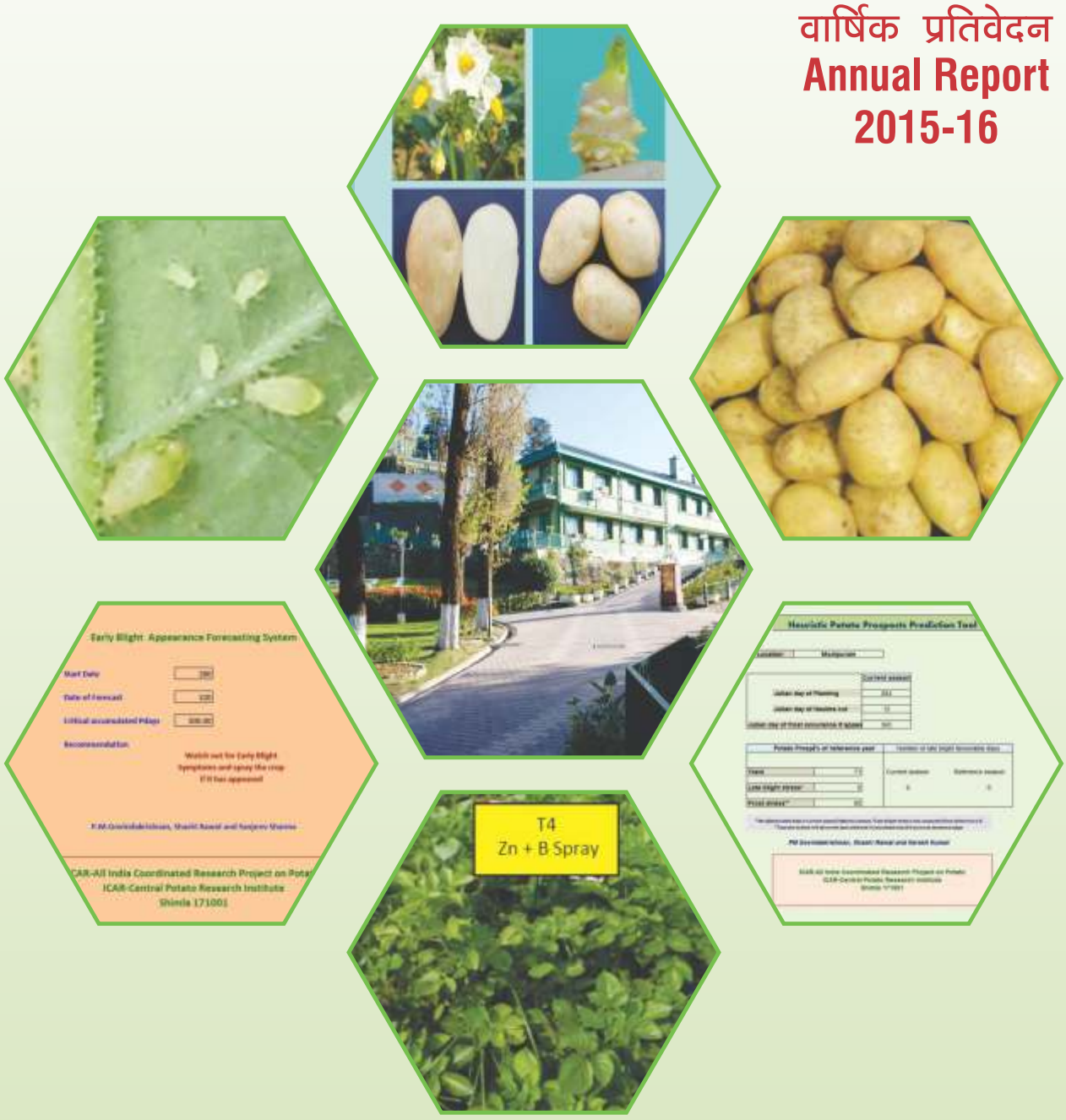
भा.कृ .अनु.प.–अखिल भारतीय समन्वित आलू अनुसंधान परियोजना

ICAR-All India Coordinated Research Project on Potato

वार्षिक प्रतिवेदन
Annual Report
2015-16



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ICAR-Central Potato Research Institute

(भारतीय कृषि अनुसंधान परिषद)

(Indian Council of Agricultural Research)

शिमला– 171 001 हि.प्र. (भारत)

Shimla - 171 001, H.P. (India)

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AICRP on Potato Annual Report 2015-16

Printed: August, 2016

No of copies: 150

Acknowledgement

Material for this report was received from 7 CPRI based, 17 SAU based and 1 Voluntary center of AICRP (Potato). The Heads of Division of CPRI and their colleagues assisted in compilation and interpretation of the results. Their assistance is gratefully acknowledged.

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Photograph: CPRI

Secretarial Assistance: Nirmala Chauhan and Sita Ram

Published by:
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Director
ICAR-Central Potato Research Institute
Shimla-171 001, HP
Month/Year of Publication: August, 2016
E-mail: pcpotato.cpri@icar.gov.in
Website: http://cpri.ernet.in

Printed at:
Azad Offset Printers
Press site, Industrial Area, Phase-I, Chandigarh
Ph. : 0172-4611489, 2656144, 2657144, 9814011543

PREFACE

All India Coordinated Research Project on Potato initiated in 1970-71 is operating through 17 State Agricultural Universities based centers, 7 CPRI based centers and 1 voluntary center.

In this 44th Annual Report of AICRP (Potato), experiments conducted during summer/*kharif* 2015 in hills/plateau and *rabi* 2015-16 in the plains have been reported. There were 17 experiments in Crop Improvement, 10 in Crop Production and 14 in Crop Protection at various locations. Efforts have been made to collect, consolidate, analyze and compile the data collected in these experiments in this report. The significant achievements during the year in Crop Improvement are the climatic zonation of potato growing regions, the quantification of different agronomic traits to yield improvement and stability analyses of varieties & advanced hybrids in different environments. Promising hybrids for release as varieties have also been identified.

Under Crop Production, detailed studies on the applied-yield, uptake-yield as well as applied- update relations were continued which led to the development of the software PENMAS. Experiments on omission plot technique were also continued and nutrient requirements for targeted yield at different locations were worked out. Detailed micro nutrients analysis has been carried out in collaboration with ICAR-IIHR and the results indicated that the micronutrient formulation "Potato Special" has promise.

Under Plant Protection the salient achievements include validation of the Indoblightcast DSS, developing fungicide schedules for late blight management for Hassan and schedules for controlling early blight as well as for mites at Pune.

I would like to record my sincere thanks to Dr NK Krishna Kumar, Deputy Director General (Horticulture Sciences), Dr AK Singh, Deputy Director General (Horticulture Sciences), ICAR, New Delhi, Dr Janakiram, Assistant Director General (Horticulture Sciences -II), ICAR, New Delhi, Dr. BP Singh Ex-director, ICAR-CPRI, Shimla and Dr SK Chakrabarti, Director, ICAR-CPRI for their keen interest in the programme, help and guidance. I am indebted to my colleagues Dr's EP Venktasalam, Dr SK Singh, ICAR-IIVR, Varanasi, AN Ganeshamurthy, ICAR-IIHR, Bengaluru for their help in compiling the results of various experiments.

I am also thankful to Dr VK Dua, (Head, Crop Production), Dr Vinay Bhardwaj (Acting Head, Crop Improvement), Dr Sanjeev Sharma, (Acting Head, Crop Protection) and Dr NK Pandey (Head, Social Sciences) as well as their colleagues Dr's Rajinder Kumar, Sridhar Jandrajupalli, Vinay Sagar and Sushil Kumar for interpreting the analyzed results and preparing write ups of their respective disciplines for this annual report. Dr Raja Shankar, Sr Scientist and Mr Dharminder Verma, Assistant Chief Technical

Officer, AICRP Unit, CPRI, Shimla have been instrumental in compiling the information and their efforts are greatly appreciated.

Statistical analyses by Mr Dharminder Verma, Assistant Chief Technical Officer; secretarial assistances by Mrs Nirmala Chauhan, UDC; and assistance provided by Mr Sita Ram, Technician are appreciated and thankfully acknowledged.

August, 2016
Shimla

PM Govindakrishnan
Project Coordinator

ABBREVIATIONS

AICRP	All India Coordinated Research Project
Av.	Average
BHN	Bhubaneswar
BW	Bacterial wilt
BS	Black Scurf
CD	Critical difference
CHN	Chhindwara
CPRIC	Central Potato Research Institute Campus
CPRS	Central Potato Research Station
CS	Common Scab
CV	Coefficient of variation
cv.	Cultivar
DAP	Days after planting
DES	Deesa
DHL	Dholi
DWD	Dharwad
EB	Early blight
FZB	Faizabad
g or gm	Gram
GWL	Gwalior
ha	Hectare
HIS	Hisar
HSN	Hassan
HYB	Hybrid
IPM	Integrated pest management
JAL	Jalandhar
JRH	Jorhat
K	Potassium
kg	kilogram
KAL	Kalyani
KAN	Kanpur
KBD	Kufri Badshah
KCM	Kufri Chandramukhi
KFI	Kufri
Kg	Kilogram
KTT	Kota
LB	Late blight
LR	*Leaf roll*
MDP	Modipuram
MM	*Mild mosaic*
N	Nitrogen
OC	Organic carbon
OOT	Ootacamund
P	Phosphorus
PALCD	Potato apical leaf curl diseases
PAS	Pasighat
PAT	Patna
PLRV	*Potato leafroll virus*
PNT	Pantnagar
PTM	Potato tuber moth
PTR	Purple top roll
PUN	Pune
q	Quintal
RBD	Randomized block design
RDF	Recommended dose of fertilizers
Rs	Rupees
RPR	Raipur
Sed	Standard error of difference
SHI	Shillong
SM	Severe mosaic
SN	Stem necrosis
SPT	Split plot
SRI	Srinagar
SW	Sclerotium wilt
t	tonne

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EXECUTIVE SUMMARY

During the year under report apart from field experiments, studies to improve the breeding efficiency, varietal deployment, modelling of pests and disease occurrence and distribution and estimating crop prospects were the highlights. The section wise highlights are presented below:

CROP IMPROVEMENT

The cluster analysis of possible potato growing locations based on mean temperature, mean night temperature, mean radiation and total Pdays and GDD of the possible potato season showed that 17 distinct clusters could be delineated. Most of the potato growing regions fall in cluster 1 which represents the Indo Gangetic plains followed by cluster 3 which is below the IGP and represents warmer temperatures. There is a large area represented by cluster 7 in the peninsular India representing kharif growing season. This study has enabled redefining production zones based on the climatic requirements of potato.

