AICRP- MAIZE

**Objective**

Pantnagar is one of the 32 research centers working under AICRP- Maize, and has been engaged in maize improvement and evaluation activities since September 1961, with following objectives:

- To develop early and medium maturity composites single cross hybrids.
- To develop and diversify germplasm
- Maintenance and seed production of released hybrids and composites
- Development of agronomic practices to enhance productivity and profitability of maize
- Screening of germplasm and test entries against BLSB and BSR and development of IDM practices
- Survey and surveillance of diseases in the state
- Supporting maize farmers through technological intervention

**A. Maize Breeding**

**1. Significant achievements:**

i) Development of composite varieties

Pantnagar has its name in composite breeding. In past, about a dozen composite maize varieties have been developed and released for general cultivation by the farmers in different maize growing areas (table 1). These composite varieties of maize are highly yielding, tolerant to major diseases and adapted to different climatic conditions. Seeds of these composites have always been in high demand because of the high yield and adaptability.

**Table 1.** Composite varieties of maize developed at Pantnagar

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Variety</th>
<th>Year of release</th>
<th>Maturity (days)</th>
<th>Grain yield (Q/ha)</th>
<th>Area of adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Protina</td>
<td>1971</td>
<td>90-95</td>
<td>30-35</td>
<td>All maize growing areas</td>
</tr>
<tr>
<td>3.</td>
<td>Navin</td>
<td>1979</td>
<td>80-85</td>
<td>45-50</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1992</td>
<td>80-85</td>
<td>45-50</td>
<td>Himanchal Pradesh</td>
</tr>
<tr>
<td>5.</td>
<td>Kanchan</td>
<td>1982</td>
<td>75-80</td>
<td>45-50</td>
<td>Uttar Pradesh</td>
</tr>
<tr>
<td>6.</td>
<td>D-765</td>
<td>1984</td>
<td>75-80</td>
<td>35-40</td>
<td>Across the country</td>
</tr>
<tr>
<td>7.</td>
<td>Surya</td>
<td>1988</td>
<td>75-80</td>
<td>35-40</td>
<td>Across the country</td>
</tr>
<tr>
<td>8.</td>
<td>Gaurav</td>
<td>1999</td>
<td>80-85</td>
<td>40-45</td>
<td>North- western plains of Punjab, Delhi, Haryana &amp; Uttar Pradesh</td>
</tr>
</tbody>
</table>
ii. Maize hybrid development (Early)

With the change in seed production and supply chain and awareness about the hybrids, development of maize hybrid was initiated since 1997. After the development of inbred lines of maize, crosses were made to identify promising high yielding single cross hybrids of maize for further boosting production and productivity of maize and also increasing farmer’s income. Pant Sankar Makka-1, Pant Sankar Makka-2 and Pant Sankar Makka-4 were developed after testing in multilocation trials for cultivation in Uttarakhand.

iii) Development of medium maturity maize hybrids DH-291, DH-296 and DH-300

Maize has now become more of an industrial crop. Because of increasing industrial uses and backbone of ever increasing poultry industry, maize demand is increasing day by day at a faster rate. Maize production and productivity enhancement through deployment of medium maturity heterotic hybrids is one of the rewarding options. To ensure the availability of potential maize hybrids to farmers for maximizing productivity and production, research work on development of medium maturity germplasm and high yielding hybrids were initiated by the University. In a short period of time three hybrids having potential of 65-70 q/ha grain yield have been identified based on the multi-location evaluation trials. In addition to high grain yield potential, these hybrids were also possessing high starch (73%), bold grain (desirable for industrial processing) and other quality parameters, and based on these parameters three hybrids namely DH-291, DH-296 and DH-300 were grouped as ‘Grade A’ by a major industry Roquette Ridhi-Sidhi, Sidcul Rudrapur.

iv) Development of popcorn hybrid DPCH-306

A popcorn hybrid developed at Pantnagar and evaluated across the country in All India Maize Evaluation trial for three years was identified by Variety Identification Committee of ICAR for release. DPCH-306 has been recommended for release in Northern Hill Zone (Zone I) includes Jammu & Kashmir, Himachal Pradesh, Uttarakhand (Hills) and NE Hill Region (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura), and PZ (Zone IV) includes Tamil Nadu, Karnataka,
Andhra Pradesh, Telangana, Maharashtra. It has high yield potential of 3975 kg/ha in Zone-I and 4997 kg/ha in Zone-IV exhibiting yield superiority of 34.79% to 22.53%, respectively over the best existing variety.

v) Diversification of maize germplasm

Pantnagar centre took lead in diversification and enhancement of maize germplasm using wild relative and most probable progenitor of maize teosinte (*Zea mays ssp parviglumis*) (Fig. 1.). Crosses and back crosses were to develop mapping populations for mapping of QTLs related with biotic and abiotic stresses. Teosinte has also been used in development of inbred lines with tolerance different biotic and abiotic stresses and also in development of specialty maize.

vi) Registration of varieties under PPV & FRA

Six varieties have been registered with PPV and FRA. (Table 3)

vii) Pantnagar Maize programme contributing 6-7 experimental hybrids/varieties each year for testing in All India Coordinated Maize evaluation trials.

viii) Pantnagar Maize programme also contributing 7-8 experimental hybrids/varieties each year for testing in SVT (plains) and SVT (Hills).

ix) Every year 150-200 new experimental hybrids are being developed and evaluated in Station trials and promising hybrids are promoted for testing in Coordinated maize trials across the zones.

x) All the populations including landraces, pools and

---

Fig. 1 Use of teosinte (*Zea mays ssp parviglumis*) in maize improvement programme.
released varieties are being maintained using maintenance breeding approaches for nucleus seed production and multiplication.

xi) Approximately 220 inbred lines of indigenous and exotic inbred lines are maintained through controlled pollination.

xii) Population derived from crossing between maize and teosinte are being advanced.

xiii) Winter Maize Nursery, IIMR, Hybderabad is being used for advancing the generation and seed multiplication of experimental hybrids under test along with their parental lines.

xiv) All station, zonal, coordinated and international (CIMMYT) trials (approximately 20-22 trials) are conducted in both kharif and rabi crop seasons.

xv) Complying with DAC indent and centre is breeder seed of composite varieties and CM lines.

xvi) The thesis research experiments of PG (M.Sc. and Ph.D.) students are conducted during both the crop seasons as usual. The materials developed and the results obtained from these experiments are utilized in the on—going breeding programme.

xvii) Research activities on sweet corn and popcorn are also in progress here at this station.

