$Y = 0.003^2X - 0.6772X + 66.97$$

With value of

$$R^2 = 0.8975$$

Effect of time of milling on broken percentage

Effect of time of milling on broken percentage was indicating that the broken percent was 2.88%. The samples were milled for 30, 60, 90 and 150 seconds. The

Table 3. Effect of time of milling on broken percentage

Time of milling (second)	Broken %
0	2.88
30	25.86
60	29.20
90	34.10
120	35.91
150	36.40

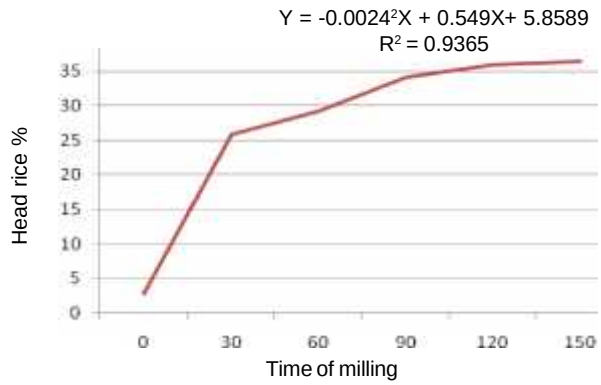

Fig 2. Effect of milling on broken rice recovery

broken percentage increased very fast when milled for 30, 60 and 90 seconds. The rate of increase of broken rice percentage was only 34.1% when milled for 90 seconds and there was a increase of only two percentage when milled for 150 seconds. The positive relationship between time of milling and broken rice recovery was recorded. (Table 3 and Fig. 2). The behavior of the broken rice recovery is presented as

$$Y = 0.0028X^2 + 0.5459X + 5.8589$$

With value of

$$R^2 = 0.9365$$

Table 4. Effect of time of milling on total yield

Time of milling (second)	Total yield
0	74.47
30	68.33
60	67.85
90	67.13
120	66.91
150	66.25

Effect of time of milling on total yield

The total rice recovery was 74.47% when dehusked by hand. It decreases with time of milling because of more and more outer layer of rice lernel removed at different time of milling. The total rice recovery was 68.33% when milled for 30 seconds and it decreases (66.25%) when time of milling (150 seconds) increases. The behavior of total rice recovery can be mathematically represented by equation (Fig 3).

$$Y = 0.0006X^2 - 0.1285X + 73.474$$

With value of

$$R^2 = 0.8772$$

The average paddy length, width, thickness were found to be 11.2, 2.27 and 1.8 mm respectively. The sphericity was 31.40% which indicate that the shape of the grain makes it difficult to roll on the surface. The thousand grain weight of paddy was 26.54 gram. The geometric mean diameter ranged from 35.10 to 44.65 mm^2. The true density, bulk density and porosity were 900 kgm^{-3}, 500 kgm^{-3} and 44%, respectively. The angle of repose of paddy was 30.76^0. The head rice recovery was maximum when milled for 30 seconds and deceases gradually as the time of milling increases. The broken percentage decreases with advance in milling time.

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Biochemical changes in serum of cows during anorexia

A. Tiwari, M.L.V. Rao, M.A. Quadri and **N.K. Jain**
Department of Veterinary Medicine
College of Veterinary Science & Animal Husbandry
MPPCVV, Jabalpur (MP)

Abstract

The experiment was conducted in thirty-two miltch cows divided into four group of (ABCD). Each group consisted of eight animals. Animals of groups A acted as control group, while C group was treated with Rumbion and D group was given Appetonic medicine. Animal of B group acted as untreated anorectic control. Clinical examination revealed non significant changes in rectal temperature, pulse and respiration rate. The serum pH of anorectic cows was significantly lower as compared to healthy and treated group. The anorectic cows revealed significantly reduce concentration of blood glucose, total volatile fatty acid, protein, calcium and phosphorus which got normal after treated with Rumbion and appetonic.

