

*A Departmental Profile - Soil Science and Agricultural Chemistry*

**OUR HEADS OF THE DEPARTMENT**



**Dr. P. M. Tamboli**

Oct. 1991 to May 1993 & June 1993 to Sept. 1997



**Dr. D. P. Motiramani**

May 1968 to May 1968 & from 1973 to Dec. 1973



**Dr. G. P. Verma**

Sept. 1990 to Dec. 1994 & Jan. 1995 to Feb. 1997



**Dr. S. S. Khanna**

Oct. 1968 to Nov. 1971



**Dr. M. M. Rai**

Apr. 1 1973 to Aug. 1973



**Dr. S. B. Sinha**

Aug. 1973 to July 1987



**Dr. G. S. Rathore**

July 1987 to Nov. 1993 & July 1996 to June 1998



**Dr. B. R. Tembhare**

July 1998 to Jan. 1999



**Dr. V. S. Tomar**

Nov. 1992 to July 1995



**Dr. D. L. Kaurav**

Feb. 1999 to Oct. 2007



**Dr. R. S. Khamparia**

Nov. 2007 to Dec. 2010 & Oct. 2012 to Nov. 2013



**Dr. A. K. Rawat**

Nov. 2013 to B.A. 2017 & Nov. 2018 (Contd.)

## Preamble

Government of India in coordination of the Government of Madhya Pradesh established the multi campus university at Jabalpur, in the heart of the country, named after the architect of modern India, Pt. Jawaharlal Nehru, based on the recommendations of Radhakrishnan Commission (1949) on the concept of establishment of Agricultural University. An approach was envisaged to narrow down the gap between the experts and farmers through Joint Indo-American Team on Agricultural Research and Education in 1954-55 and 1959-60 on the pattern of Land Grant Colleges of USA. College of Agriculture, Jabalpur was established in 1955 (affiliated to then Jabalpur University). On October 2, 1964, Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV) was inaugurated by the then Union Minister of Information and Broadcasting, Smt Indira Gandhi. Dr. J.S. Patel took over as the first Vice Chancellor in October 1964.

With the establishment of the Faculty of Agriculture in Jawaharlal Nehru Krishi Vishwa Vidyalaya, the Department of Soil Science & Agricultural Chemistry came into existence during 1967 which was first headed by Prof. P.M. Tamboli. However, M.Sc.(Ag.) and Ph.D. in Soil Science & Agricultural Chemistry was started in 1962 and 1971, respectively. The Department runs M.Sc.(Ag.) and Ph.D. degree programmes as scheduled by the VV. Soil Fertility and Plant Nutrition, Soil Physics, and Soil Microbiology are the prime areas of specialization in the department. The department has established several magnificent milestones in research, teaching and extension activities for the benefit to mankind, particularly to the farming community.

## Mission

To conduct Education, Research and Extension activities for enhancing productivity, profitability and sustainability of agricultural production systems through maintaining soil fertility and productivity so as to improve quality of rural livelihood in the state of Madhya Pradesh.

## Mandate

- To conduct research and develop human resource in the field of Soil Science and Agricultural Chemistry.
- To disseminate technologies to farmers, extension functionaries and organizations engaged in agricultural development through various extension programmes.

## Objectives

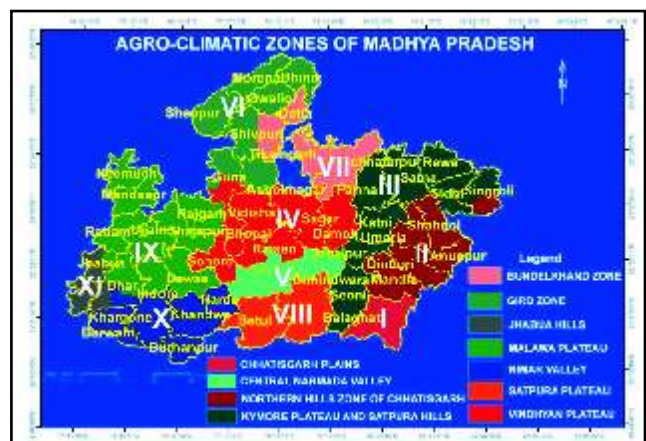
- To offer courses in different disciplines of Soil Science and Agricultural Chemistry for the undergraduate degree programmes in Agriculture, Horticulture, Agricultural Engineering and Forestry, and Masters and Ph.D. degree programmes in Soil Science & Agricultural Chemistry.
- To exchange information with other scientists and extension staff engaged in similar pursuits through field trials, training, group discussion, symposia, seminar,

conference and publications.