Studies to identify traits to increase productivity viz. increase in intercepted radiation, light use efficiency and harvest index showed that the maximum increase is possible through increased intercepted radiation followed by harvest index. Thus the study indicated the need for greater emphasis on canopy architecture to break the yield barrier.

The stability analysis of the newly released variety Kufri Mohan was carried out. The results showed that except for total yield at 75 days, Kufri Mohan recorded greater mean marketable yield at 75 days and total and marketable yield at 90 days with regression coefficient (b) greater than unity and deviation from regression (S^2d) greater than zero indicating specific adaptability of this genotype to rich (favourable) environments.

Stability analysis of the released varieties across locations was also carried out to identify the most suited environments for their deployment. Kufri Khyati was found to have above average mean yield, regression coefficient value slightly greater than unity (bi=1.072) and minimum deviations from regression nearing zero (s^2di=0.197) which showed its high stability and wider adaptability across environments.

Promising hybrids have been evaluated in field experiments and those found promising were further advanced to the next stage i.e. onfarm trials.

CROP PRODUCTION

Under crop production, a protocol to quantify the effect of seasonal weather factors, late blight and frost on productivity was developed.

The nitrogen requirement of heat tolerant variety Kufri Surya across locations was studied and recommendations developed. Yield increased significantly upto 150 kg N/ha at all the locations thereafter the increase even if

it occurred in some locations, was marginal. Thus the results showed that Kufri Surya responded upto 150 Kg N/ha.

Site specific nutrient management studies were carried out at different locations and nutrient requirements for targeted yield were worked out. Total N uptake ranged from 65.3 Kg/ha in the control plots to 75.4 Kg/ha in N omission plots while in optimally fertilized plots it was 127.3 Kg/ha. The average apparent recovery was 29.8% irrespective of location, while the average apparent recovery of P was 11.5% and the apparent recovery of K was 28.4%. For the same target yield of 35 t/ha, the requirement of N worked out to 20, 25.5 and 177.6 Kg/ha at Gwalior, Kanpur and Srinagar respectively.

The nitrogen requirement under drip irrigation system was worked out. The results showed that upto 120% of the recommended dose of N, the yields were at par and significantly higher than that under recommended dose of N under furrow irrigation. The results showed that under drip irrigation 60% of recommended dose is sufficient to meet the N needs.

Integrated nutrient management practices in different regions were evaluated.

A micronutrient formulation for potato was developed in collaboration with ICAR-IIHR and evaluated across locations.

CROP PROTECTION

Ecological niche modelling techniques were used along with pest and disease surveillance data and areas most suited for different pests and diseases were identified.

The late blight forecasting model Indo-Blightcast was further tested and used for realtime issue of agro advisories through the AICRP(Potato) centres and IMD Agromeorological Field Units. The model predicted the late blight appearance at all the locations extending from Ludhiana in the West to Jorhat in the East accurately.

A P-days model for forecasting early blight appearance was developed.

Population buildup of whitefly and aphids in relation to weather factors was studied. The product of Pdays and Vapour Pressure Deficit was found to describe whitefly populations reliably.

Management schedules for late blight at Hassan as well as for early blight and mites at Pune were developed.

Prophylactic spray (just at the time of canopy closure) with mancozeb @0.2% followed by Fenamidone + mancozeb @ 0.3% and one more spray with mancozeb @0.2% was effective to control late blight at Hassan. However, prophylactic spray (just at the time of canopy closure) with mancozeb followed by dimethomorph + mancozeb @ 0.3% followed by mancozeb @0.2% was equally effective.

Spray of cholorothalonil 75WP (0.25%) followed by hexaconazole 5EC (0.05%) and one more spray with cholorothalonil 75WP (0.25%) at days interval gave best control against early blight at Pune. Spray of mancozeb 75WP (0.25%) followed by hexaconazole 5EC (0.05%)

and one more spray of mancozeb 75WP (0.25) was equally effective.

Spraying of Emmamectin Benzoate 5 SG 50g.a.i. per litre of water immediately after appearance of mites on potato and second spray of Spiromesifen 240 SC @ 48g.a.i. 15 days after first spray effectively controlled the mites.

First spray of Emmamectin Benzoate 5 SG 50 g.a.i. per litre of water and second spray of Spiromesifen240 SC 0.48g.a.i. per litre of water 15 days after first spray was equally effective in controlling mites.

An integrated Pest and disease management protocol for eastern region was developed.

CROP IMPROVEMENT

During the year following targets were accomplished:

CLIMATIC ZONATION OF THE POTATO GROWING REGIONS OF THE COUNTRY

Potato is grown in about 2.2 mha in the country. Developing suitable varieties and good agricultural practices for such a huge area varying widely in environmental conditions and management practices is a huge task. Therefore, there is need for defining homogenous zones. The agroecological zones developed earlier (NBSS &LUP) are not very appropriate for potato since potato is essentially an irrigated crop and is very sensitive to climatic conditions primarily temperature. Climatic zonation can be used to delineate climatically homogenous regions for potato. Therefore, studies were taken up to delineate climate based potato growing zones in India. For this purpose a long-term climate database for more than 1500 locations was developed and the climatic features of the potato growing season (based on temperature suitability for potato) at these locations viz the growing degree days, P days, mean temperature, mean night temperature, mean radiation and altitude of the location were delineated. This data was subjected to cluster analysis and their similarity/ dissimilarity was calculated based on Euclidean distances and unweighted pair-group average (UPGA) was used as the agglomeration method.The results showed that the potato growing regions of the country could be grouped into 17 clusters (Fig.1). The largest cluster was cluster-3 in which 639 locations were grouped together followed by cluster-1 with 411 locations, cluster-7 with 211 locations and cluster-2 with 58 locations. As regards the AICRP (Potato) centres the 23 centres were grouped into 8 different clusters (Table 1.) and maximum number of centres were in cluster-1 followed by 5 AICRP (Potato) centres each in cluster-3 and 11. Four AICRP (Potato) centres viz., Shimla, Shillong, Jalandhar and Ooty were represented in separate clusters.

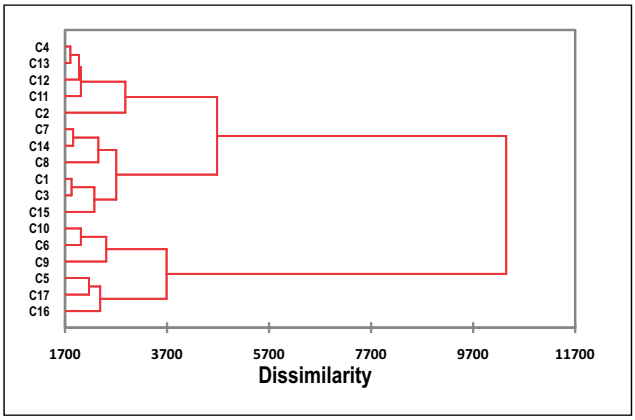


Fig.1: Distances among different environmental clusters

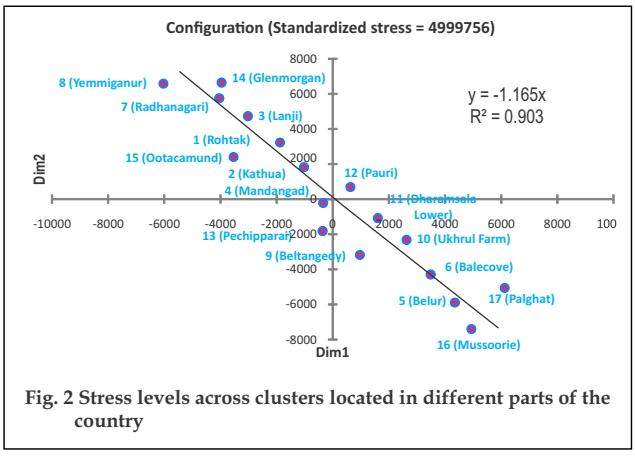


Fig. 2 Stress levels across clusters located in different parts of the country

Table 1.Grouping of different AICRP (P) centres into different clusters

Cluster number	No. of AICRP (P) centre (s) grouped in the same cluster	Name of AICRP (P) centre (s) grouped in the same cluster
1	7	Faizabad, Hasan, Hisar, Kanpur, Kota, Modipuram, Patna
3	5	Bhubneshwar, Chhindwara, Deesa, Gwalior,Raipur
5	1	Shimla
6	1	Shillong
7	2	Dharwad, Pune
8	1	Jalandhar
11	5	Jorhat, Kalyani,Pasighat, Pantnagar, Srinagar
15	1	Ooty
Total	**23**	

The locations existing in the same cluster are expected to experience the same level of stress and it is expected that the locations experiencing the mean value of all the 5 variables are least stressed, while locations with extremities are the most stressed. The standardized stress was calculated using Multidimensional Scaling (MDS) and it was observed that the stress across locations followed a linear pattern with R^2=0.90. The least stressed conditions were observed in the cluster-12 with 3 locations like Chakarata, Dalhousie and Pauri and cluster4 with 27 locations, while the clusters with highest stress were cluster 8 with 28 locations and cluster-17 with three locations (Fig 2). Thematic maps were then developed using Voronoi polygons with the cluster class number as the attribute around each of the point locations defined by its geographic coordinates. The map shows that most of the Indogangetic plains are in the same cluster i.e. cluster number 1 while most of the northern peninsular India is in the cluster-3 while large parts of peninsular India is in cluster-7.