गायों में भूख कम लगने कीअवस्था सामान्यतः पायी जाती है। इस प्रयोग में बत्तीस गायों के समूह को चार भागों में बांटा गया (अ.ब.स.द) प्रत्येक समूह के 8 पशु को लिया गया। समूह अ में स्वस्थ्य पशुओं को लिया गया समूह स और द के पशुओं को रुमवियान एवं एपिटोनिक दवा दी गयी है। समूह ब के पशुओं को बिना दवा के रखा गया जिनमें भूख कम लगने के लक्षण थे। परीक्षण करने पर तापमान, नाडी एवं श्वास गति लगभग सभी पशुओं में सामान्य पायी गयी परन्तु रक्त का पी.एच. ग्लूकोश टी.व्ही.एफ.ए., प्रोटीन, कैल्शियम एवं फास्फोरस की मात्रा कम पायी गयी एवं जिन गायों को दवा दी गयी उनमें यह मात्रा सामान्य हो गयी।

Keywords: Biochemical changes, serum, anorexia, cow

Simple indigestion is common problem especially in dairy animals with varying type of manifestation and anorexia is one of them. Anorexia directly reflects on the milk yield of the dairy animals and thus the economy of the farmer and the nation is affected. A reduced feed intake will not only result in deficiency of serum electrolytes but also lead in fatty infiltration and degradation of liver and sometimes may result into mortality of animals (Blood et al. 2001). It is therefore logical to evaluate the condition of compatibility of rumen and relative alteration in blood at an early stage in such cases so as to take prompt and remedial measures. The present paper describes biochemical changes in blood in anorectic cows suffering from simple indigestion.

Material and methods

The present study included the observation on thirty-two miltch cows (Bos indicus) of nearest lactation and similar age group. Out of these twenty-four animals suffering from anorexia were arbitrarily divided into three groups (B, C and D) of eight animals each. These animals had the history of partial to complete anorexia. Clinical observation revealed normal temperature, pulse and respiration but decreased ruminant motility. Remaining eight animals were apparently healthy and served as control group (A). Animals of group C wee treated with Rumbion, group D with Appetonic at the rate of 2 bolus bid for 3 days, and animal of group B were given no treatment and they acted as untreated control group. An amount of 20 ml blood was collected from jugular vein and the parameters studied are pH was determined by pH strips, serum glucose was estimated by enzymatic GOD-POD method by using kit, serum protein was estimated by Biuret method (as per Weichselboum 1946) by using kit, calcium was estimated by O.C.P.C. method (Moorehead and Briggs 1974) by using kit, Serum phosphorus was estimated by method of Fiske and Subbarow, 1925 as described by Oser (1965), Serum chloride was estimate by Schales and Schales method as described by Oser (1965), total volatile fatty acids (TVDA) was estimated by the method of Scarisbrick (1952), serum sodium and potassium were estimated with help of flame photometer.

The data were statistically analyzed by "F" test. The group difference were tested by using critical difference as per the method suggested by Steel and Torrie (1980).

Results and Discussion

Clinical examination revealed that rectal temperature,

Table 1. Clinical, Biochemical, mineral and electrolytes examination of normal, anorectic and treated cows

Parameters	Normal healthy cows	Anorectic cows	Rumbion treated cows	Appetonic treated cows
Temperature ^{0}F	101.35±0.14	101.48±0.09	101.67±0.11	101.23±0.19
Pulse rate/min	63.62±0.53	63.87±0.491	63.75±0.61	63.87±0.66
Respiration/min	17.62±0.45	17.37±0.49	16.62±0.26	17.87±0.66
Clinical signs	Appetite, rumination, defecation normal and no abnormal clinical signs	Anorectic/off-feed in-appetence dull, rough hair coat, reduce rumination emaciation, dry and wrinkled mucous membrane	Appetite, rumination, defecation normal and no abnormal clinical signs	Appetite, rumination, defecation normal and no abnormal clinical signs
pH CD=0.08 (0.05)	7.31±0.02	6.17±0.04*	7.31±0.02	7.28±0.02
Glucose (mg/dl) CD=15.68 (0.01) CD=11.65 (0.05)	58.81±0.81	39.13±1.17**	62.93±1.47	56.15
TVFA (meq/l) CD=9.64 (0.01) CD=7.61 (0.05)	57.87±2.61	36.75±2.50**	62.87±2.16	55.62±2.57
Total protein (g/dl) CD=1.53 (0.01) CD=1.14 (0.05)	10.42±0.48	7.79±0.49**	10.87±0.50	10.90±0.46
Calcium (mg/l) CD=1.29 (0.01) CD=0.83 (0.05)	10.68±0.13	7.09±0.12**	11.96±0.40**	11.93±0.37**
Phosphorus (mg/dl) CD=0.32 (0.01) CD=0.23 (0.05)	4.8±0.03	3.81±0.04**	5.53±0.12**	5.28±0.09**
Chloride (meq/l) CD=5.42 (0.01) CD=4.03 (0.05)	93.71±1.06	117.75±1.21**	92.73±1.789	90.50±1.37
Sodium (meq/l) CD=10.6 (0.01) CD=8.10 (0.05)	131.12±3.62	104.0±1.16**	151±3.54**	131.12±2.05
Potassium (meq/l) CD=0.57 (0.01) CD=0.42 (0.05)	4.62±0.12	6.17±0.18**	4.66±0.14	4.36±0.13