- To carry out the fundamental and applied researches on soils, especially in Pedology, Soil Classification, Soil physics, Soil Fertility, Soil Microbiology, Plant Nutrition, Agricultural Chemicals and Farm and Industrial Wastes Utilization.
- Teaching: Under graduate and post graduate teaching, and trainings of scientists / teachers of ICAR, SAUs and State Agriculture Department under Centre of Advanced Faculty Training (CAFT) and other programmes.
- Extension: Technology transfer and other activities.

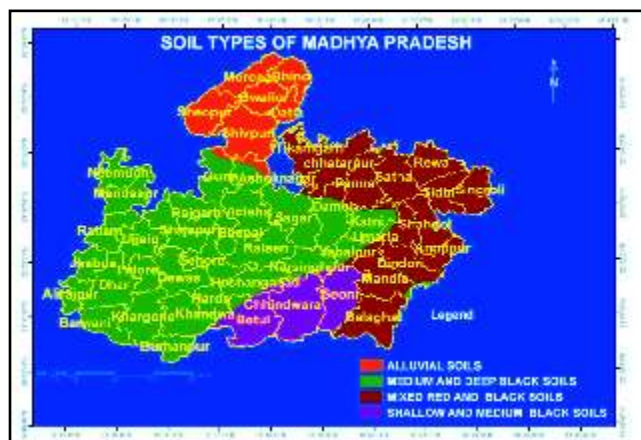
## Agro-climatic Characteristics

Out of 15 major agro-climatic zones of India (Planning Commission), three are spread over the Madhya Pradesh viz., Eastern plateau and hills region, Central plateau and hills region, and Western plateau and hills region. Further, the National Agriculture Research Project (NARP), based on rainfall, existing cropping pattern and administrative units, divided the whole country into 129 sub-zones (agro-climatic zones), out of which 11 sub-zones are of Madhya Pradesh State. The area under the University jurisdiction contains 7 agro-climatic zones viz., I. Chhattisgarh plains, III. Northern hills region of Chhattisgarh, IV. Kymore plateau and Satpura hills, V. Vindhyan plateau, VI. Central Narmada valley, VIII. Bundelkhand zone, and IX. Satpura plateau.



Major soils of the country viz., Vertisols (high content of expansive clay, black cotton soils), Inceptisols (weakly developed soils due to rapid alteration of parent materials, red and black of soils), Entisols (little or no morphological / horizon developed soils of recent origin, river alluvium), and Alfisols (weathered / leached soils under deciduous forests, rich in Fe and Al) cover large tracts of the Madhya Pradesh State. These soils are highly diversified and are being cultivated primarily under rainfed conditions. Vertisols and associated soils are potentially productive but are faced with problems of drainage, tillage, excess moisture and drought stress. If managed properly, these may prove to be the grainaries of the country. The second biggest group of soils is Alfisols which are inherently poor in fertility and moisture

retention capacity. The third major group is of alluvial soils which have high percentage of irrigated farming and are faced with problems of salinity / alkalinity / water logging. Besides deficiency of major nutrients, some of the soils are reported to be deficient in secondary and micronutrients, especially in S and Zn. Also wastelands, such as gullied and/or ravenous lands, degraded forest/plantation crops/pasture lands and mining industrial wastelands cover large tracts of the State.