2. Research publications:


3. Thesis Research:


19. Pheru Singh. 1979. Inheritance studies on stalk rot caused by Erwinia pathotype zea in maize submitted for Ph. D. to GBPUAT under supervision of Dr. V.L. Asnani.


of maize submitted for Ph. D. to GBPUAT under supervision of Dr. B.D. Agarwal.

33. O.S. Kanwar. 1986. A study on genotypic and environmental correlation and combining ability in maize submitted for M. Sc. to GBPUAT under supervision of Dr. B.D. Agarwal.


35. J.K Roy 1990. Studies on evaluation of inbred lines from four sources for top cross performance in maize submitted for M. Sc. to GBPUAT under supervision of Dr. MZK Warsi.


41. K.P.S. Tomar. 1995 Line x Tesyer analysis in maize (Zea mays L.) submitted for M. Sc. to GBPUAT under supervision of Dr. MZK Warsi.

42. Saurabh Banerjee. 1996. Studies on combining ability of local varieties of maize submitted for M. Sc. to GBPUAT under supervision of Dr. MZK Warsi.

43. Sanjeev Kumar. 1996. Efficacy of s1 family selection for improvement of two populations of maize submitted for M. Sc. to GBPUAT under supervision of Dr. S. S. Verma.

44. Amajit Mukherjee. 1997. Line x Tester analysis for certain agronomic traits in early maturing inbred lines of maize submitted for M. Sc. to GBPUAT under supervision of Dr. MZK Warsi.

45. S. K. Bhatt. 1998. Genetics of resistance to Erwinia stalk rot and certain other quantitative traits in maize (Zea mays L.) submitted for Ph. D. to GBPUAT under supervision of Dr. S. N. Mishra.


47. K. Pradhan. 1999. Classification and characterization of inbred lines of maize (Zea mays L.) submitted for Ph. D. to GBPUAT under supervision of Dr. S. N. Mishra.

48. Shailesh Tripathi. 2000. Studies on screening of inbred lines for water logging tolerance in maize submitted for M. Sc. to GBPUAT under supervision of Dr. MZK Warsi.


52. K.P.S. Tomar. 2002. Studies of heterosis, combining ability and phenotypic stability analysis involving indigenous and exotic inbred lines of maize (Zea mays L.) submitted for Ph. D.

V.K. Tiwari. 2003. Studies on heterosis, combining ability, inbreeding tolerance and phenotypic stability in intra- and inter-group single cross hybrids of maize (Zea mays L.) submitted for Ph. D. to GBPUAT under supervision of Dr. I.S. Singh


A.A. Lone. 2005. Genetic studies on excess soil moisture tolerance in maize submitted for Ph. D. to GBPUAT under supervision of Dr. MZK Warsi.

V.K. Yadav. 2005. Distinctness, Uniformity and stability (DUS) testing of maize (Zea mays L.) inbred lines using morphological and molecular markers submitted for Ph. D. to GBPUAT under supervision of Dr. I.S. Singh.

S. Alamerew. 2007. Genetic studies on low nitrogen tolerance in maize (Zea mays L.) submitted for Ph. D. to GBPUAT under supervision of Dr. MZK Warsi.

Preeti Massey. 2008. Studies on development of abiotic stress tolerant hybrids in maize submitted for P.D. to GBPUAT under supervision of Dr. MZK Warsi.


Seema Sat. 2008. Line x Tester analysis in maize (Zea mays L.) submitted for M. Sc. to GBPUAT under supervision of Dr. D.C. Baskheti


Arvind Kumar. 2009. Studies on genetic components of variance under low nitrogen and drought conditions in maize (Zea mays L.) submitted for Ph. D. to GBPUAT under supervision of Dr. MZK Warsi.


Abhijeet Kumar. 2010. Molecular and morphological characterization of short duration inbred lines of maize (Zea mays L.)


Kamal Pandey. 2010. Combining ability and heterosis analysis for grain yield and its components in exotic inbred lines of maize (Zea mays L.) submitted for Ph. D. to GBPUAT under supervision of Dr. S. S. Verma.


Chandana Behera. 2011. Studies on molecular diversity in short duration inbred lines of maize
submitted for M. Sc. to GBPUAT under supervision of Dr. N. K. Singh.


76. Pooja Devi. 2012. Combining ability, heterosis and genotype x environment interaction in tropical maize (Zea mays L.) under heat stress and the optimal environment submitted for Ph. D. to GBPUAT under supervision of Dr. S.S. Verma.


81. P.S. Holiyachi. 2014. Estimation of combining ability, heterosis and variability for grain yield and other characters under two plant population density environments in maize submitted for Ph. D. to GBPUAT under supervision of Dr. S.S. Verma.

82. E. Lama Laxmi. 2014. Combining ability and heterosis analysis for yield and contributing traits under two plant densities and assessment of molecular diversity in maize (Zea mays L.) submitted for Ph. D. to GBPUAT under supervision of Dr. S.S. Verma.


84. Mahak Tufchi. 2014. Marker assisted conversion of normal maize into quality protein maize submitted for Ph. D. to GBPUAT under supervision of Dr. N. K. Singh.

85. Rashmi. 2014. Marker based genotyping of Lcy and CrtRB1 loci in maize (Zea mays L.) submitted for M. Sc. to GBPUAT under supervision of Dr. S.S. Verma.

86. Mrinal Shastry. 2015. Determining behavior of inbred lines of maize (Zea mays L.) over different environmental conditions submitted for M. Sc. to GBPUAT under supervision of Dr. N. K. Singh.


88. Manisha Negi. 2015. Genetic analysis and effect of seed quality on yield and its attributes in single cross hybrid of maize (Zea mays L.) submitted for Ph. D. to GBPUAT under supervision of Dr. D.C. Baskheti.
89. Manjeet Kumar. 2015. Studies on molecular diversity of parental lines, combining ability, heterosis across the environments in maize (*Zea mays* L.) submitted for Ph. D. to GBPUAT under supervision of Dr. S.S. Verma.

90. Himanki Dabral. 2016. Effect of plant densities on genetic parameters related to yield associated traits and molecular diversity in maize (*Zea mays* L.) submitted for Ph. D. to GBPUAT under supervision of Dr. D.C. Baskheti.


4. **Future Thrusts:**

1. Development high yielding medium maturity maize hybrids for plain areas whereas as early maturing hybrids for hilly areas of the Uttarakhand.

2. Focused approach on pre-breeding using wild relatives of maize for diversification of maize germplasm and also for domestication of wild adaptive alleles.