QUANTIFYING THE EFFECT OF MAJOR AGRONOMIC TRAITS IN YIELD ENHANCEMENT

The primary focus of crop improvement studies is to breed for yield improvement. Unless the genetic potential of hybrids is enhanced, the management practices will have little impact. The breeding efforts during early years resulted in significant yield improvements over the controls but in recent years, the quantum of yield improvement is marginal. Therefore, there is a need for more focused breeding and evaluation strategy so as to ensure yield improvement. This calls for dissecting the yield in terms of its components and quantifying the contribution of each of the components so that the selection criteria can be designed accordingly. Keeping the same in view, studies were undertaken to analyze the yield in terms of the quantifiable contribution made by each of its major components *viz.*,Intercepted Radiation (IR), Light Use Efficiency (LUE) and Harvest Index (HI) using the LINTUL yield equation viz. Y = IR*LUE*HI.

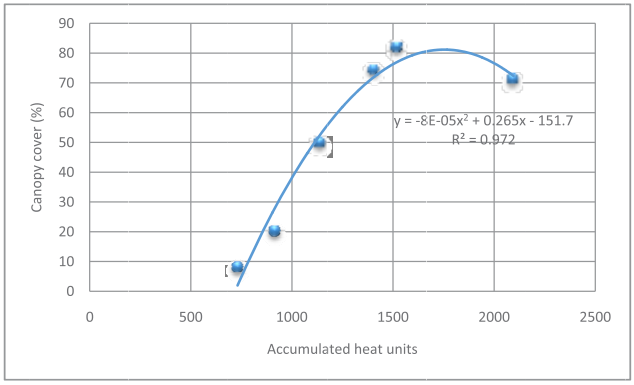


Fig 3: Canopy cover vs cumulative heat units under irrigated conditions

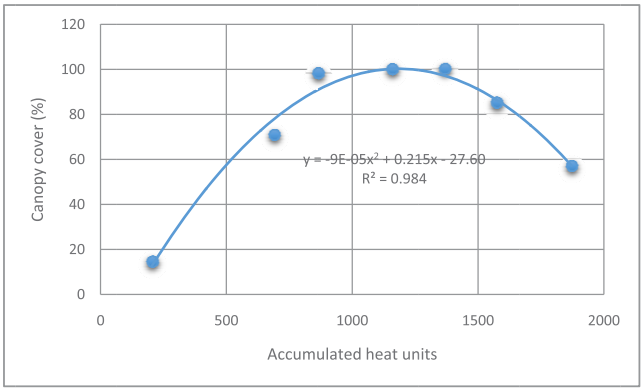


Fig 4: Canopy cover vs cumulative heat units under river bed conditions

As regards intercepted radiation, earlier studies at Deesa had identified two distinct patterns of canopy cover viz., one under irrigated conditions (IR_CC) and the other under river bed (RB_CC) conditions (Fig. 3 & 4). Under irrigated conditions, the canopy cover increased slowly reaching a peak by about 60 days (1500 heat unit (HU) with HU calculated using non crop specific base temperature of 0^0C) after planting (DAP) and decreasing thereafter. The duration of canopy cover near about 100% is also short under irrigated conditions. On the contrary, under river bed conditions, the canopy cover establishes very fast and peak canopy cover is reached by about 45 DAP (1200 HU) and it is also maintained near the optimum for a considerable period and decreases thereafter. Moreover, the shape of the canopy cover curve under river bed conditions resembles almost a normal curve.

As regards LUE, generally a conversion efficiency of 1.25 g/MJ has been used for potato. It is reasonable to assume a 10% increase in efficiency through breeding, therefore, two scenarios viz. normal scenario of 1.25 g/MJ (LUE1) and another with 10% higher efficiency than the normal (LUE2) were used in the study. In the case of HI, it is already very high in the case of potato and is around 75%. In this case also two scenarios viz. 70% and 80% were used in the study. As regards crop duration, it is dependent upon temperature and is fixed based on the thermal time. Under the irrigated and river bed situations of Deesa, the thermal time accrued till harvest is 2095 and 1871 HU, respectively hence harvest according to these thermal times was one scenario studied. However, in the northern plains the potato is a short duration sandwich crop between the kharif and the spring crops and is also amenable to harvest earlier than full maturity, hence another scenario viz. harvest at 105 DAP was also studied.

The results (Table 2.) show that 2095 HU is accumulated in 151, 138, 120 and 135 DAP at Jalandhar, Modipuram, Patna and Shimla respectively while 1871 HU is accumulated in 136, 126, 110 and 119 DAP respectively. In this scenario, increase in light interception through increase in canopy cover gave the largest increase in biomass yield among the three yield contributing factors studied. Considering IR_CC_LUE1 as the reference, it was 76.5% and 93.5% higher under RB_CC_LUE1 and RB_CC_LUE2 scenarios, respectively at 105 DAP. The corresponding figures for Modipuram, Patna and Shimla were 42.1% and 55.7% at Modipuram, 45.2% and 59.1% at Patna and 7.3% and 17.6% at Shimla, respectively. This shows that the largest increase was at Jalandhar and the lowest at Shimla. Similar trend was noticed in the case of harvest according to thermal time at Jalandhar, Modipuram and Patna but in the case of Shimla no yield benefit was expected due to increased canopy cover.

As regards biomass yield increase due to increase in LUE, the calculations showed that it would be about 9.6% higher for a 10% increase in LUE at all the locations. However, under RB_CC scenarios it is expected to be 17, 13.6, 13.9 and 10.3% at 105 DAP at Jalandhar, Modipuram, Patna and Shimla, respectively while at harvest according to

thermal time it is expected to be 12.3, 11.1 and 12.2% respectively at Jalandhar, Modipuram and Patna. No yield increase is expected at Shimla under this scenario. As regards harvest index, it is generally calculated as a fixed fraction of the total biomass (0.7 and 0.8 in this study) and is expected to lead to corresponding yield increase of 14%.

The calculations thus show that increasing the intercepted radiation through manipulating canopy architecture either through management practices or through improved varieties can lead to further yield improvement. Small but significant yield increases can also occur due to increased LUE. Further, wherever possible priority should be given to raise a full duration crop and not restrict the crop duration to 105 days to realize the full yield potential of the crop season. However, these are preliminary results using a simple yield equation and points to the need for a detailed study using a detailed physiological model.

Table 2. Expected increase in potato yield under different scenarios of LUE and canopy covers

Duration	Canopy cover scenario	Biomass yield (kg/ha)	% increase over reference scenario
Jalandhar			
105.0	IRRIG LUE1	9404.4	100.0
105.0	IRRIG LUE2	10307.2	9.6
105.0	RB LUE1	16602.8	76.5
105.0	RB LUE2	18196.7	93.5
151.0	IRRIG LUE1	18890.4	100.0
151.0	IRRIG LUE2	20703.9	9.6
136.0	RB LUE1	24217.8	28.2
136.0	RB LUE2	26542.8	40.5
Modipuram			
105.0	IRRIG LUE1	8173.9	100.0
105.0	IRRIG LUE2	8958.6	9.6
105.0	RB LUE1	11612.3	42.1
105.0	RB LUE2	12727.1	55.7
138.0	IRRIG LUE1	15111.9	100.0
138.0	IRRIG LUE2	16562.6	9.6
126.0	RB LUE1	17463.6	15.6
126.0	RB LUE2	19140.1	26.7
Patna			
105.0	IRRIG LUE1	7911.3	100.0
105.0	IRRIG LUE2	8670.8	9.6
105.0	RB LUE1	11487.2	45.2
105.0	RB LUE2	12590.0	59.1
120.0	IRRIG LUE1	11289.8	100.0
120.0	IRRIG LUE2	12373.6	9.6
110.0	RB LUE1	14355.1	27.2
110.0	RB LUE2	15733.1	39.4

Shimla			
105.0	IRRIG LUE1	6060.2	100.0
105.0	IRRIG LUE2	6642.0	9.6
105.0	RB LUE1	6500.2	7.3
105.0	RB LUE2	7124.2	17.6
135.0	IRRIG LUE1	10854.1	100.0
135.0	IRRIG LUE2	11896.1	9.6
119.0	RB LUE1	10103.4	-6.9
119.0	RB LUE2	11073.3	2.0