The overall climate varies from semi-arid to sub-humid with hot summer (38 to 44 °C), cool and dry winter (7 to 13 °C) with rainfall (during June to October) maximum 1200 to 1600 mm in Chhattisgarh plains and Northern hills region of Chhattisgarh, and minimum 1000 to 1500 mm in other agro-climatic zones; average crop growing period is 150 to 180 days; and forest type is tropical moist to tropical dry deciduous (sal, teak, tendu, dhak/betua, anjan, etc. in Chhattisgarh plains, Vindhyan, Satpura and other hilly ranges; and semi-xerophytic vegetation, thorny, bushy type in northern and western parts). The main food crops are sorghum, wheat, rice and coarse grain such as kodo, little Italian millets. Important commercial crops are pulses, oilseeds, cotton, sugarcane and medicinal crops. The state is poised for a breakthrough in soybean cultivation. It is first in soybean, oilseeds, chickpea and maize production in the country. *Kharif* crops occupy 60% and *Rabi* crops 40% areas with 71.4% area under food grain production. Nearly 53% of landholders are marginal, whereas small farmers share 18% of farmland. Low literacy (35.45%), undulating topography, large waste land (13.2%), low ground water utilization, large proportion of rainfed agriculture (75%), practice of *Kharif* fallow (3.6%), low cropping intensity (126%), low fertilizer consumption (31 kg/ha), high proportion of low value crops, and high population of low productive livestock are the major constraints of the state.

### TEACHING

M.Sc. (Ag.) and Ph.D. in Soil Science & Agricultural Chemistry was started in 1962 and 1971, respectively. A strong postgraduate teaching programme offers a wider choice to select the subjects of specialization in the following major areas.

### Areas of Specialization

- Soil Pedology
- Soil Fertility and Plant Nutrition
- Soil Physics
- Soil Chemistry
- Soil Microbiology

Admission to post graduate students is provided on the merit basis at the University level. Education is offered through English medium, under semester system with 10 point scale for evaluation. Courses offered during the degree programme in the above areas of specialization are based on Fourth Deans' Committee. The doctorate degree programme is offered as per new course curriculum proposed by ICAR from the academic session 2008-09.

For Bachelor degree programme, admission is made through Pre-Agriculture Test (PAT) organized by Madhya Pradesh Board of Professional Examination, Bhopal. Apart from the programme of theory and practical for different courses, innovative programmes are also introduced to expose the students to the real farming and farmers conditions. This includes Rural Agriculture Work Experience (RAWE) and Forestry Work Experience (FWE) for one semester and course on crop and tree plantation.

### Students' Research activities

The research works of M.Sc.(Ag.) and Ph.D. students involve the following major research areas

- Soil degradation and restoration of soil health
- Nutrient management in crops and soils
  - Soil testing crop response studies
  - Long term fertilizer experiment
  - Sustainable nutrient management in agriculture
  - Micro and secondary nutrients deficiency and management
- Environmental pollution and remedication
  - Heavy metal contamination in soils, plants and water
  - Pesticide residues in soils, plants and water
- Natural resource management in enhanced livelihood
- Development and application of analytical methods for testing soil, plant, water, fertilizer, pesticides and pollutants
- Soil Biodiversity, biofertilizers and organic matter management
  - Microbial ecology and biochemistry
  - Nutrient management by microbiological techniques
  - Plant protection with bio-control agents
  - Commercial production technology of biofertilizers/ biopesticides
  - Soil organic matter management
  - Recycling of industrial and farm wastes in agriculture



## Academic Programmes & Courses Offered

### A. Undergraduate Degree Programme

- Introduction to Soil Science
- Agricultural Microbiology
- Soil Chemistry, Soil Fertility and Nutrient Management
- Manures, Fertilizers and Agro-chemicals
- Experiential Learning
  - Module : Crop Production
  - Sub module : Soil Management

### B. Masters Degree Programme

- Soil Fertility and Fertilizer use
- Soil Chemistry
- Fertilizer Technology
- Basic concepts in Laboratory Techniques
- Soil Physics
- Soil Mineralogy, Genesis, Classification and Survey
- Soil Biology and Biochemistry
- Soil, Water and Air Pollution
- Master's Seminar
- Master's Research