3. Development of potential inbred lines having biotic and abiotic stress tolerance.

4. Diversification and development of specialty corn parental lines for exploitation on hybrid breeding programme.

5. Development of seed production packages and seed production of promising hybrids.

6. Focused research on development of inbred lines and hybrids adapted to spring season.

7. Multi-institutional collaborative efforts involving ICAR institutes, CIMMYT and Universities for development of maize germplasm for management of Fall Army Worm.

8. Integration of markers in mapping and precise selection of desirable alleles.

**B. Maize Agronomy**

1. **Significant Achievements:**

1. During past > 50 years, large number of varieties and hybrids were evaluated under low, optimum and high nutrient management conditions and several varieties of maize have been released and adopted by farmers for cultivation.

2. Optimum plant population is 66 - 75 thousand plants/ha. Row to row spacing 60 cm with plant to plant spacing is 25 cm or row to row spacing 75 cm with plant to plant spacing is 20 cm.

3. Seed rate for composite varieties is 15-18 kg/ha and for hybrids 18-25 kg/ha.

4. An advanced sowing of late maturing hybrid, normal sowing of medium maturing hybrid and delayed sowing of early maturing hybrid may be adopted for higher grain yield and net return.

5. Sowing of maize can be advanced or delayed up to 10 days from normal date of sowing without significant reduction in yield.

6. Seed treatment with ZnO nano particles or TiO$_2$ nano particles at 0.01 % is helpful in improving seedling vigour.

7. Baby corn may be sown at spacing 45 × 20 cm.
8. Row spacing for no till maize is 45 cm with 90,000 plants/ha.

9. Optimum plant population for hybrid maize is 75 thousands/ha.

10. Maize seed may be treated with Azotobacter to improve yield.

11. For seed production of single cross hybrid maintain 4:1 female : male rows ratio.

12. A dose of 120 kg N, 60 kg \( P_2O_5 \) and 40 kg \( K_2O/ha \) is required. Zinc sulphate @ 20-25 kg/ha should be used in zinc deficient areas.

13. Apply fertilizers 5 cm side to the seed and 3-5 cm below the seed.

14. Nitrogen applied in five splits at 20% basal, 25% at 4-leaf stage, 30% at 8-leaf stage, 20% at tassel emergence and remaining 5% at early grain filling stage produced higher yield and net returns.

15. Apply 180 kg N, 60 kg \( P_2O_5 \) and 40 kg \( K_2O/ha \) for baby corn.

16. Hybrid maize responded to 200:75:75 kg N: \( P_2O_5 : K_2O/ha \).

17. Inbred lines responded to 200 kg N, 75 kg \( P_2O_5 \) and 75 kg \( K_2O/ha \).

18. Lysine and tryptophan content in grain of quality protein maize (HQPM-1) remain unaffected by either organic or inorganic mode of nutrition.

19. The 50% of the inorganic fertilizers dose may be replaced by vermicompost in quality protein maize.

20. Application of 187.5 kg N, 75 kg \( P_2O_5 \) and 50 kg \( K_2O/ha \) is optimum for higher productivity of sweet corn.

21. Apply 200 kg N, 75 kg \( P_2O_5 \) and 75 kg \( K_2O/ha \) for seed production of single cross hybrid.

22. After 4 years of study, in maize-wheat–mungbean/cowpea cropping system conventional tillage produced significantly highest maize equivalent yield but net return of the system remained at par among conventional tillage, zero tillage and permanent bed system. Crops fertilized with 100% RDF (120:60:40 kg N-\( P_2O_5 \)-K\( _2O/ha \) in maize and 150:60:40 kg N-\( P_2O_5 \)-K\( _2O/ha \) in wheat) being at par with SSNM (120:10:46 kg N-\( P_2O_5 \)-K\( _2O/ha \) in maize and 110:15:64 kg N-\( P_2O_5 \)-K\( _2O/ha \) in wheat) produced significantly more net return than farmer’s practice (93:64:32 kg N-\( P_2O_5 \)-K\( _2O/ha \) in maize and 116:64:32 kg N-\( P_2O_5 \)-K\( _2O/ha \) in wheat).

23. Soil analysis after four year completion of maize-wheat–mungbean/cowpea cropping system revealed that organic carbon, available N and available P were significantly more in zero tillage than conventional tillage but remained at par with permanent bed system. Available K, soil pH and bulk density did not differ significantly due to different tillage treatments.

24. Full maturity hybrid maize (planted at geometry 67.5 cm x 15 cm, 98700 plants/ha and 67.5 cm x 20 cm, 74000 plants/ha) fertilized with STCR (212:106:87 kg N-\( P_2O_5 \)-K\( _2O/ha \)) produced significantly highest grain yield and gross return but net return and B:C ratio did not differ significantly from RDF (120:60:40 kg N-\( P_2O_5 \)-K\( _2O/ha \)) and SSNM (120:30:46 kg N-\( P_2O_5 \)-K\( _2O/ha \)). Residual fertility effect was not noticed in succeeding wheat crop.

25. Flowering stage is the most critical stage for irrigation. Drainage is must in maize. Water stagnation for is harmful. Early stage of crop is very sensitive to water stagnation.

26. Two to three hand weeding is sufficient.

27. Atrazine @ 0.75-1.00 kg a.i./ha or Alachlor @ 2.0 kg a.i./ha or Pendimethalin @ 1.0 kg a.i./ha should apply just after sowing or before germination of weeds.

28. In maize + legume intercropping system, apply Alachlor @ 2.0 kg a.i./ha just after sowing or before germination of weeds.

29. In no till maize 2 hand weeding at 20 and 40 days after sowing or application of paraquat @ 0.75 kg a.i./ha at 30 days after sowing is effective.
30. Application of Atrazine @ 1.0 kg a.i./ha (Pre emergence) followed by 2,4-DEE @ 0.1 kg a.i./ha (Post emergence) was found the most effective and was comparable to weed free condition. Herbicides atrazine, metribuzine, alachlor, glyphosate and 2, 4-DEE applied in preceding maize crop did not have their residual phyto-toxic effect on succeeding wheat crop.

31. Post emergence herbicide Tembotrione @ 120 g a.i./ha can be used in maize 25 days after sowing for effective weed control without residual toxic effect on succeeding wheat crop.

32. Application of nano ZnO or nano TiO$_2$ either through seed treatment or foliar spray increased maize grain yield. Nano particles at concentration of 0.01% were more effective to enhance growth and productivity. To fetch more net return seed treatment with TiO$_2$ at 0.01% concentration is a viable option.