**Highly significant at (P<0.01), *Highly significant at (P<0.05)

respiration and pulse rate did not vary among the different groups of animals, which clearly indicated that animals were not suffering from any infectous diseases (Table 1) The pH of anorectic cows was significantly low in comparison to normal and treated cows. Result clearly indicated that catabolism of fatty acid in anorectic cows resulted into ketone bodies production which might have resulted into low blood pH. Observation for pH of blood in anorectic lactating cows confirmed with the result of Blood et al. (2000). The blood glucose, total volatile fatty acids and protein concentration in serum of anorectic cows got significantly reduced as compared to normal cows. The lower value of TVFA and glucose in serum of anorectic cows due to reduced feed intake and thus, poor fermentation resulting into lower values of these two parameters in blood sample of anorectic cows. However, all these above parameters were brought to normalcy after Rumbion and Appetonic treatments had given to anorectic cows. Kumar et al. (2001) recorded lower production of TVFA and glucose in anorexic syndrome in bovines.

Similarly, lack of feed intake, resulted into lower serum protein concentration of anorectic cows in comparison to control normal cows.

Calcium and phosphorus levels got reduced in the sera sample of the anorectic animals as compared to healthy and anorectic treated cows. These animals were in lactation and giving around three litres of milk. Since, the intake of calcium and phosphorus was reduced and excretion of calcium alongwith milk continued which was derived from blood it-self, which might have been the cause of low serum calcium and phosphorus levels. These two minerals goat elevated significantly in thee concentration in their concentration in the serum after giving the Appetonic and Rumbion treatments. Prasad et al. (1972) worked on clinical cases of anorexia of cattle and buffaloes, and recorded low calcium levels in some cases, while inorganic phosphorus were in normal range.

Sodium got significantly reduced in anorectic animals. These anorectic animal giving milk but consuming less food might have been the cause of low blood sodium in these anorectic animals. However after treatment with Rumbion and Appetonic the sodium level became normal. Serum potassium levels were significantly higher in the blood of anorectic cows in comparison to healthy and treated cows, which may be due to the metabolic acidosis occurred during anorexia. However, the serum chloride levels were significantly enhanced in anorectic cows due to shift from intra cellular fluid to extra cellular fluid. The results are in agreement with the observation of Kumar (2000), who recorded decrease in sodium level of blood and enhancement of potassium and chloride level in the blood of anorexic cows.

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Epidemiological studies of sub-clinical mastitis in different organized dairy farms

Brijesh Singh, M.L.V. Rao, D.K. Gupta, N.K. Jain and **P.C. Shukla**
Department of Veterinary Medicine
College of Veterinary Science & Animal Husbandry
MPPCVV, Jabalpur

Abstract

A survey on incidence of sub clinical mastitis was carried out on 500 crossbred cows of different organized dairy farms of Jabalpur region (M.P.). Total of 210 animals were found positive for subclinical mastitis by modified California mastitis test, milk pH, electrical conductivity (EC) and somatic cell count (SCC). The incidence of subclinical mastitis in crossbred cows was found as 42% (210/500) and 28.15% (525/1865) on animals and quarter basis, respectively. Age wise incidence revealed highest (46.19%) in 5-6 years group followed by 7-8 years (22.38%), (3-4 years 20.95%) 9-10 years (6.66%) and 11-12 years (3.80%), respectively. Higher incidence was found during the early stage of third lactation (24.76%). Quarter wise incidence was also higher in hind quarters (67.92%) in comparision to fore quarters (32.56%) and in the right side quarters (55.99%) as compared to left side quarters (43.99%). In rainy season animals were found more prone to the subclinical mastitis (69.54%) as compared to that of winter (30.76%) and summer (23.56%) season.