### C. Doctoral Degree Programme

- Advances in Soil Physics
- Advances in Soil Fertility
- Physical Chemistry of Soils
- Biochemistry of Soil Organic Matter
- Basic Concepts in Laboratory Techniques
- Soil Genesis and Micropedology
- Land Use Planning and Watershed Management
- Soil, Water and Air Pollution
- Doctoral Seminar
- Doctoral Research

### Significant Achievements

- Passed out students since the inception of department:
  - M.Sc. (Ag.) : more than 276
  - Ph.D. : more than 41
- ICAR Senior Research Fellowship : 03
- Student's Placement : Assistant Director Agriculture through MPPSC, Bank Services, UPSC, ICAR Services, Private Companies and NGOs
- Abroad for Ph.D. : 01

### Centre of Advanced Faculty Training

- Year of Start : 1995-96



- Training programmes organized till 2013-14 : 27
- Faculties trained : 535

### Facilities Available

- Well equipped seminar hall
- Green house
- Gamma Chamber
- Environmental Growth Room
- Bio-fertilizer Production Unit
- Laboratory for UG students
- Soil Testing Laboratory
- Soil Physics laboratory
- Micronutrient and Heavy Metal Testing Lab
- Soil Fertility Laboratory
- Soil Microbiology Laboratory
- Water distillation Plant
- Digestion Room
- Departmental Library with quality books and periodicals
- Postgraduate Classroom with audio-visual aids



### Library

Specialized Library with a Reading Hall

Books	:	More than 600
Manuscripts	:	Around 100
Journals	:	More than 10
Thesis of M.Sc. and Ph.D.	:	More than 300

### RESEARCH

#### Projects Currently Under Operation

##### ICAR Projects

- AICRP on Micro and Secondary Nutrients and Pollutant Elements in Soils and Plants
- AICRP on Long Term Fertilizer Experiment

- AINP on Soil Biodiversity and Biofertilizers
- AICRP on Soil Test Crop Response
- Centre of Advanced Faculty Training

#### Ad hoc Projects

- Use of Microbes for Plant Protection and Nutrient Management in increasing Crop Productivity (funded by Mandi Board, Bhopal M.P.)
- Establishment of Biofertilizer Plant under BPD Project (funded by ICAR)
- Evaluation of Soil Fertility and Fertilizer Effects in the Soybean Fields of Madhya Pradesh (funded by JICA)

#### Resource Generation Projects

- Commercial Production of Biofertilizers
- Soil Testing

#### Salient Achievements of Research Projects

##### AICRP on Micro and Secondary Nutrients and Pollutant Elements in Soils and Plants

- Generated soil fertility maps of state for micronutrients
- Deficiency of micronutrients in Madhya Pradesh Zn - 71%, Fe - 7%, Mn - 2% and S - 41%
- In Zn deficient soils, application of 10 kg Zn ha<sup>-1</sup> (50 kg ZnSO<sub>4</sub>) to heavy clay soil and 5 kg Zn ha<sup>-1</sup> (25 kg ZnSO<sub>4</sub>) to light textured soil are recommended. One time application of 10 kg Zn ha<sup>-1</sup> (50 kg ZnSO<sub>4</sub>) is sufficient for 6 crops giving about 10-14% more yields of crops
- Zn deficiency in standing crops can be ameliorated by 2-4 foliar applications of 0.5% ZnSO<sub>4</sub> + 0.25% lime at 10-15 days interval
- Soils deficient in both Zn and S, application of 5 kg Zn ha<sup>-1</sup> (25 kg ZnSO<sub>4</sub>) + 40 kg S ha<sup>-1</sup> (333 kg SSP) gives significant increase in yield
- Application of 5 t FYM / compost along with 5 kg Zn ha<sup>-1</sup> (25 kg ZnSO<sub>4</sub>) gives the equivalent yield to that obtained from 10 kg Zn ha<sup>-1</sup> (50 kg ZnSO<sub>4</sub>)
- Application of 1.25 kg Boron ha<sup>-1</sup> (11 kg Borex) in cauliflower is recommended for harvesting higher yields