33. Maize + legumes (soybean, groundnut and urdbean) intercropping system provides 40-50% nitrogen requirement of maize. This beneficial effect is more pronounced under low fertility soil or low fertilizer application condition. This system also has good effect on succeeding wheat crop.

34. The rotation of maize with rabi pulses, lentil and chickpea saved 30 kg nitrogen/ha for maize and was economically profitable.

35. Maize + soybean- wheat, maize - maize + toria, Maize- mustard - mungbean, maize –toria - wheat and maize-potato-wheat are profitable cropping system.

36. Maintain 55-60 thousands plants of maize for intercropping with legumes.

37. Intercropping of two rows of groundnut in paired row maize (45/90 cm) is more profitable compared to intercropping of mungbean, urdbean, cowpea and soybean.

38. Paired row maize (45/90 cm) is advantageous for intercropping of urdbean in 2+2 row ratio as compared to intercropping of one row of urdbean between two rows of maize (67.5 cm apart).

There is saving of 30 kg N/ha in maize with urdbean intercropping. Furrow placement of fertilizer gave the maximum maize grain equivalent yield and earned more net return than broadcast application.

39. In maize-wheat-mungbean cropping system, mungbean is not profitable due to poor seed setting.

40. The optimum plant population for rabi maize is 80 thousands/ha and row distance is 60 cm.

41. A dose of 150 kg N, 60 kg P$_2$O$_5$ and 40 kg K$_2$O/ha is required for rabi maize.

42. Irrigate the rabi maize at IW/CPE ratio of 1.0 and maintain depth of irrigation 6.0 cm.

43. A 50% tassel removal in rabi maize is advantageous.

44. Application of nitrogen as 20% at basal, 20% prior to knee height, 40% at knee height and 20% at tasseling stage is ideal to get maximum productivity, nitrogen use efficiency and profit.

45. Mechanized earthing with band placement of urea by Pant Fertilizer Band placement cum Earthing machine is helpful for obtaining higher productivity and profitability of maize in rabi season.

46. Spring maize is not compatible in replacement manner either with sunflower or urdbean in spring season. Maize + urdbean (1+1) additive system had significantly higher production efficiency, more utilization of land and yield advantage.

47. Ridge planting technique with irrigation scheduling at 75 mm CPE with 6 cm depth is profitable for sweet corn in spring season.

48. In spring season Quality protein maize (QPM) may be grown at plant density of 83,333 plants/ha and with the application of 120:60:40 kg N:P$_2$O$_5$:K$_2$O/ha.

49. A dose of 120 kg N, 60 kg P$_2$O$_5$ and 40 kg K$_2$O/ha along with 5 t FYM/ha is optimum for sweet corn in spring season.

50. In spring season, application of rice straw mulch
@ 5 t/ha after 2nd irrigation is effective in increasing productivity, net return and irrigation water use efficiency.

2. Research Publications:


3. Thesis Research:

1. G. G. Robinson. 1965. Response of three hybrids and one open pollinated variety of maize to different rates of nitrogen submitted for M.Sc. to GBPUAT

2. P. C. Gupta. 1965. Effect of four plant populations and five rates of nitrogen fertilization on the performance of hybrids maize (Ganga safed hybrid makka-2) submitted for M.Sc. to GBPUAT


4. R. K. Pandey. 1966. Response of three hybrids and one open pollinated variety of maize to different rates of nitrogen submitted for M.Sc. to GBPUAT

5. K. N. Arora. 1967. Studies on the effect of levels and sources of nitrogen on hybrids maize (Ganga hybrid makka-3) submitted for M.Sc. to GBPUAT

6. N. P. Singh. 1967. Response of hybrids maize to nitrogen, phosphate and potash submitted for M.Sc. to GBPUAT


8. Tajuddin. 1968. Study of the associated growth of maize and soybean submitted for M.Sc. to GBPUAT


of spring planted maize submitted for M.Sc. to GBPUAT


12. P. N. Choudhary. 1971. Response of maize germplasms to different levels of nitrogen submitted for M.Sc. to GBPUAT


15. P. Rungchang. 1972. Effect of different rates on nitrogen and plant population on five germplasms of maize submitted for M.Sc. to GBPUAT under supervision of Dr. K. C. Sharma


28. V. P. Sharma. 1975. Studies on the effectiveness of slow release nitrogenous fertilizers and nitrification retarders in maize submitted for M.Sc. to GBPUAT


32. Vimal Kishor. 1981. Influence of source and sink size on grain yield of maize submitted for M.Sc. to GBPUAT

34. M. M. Pandey. 1982. Effect of Zn reinforced super phosphate on paddy and maize in the silt loam soils of Pantnagar submitted for M.Sc. to GBPUAT

35. Rishipal Singh. 1982. In-vitro and in-vivo studies on controlled release of N fertilizers and inhibitors in maize submitted for Ph.D. to GBPUAT

36. N. Bahadur. 1982. Nitrogen and plant population studies in pure and legume intercropping system of maize cultivation submitted for Ph.D. to GBPUAT


38. D. P. Singh. 1984. Efficiency of certain herbicides on weed control in maize and their toxicity estimation by bioassay submitted for M.Sc. to GBPUAT


40. R. C. Joshi. 1985. Effect of weed control measures and levels of nitrogen on maize and associated weeds submitted for M.Sc. to GBPUAT under supervision of

41. S. K. Tripathi. 1985. Studies on the direct effect of manuring in maize and residual effect on wheat submitted for Ph.D. to GBPUAT

42. Sahish Kumar. 1987. Management studies in maize-legume intercropping system submitted for M.Sc. to GBPUAT

43. Sandeep Garg. 1988. Effect of nitrogen levels and seed rates on yield and quality of fodder maize submitted for M.Sc. to GBPUAT under supervision of Dr. J. S. Khokhar

44. Hari Shankar Kushwaha. 1988. Flooding studies in maize culture submitted for M.Sc. to GBPUAT under supervision of Dr. R. P. Singh


46. Mahesh Kumar Kushik. 1988. Nitrogen economy in maize culture through legume submitted for Ph.D. to GBPUAT

47. Ahmed Fazeel. 1989. Effect of nitrogen rate and tassel removal on growth, and productivity of maize submitted for M.Sc. to GBPUAT under supervision of Dr. R. C. Gautam


49. Deonath Yadav. 1990. Growth and productivity of maize under different crop sequences and nitrogen rates submitted for Ph.D. to GBPUAT

50. S. I. Halikatti. 1990. Effect of mulch and intercropping grain legumes with maize on soil conservation and crop productivity submitted for Ph.D. to GBPUAT