EVALUATION OF POTATO GERMPLASM LINES UNDER KHARIF CONDITIONS

Eighty germplasm lines were assessed in the field at Hassan.The traits recorded were plant height, plant width (E-W) and plant width (N-S) at 45 days after planting, total yield per ha (t/ha) and tuber dry weight yield (g/plant). The statistical analysis carried out were analysis of variance, estimation of variance components, coefficient of variation and heritability in broad sense and genetic advance as per cent mean. The extent of variability present in germplasm was estimated in terms of range, mean, standard error, phenotypic and genotypic coefficient of variation. The analysis of variance estimated for different characters showed highly significant mean sum of square estimates for all the characters under study. In plant height, the genotype, CP-1927 was found to be the shortest, while CP-1893 recorded the highest height (43.50cm). Total yield per ha ranged from 1.0 t/ha in CP-1902 to 66.50 t/ha in CP-1816. Tuber dry weight (g/plant) ranged from 9.50 g/plant in CP-1902 to 771.50 g/plant in CP-1816. The genotypes CP-1816, CP-1889, CP-1914 and CP-1921 were found to be the high yielding genotypes and can be used as parental lines. The range for different characters (Table 3) observed for all the traits showed scope for selection among the existing genotypes. The traits under study exhibited higher values for GV and PV (Table 4). However, the coefficients of variation estimation appear to be a better index when the characters with different units of measurements are to be compared as it indicates the relative amount of variability present in the germplasm. In the present study, considerable difference between phenotypic and genotypic coefficient of variation were observed for the characters studied. In general, the magnitude of phenotypic coefficient of variation (PCV) was greater than the corresponding genotypic coefficient of variation (GCV) for all the characters indicating the interaction of the genotypes with the environment and its influence on the expression of these characters. The results also revealed that the magnitude of heritability were quite high for all the characters. Higher GCV and heritability estimate associated with greater genetic gain was observed for tuber dry weight yield and total yield. Plant height and plant width exhibited low values of GCV and moderate to high value of heritability estimates and low magnitude of genetic gain indicating the non-additive gene action governing this character. Considering the diverse nature of the material, it is concluded that the genotypes under investigation at Hassan had the greater quantum of heritable variation, particularly for tuber dry weight yield (g/plant), total yield (t/ha) and there is possibility for improvement of these traits by selection.

Table 3: Variability for different morphological traits under kharif season

Characters under study	Range	Mean± SE	SD	Genotype
Plant height at 45 days	9.0-43.50	25.67 ±0.73	6.87	CP-1927 -CP-1893
Plant width (EW) at 45 days	9.0-50.00	26.10 ±0.91	8.54	CP-1916 -CP-1908
Plant width(N-S) at 45 days	10.0-41.50	22.61 ±0.83	7.79	CP-1940 -CP-1817
Total yield (t/ha)	1.0-66.50	20.96 ±1.60	14.93	CP-1902 -CP-1816
Tuber dry matter content(g/plant)	9.50-771.50	233.14 ±18.86	175.94	CP-1902 -CP-1816

Table 4. Genetic analysis of potato genotypes under kharif condition

Characters	Variance		Coefficients of variance		Heritability	Genetic Advance	Genetic Gain
	G	P	GCV	PCV			
Plant height at 45 days	46.2	48.4	26.47	27.09	0.95	13.68	53.27
Plant width (EW) at 45 days	71.6	74.5	32.41	33.06	0.96	17.08	65.43
Plant width (NS) at 45 days	59.7	61.9	34.17	34.81	0.96	15.63	69.09
Total yield (t/ha)	222.9	223.2	71.19	71.25	1.00	30.73	146.54
Tuber dry matter content (g/plant)	30914.1	30996.4	75.41	75.51	1.00	361.72	155.15

STABILITY OF NEWLY RECOMMENDED HYBRIDS IN DIFFERENT ENVIRONMENTS

One of the main objectives of AICRP (Potato) is to evaluate advanced hybrids in different environments to study the yield potential, adaptability and stability of genotypes and accordingly determine their target domains. During the year under report, the stability of the promising hybrid, MS/5-1543 recommended for release as Kufri Mohan was studied for total and marketable yield at 75 and 90 days of harvest along with four already released cultivars viz.,K. Badshah, K. Bahar, K. Pushkar and K. Sadabahar in the Northern plains at 4 centres viz. Hisar (Haryana), Jalandhar (Punjab), Modipuram (Uttar Pradesh) and Pantnagar (Uttarakhand) and against K. Jyoti and K. Pushkar in the Eastern plains at 8 centres viz. Bhubaneswar (Orissa), Dholi (Bihar), Faizabad (Uttar Pradesh), Jorhat (Assam), Kalyani (West Bengal), Pasighat (Arunachal Pradesh), Patna (Bihar) and Kanpur (Uttar Pradesh) using the data of two years viz. 2012-13 and 2013-14.

The statistical analyses carried out were one-way ANOVA for each trait and the means were compared using Duncan's multiple range test. Stability analysis (genotype x environment interaction) for total and marketable yield was performed as per standard procedures. Stability parameters calculated were regression coefficient (bi) and deviation from regression coefficient (S^2d). Genotypes were considered as fixed effects and the locations were considered as random effects. Mean square deviations from linear regression response were used to compare magnitude of S.E (bi) as a method in which average yield of each genotype at each location was used as an environmental index for subsequent regression analysis.

The study showed that at all the four locations of northern plains, the genotypes tested exhibited significant difference for total and marketable yields at 70 and 90 days of harvest (Table 5). K. Pushkar gave the highest mean yield (31.23 t/ha) at 75 days of harvest in the Northern plains followed by MS/5-1543 (30.75 t/ha) which was at par to the best check. The total yield at 90 days of harvest indicated better performance of MS/5-1543 (42.02 t/ha) across locations compared to the best check, K. Pushkar (41.96 t/ha). The same trend was observed for marketable yield at 90 days, MS/5-1543 (39.07 t/ha) followed by K. Pushkar (38.02 t/ha) were the highest yielders. Among the locations in the Northern plains, Modipuram recorded the highest mean genotypic yield potential for total yield (29.77 t/ha) at 75 days and for total (45.21 t/ha) and marketable yield (40.13 t/ha) at 90 days after planting.

In the eastern plains, the hybrid, MS/5-1543 recorded significantly higher mean total yield (26.54 t/ha) and marketable yield (24.00 t/ha) at 75 days of harvest (Table 6) over the check variety K. Pushkar at five locations viz., Bhubaneswar, Dholi, Faizabad, Kalyani and Pasighat. Similarly, the advanced hybrid, MS/5-1543 recorded significantly higher total and marketable yields (32.08 t/ha and 29.28 t/ha, respectively) across all locations at 90 days after planting compared to the best check, K. Pushkar (29.01 t/ha and 26.59 t/ha respectively).

The pooled analysis of variance showed that the effect of cultivar when tested against G x E interactions was non-significant in Northern plains and significant in Eastern plains for both the traits observed (Table 7). The differences among environments for both total and marketable yields were non-significant at 75 days of harvest and highly significant at 90 days of harvest in Northern plains and for both the yields at 90 days harvest in Eastern plains. The mean square due to G x E interaction was significant when tested against pooled error for both the traits in Northern plains and Eastern plains except for marketable yield at 75 days.

The stability parameters worked out were, (1) the average (x) of different traits, (2) the regression coefficient (bi) of the performance on environmental indices and (3) squared deviation (S^2d) from regression developed for simultaneous selection for yield and stability (Table 8). At 75 days crop, K. Pushkar had regression coefficient value slightly greater than unity (bi=1.200) and non-significant mean square for deviations from regression nearing zero (S^2di=0.638) which showed its high stability and wider adaptability across the environments. However, MS/5-1543 which had above average total yield with regression coefficient greater than unity (bi=2.179) and non-significant mean square for deviations from regression indicated that this hybrid is more responsive for favourable environments. In Northern plains, only K. Bahar and K. Pushkar exhibited linear response for G x E interaction at 90 days of harvest, which indicates that the prediction of their performance over environments would be realistic. In the Eastern plains, MS/5-1543 for total yield at 75 days, and K. Pushkar and MS/5-1543 for marketable yield at 90 days exhibited non linear response for G x E interaction hence the possibility for prediction of their performance over environments is remote. On the other hand, K. Jyoti exhibited a linear response for G x E interaction for both the traits studied in the Eastern plains, hence prediction of its performance over environment would be possible and authentic.

In North-Eastern plains, the hybrid MS/5-1543 produced the highest mean yield (26.54 t/ha) over all environments and had regression

coefficient greater than unity (bi=1.118) and deviation from regression greater than zero (S^2d=5.749) for total yield at 75 days of harvest. It was also reflected in marketable yield at 75 days that greater mean yield (24.00 t/ha) with regression coefficient value at unity (bi=1.082) and non-significant deviation from regression greater than zero (S^2d=4.226) indicating wider adaptability of this hybrid to environments. Considering the total yield at 90 days of harvest a greater mean yield across environments was observed in MS/5-1543 and K. Pushkar with regression coefficient greater than unity (bi=1.254, bi=0.978 respectively) and deviation from regression greater than zero (S^2d=3.927, S^2d=2.597, respectively) indicating specific adaptability of these genotypes to rich (favourable) environments, in which the MS/5-1543 performance can be predictable as against K. Pushkar. The similar pattern was also observed for marketable yield at 90 days of harvest, however the performance cannot be predicted in these two cultivars.