##### AICRP on Long Term Fertilizer Experiment

- Balanced dose of fertilizers (as Urea, SSP, MOP) with FYM (15 t ha<sup>-1</sup>) improves soil fertility and sustains crop productivity in soybean-wheat (irrigated) cropping system
- Imbalanced use of fertilizers deteriorates soil health and subsequent productivity of crops



#### AINP on Soil Biodiversity & Biofertilizers

##### Soil Biodiversity of 'Haveli' fields

- Nutrient availability, enzymatic activities and soil microbial biomass carbon observed remarkably higher after release of water in 'Haveli' fields
- Maximum soil respiration detected during submergence of 'Haveli' fields



- Microbial populations declined at submergence but it increases soon after attaining favourable aerobic conditions
- Biofertilizer demonstrations : Minor millets (Kodo and Kutki) or little millet and Niger in tribal areas of Dindori significantly responded towards IPNS
- PGPR and *Rhizobium* enhance germination, nodulation, total N uptake and grain yields
- Soybean rhizobial diversity : Madhya Pradesh soils harbor either *B. japonicum* or *B. elkanii* and the fast growing species are rare



##### AICRP on Soil Test Crop Response

- Generated soil fertility maps of state
- Based on the soil test values the project has developed



equations for targeted yields towards balanced fertilizer recommendation for different crops. There are two components for recommending fertilizer doses i.e. soil test value and targeted yield level.

### Fertilizer Adjustment Equations for different crops

S.No.	Crops	Fertilizer Adjust equation
1.	Wheat	FN = 4.4 T - 0.40 SN FP <sub>2</sub> O <sub>5</sub> = 4.0 T - 5.73 SP FK <sub>2</sub> O = 2.53 T - 0.16 SK
2.	Paddy	FN = 4.25 T - 0.45 SN FP <sub>2</sub> O <sub>5</sub> = 3.55 T - 4.89 SP FK <sub>2</sub> O = 2.10 T - 0.18 SK
3.	Soybean	FN = 5.19 T - 0.48 SN FP <sub>2</sub> O <sub>5</sub> = 5.2 T - 4.1 SP FK <sub>2</sub> O = 3.9 T - 0.22 SK
4.	Gram	FN = 3.73 T - 0.18 SN FP <sub>2</sub> O <sub>5</sub> = 5.0 T - 2.5 SP FK <sub>2</sub> O = 3.8 T - 0.17 SK
5.	Pea	FN = 7.54 T - 0.76 SN FP <sub>2</sub> O <sub>5</sub> = 3.88 T - 1.51 SP FK <sub>2</sub> O = 6.33 T - 0.24 SK
6.	Mustard	FN = 9.11 T - 0.37 SN FP <sub>2</sub> O <sub>5</sub> = 3.6 T - 0.75 SP FK <sub>2</sub> O = 4.66 T - 0.13 SK

Where: FN, FP<sub>2</sub>O<sub>5</sub>, and FK<sub>2</sub>O are the fertilizer nutrient requirements (kg ha<sup>-1</sup>), T is targetted yield (q ha<sup>-1</sup>) and SN, SP and SK are available soil test values of N, P and K (kg ha<sup>-1</sup>)

### Evaluation of Soil Fertility and Fertilizer Effects in the Soybean Fields of Madhya Pradesh

- The correlation coefficient between soybean plant P uptake and available P values was found for Bray's 2 method, followed by Truog and Olsen's methods
- Improvement of extraction method is required for a better estimation of P availability in vertisol, by considering the acidification of rhizosphere



### Biofertilizer Production

#### Jawahar *Rhizobium* Biofertilizer

- Contains root nodule bacteria that fixes atmospheric nitrogen symbiotically
- Specifically useful for pulses / oil seeds / forage legumes
- Increases 10-35% grain yield



#### Jawahar *Azotobacter/Azospirillum*

- Contains free nitrogen fixing bacteria
- In addition, secretes growth promoting substances
- Useful to all crops
- Increases 10- 15% grain yield



#### Jawahar Phosphate Solubilizing Bacteria

- Possesses the ability to bring insoluble / fixed soil phosphate into soluble forms
- Useful to all crops
- Increase 10-20% grain yield