51. S. P. Singh. 1990. Productivity and economics of maize based crop sequences and their effects on soil fertility in sandy soil of Western Uttar Pradesh submitted for Ph.D. to GBPUAT

52. Jojee Philipp. 1991. Effect of plant population and tassel removal on growth and productivity of maize submitted for M.Sc. to GBPUAT under supervision of Dr. R. C. Gautam

53. Prabal Kumar. 1991. Leaf removal studies in maize culture submitted for M.Sc. to GBPUAT under supervision of Dr. R. P. Singh

54. A. Bhattacharyya. 1991. Intercropping studies in maize at different nitrogen rates submitted for M.Sc. to GBPUAT under supervision of Dr. R. C. Gautam

nitrogen submitted for M.Sc. to GBPUAT under supervision of Dr. R. C. Gautam


57. P. K. Ghosh. 1992. Performance of maize under varying levels of nitrogen and preceding crop submitted for Ph.D. to GBPUAT

58. D. Chandra. 1993. Performance of maize varieties at varying plant densities submitted for M.Sc. to GBPUAT under supervision of Dr. R. C. Gautam

59. A.K. Bishnoi. 1993. Effect of flooding on maize sown at different dates submitted for M.Sc. to GBPUAT under supervision of Dr. R. P. Singh

60. Hari Shankar Kushwaha. 1994. Nitrogen requirement of soybean+maize and soybean+Sorghum inter-cropping system in Mollisols of Nainital submitted for Ph.D. to GBPUAT


62. Puneet Pachauri. 1995. Response of winter maize to irrigation schedule and tassel removal densities submitted for M.Sc. to GBPUAT under supervision of Dr. R. C. Gautam

63. Y. S. Shivay. 1995. Studies on nitrogen requirement of maize based intercropping system submitted for Ph.D. to GBPUAT

64. Arvind Kumar. 1996. Effect of nitrogen levels and row spacing on growth, yield and quality of fodder maize submitted for M.Sc. to GBPUAT under supervision of Dr. S. S. Verma

65. Saurbh Verma. 2000. Effect of herbicides on maize + cowpea for fodder and their associated weeds submitted for M.Sc. to GBPUAT under supervision of Dr. Ram Prasad


68. Prakash Singh Shakhawat. 2001. Effect of row spacing and weed control methods on growth and productivity of maize (Zea mays L.) under tilled and untilled conditions submitted for Ph.D. to GBPUAT

69. Vijay Singh. 2003. Effect of intra row-spacing and nitrogen levels on yield of double cross maize hybrids submitted for M.Sc. to GBPUAT under supervision of Dr. S. K. Tripathi


72. Kuldeep Kumar. 2006. Effect of nitrogen levels and seed rates on growth, yield and quality of fodder maize submitted for M.Sc. to GBPUAT under supervision of Dr. Y. P. Joshi

73. Amit Painyali. 2010. Effect of irrigation and planting techniques on productivity and economics of sweet corn (Zea mays) submitted for M.Sc. To GBPUAT under supervision of Dr. M. S. Pal


75. Kusum Lata. 2012. Effect of planting geometry and nitrogen on quality production of baby corn (Zea mays L.) submitted for M.Sc. To GBPUAT under supervision of Dr. M. S. Pal

76. Amol Kantilal Babar. 2013. Studies of metal nano particles on growth and productivity of maize (Zea
77. Vinod Kumar Joshi. 2014. Studies on crop establishment and moisture management practices in spring maize (Zea Mays L.) submitted for M.Sc. To GBPUAT

78. Jayant Kumar Singh. 2014. Studies on integrated nutrient management in sweet corn (Zea mays saccharata) submitted for M.Sc. to GBPUAT under supervision of Dr. Amit Bhatnagar

79. Dilkhush Meena. 2014. Effect of planting geometry and nutrient management on quality production of baby corn (Zea mays L.) submitted for M.Sc. to GBPUAT

80. Deepak Pandey. 2015. Nitrogen management in maize based legume intercropping system submitted for M.Sc. to GBPUAT under supervision of Dr. Amit Bhatnagar

81. Meenakshi. 2015. Performance of maize (zea mays L.) and associated weeds under different herbicides schedule submitted for M.Sc. to GBPUAT under supervision of Dr. Naresh Malik

82. Garima Joshi. 2016. Integrated nutrient management in baby corn submitted for M.Sc. to GBPUAT under supervision of Dr. M. S. Pal

83. Yash Pal. 2016. Drip fertigation study in spring maize (Zea mays L.) submitted for M.Sc. to GBPUAT

84. Ajay K. Prabhaker. 2016. Influence of planting pattern and weed management on the performance of component crops in maize + urd bean intercropping system submitted for Ph.D. to GBPUAT under supervision of Dr. submitted for Ph.D. to GBPUAT under supervision of Dr. V. K. Singh

85. Amarendra Kumar. 2016. Effect of tillage and Nutrient management on productivity, profitability and resource use efficiency of maize-wheat cropping system submitted for Ph.D. to GBPUAT under supervision of Dr. submitted for Ph.D. to GBPUAT under supervision of Dr. M. S. Pal

86. Prithwiraj Dey. 2018. Weed management option for spring sweet corn (Zea mays L. var. saccharata) submitted for M.Sc. to GBPUAT under supervision of Dr. Tej Pratap

87. Shraddhanjali Dehury. 2018. Sowing dates and different mulching study in sweet corn (Zea mays L. var. saccharata) in spring season submitted for M.Sc. to GBPUAT under supervision of Dr. Amit Bhatnagar.

4. Future Thrusts:

1. Possibilities of sweet corn and baby corn production in different seasons to improve economy of the farmers.

2. Enhancement of nutrient use efficiency in different types of corn.

3. Plant establishment methods for a better rhizosphere.

4. Combating deficit moisture stress in green cob crop during spring season.

5. Mitigating excess moisture stress in kharif season.

C. Maize Soil Science:

1. Significant Achievements:

Excess soil moisture in maize

During the past 40 years, more than thousand entries from coordinated trials were screened and characterized under excess soil moisture/water logging conditions at knee high stage. Under the condition of continuous seven days ponding of water, crop is found to be completely damaged within three days if the sky is clear however, there is no damage till 12 days if the sky is not clear or temperature is low. Early stage of crop is more prone to waterlogged than the later stage. However, knee high and tassel stages are more prone to the waterlogging as compared to other stages.

Under prolonged ponding of water, there was reduction of 40.7 and 39.0% nitrogen and potash in crop leaves, respectively, however phosphorus increased to 57.1% than normal condition. Yield was reduced to 42.1, 34.3, 28.4 and 16.6% in late, medium, early and extra early maturity, respectively,
under waterlogged condition than normal condition. It reveals that extra early maturity group is more prone to waterlogged condition.