गायों के थन शोध के विषय में 210 गायों पर शोध कार्य किया। इस रोग की जाँच केलिफोर्निया मेसटाइटिस टेस्ट, दध के क्षार की मात्र एवं शारीरिक सेल की गणना कर की गयी 28.15% पाया गया शंकर गायों में यह रोग 42% एवं अन्य गायों में पाँच से छः वर्ष की गायों में रोग का प्रतिशत 46.19% सात से आठ वर्ष की गायों 22.38% तीन से चार वर्ष की गायों मे 20.95% नौ से दस वर्ष की गायों में 6.66% एवं ग्यारह से बारह वर्ष की गायों मे 3.88% पाया गया। तीसरे व्यात की शरुआती अवस्था में सर्वाधिक 24.76% था। पिछले थनों में गंग 67.92% अधिक या जबकि अगले थनों 32.56% था। दाहिने भाग के थनों में 55.99% प्रतिशत गंग पाया गया जबकि बाये थनों में 43.99% था। वर्षा ऋतु में रोग 65.54% था जोकि शीत कालीन में 30.76% एवं ग्रीष्म ऋत में 23.56% था।

Keywords: Biochemical changes, serum, anorexia, cows

Subclinical mastitis (SCM) in a lactating animals is a condition characterized not only by the presence of pathogens in the udder but also by changes in the biochemical profile in the milk. It causes decrease in milk quality and its market value as well as it is responsible for up to 70% of losses in mastitis (Ahmed et al. 2008) SCM causes great economic losses than clinical mastitis (Joshi and Gokhale 2006). The prevalence of SCM has increased enormously in India in the recent years (Tiwari and Sisodia 2000).

The subclinical form of mastitis is more difficult to identify and can only be diagnosed by a variety of direct or indirect laboratory tests. The detection of SCM happens to be first pre-requisite of a modern dairy establishment. If the owner wishes to avoid the economic losses in their herd early detection of SCM has always been a matter of great curiosity since subclinical evinces gross signs of inflammation. Successful containment of SCM involves rapid diagnosis.

Material and methods

An epidemiological investigation on incidence of SCM was made on 500 animals, were tested by using modified California Mastitis Test (MCMT) from different private organized dairy farms and livestock Farm, Adhartal, MPCVVV, Jabalpur.

The screening for the detection of SCM was done by using Modified California Mastitis Test (MCMT), (Schalm et al. 1971). Milk samples were collected aseptically in a clean environment, thoroughly wiping the teats with 70% Isopropyl alcohol. After discarding the first few milk squirts, 3 ml of milk samples from each quarter was drawn in each of the 4 shallow cups in the CMT paddle then 3 ml of the commercial available CMT reagent was added to each cup and mixed together through swirling the paddle in a circular motion for few seconds.

According, to the visible reaction of the CMT, the results were classified into four scores: 0=negative or traces (no change in consistency), 1 = slightly positive (+), 2=positive (++) and 3=highly positive (+++). Scores 1, 2 and 3 depend on the degree of gelatin that were indicated by gelatinous mass (Schuppel and Schwope, 1998).

Results and Discussion

The overall incidence of infected animal was found to be 42% (210/500) on animal basis and 28.15% (525/1865) on quarter basis which is closely similar with the finding of Tiwari et al. (2000b) who reported 47.10% incidence of SCM in Malwa region of Madhya Pradesh. The overall incidence SCM was found to be 28.15% on quarter basis which was closely correlated to 23.08%, 25.12% and 23.10% recorded by Bansal et al. (1995); Tiwari et al. (2000b) respectively.

Age wise incidence of SCM in lactating cows revealed highest 46.19% (6-6 years) group followed by 22.38% (7-8 years), 20.95% (3-4 years), 6.66% (9-10 years) and 3.80% (11-12 years), respectively. These finding are in agreement with those of Lairintlunanga et al. (2003) who reported that cows between 4-6 years of age were more prone to infection. During 5-6 years of age, the animals were approximately in 3rd to 4th lactation had a highest milk yield, thus remained under stress and were more prone to infection. In the present study, the incidence of SCM was higher in the hind quarters (67-42%) when compared to fore quarters (3256%); Joshi and Gokhale 2006 (56.52% and 43.47%) and Ramprabhu and Rajeswar, 2006 (54.54% and 45.46%). The higher incidence of SCM in hind quarter could be duet to greater exposure to dung and urine contamination (Singh and Baxi 1980; Bansal et al. 1995).