#### Jawahar *Trichoderma*

- Contains cellulose decomposing fungi
- Helps in decomposition of plant residues
- Protects the crop plants from seed and soil borne fungal diseases



#### Jawahar Blue Green Algae

- Nitrogen fixing biofertilizer for flooded rice
- In addition, secretes growth promoting substances
- Increase 10-15% grain yield

**Soil testing services :** pH, EC, OC and available major and micro nutrients (N, P, K, S, Zn, Mn, Fe and Cu) for farmers and other organizations

#### Future Thrust Areas

- Delineating areas of secondary and micro nutrient deficiencies and their influence on fertilizer use efficiency in different agroclimatic zones of the state
- Soil test crop response studies for refining fertilizer recommendations in different soil types of the state
- Maximization of fertilizer use efficiency based on soil-test values and yield target concept
- Long-term effects of balance and imbalance use of inorganic fertilizers and their integration with organic manures on crop yields and soil health
- Development of PGPR mixed consortium biofertilizers
- To provide quality biofertilizers and soil testing services to farmers
- Application of GIS/GPS in mapping the soil fertility
- Development of multi-nutrient extractant with minimum shaking time to minimize the cost, labour and time of soil testing

## EXTENSION

- Front line demonstrations : more than 200
- Field Days at farmer's field : more than 40
- Kisan Gosthi : more than 10
- Trainings for farmers mainly in tribal districts on use of biofertilizers, soil test based fertilizer application, role of micronutrients, and integrated nutrient management
- Soil testing services for the farmers
- Technical advisory service to the farmers
- Holding training programmes for the farmers towards importance of soil testing
- Participation in farmer fairs and Kisan Sangosthis, TV and Radio talks
- Supply of biofertilizers to the farming community
- Popularization and awareness about biofertilizers through field demonstrations and farmer fairs



### Use of Natural Resources and Enhanced Livelihoods under MSSRF Project

- Undertaken the programme of Bio-industrial Watershed Management: Soil Water Management, Crop Diversification & Productivity Enhancement, Post Harvest & Value Addition and Promotion of Bio-industrial & Input Services
- Construction of check dam across Bandhanala, micro watershed for checking soil erosion, siltation of eroded soil, recharging the ground water, bunding of cultivated fields, pond preparation in the field to conserve water
- Constructed 32 Bio-gas plants which benefitted about 100 families
- Technical knowledge and resource material have been made available for small scale production of various items like dona making from locally available tree leaves, cutting & tailoring and fancy bag making, value addition to seasonal fruits preparing Jam Jelly, pickles, soya products, vermicomposting etc.



## AWARDS

- Young Scientist Award : 06
- ISSS Zonal Award : 01
- Best poster award : 03
- Aryabhata award for best paper presentation to Ph.D. student (B.S. Dwivedi and A.K. Rawat)  
Dr. J.M. Dasgupta Memorial award : 01
- Bioved Young Scientist Associate Award-2013 was conferred to Dr. H.K. Rai for his outstanding contribution in Soil Science by Bioved Research Institute of Agriculture and Technology, Allahabad : 01
- DST INSPIRE fellowship to Ph.D. student : 01
- Jindal Group fellowship to M.Sc. (Ag.) student : 01
- **Fellows of Indian Society of Soil Science (FISS) :**
  - 1987 Dr. S.B. Sinha
  - 1992 Dr. Ram K. Gupta\*
  - 1998 Dr. V.S. Tomar\*
  - 1999 Dr. S.K. Banerjee
  - 2009 Dr. S.S. Tomar

\*Also Fellow of National Academy of Agricultural Sciences (FNAAS)

### Publication since last 10 years in department of Soil Science

Research papers	:	75
Review articles	:	09
Technical Bulletins	:	16
Book chapters	:	33
Manuals	:	27
Practical Manuals	:	15
Question Bank publications	:	10
Compilation of Publications	:	08
Popular articles	:	253
Phaphlets/ Folders /Tech. Folders	:	95
Papers present in seminar/workshop	:	122



## Soil fertility maps of Madhya Pradesh