Table 5. Mean values of traits in four environments of Northern plains

Variety	Growing Environments				Genotypic Mean
	Hisar	Jalandhar	Modipuram	Pantnagar	
Total yield at 75 days (t/ha)					
K. Badshah	25.92	27.18	26.60**	27.99	26.92
K. Bahar	28.17*	27.33	30.66**	27.17	28.33*
K. Pushkar	34.06	31.51**	33.45**	25.93	31.23
K. Sadabahar	24.51**	29.17*	23.14	26.64*	25.86
MS/5-1543	34.19**	30.57**	34.99**	23.75	30.75**
Site Mean	29.37	29.152	29.768	26.29	28.61
SE	1.23	0.74	0.68	1.22	1.02
CV (%)	5.94	3.58	3.25	6.56	4.83
F value	**	**	**	*	
Marketable yield at 75 days (t/ha)					
K. Badshah	24.44	26.31	21.10**	26.17	24.50
K. Bahar	26.78*	26.46	25.19**	25.42	25.96*
K. Pushkar	31.57**	30.16**	25.71**	24.03	27.87**
K. Sadabahar	23.74	28.33*	18.65	24.68*	23.85
MS/51543	32.70**	29.71**	28.68**	21.62	28.18**
Site Mean	27.84	28.19	23.86	24.38	26.07
SE	1.21	0.69	0.75	1.17	1.61
CV (%)	6.13	3.46	4.47	6.78	5.21
F value	**	**	**	*	
Total yield at 90 days (t/ha)					
K. Badshah	42.58**	33.54	38.46	28.46	35.76
K. Bahar	39.09	34.16	43.17**	28.34	36.18
K. Pushkar	46.17**	42.26**	51.01**	28.41	41.96**
K. Sadabahar	37.11	36.94**	38.49	30.24	35.69
MS/51543	46.57**	38.67**	54.95**	27.90	42.02**
Site Mean	42.30	37.11	45.21	28.67	38.32
SE	1.37	0.61	0.64	0.68	1.23
CV (%)	4.57	2.34	2.01	3.37	3.07
F value	**	**	**	*	

Marketable yield at 90 days (t/ha)					
K. Badshah	40.51**	32.58	32.32	26.33**	33.43
K. Bahar	34.63	32.94	39.44**	22.28	32.32
K. Pushkar	42.02**	40.64**	44.78**	24.65**	38.02**
K. Sadabahar	35.84	36.34**	34.53**	27.56**	33.57
MS/51543	44.31**	37.72**	49.61**	24.65**	39.07**
Site Mean	39.46	36.04	40.13	25.09	35.28
SE	1.44	0.66	0.69	0.56	1.45
CV (%)	5.16	2.60	2.44	3.16	3.34
F value	**	**	**	**	

* Significant at the level P=0.05. ** Significant at the level P=0.01.

Table 6. Mean values of traits in eight environments of Eastern plains

Variety	Growing Environments								Genotypic Mean
	BHN	DHL	FZB	JRH	KAL	PAS	PAT	KAN	
Total yield at 75 days (t/ha)									
K Jyoti	18.35	19.46	15.66	12.64	28.52	31.55	27.14	26.50	22.48
K Pushkar	17.01	25.07**	17.96**	14.69	30.74	33.68**	28.26	30.70	24.76
MS/5-1543	18.95*	31.90**	19.74**	13.64	35.52**	37.69**	28.30	26.60	26.54**
Site Mean	18.10	25.48	17.79	13.66	31.59	34.31	27.90	27.93	24.59
SE	0.61	1.41	0.48	1.01	1.09	0.44	0.67	2.61	0.76
CV (%)	4.73	7.84	3.83	10.43	4.87	1.80	3.56	13.20	6.28
F value	*	**	**	NS	**	**	NS	NS	
Marketable yield at 75 days (t/ha)									
K Jyoti	17.63	14.58	14.16	10.67	26.23	30.86	25.16	23.16	20.31
K Pushkar	15.90*	20.27*	16.31**	11.42	27.06	33.03**	25.72	27.35	22.21
MS/51543	17.91*	25.69**	17.85**	11.79	31.66**	37.35**	26.08	23.64	24.00**
Site Mean	17.15	20.18	16.11	11.29	28.32	33.75	25.65	24.72	22.17
SE	0.55	1.75	0.39	1.06	1.15	0.50	0.80	2.24	0.71
CV (%)	4.52	12.27	3.41	13.28	5.77	2.11	4.39	12.84	7.32
F value	*	**	**	NS	**	**	NS	NS	
Total yield at 90 days (t/ha)									
K Jyoti	19.72*	30.22	23.76	17.30	33.43	31.35	31.60	31.35	27.34
K Pushkar	17.41	31.27	25.81**	17.09	33.87	34.38**	36.0**	36.24	29.01
MS/51543	18.66	41.40**	28.82**	15.40	39.65**	39.43**	39.7**	33.52	32.08**
Site Mean	18.60	34.30	26.13	16.60	35.65	35.05	35.80	33.70	29.48
SE	0.66	1.35	0.42	0.98	0.68	0.05	1.18	2.02	0.64
CV (%)	5.02	5.57	2.30	8.36	2.70	0.20	4.65	8.47	4.66
F value	*	**	**	NS	**	**	**	NS	
Marketable yield at 90 days (t/ha)									
K Jyoti	18.64	22.94	22.46	15.73	32.06	30.66	29.69	28.07	25.03
K Pushkar	16.25	23.11	24.44*	15.97	33.37	33.44**	33.3**	32.8*	26.59
MS/51543	17.24*	34.63**	27.26**	13.26	37.29*	38.75**	37.3**	28.44	29.28**
Site Mean	17.38	26.89	24.72	14.99	34.24	34.28	33.4	29.77	26.97
SE	0.56	0.64	0.64	1.41	1.79	0.18	1.12	1.93	0.83
CV (%)	4.52	3.37	3.65	13.34	7.40	0.76	4.75	9.17	5.87
F value	*	**	**	NS	NS	**	**	NS	

*BHN= Bhubaneswar, DHL= Dholi, FZB= Faizabad, JRH=Jorhat, KAL=Kalyani, PAS= Pasighat, PAT= Patna, KAN= Kanpur * Significant at the level P=0.05. ** Significant at the level P=0.01.*

Table 7. Mean squares (MS) variation for total tuber yield and marketable yield (at 75 and 90 days) at North-Central and North-Eastern plains

Source of variation	Mean sum of square values								
	d.f	Northern plains				d.f.	North Eastern plains			
		Total yield at 75 days (t/ha)	Marketable yield at 75 days (t/ha)	Total yield at 90 days (t/ha)	Marketable yield at 90 days (t/ha)		Total yield at 75 days (t/ha)	Marketable yield at 75 days (t/ha)	Total yield at 90 days (t/ha)	Marketable yield at 90 days (t/ha)
Variety	4	21.9^{ns}	15.06^{ns}	44.9^{ns}	37.0^{ns}	2	33.1*	27.7*	46.3*	36.9*
Environment	3	13.3^{ns}	25.5^{ns}	263.3**	249.0**	7	160.4**	160.5**	191.0**	170.2**
Variety x Environment	12	9.80**	7.90**	13.9**	13.1**	14	5.7*	4.79^{ns}	7.4**	9.0**
Environ. + (Variety x Environ)	15	10.5**	11.43**	63.84**	60.31**	21	57.34**	56.71**	68.64**	62.79**
Environ (L)	1	40.0**	76.7**	789.9**	747.1**	1	1123.2**	1123.9**	1337.0**	1191.6**
Environ x Variety (L)	4	21.5**	4.19^{ns}	30.5*	23.6**	2	4.49^{ns}	2.14^{ns}	26.6**	20.3*
Pooled deviation	10	3.1**	7.8**	4.5**	6.2**	18	4.0**	3.4**	2.8**	4.7**
Pooled Error	48	2.01**	1.93**	1.56**	1.65**	48	3.05*	2.97^{ns}	2.33^{ns}	2.83^{ns}

Significant at 5% level for G, E was tested against G x E interaction; Significant at 5% level for G (L) and G x E (L) was tested against pooled deviation;
Significant at 5% level for G x E, E+ (G x E)was tested against pooled error.
* Significant at the level P=0.05. * Significant at the level P=0.01.

Table 8. Mean, regression coefficient and stability index for total tuber yield and marketable yield (at 75 and 90 days) at North-Central and North-Eastern plains

Variety	Northern plains											
	Total yield at 75 days (t/ha)			Marketable yield at 75 days (t/ha)			Total yield at 90 days (t/ha)			Marketable yield at 90 days (t/ha)		
	x	b_i	S^2d_i	x	b_i	S^2d_i	x	b_i	S^2d_i	x	b_i	S^2d_i
K Badshah	26.92	-0.445	-0.137	24.50	0.547	6.021*	35.76	0.753	10.90**	33.43	0.709	13.06**
K Bahar	28.33*	0.602	1.939*	25.96*	0.333	-0.435	36.18	0.872	0.884	32.32	1.003	3.094
K Pushkar	31.23	2.200**	0.638	27.87**	1.477	1.957**	41.96**	1.327	2.280	38.02**	1.275	1.900
K Sadabahar	25.86	-0.529	8.755**	23.85	1.261	11.19**	35.69	0.482	1.863	33.57	0.521	4.219*
MS/5-1543	30.75**	3.173*	2.009	28.18**	1.383	17.87**	42.02**	1.567	4.866**	39.07**	1.493	7.119**
Mean	28.63	1.00		26.08	1.00		38.33	1.00		35.29	1.00	
SE	1.020	0.626		1.61	0.713		1.23	0.170		1.45	0.205	
Eastern plains												
K Jyoti	22.48	0.902	2.907	20.31	0.933	2.994	27.34	0.767	0.265	25.03	0.780	0.749
K Pushkar	24.76	0.980	1.055	22.21	0.985	1.017	29.01	0.978	2.597*	26.59	0.988	3.648*
MS/5-1543	26.54**	1.118	5.749**	24.00**	1.082	4.226	32.08**	1.254	3.927	29.28**	1.232	7.854**
Mean	24.60	1.00		22.15	1.00		29.48	1.00		26.97	1.00	
SE	0.76	0.103		0.71	0.097		0.64	0.080		0.83	0.110	

x= Mean, b_i= regression coefficient, S^2di= stability index

* Significant at the level P=0.05. * Significant at the level P=0.01.