The right side quarters were more susceptible to SCM (55.99%) as compared to left side quarters (43-.99%) because the animals adapted to right side sitting posture. This posture caused widening of teat canal due to pressure exerted to right side quarters, provided exposed to organism entrance. The higher incidence of SCM was noticed during the third location in cows (24.76%). It was also higher (51.42%) during the early stage of lactation (Lairintlunanga et al. 2003). This might be confined to higher yielding stress on udder caused the broadening of teat canal due to the pressure on teat sphincters resulting in increased chances of microbes entry and hence increased incidence of SCM during advance lactation.

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Short Communication

Price behaviour of pegionpea in middle Gujarat state, India

Preeti Upadhayay and **Y.C. Zala**
Department of Agricultural Economics
B.A.College of Agriculture, Anand Agricultural University
Anand, Gujarat 388 110

Abstract

Wholesale as well as farm harvest prices of pegionpea continued to increase over time with few exceptions. Gross increase in the price during two selected triennium was in the range of -30 to 27 whereas, farm harvest price was negative in the selected districts. Thus, marked variation in inter year price behavior of pegionpea was noticed across the markets of middle Gujarat state during the study period. Price of pegionpea in the selected markets followed the normal seasonal pattern. In majority of the market lower seasonal price indices (99 to 94) for pegionpea was there in harvesting month of January-February.

India has a distinction of being world's largest producer of pulse crops. These are grown on an area of 22 to 23 million hectares adding 14 to 15 million tones of grains to the food basket of the country. However, there is a wide gap in demand and supply of pulse grain in the country. The demand of the pulses in 2006-07 was 21 million tones as against the supply of 18 million tones leave a deficit of 3 million tones.

The study has been undertaken in middle Gujarat to estimate the inter year and intra year price behavior of pegionpea in the selected markets of the middle Gujarat.

The study was limited to major pulse crop of middle Gujarat viz., pegionpea. This account for 9.25 per cent of area and 9.20 per cent of production in Middle Gujarat .Three districts Vadodra, Panchmahal and Dahod ranking high in production for pegionpea crop were selected. The study covers ten regulated markets of three districts of middle Gujarat.

Monthly as well as annual wholesale prices of pegionpea of the selected markets and annual fram-harvest prices of pegionpea for the selected districts were obtained from the record of Department of Agriculture, Government of Gujarat, Ahemdabad.

Linear and exponential functions in annual and farm-harvest price index numbers (with 1997-98 as base year) were estimated using the models:

Linear $P_t = \beta_0 + \beta_1 T + U_t$ .....Model 1

Exponential $Pt = \beta_0 \beta_1 T U_t$

where

P = Annual index numbers of wholesale/farmharvest prices

β_0 = Intercept,

P_t = Annual index number of wholesale prices/farm harvest prices,

T = Time variable (year) (1, 2, 3, ……. 11),

β_1 = Parameters to be estimated, and

U_t = Error term with usual assumptions.

The logarithmic transformation of this model is

$$\log P_t = \log\beta_0 + T \log\beta_1 + \log U_t$$

The per cent compound growth rate (r) was estimated using the identity

$$r = (\beta_1 - 1) \times 100$$

where

β_1 = antilog of β_1

The standard error of 'r' was estimated using the formula:

$$SE(r) = \frac{100\beta}{\log 10^e} \frac{\sqrt{(\Sigma \log P_t^2) - \frac{(\Sigma \log P_t)^2}{n} - [\Sigma T^2 - \frac{(\Sigma T)^2}{n}] (\log\beta)^2}}{(n-2)[\Sigma T^2 - \frac{(\Sigma T)^2}{n}]}$$

where

$\log 10^e = 0.4343$

The intra-year/seasonal price behavior was analysed using multiplicative model of time series analysis. To remove the effects of trend and cyclical variations,

twelve months moving average were calculated and centered. The ratio of original price indices to centered 12 months moving averages were worked out. For each month the ratio to centered moving averages were averaged and adjusted seasonal indices were worked out.

The coefficients of average seasonal price index variation were worked out using the formula:

$$ASPV = \frac{[\text{Highest price index - lowest price of index}]}{[\text{Highest price index + lowest price of index}]} \times 200$$

$$\text{Coefficient of variation of seasonal indices (\%)} = \frac{\text{Standard deviation (s)}}{\text{Mean of price indices}(\bar{X})} \times 100$$

Inter year price behaviour

Wholesale prices of pegionpea have shown rising trend during the period of 1995-96 to 2005-2006 except Senor and Devgadhbari market. The frequency distribution of number of years with positive and negative price variations reveals that negative price change (40 to 70 per cent) was more than positive price change (30 to 60 per cent year). The variation in farm harvest price had shown positive price change of 50 percent years.