Developed a maize variety “Pragati” in 2003 in association with maize breeders suitable for growing in waterlogged areas of Eastern U.P., Bihar, Jharkhand, Orissa and West Bengal.

Conservation agriculture

During three years, reexperiment, raised bed with or without residue conservation could substitute for conventional tillage method on Mollisols of tarai region in maize and soil fertility. However zero tillage and permanent bed system are equally effective to conventional tillage in maize-wheat system in long run. Overall, raised fresh beds had been observed superior in terms of yield deciding factors and yield over other tillage pratices. But zero tillage favours the saving of irrigation water followed by residue conservation. Zero tillage significantly increase the bulk density over the conventional tillage system under the continuous maize based cropping system. However, no significant effect was observed on pH and EC under various tillage systems.

Site Specific Nurtient Management

In 3 years maize-wheat rotation, SSNM based on Nutrient Expert Software resulted 15.8% more grain yield over 100% RDF(120:60:40: N:P:K), while in succeeding wheat crop highest grain yield of wheat 42.02 q/ha was obtained at SSNM (N-130, P2O5 – 33, K2O -55 kg/ha) in HQPM-1 plot. Hybrids PMH-1 gave the highest grain yield (62.7 q/ha) with 120:55:55 N:P:K Kg/ha calculated based on Nutrient Expert Software over other hybrids.

Nutrient mangement based on leaf colour chart

In 2 years study on nutrient management based on leaf colour chart (LCC) of < 3.0 with 90 kg N resulted in equivalent yield and saved 30–60 kg N/ha to that of N applied at 120 and 150 kg at fixed time intervals. Usefulness of LCC threshold value of 5.0 during vegetative growth stage had been found optimal for obtaining higher grain yield and saving of N. The critical levels below which grain yield of maize and agronomic efficiency loss occurred owing to shortage of N seems to be 4.6 and 4.5 for vegetative stage and 4.9 and 4.8 for reproductive stage, respectively.

Organic maize production

Continuous application of recommended dose of N, P and K through chemical fertilizers along with farm yard manure 5 t ha⁻¹ brought out a marked increase in productivity and nutrient uptake by maize and wheat as well as beneficial for the enhancing the soil organic carbon content and sequestration and maintaining soil health in maize-wheat rotation in mollisols hence may be the best option for higher crop yields. Intercropping of cowpea with maize crop is not suitable as it reduced the grain yield of maize however may be beneficial for succeeding wheat crop as it increased the grain yield of wheat by improving the soil organic carbon content in the soil. Incorporation of farm yard manure @ 5 t ha⁻¹ along with half dose of recommended nutrients in maize crop accomplished grain yield at par with sole application of full dose of nutrients for both the crops hence may be more sustainable. Use of half dose of recommended nutrients, state practice (farm yard manure @ 5 t ha⁻¹) and control led to reduction in the crop yields and SOC sequestration rate.

Zn and P applications in maize

In conclusion, application of P up to 60 kg/ha and Zn up to 10 kg/ha in general, increased the P and Zn uptake by maize, therefore, combination of P 60kg/ha and Zn 10 kg/ha appears to be the best for obtaining the higher maize productivity and maintaining the fertility. Phosphorus application at higher level (90 kg/ha) did harm the Zn status in soil as well as in plant in Zn deficient soil, however Zn @ 15kg/ha found to be beneficial and can be applied. Quality assessing parameters viz., protein, tryptophan and lysine contents were found to be increased significantly with increase in P and Zn levels.

2. Research Publications:


3. Thesis Research:

1. Poonam Gangola. 2016. Soil test crop response studies in french bean (Phaseolus vulgaris L.)—maize (Zea mays L.) cropping sequence submitted for Ph.D. to GBPUAT under supervision of Dr. Poonam Gautam

2. Rakesh Joshi. 2015. Effect of soil compaction and fertilizer placement on growth, yield and nutrient uptake by hybrid maize (Zea mays L.) submitted for M. Sc. to GBPUAT under supervision of Dr. Veer Singh

3. Abhishek Kumar. 2013. Effect of P and Zn interactions on growth, yield, nutrient uptake and quality of maize (HQPM-1) grown in mollisol submitted for M. Sc. to GBPUAT under

4. Megha Joshi. 2010. Effect of Zinc and phosphorus levels on dry matter yield, uptake and utilization of $^{65}$Zn, B, maize in mollisol submitted for M. Sc. to GBPUAT under supervision of Dr. Shri Ram

6. Ashutosh Singh. 2010. Effect of INM in pigeon pea based intercropping system on soil properties, growth and yield of pigeon pea, black gram, maize on mollisols of the Tarai region submitted for Ph.D. to GBPUAT under supervision of Dr. H.S. Mishra


10. Sandeep Upadhyay. 2005. Studies on integrated nutrient management (INM) in maize submitted for M. Sc. to GBPUAT under supervision of Dr. H.N. Singh

11. Vinod Kumar. 2002. Studies on integrated plant nutrient supply system for maize intercropping with urd under maize-wheat cropping system in Tarai region of Uttaranchal submitted for M. Sc. to GBPUAT under supervision of Dr. Narendra Kumar


14. Debashish Mandal. 1994. Forms of sulphur in tarai and bhabhar and sulphur content and yield of wheat and maize under different doses of fertilizer submitted for M. Sc. to GBPUAT under supervision of Dr. Room Singh

15. B. P. Singh. 1990. Effect of water logging on nutrient uptake and growth of maize germplasm submitted for M. Sc. to GBPUAT under supervision of Dr. T.R. Rathore


18. K. P. Sharma. 1985. Effect of flooding at different stages of development on the growth and praline content of maize verities submitted for M. Sc. to GBPUAT under supervision of Dr. T.R. Rathore


22. M. Singh. 1979. Effect of plant population, N level, excess soil moisture and temperature on growth of maize submitted for M. Sc. to GBPUAT under supervision of Dr. T.A. Singh
23. B. S. Mehara. 1979. Effect of carbonates and boron availability to maize and its fixation in soil submitted for M. Sc. to GBPUAT under supervision of Dr. M. S. Gangwar

24. Dilip Kumar. 1977. Studies on zinc retention in cultivated and forest soils of tarai and its effect on zinc uptake by maize submitted for M. Sc. to GBPUAT under supervision of Dr. M. S. Gangwar


27. M.V.S murthy. 1972. Soil moisture extracting pattern in maize crop submitted for M. Sc. to GBPUAT under supervision of Dr. B. P. Ghildyal

28. V. K. Bhatnagar. 1965. Effect of soil compaction and fertility levels on soil properties and performance of hybrid maize submitted for Ph.D. to GBPUAT under supervision of Dr. S. C. Modgal


4. Future Thrusts:

1. Development and refinements of site specific nutrient management practices for new high yielding varieties of maize.

2. Enhancement of nutrient use efficiency in different types of corn under normal and waterlogged condition in tarai region.