VARIETAL EVALUATION TO IDENTIFY TOP THREE PROMISING VARIETIES

The stability of four commercial cultivars K. Jyoti, K. Pushkar, K. Khyati and K. Pukhraj (Table 9) for total and marketable yield at 75 and 90 days of harvest was studied at ten locationsviz., Bhubaneswar (Odisha), Dholi (Bihar), Jalandhar (Punjab), Jorhat (Assam), Kalyani (West Bengal), Kanpur (Uttar Pradesh), Pasighat (Arunachal Pradesh), Patna (Bihar), Pantnagar (Uttarakhand) and Pune (Maharashtra) using two year's data of 2013-14 and 2014-15 (Table 10). The total tuber yield (t/ha) and marketable yield (t/ha) were recorded at 75 and 90 days after planting and were analyzed in two steps. In the first step a classical one-way ANOVA for each trait to determine differences among cultivars in all the ten locations was carried and the means were compared using Duncan's multiple range test. In the second step, pooled ANOVA for all the sites was carried out. Stability analysis (genotype x environment interaction) for total and marketable yield was performed according Eberhart and Russell method. Stability parameters calculated were regression coefficient (bi) and deviation from regression coefficient (S^2d). Genotypes were considered as fixed effects and the locations were considered as random effects. Mean square deviations from linear regression response were used to compare magnitude of S.E (bi) as a method in which average yield of each genotype at each location was used as an environmental index for subsequent regression analysis.

Among the ten locations tested, a significant difference among the genotypes for total and marketable yield at 75 days crop duration was observed at Jalandhar, Pasighat and Pune. However, at Kalyani and Kanpur no significant difference among cultivars was observed both for total and marketable yields (Table 10). The cultivar, K. Khyati recorded the highest mean yield (27.26 t/ha) and marketable yield (25.24 t/ha) at 75 days of harvest across locations, and was followed by K. Pukhraj which was at par (27.26 and 24.88 t/ha, respectively). The cultivar K. Khyati recorded significant higher total yield at five locations at 75 days as compared to K. Phukraj (4 locations) and K. Phuskar (4 locations). The locations such as Pasighat (42.46 t/ha), Jalandar (37.26 t/ha) and Patnagar (30.77 t/ha) were classified as high yielding environments for total yield as against the poor yielding environments like Pune (17.79 t/ha), Dholi (17.72 t/ha) and Bhubaneswar (19.05 t/ha).

At 90 days harvest, K. Khyati recorded significantly higher yield at seven locations both for total (31.23 t/ha) as well as marketable yield (28.19 t/ha), followed by the cultivar K. Pushkar and K. Pukhraj (Table 11). Among the ten locations, eight locations exhibited significant yield difference among the cultivars, however Pasighat recorded non-significant difference among the cultivars despite the higher total and marketable yield obtained at the centre (42.81t/ha and 42.52t/ha, respectively). Locations like Jalandhar (46.58 t/ha), Pasighat (42.8 t/ha) and Pantnagar (34.15 t/ha) were found to be the high yielding environments for total yield while Jalandhar, Pasighat and Kalyani were found to be the high yielding environments for marketable yield at 90 days of harvest. The poor yielding environments were Pune, Dholi and Bhubaneswar for both total and marketable tuber yields.

The pooled analysis of variance showed that the cultivar and environment mean square differences were highly significant for both the traits when tested against G x E interactions

(Table 12). The mean squares due to G x E interaction were highly significant when tested against pooled error for total and marketable yield at 90 days; however there was a non-significant G x E interaction for total and marketable yield at 75 days of harvest.

The studies showed that the G x E interaction is of cross over type since the ranking of cultivars changed at every location. Hence, apportioning of G xE interaction into linear (E + G x E) and non linear (Pooled deviations) components was carried out.The mean squares due to environment (linear) were highly significant for both the traits at 75 days and 90 days of harvest. Both the yields recorded a significant G x E (linear) interaction, except total yield at 75 days of harvest.

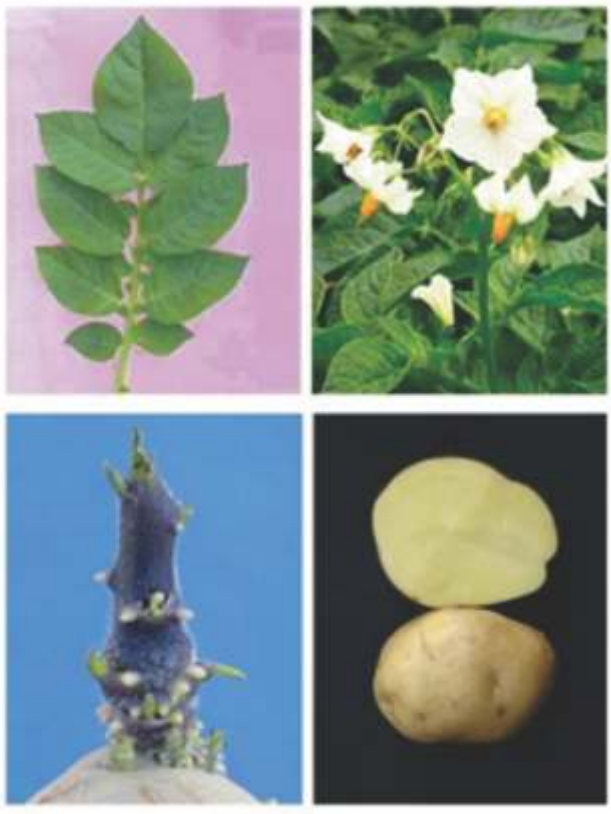
The stability analysis using mean, regression coefficient and stability index for total and marketable yield at 75 and 90 days of harvest are presented in (Table 13). Stability parameters are: (1) the mean (x) for different traits, (2) the regression coefficient (bi) of the performance on environmental indices, (3) the squared deviation (S^2d) from regression developed for simultaneous selection for yield and stability. Based on the mean yield, except K. Jyoti all the other three cultivars viz. K. Khyati, K.Pukhraj and K. Pushkar recorded above average mean yield than the location mean yield. However, K. Khyati recorded the highest above average mean yield for both total (27.45 t/ha, 31.23 t/ha) and marketable tuber yields (25.24 t/ha, 28.19 t/ha) at 75 and 90 days crop durations.

Analysis of the stability parameters of the individual cultivar depicted non-linear response for significant G x E interaction for all the cultivars for both the traits. For total and marketable yield at 75 days of harvest, K. Pukhraj recorded greater above mean yield, having regression coefficient value equal to unity (bi=1.004; bi=0.996) and non-significant mean square for deviations from regression nearing zero (S^2di=0.480; S^2di=0.463) indicating its high stability and wider adaptability across the environments. K. Khyati on the other hand, recorded greater mean yield with regression coefficient value slightly greater than unity (bi=1.104; bi=1.108) and non significant mean square for deviations from regression nearing zero (S^2di=0.646; S^2di=0.567) which showed its high stability and wider adaptability in the favourable environments only. Although, the cultivar K. Jyoti exhibited low mean performance, its regression value near to unity (bi=1) and non significant deviation from regression (S^2di=0) indicated its high stability and wider adaptability across the environments. The cultivar K. Pushkar, despite having greater above average yield and regression coefficient nearing unity, the greater deviation from regression (S2di) reveals its unpredictable stability. Similarly for total and marketable yield at 90 days, the cultivars K. Pukhraj and K. Pushkar recorded greater above average yield, regression coefficient value slightly greater and lesser than unity respectively and greater deviation from regression. However, K Khyati had above average mean yield, regression coefficient value slightly greater than unity (bi=1.072) and minimum deviations from regression nearing zero (S^2di=0.197) which showed its high stability and wider adaptability across environments.