The estimates of gross increase in wholesale and farm-harvest prices in the selected markets are presented in Table 1. These show that the wholesale prices was highest in Lunavada market (27.5 per cent) and lowest in Devgadhbaria market (-30.01 percent) which show negative increase in annual wholesale prices.

The gross increase in farm-harvest prices of tur for all the districts were negative and for state as a whole it was 9.95 percent. Thus, farm-harvest prices of pegionpea showed comparatively lesser percentage increase during the study period.

Linear rate of increase in prices

The result of estimates of linear trend equation in wholesale prices of pegionpea in selected markets of the state revealed that regression coefficient were positive for majority of markets except in Karjan and Devgadhbaria market. The value of regression coefficient was non-significant in majority of market except for Santrampur and Devgadhbaria markets (Table 2). The linear rate of increase in wholesale prices ranged between 0.16 to 1.95 per cent except in Karjan and Devgadhbaria market which showed negative linear growth rate . The coefficient of multiple determination had shown wide variation from 0.14 to 37 per cent.

Thus, on the basis of value of slope coefficient and value of R^2, it can be inferred that price of pegionpea in the selected markets of the state increased linearly by around 0.3 to 4 percent per annum and 0.1 to 1.9 per cent per annum respectively. The linear increase in farm harvest price for the crop was significant in all the selected district and state as a whole. Among the districts the linear rate of increase in farm harvest prices was negative in Vadodra district and positive in Panchmahal and Dahod district. The value of coefficient of multiple determination indicated that only 12 to 14 per cent variations was explained through linear equation.

Compound rate of increase in prices

Wholesale prices of pegionpea increased at a compound rate of -4.7 to 3 per cent per annum in selected markets during the period 1995-96 to 2005-06. The coefficient of

Table 1. Gross increase in price indices of pegionpea in selected markets/districts of Gujarat

	Wholesale prices				Farm harvest prices		
Markets	Average price indices1995-96 to1997-98	Average price indices2003-04 to2005-06	Per cent increase between two trienniums	Districts	Average price indices1995-96 to1997-98	Average price indices2003-04 to 2005-06	Per cent increase between two trienniums
Karjan	1601.08	1639.38	1.80	Vadodra	1586	1449	-8.63
Dabhoi	1573.38	1676.42	6.54	Panchmahal & Dahod	2015	1641.33	-18.55
Senor	1679.38	1656.86	-1.34	Gujarat State	1521.33	1672.67	9.95
Padra	1712.97	1715.27	0.13				
Naswadi	1262.86	1594.44	25.25				
Lunavada	1304.86	1663.74	27.50				
Shera	1761.03	1828.05	3.81				
Santrampur	1411.24	1579.72	11.94				
Dahod	1439.58	1639.08	13.85				
Devgadh Baria	2883.79	2018.30	-30.01				

Table 2. Estimation of linear rate of increase in price indices of pegionpea in selected markets/districts of Gujarat

Markets	Intercepts (β_0)	Coefficient for time (T) (β_1)	Linear growth rate (per cent)	Coefficient of multiple determination (R^2)
Whole sale price indices (1995-96 to 2005-06)				
Karjan	1649.36	-1.81	-0.11	0.0014
Dabhoi	1640.52	2.71	0.16	0.0017
Senor	1556.02	6.00	0.38	0.0092
Padra	1573.38	8.77	0.55	0.0177
Naswadi	1351.29	28.96	1.95	0.143
Lunavada	1338.71	27.56	1.88	0.1509
Shera	1658.43	8.99	0.52	0.0738
Santrampur	1383.62	16.62*	1.12	0.3229
Dahod	65.38	15.08	1.01	0.0892
Devgadh Baria	20.94	-111.61*	-4.40	0.3781
Farm harvest indices (1995-96 to 2005-06)				
Districts				
Vadodra	1773.64	-24.71	-1.54	0.1418
Panchmahal and Dahod	1458.85	18.37	1.18	0.1277
Gujarat state	1541.76	12.37	0.76	0.1484

*Significant at five per cent level of probability

multiple determination showed that 0.01to 39 per cent variations was explained through the variables included in the equation.