3. Development of effective soil management practices in maize through resource conservation technique for combating moisture stress.

4. Evaluation and enhancement of soil quality and health under maize based cropping system.

5. Evaluation of biofertilizers in maize under maize-wheat rotation

D. Maize Pathology:

1. Significant achievements:

1.1 Screening of germplasm

Resistant Lines were identified against Bacterial Stalk Rot, Banded Leaf and Sheath Blight and Brown Strip Downy Mildew.

1.2 Disease Management

General

1. If farmer wishes to use their own seed then seeds should be treated with Tiram or Captan (2 gm/kg) before sowing.

2. Neem cake soil application provided maximum germination and suppressed the seed & seedling rots.

3. Sowing at the end of June may avoid effect of different diseases.

Management of Bacterial Stalk Rot

1. Developed artificial inoculation technique for field screening of maize germplasm against bacterial stalk rot

2. Worked out epidemiology of the stalk rot of maize under tarai condition of Uttar Pradesh

3. For management of Bacterial stalk rot of maize soil application of bleaching powder @ 25 kg/ha at the time of flowering followed by second application after 10 – 12 days.

4. For the management of bacterial stalk rot application of bleaching powder (3%) @ 16.5 kg/ha through irrigation water at the time of disease appearance or at flowering is recommended.

Management of Downy mildew

1. Worked out epidemiology of Brown stripe downy mildew of maize under tarai condition of Uttar Pradesh
<table>
<thead>
<tr>
<th>Year</th>
<th>No. of entries</th>
<th>Late Maturity</th>
<th>Medium Maturity</th>
<th>Early and Extra Early</th>
<th>Pop Corn</th>
<th>Sweet Corn</th>
<th>Baby Corn</th>
<th>QPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>245</td>
<td>Nil</td>
<td>HKM31, HM8</td>
<td>Early Maturity: R2006-1</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>HQPM-2, JHQPM-304, JHQPM-250, HQPM-7</td>
</tr>
<tr>
<td>2011</td>
<td>606</td>
<td>M9977, A7501, NMH958, X8B562, HM10(C), EHQ-16, DMIH7705, GK3103, MCH45, A7501, BIO-562, PMH1(C)</td>
<td>BH4100, X35A17, KDMH176, BIO-688, JH31292, KDMH017</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>MHQPM-09-8</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>548</td>
<td>GA4100, BIO-688, KDMH176, KNMH401061, NMH1242</td>
<td>Early Maturity: JH31485, K21, CMH10-525</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>HQPM-1 (Filler), HQPM-2 (Filler), MHQPM-09-8, HQPM-1 (Filler), HQPM01 (Filler), HQPM-5 (Filler), HQPM-1 (C), NSCH12, HQPM1 (F), PMH4 (F)</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>500</td>
<td>NR31834, CP999</td>
<td>RASI3033, PRO383</td>
<td>Early Maturity: FH-3626, EHL162508, KNMH401014</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>BAUQM-H17</td>
</tr>
<tr>
<td>2014</td>
<td>615</td>
<td>VNR-4325, DAS-MH-106, JH13282, JH12010, PM14101L, DKC9159 (IN8570), CMH10-555, CMH11-618, Gold1166, HT51412607, ADV0990296, ADV1190384, JH13270, DKC9151 (IN8902), BH4120 84, HT51412607, HTMHH5402, BIO9637-C</td>
<td>KDN1263SC* (First Year), FH3605, FH3612, Bio9720, AH1317</td>
<td>HPC1, DMRH1401, IMHP1535</td>
<td>ADVSW-2, FSCSCH41, ADVSW-1, WOSC-, Priya-C</td>
<td>IMHB1539, IMHB1537, DMRH1305, IMHB1531, IMHB1532, GAYMH1, JH1525, BAUM-3, HKH425, ASKBH1, AH5021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>606</td>
<td>VNR-4325, DAS-MH-106, JH13282, JH12010, PM14101L, DKC9159 (IN8570), CMH10-555, CMH11-618, Gold1166, HT51412607, ADV0990296, ADV1190384, JH13270, DKC9151 (IN8902), BH4120 84, HT51412607, HTMHH5402, BIO9637-C</td>
<td>KDN1263SC* (First Year), FH3605, FH3612, Bio9720, AH1317</td>
<td>HPC1, DMRH1401, IMHP1535</td>
<td>ADVSW-2, FSCSCH41, ADVSW-1, WOSC-, Priya-C</td>
<td>IMHB1539, IMHB1537, DMRH1305, IMHB1531, IMHB1532, GAYMH1, JH1525, BAUM-3, HKH425, ASKBH1, AH5021</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Moderately Resistant Lines against Banded Leaf and Sheath Blight in AVT
<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
<th>Variety</th>
<th>Early Maturity</th>
<th>Resistant</th>
<th>Nil</th>
<th>Nil</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>538</td>
<td>NMH-1247, Super-1177, KMH-3981, GK3118, 115-08-01, DMRH1308, DKC9133, DKC9141 (IM8539), IM8556, CP999, X35D601, Siri-4527, PMH-3-C PM15103L, DKC9164 (IP9002), PM15104L, DKC9163 (IP8703), SYN516753, CMH12-688, DKC9151 (IN9002), ADV0990296</td>
<td>Early Maturity: JH31785</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>647</td>
<td>IMH1527</td>
<td>Resistant IMH 1603 Mod. Resistant JKM1-414, DMRH141, 9DKC9179, LMH616, CMH08-292</td>
<td>Nil</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>442</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>BSCH 416078, DSCH320, Misthi</td>
<td>Nil</td>
</tr>
</tbody>
</table>

2. For the management of Brown stripe downy mildew 4–6 foliar spraying of mancozeb (0.3%), Captan (0.2%) at 7 to 10 days interval.

3. Three foliar spraying of Zinc Sulphate + Lime (0.5% + 0.25%) and Copper sulphate (0.1%) at 7 days interval was found effective in managing Brown strip downy mildew of maize.