Table 9. General traits of the potato cultivarsused in the present study

Sl. No	Cultivars	Parentage	Maturity	Tuber traits
1.	K Jyoti	3069d(4) x 2814a(1)	Medium	White cream, ovoid with shallow eyes and cream flesh
2	K Pushkar	QB/A-9-120 x Spartz	Medium	Yellow, ovoid with medium -deep eyes and cream flesh
3	K Khyati	MS/82-638 x K Pukhraj	Early	White cream, ovoid with medium -deep eyes and white-cream flesh
4	K Pukhraj	Craige Defian ce x JBX/B-687	Early to Medium	Yellow, ovoid with medium -deep eyes and yellow flesh

Kufri Khyati



Kufri Pukhraj

Table 10. Mean total and marketable yields (t/ha) of potato cultivars at 75 days crop duration across ten environments

Cultivars	Growing Environments										Genotypic Mean
	BHN	DHL	JAL	JRH	KAL	KAN	PAS	PAT	PNT	PUN	
Total yield (t/ha) at 75 days											
K Jyoti	18.16	14.94	32.64	23.96	23.91	26.23	39.75	22.92	28.89	16.20	24.80
K Pushkar	19.77*	20.32*	39.61**	23.94	27.80	25.13	42.37	25.90	29.30	17.64*	27.18
K Khyati	19.81*	17.54	39.77**	27.46*	25.64	26.77	44.80**	23.09	32.01	17.66*	27.45
K Pukhraj	18.45	18.07	37.13**	25.89	27.28	25.29	42.91*	26.33*	32.87	18.44**	27.26
Site Mean	19.05	17.72	37.29	25.31	26.16	25.86	42.46	24.56	30.77	17.49	26.67
SE	0.40	1.21	0.26	0.97	1.25	1.40	0.79	0.98	1.40	0.39	0.905
CV (%)	2.56	8.35	0.84	4.69	5.45	6.61	2.27	4.89	5.57	2.72	4.51
F value	*	*	**	*	NS	NS	**	*	NS	**	
LSD (0.05%)	1.38	4.18	0.89	3.35	4.03	4.83	2.73	3.39	4.85	1.35	3.39
Marketable yield (t/ha) at 75 days											
K Jyoti	17.60	12.60	31.55	19.26	22.62	22.83	37.79	19.65	25.32	15.33	22.46
K Pushkar	18.91**	16.44*	37.38**	18.91	29.44	22.38	41.35**	21.60	25.02	16.72*	24.81
K Khyati	18.88**	15.18	38.78**	22.33*	24.78	23.01	43.59**	19.63	29.42	16.76*	25.24
K Pukhraj	17.70	15.38	35.46**	21.11	26.06	21.49	41.52**	22.56	30.05	17.49**	24.88
Site Mean	18.27	14.90	35.79	20.40	25.73	22.43	41.06	20.86	27.45	16.58	24.35
SE	0.17	0.92	0.26	0.75	2.18	1.65	0.50	1.99	1.51	0.38	1.031
CV (%)	1.17	7.52	0.89	4.47	10.39	9.03	1.48	11.69	6.74	2.82	6.29
F value	**	*	**	*	NS	NS	**	ns	*	**	
LSD (0.05%)	0.61	3.17	0.90	2.58	7.55	5.72	1.72	6.89	5.22	1.32	4.32

BHN= Bhubaneswar, DHL= Dholi, JA=Jalnadhar, JRH=Jorhat, KAL=Kalyani, KAN= Kanpur , PAS= Pasighat, PAT= Patna, PNT=Pantnagar

** Significant at the level P=0.05. * Significant at the level P=0.01.*

Table 11. Mean total and marketable yields (t/ha) of potato cultivars at 90 days crop duration across ten environments

Cultivars	Growing Environments										Genotypic Mean
	BHN	DHL	JAL	JRH	KAL	KAN	PAS	PAT	PNT	PUN	
Total yield (t/ha) at 90 days											
K. Jyoti	18.92	15.10	40.65	24.59	28.55	32.67	40.25	28.76	32.34	16.53	27.83
K. Pushkar	21.67**	23.29**	49.66**	25.98**	35.07**	30.48	42.98	30.32	32.38	18.23**	31.00
K. Khyati	20.49**	18.86**	49.28**	23.75	34.28**	35.01*	44.87	31.47	36.20*	18.09*	31.23*
K. Pukhraj	17.64	14.38	46.71**	24.51	37.13**	38.16**	43.15	33.02	35.67	18.67**	30.90
Site Mean	19.68	17.91	46.58	24.71	33.76	34.08	42.81	30.89	34.15	17.88	30.24
SE	0.46	0.50	0.71	0.34	0.54	1.22	1.52	1.71	1.00	0.31	0.831
CV (%)	2.87	3.41	1.87	1.70	1.98	4.40	4.36	6.79	3.59	2.13	3.89
F value	**	**	**	**	**	**	ns	ns	*	**	
LSD (0.05%)	1.60	1.72	2.47	1.19	1.88	4.24	5.27	5.93	3.46	1.08	3.33
Marketable yield (t/ha) at 90 days											
K. Jyoti	18.24	12.88	38.61	19.20*	27.89	28.43	39.67	25.06	29.28	15.92	25.51
K. Pushkar	20.82**	19.46**	47.64**	18.12	33.58**	25.59	42.31	25.58	29.16	17.58**	27.98
K. Khyati	19.57**	14.79*	47.85**	17.85	32.97*	30.46*	44.07	23.69	33.26*	17.45*	28.19
K. Pukhraj	16.88	12.07	45.40**	18.88	34.83**	28.85	44.01	29.34*	32.71*	17.98**	28.09
Site Mean	18.88	14.80	44.88	18.51	32.32	28.33	42.52	25.92	31.10	17.23	27.44
SE	0.39	0.78	0.60	0.38	1.05	1.15	2.07	1.18	0.98	0.30	0.888
CV (%)	2.52	6.43	1.63	2.51	3.98	4.97	5.97	5.59	3.88	2.10	4.56
F value	**	**	**	*	**	*	ns	*	**	**	
LSD (0.05%)	1.35	2.69	2.07	1.31	3.63	3.98	7.18	4.09	3.41	1.02	3.54

BHN= Bhubaneswar, DHL= Dholi, JAL-Jalnadhar, JRH=Jorhat, KAL=Kalyani, KAN= Kanpur, PAS= Pasighat, PAT= Patna, PNT=Pantnagar

* Significant at the level P=0.05. * Significant at the level P=0.01.

Table 12. ANOVA based on means over replicates for total tuber yield and marketable yield (at 75 and 90 days)

Source of variation	d.f.	Mean sum of square values			
		Total yield at 75 days (t/ha)	Marketable yield at 75 days (t/ha)	Total yield at 90 days (t/ha)	Marketable yield at 90 days (t/ha)
Variety	3	15.67**	16.23**	25.97**	16.67*
Environment	9	269.68**	284.37**	406.53**	439.18**
Variety x Environment	27	2.20	2.63	5.38**	5.044**
Environ. + (Variety x Environ)	36	69.07	73.07	105.6	113.57
Environ (L)	1	2427.1**	2559.3**	3658.7**	3952.64**
Environ x Variety (L)	3	3.83	5.09*	10.23*	12.3*
Pooled deviation	32	1.49**	1.74**	3.58**	3.09**
Pooled Error	60	1.47	2.34	1.38	1.56

Significant at 5% level for G, E was tested against G x E interaction; Significant at 5% level for G (L) and G x E (L) was tested against pooled deviation; Significant at 5% level for G x E, E+ (G x E)was tested against pooled error. Significant at the level P=0.05. * Significant at the level P=0.01.*

Table 13. Stability parameters for total tuber yield and marketable yield (at 75 and 90 days) across ten environments

Variety	North-Central plains											
	Total yield at 75 days (t/ha)			Marketable yield at 75 days (t/ha)			Total yield at 90 days (t/ha)			Marketable yield at 90 days (t/ha)		
	x	b_i	S^2d_i	x	b_i	S^2d_i	x	b_i	S^2d_i	x	b_i	S^2d_i
K. Jyoti	24.80	0.913	1.038	22.46	0.890	0.407	27.83	0.890	2.004	25.51	0.856	1.931
K. Pushkar	27.18	0.978	1.860	24.81	1.007	2.428	31.00	0.931	6.066*	27.98	0.996	4.780*
K. Khyati	27.45	1.104	0.646	25.24	1.108	0.567	31.23	1.072	0.197	28.19	1.091	1.117
K. Pukhraj	27.26	1.004	0.480	24.88	0.996	0.463	30.90	1.107	4.225*	28.09	1.087	2.461
Mean	26.67	1.00		24.35	1.00		30.24	1.00		27.44	1.00	
SE	0.41	0.050		0.44	0.052		0.63	0.063		0.59	0.056	

*x= Mean, b_i = regression coefficient, S^2di= stability index; * Significant at the level P=0.05. * Significant at the level P=0.01.*

VARIETAL EVALUATION FOR PRODUCTION OF BABY / SALAD POTATOES (SPECIALTY POTATO)

Tuber size distribution is a genetic character but is also affected by environmental factors. Temperature is one of the important environmental factors affecting the tuber size and high mean seasonal temperatures have been reported to lead to higher small sized tuber yields. Therefore, locations with higher temperatures can be target locations for the production of baby potatoes. Field experiments were therefore, conducted at Bhubaneshwar and Raipur during 2014-15 to 2015-16 with four high yielding cultivars viz. K. Khyati, K. Himsona, K.Pukhraj and K. Pushkar to evaluate the potential of these varieties for baby potato production. The crop was grown under optimum conditions adopting recommended package of practices and harvesting was done at 60, 75 and 90 days after planting. At harvest, the tubers were graded into small (10.0-25.0g), medium (25.0-50.0g), and large (>50.0g) grades and their yield was recorded.

The results showed that the main effect of cultivars and its interaction with location was highly significant for all the traits under study. The harvesting stage also had strong effect on total yield, gradewise yield and dry matter per cent (Table 14). The interaction effect of location and harvesting stage was also highly significant on tuber yield of 20-50g and >50g grades, total yield and dry matter content.

Genotypic effect

Raipur recorded higher yield of 10-25g category (5.53 t/ha) across cultivars, which was almost double of that at Bhubaneswar (2.25 t/ha). The best cultivar was K. Khyati (4.23 t/ha) followed by K. Pukhraj (4.06 t/ha). Harvesting at 75 days found to be more effective in realizing greater tuber yield of 10-25g in all cultivars, except K. Himsona in which higher yield of this grade tubers was obtained at 90 DAP. Similarly, the higher tuber yield of 25-50g across cultivars was also observed at Raipur (9.46 t/ha), which was almost double that at Bhubaneswar (4.38 t/ha). The cultivar K. Pushkar recorded the highest yield (10.47 t/ha) at Raipur, followed by K. Khyati (9.48 t/ha). At 75 DAP higher yield (7.41 t/ha) of tuber size 25-50g was obtained across locations and cultivars while K. Phuskar recorded greater yield (7.64 t/ha) across harvesting stage.