Farm-harvest prices was negative in Vadodra district (-1.5 per cent) and 5.58 percent in Panchmahal and Dahod districts. Coefficient of multiple determination (R^2) explained 13 to 64 per cent variation in farm-harvest price through exponential equation (Table 3).

The comparison of linear and compound rate of increase in two type of prices of pegionpea both linear and compound rate of increase in farm-harvest prices were higher in Panchmahal and Dahod districts than Vadodra district. Although farm harvest prices have experience high rate of compound increase than wholesale prices.

Table 3. Estimation of compound rate of increase in price indices tur in selected markets/districts of Gujarat

Markets	Intercepts (β_0)	Coefficient for time (T) (β_1)	Compound growth rate (per cent)	Coefficient of multiple determination (R^2)
Whole sale price indices 1995-96 to 2005-06				
Karjan	1628.45	1.00032	3.20	0.00012
Dabhoi	1593.36	1.0049	0.49	0.0123
Senor	1524.36	1.0057	0.57	0.01661
Padra	1540.69	1.007	0.73	0.0237
Naswadi	1303.78	1.0240	2.40	0.1851
Lunavada	1302.25	1.022	2.22	0.1861
Shera	1659.44	1.0049	0.49	0.0669
Santrampur	1382.89	1.011	1.14*	0.3247
Dahod	1398.22	1.019	5.07	0.0985
Devgadh Baria	3508.74	0.9552	-4.76*	0.3953
Farm harvest indices 1995-96 to 2005-06				
Districts				
Vadodra	1772.59	0.9842	-1.57	0.1370
Panchmahal and Dahod	945.30	1.055	5.58	0.6462
Gujarat state	1536.47	1.008	0.81	0.1554

*Significant at five percent level of probability

Comparative view of linear and compound rate of increase in two type of prices of selected markets/districts of middle Gujarat show that not much difference was found in both of trends for both prices for selected markets/districts of the state. The coefficient of multiple determination (R^2) indicated that both the prices almost at par in both linear and compound trend equations.

Intra year price behaviour

The intra-year (seasonal) variation in prices of selected pulse crop was examined by working out indices of seasonal variation and coefficient of average seasonal variation.

Indices of seasonal variation

The seasonal price indices of pegionpea were lowest in January-February (1994 to1999) in majority of the markets except in Karjan, Padra and Naswadi markets. Price were more than 100 from Jan-Feb to Sept-Oct onwards in majority of market and decrease thereafter till the arrival of the next crop. These price indices in Jan-Feb month for the crop in majority of the markets may be due to tendency of farmers to sell the produce immediately after harvest, new arrivals of the crop and release of old stock lying with traders and big farmers.

Coefficient of average seasonal price variation

The coefficient of average seasonal price variation for pegionpea was lowest for Daboi market (6.61 per cent) and highest in Karjan market (1.96 per cent). The coefficient of variation of seasonal indices for tur ranged between 30 percent in Devgadhbaria market to 10.99 per cent in Sehra market. It was due to the location of these markets in remote places from other regulated market and as such flow of market information between the markets may be less as particularly in Devgadhbaria market. The moderate coefficient of variation 23 to 14 per cent in Karjan, Santrampur, Lunavda, Naswadi, Padra, Dahod and Sehra market may be due to better market infrastructure facilities.

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Short Communication

Analysis of constraints in integrated tribal dairy development project in Mandla district of Madhya Pradesh

Mukesh Patel , A.K. Sarawgi*, Preeti Uphayay, and Mukesh Verma
*Department of Agricultural Economics & Farm Management
Department of Agronomy
Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur 482 004 (MP)

Abstract

Integrated Tribal Dairy Development Project was started in the year 2004-05 for the people under Below Poverty Line (BPL) ad interested in dairy farming. The major problem encountered by beneficiaries were Poor extension services (86%), poverty illiteracy and lack of veterinary hospital facility followed by lack of knowledge disease and feeding and lack of technical knowledge.