4. For the management of brown stripe downy mildew seed treatment with Metalaxyl 35% WS @ 7 gm/kg seed followed by foliar spraying of mancozeb 75% WP or Metalaxyl 8% + Mancozeb 64% WP @ 2–2.5 kg/ha was found effective.
### Table 2: Moderately Resistant Lines against Banded Leaf and Sheath Blight in AVT

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of entries</th>
<th>Late Maturity</th>
<th>Medium Maturity</th>
<th>Early and Extra Early</th>
<th>Pop Corn</th>
<th>Sweet Corn</th>
<th>Baby Corn</th>
<th>QPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>245</td>
<td>Nil</td>
<td>- Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>2011</td>
<td>606</td>
<td>Nil</td>
<td>JH31292</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>EHQ-16, VEHQ-3019, HQPM-1(C), HQPM-7(C)</td>
</tr>
<tr>
<td>2012</td>
<td>548</td>
<td>Nil</td>
<td>JH31292</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>2013</td>
<td>500</td>
<td>CMH09-464</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>2014</td>
<td>615</td>
<td>Nil</td>
<td>Nil</td>
<td>EE Maturity: HM10-F</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>MMHQPM-6-12-13</td>
</tr>
<tr>
<td>2015</td>
<td>606</td>
<td>Resistant lines- JH31282, PM14101L, CMH12-663, 115-08-01, CP999, X35 D601</td>
<td>Nil</td>
<td>Nil</td>
<td>ASKH1, FSCH 41, ASKH4</td>
<td>MBC-11-15, IMHB 1537</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>538</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>IIMRQPMH1609</td>
</tr>
<tr>
<td>2017</td>
<td>647</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>2018</td>
<td>442</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>

### Table 3: Resistant Lines against Brown Stripe Downy Mildew in AVT

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of entries</th>
<th>Late Maturity</th>
<th>Medium Maturity</th>
<th>Early and Extra Early</th>
<th>Pop Corn</th>
<th>Sweet Corn</th>
<th>Baby Corn</th>
<th>QPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>500</td>
<td>JH 31601, P 3596(X 35B396), NMH 1265, CMH 09-464, MCH 46</td>
<td>JH 31470, EH 1974, HM 8(C)</td>
<td>Early: FH 3626, EH 2223, Bio 6008, REH2011-2, FH 3605, CMH 10-484, AH 1206, K 21, DAS-MH 501, EHL 162508 Extra Early: DH 262, FH 3558</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>EHQ 63, VEHQ 11-1, MMHQPM-6-12-13, HQPM 5©, BISCO, MADHU, MADHURI, HM 4©</td>
</tr>
</tbody>
</table>
Management of Banded Leaf and Sheath Blight

1. Loss assessment studies conducted for 3 years showed that BLSB may cause yield loss up to 33 percent under tarai conditions.

2. Chopped green paddy stem with 10% sucrose and peptone was found the best substrate for mass production of *Rhizoctonia solani* for artificial inoculation under field conditions.

3. For the management of Banded leaf and sheath blight drainage of water, weed control and removal of infected leaf at second interculture operation was found effective in minimizing the disease.

4. For chemical management of banded leaf and sheath blight two foliar spraying of Propiconazole 25 EC/ Dinfonconazole 25 EC @ 0.1% at 10-15 days interval was found effective.

5. Among newer compounds Pencycuran 250 SC @ 0.1% or Azoxyxstrobin 250 Sc @ 0.05% was found effective for the management of BLSB.

6. For biological management of Bacterial Leaf & Sheath Blight, soil application of *Trichoderma harzianum* impregnated FYM @ 100kg/ha and seed dressing with the same @ 2.5g/ka seed gave the highest disease control and yield.

Post Flowering Stalk Rot

1. For management of Post flowering of stalk rot seed treatment with Benlate (2 gm/kg seed), drainage of water at the time of flowering and irrigation in case of moisture stress was found effective in minimizing the disease incidence. In hot and dry weather harvesting should be preponed by 8 – 10 days.

Foliar Diseases

1. For the management of Maydis leaf blight two spraying of mancozeb 75WP or Zineb 75WP @ 2 – 2.5 kg/ha at 10 to 15 days interval is recommended.

2. For management of foliar diseases like brown strip downy mildew, leaf blight and rust 3 – 4 spraying of mancozeb @ 2kg./ha at 10 to 12 days interval was found effective.

2. Research Publications:


8. Bhandari Chandra Prabha and Vishunavat K.


3. Thesis Research
   a. M.Sc. Ag. Thesis


b. Ph. D. Thesis


4. Future Thrusts:

1. Preparation of disease distribution map of Uttarakhand and identification of emerging problem of the state through survey and surveillance.

2. Development of sick plot for screening of germplasm against BLSB abd BSR.


5. Studies on diseases of winter/spring maize.


7. Study of root microbiome of maize growing in varying agro climatic conditions.
8. Studies on interaction of biotic and abiotic stresses on maize

E. Maize Entomology:

1. Significant Achievements:

1. Survey: In kharif 14, rabi 29 and spraying 23 insect pests were recorded. Maize stem borer in kharif season army worm in rabi season and shoot fly in spring season identified as major pest.

2. Screening of Resistant Germplasm

a. Stem borer : CM500
b. Shoot fly : CM200, CM201, D765 and Synthetic PS29 × Kisan
c. Army Worm : D768 × D787, Kanchan, Taseen, D861, D822 & Naveen was found moderately resistant
d. Corn Maggot : Tarun, Ganga-5 less prone
e. Multiple resistance : M-15
f. Cytotriga : D741, Suwan resistant
g. Multiple pest resistance : PR7921 (Stem borer, Shootfly, Grain moth, Rice Moth, Rice weevil)

3. Management:

a. Stem Borer:

i. To break the life-cycle of stem borer Maize stem should be chopped before January and stored.
ii. Stubbles should be removed from the field
iii. Seed rate should be increased and optimum plant population be maintained by thining
iv. In standing crop apply Carbofuran 3G@7.5 Kg/ha in whorls.
v. Spray Deltamethrin or Cypermethrin @ 100ml/ha
vi. Spraying of mixture of Neem and Karanj oil was found effective.
vii. Developed artificial diet for rearing of stem borer of maize

b. Shoot Fly:

i. In areas where incidence is low problem can be managed by increasing the seed rate.
ii. Sowing of spring maize should be done in last week of January.
iii. Apply Thimate 10G@15K/ha in furrows at the time of planting or
iv. Spray Methosystox @ 0.025% (400 – 600 l/ha)
v. Remove wild sorghum from the surrounding the field.

c. Army Worm:

i. Spray Fenvelrate@100 ml/ha or apply Carbofuran 3G in whorles.

110