Livestock sector plays an important role in generating income and employment, augmenting income of marginal farmers and landless laborers and meeting nutritional requirement. Farmers in general in India follow mixed crop and livestock farming system because of strong linkage between these two. Livestock formed a major component of poverty alleviation strategy of the Government of India. Domestic demand for livestock products is rising at a fast rate and export demand is also increasing. Demand for livestock products during 11th Five-year plan is envisaged to grow at an annual rate varying from 3.2 to 4.7 per cent for various products. On the supply side, India has a very large population of livestock but productivity is very low. The main reasons for this are poor feeding, low quality of animals and inadequate veterinary facilities. . In order to meet the rising demand for livestock products, and to harness the potential of this sector, there is a need to understand the structure of livestock sector, and, factors that affect growth of livestock output. The state government initiated certain step to develop this sector by integrated activities of milk production, processing and marketing. In this connection, the Integrated Tribal Dairy Development Project (ITDDP) was started in the year 2004-2005. This project mainly covered the people who come under BPL (Below Poverty Line) categoring and those who are interested in dairy. An attempt is made in the papar to assess problems faced by dairy farming beneficiaries under ITDDP in the study area.

Sampling technique

Mandla district of Madhya Pradesh was selected purposively as the project ITDDP was started in the year 2004-05.Mandla district is having nine blocks viz., Nainpur, Bejadandi, Mohagoan, Ghugrhi, Bhichia, Mabai, Niwas and Narayanganj. Out of which Mandla block was selected on the basis of more number of villages covered by the project. After selection of block, lists of project operated villages were prepared and then five villages namely Umaria, Khari, Khairi, Bakccheragodi and Peparpani, were selected randomly as per the method advocated by Bheemappa et al. (1990); Thakur et al. (1989).

Table 1. Problems faced by ITDDP beneficiaries (Each village 10 selected beneficiaries)

	Umaria		Kheri		Bakschera		Piperapani		Khera		Overall		
Constraints	NB	PTB	NB	PTB	NB	PTB	NB	PTB	NB	PTB	Total	%	Rank
Lack of technical knowledge on dairy	7(3)	70	7 (3)	70	6(4)	60	7(3)	70	6(4)	60	33	66	IV
Lack of knowledge on disease and feeding etc.	7(3)	70	6(4)	60	7(3)	70	8(2)	80	7(3)	70	35	70	III
Poverty illiteracy	8(2)	80	8(2)	80	7(3)	70	8(2)	80	8(2)	80	39	78	II
Poor extension services	9(1)	90	8(2)	80	9(1)	90	8(2)	80	9(1)	90	43	86	I
Lack of veterinary hospital facilities	8(2)	80	8(2)	80	7(3)	70	8(2)	80	8(2)	80	39	78	II

NB-No. of beneficiaries, PTB- Percentage to total beneficiaries

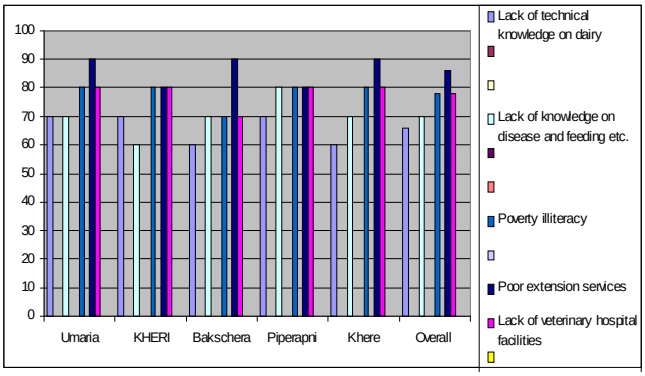
From the Selected villages, lists of beneficiaries were prepared. From each village ten beneficiaries were selected randomly. Thus total of fifty respondents were considered for detail investigation. The primary data in the study pertains to the agricultural Year 2006-07. Data were collected with the help of personal interview with the help of pretested interview schedule. The simple average and percentage statistical tools were employed for analysis of data.

Problems faced by respondents

It is evident from the data that the major problems expressed by the beneficiaries were poor extension services 86%, poverty illiteracy and lack of veterinary hospital facility 78%, lack of knowledge disease and feeding 70%, lack of technical knowledge dairy 66%, were the main problem for low milk production supported by Thakur et al. (1989); Halyal et al. (1980).

Following main problem faced by beneficiaries under ITDDP were observed in the study area.

- Due to illiteracy, the skill and experience which are required for a dairy business was found lacking among the beneficiaries.
- Majority of respondents of the project did not have full knowledge about the ITDDP project.
- Due to lack of experienced staff, certain operational problems were found which have affected effective implementation of the project.
- Lack of coordination among the staff and local persons in the village



- Accumulation of application forms at the block office and their quick processing and disposal, was also a tedious problem for officials.
- Thus, proper knowledge about the project through educating the target groups in the needed area which helps poorer strata of the rural society in availing the benefits of the programme.

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