With regard to large tuber size, Raipur recorded higher yield of above 50g grade yield (8.45 t/ha) across cultivars followed by K. Pukhraj (7.99 t/ha) and K. Pushkar (7.89 t/ha). Higher total tuber yield was also obtained at Raipur (23.45 t/ha), which was almost double than that at Bhubaneswar across cultivars tested (11.88 t/ha). Although, the cultivar K. Pushkar recorded higher total yield (26.11 t/ha) at Raipur, the highest yield across locations was obtained in K. Khyati (19.21 t/ha). K. Khyati gave the highest yield (19.21 t/ha) across harvesting stage at 90 DAP. Similar to yield, the tuber dry matter content was also higher at Raipur (17.58%) across cultivars and K.Pushkar had higher dry matter content across locations (17.34%) followed by K. Himsona (16.86%). Harvesting at 90DAP invariably recorded higher tuber dry matter content across cultivars (17.54%).

The desirable traits for baby potatoes are viz., high tuber yield of (25-50g), tubers, round tubers, yellow flesh, low dry matter content (about 18%) etc. The results show that variety, K. Pushkar followed by K. Khyati and K. Pukhraj are most suitable. The 75 days crop duration is most suitable for getting highest yields of baby potatoes and among 2 warmer locations viz., Bhubaneswar and Raipur the later location resulted in higher yields.

Table 14. Performance of varieties for baby tuber production over locations and years for following traits:

A.Tuber yield (10-25g) (t/ha) and Tuber yield (25-50g) (t/ha)

Factors	Bhubaneswar			Raipur			Mean
	60DAP	75DAP	90DAP	60DAP	75DAP	90DAP	
Tuber yield (10 -25g) (t/ha)							
K Khyati	2.500	2.407	2.050	5.893	6.933	5.637	4.2 37
K Himsona	1.967	1.790	2.027	5.213	5.830	6.527	3.892
K Pukhraj	2.190	2.750	2.357	5.643	6.597	4.863	4.067
K Pushkar	2.310	2.303	2.403	4.377	4.573	4.350	3.386
Mean	2.242	2.313	2.209	5.282	5.983	5.344	3.895
CD	L=0.229, C=0.324, HS=0.280, LxC=0.458, LxHS=NS, CxHS=0.561, LxCxHS=NS						
Tuber yield (25 -50g) (t/ha)							
K Khyati	4.420	5.190	4.963	8.153	10.480	10.087	7.216
K Himsona	3.613	3.480	3.620	6.583	7.890	9.743	5.822
K Pukhraj	4.337	4.803	4.487	8.813	11.170	8.457	7.011
K Pushkar	5.350	4.073	4.220	8.563	12.213	11.463	7.647
Mean	4.430	4.387	4.323	8.028	10.438	9.938	6.924
CD	L=0.344, C=0.486, HS=0.421, LxC=0.687, LxHS=0.595, CxHS=0.841, LxHSxC=1.190						

L= Location, C=Cultivars, HS= Harvesting stage, LXC=Location x Cultivars, LXHS=Location x Harvesting stage, CXHS= Cultivars x Harvesting stage, LXCXHS= Location x Cultivars x Harvesting stage

B. Tuber yield (>50g) (t/ha), Total Tuber yield (t/ha) and Tuber DM (%)

Factors	Bhubaneswar			Raipur			Mean
	60DAP	75DAP	90DAP	60DAP	75DAP	90DAP	
Tuber yield (>50g) (t/ha)							
K. Khyati	3.990	6.883	6.803	5.820	8.237	14.833	7.761
K. Himsona	3.087	3.850	3.887	1.307	3.287	6.457	3.646
K. Pukhraj	4.673	7.563	7.097	6.813	8.997	12.850	7.999
K. Pushkar	3.460	5.760	5.900	7.183	8.813	16.813	7.988
Mean	3.803	6.014	5.922	5.281	7.334	12.738	6.848
CD	L=0.414, C=0.585, HS=0.507, LxC=0.828, LxHS=0.717, CxHS=1.014, LxCxHS=1.433						

Total Tuber yield (t/ha)							
K. Khyati	10.907	14.483	13.813	19.870	25.650	30.557	19.213
K. Himsona	8.673	9.120	9.533	13.110	17.003	22.727	13.361
K. Pukhraj	11.197	15.120	13.937	21.267	26.167	26.760	19.075
K. Pushkar	11.120	12.140	12.523	20.123	25.600	32.627	19.022
Mean	10.474	12.716	12.452	18.593	23.105	28.167	17.668
CD	L=0.845, C=1.195, HS=1.035, LxC=1.691, LxHS=1.464, CxHS=2.071, LxCxHS=NS						
Tuber DM (%)							
K. Khyati	14.487	15.730	16.443	17.100	17.717	18.733	16.702
K. Himsona	15.143	16.093	16.813	16.533	17.800	18.833	16.869
K. Pukhraj	15.010	15.177	15.377	16.483	17.217	17.700	16.161
K. Pushkar	16.130	17.167	17.857	16.817	17.517	18.567	17.343
Mean	15.193	16.042	16.623	16.733	17.563	18.458	16.769
CD	L=0.090, C=0.127, HS=0.110, LxC=0.180, LxHS=0.156, CxHS=0.220, LxCxHS=0.311						

L= Location, C=Cultivars, HS= Harvesting stage, LXC=Location x Cultivars, LXHS=Location x Harvesting stage, CXHS= Cultivars x Harvesting stage, LXCXHS= Location x Cultivars x Harvesting stage

RABI SEASON TRIALS

ON FARM TRIAL WITH EARLY AND MEDIUM MATURING HYBRIDS

The data obtained over locations was pooled across zones.

NORTHERN PLAINS

In the northern plain locations viz., Hisar, Jalandhar and Modipuram the results with common two hybrids viz., MS/6-1947 and PS/06-88 and two controls viz., Kufri Pukhraj and Kufri Khyati showed that Kufri Pukhraj was the best for both total and marketable tuber yields at 60 and 90 days crop durations while at 75 days crop duration, MS/6-1947 was the best yielder, though the differences among hybrids and controls were non-significant (Table 15).

Table 15: Total and marketable tuber yield (t/ha) & dry matter (%) in 60, 75 and 90 days crop Centres: HIS, JAL, MDP

Hybrid/ variety	Total yield (t/ha)	Marketable yield (t/ha)	Total yield (t/ha)	Marketable yield (t/ha)	Dry Matter (%)	Total yield (t/ha)	Marketable yield (t/ha)	Dry Matter (%)
	60 days		75 days			90 days		
MS/61947	20.78	18.95	33.81	31.51	14.27	42.29	39.14	14.50
PS/0688	15.74	14.65	25.85	23.47	16.54	33.41	30.88	17.03
K Khyati	19.79	17.65	30.77	28.64	15.07	37.96	35.00	16.20
K Pukhraj	21.34	18.26	31.94	28.71	14.99	43.03	39.92	16.12
SEd	1.75	1.95	2.83	2.85	0.81	3.56	3.40	1.09
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	11.06	13.75	11.32	12.42	6.54	11.14	11.50	8.35

EASTERN PLAINS

In the eastern zone i.e. Dholi, Faizabad, Jorhat, Kalyani, Kanpur and Patna the hybrid, MS/6-1947 was the best for both total and marketable tuber yield but the differences among hybrids and controls were non-significant (Table 16) for all traits viz., total tuber yield, marketable yield and dry matter (%).

Table 16: Total and marketable tuber yield (t/ha) & dry matter (%) in 60, 75 and 90 days crop

Centres : DHL, FZB, JRH, PAT, KAL, KAN
At 60 days : All centers except Patna
At 75 & 90 Days : All Above centers
Dry Matter 90 days : All Above centers except Kalyani

Hybrid/ variety	Total yield (t/ha)	Marketable yield (t/ha)	Total yield (t/ha)	Marketable yield (t/ha)	Dry Matter (%)	Total yield (t/ha)	Marketable yield (t/ha)	Dry Matter (%)
	60 days		75 days			90 days		
MS/6-1947	15.66	12.75	22.62	18.75	18.17	28.77	24.16	18.78
PS/06-88	14.06	11.56	19.93	16.73	17.08	25.74	21.30	19.11
K Khyati	14.72	11.58	21.93	17.89	17.04	26.96	22.24	17.78
K Pukhraj	15.03	12.44	20.71	16.75	17.65	27.32	22.47	18.96
SEd	1.12	0.84	1.23	0.94	0.85	1.76	1.25	0.56
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	11.87	10.99	10.01	9.30	8.43	11.23	9.58	4.72

CENTRAL PLAINS: In central zone *viz.*, Deesa, Chhindwara and Raipur only the total tuber yields at 60 days and 90 days were significant and the hybrid, MS/6-1947 yielded statistically at par with the best control, Kufri Khyati and Kufri Pukhraj, respectively (Table 17).

Table 17: Total and marketable tuber yield (t/ha) & dry matter (%) in 60, 75 and 90 days crop

Centres : CHN, DES, RPR

Marketable yield : All Above centers except Raipur

Hybrid/ variety	Total yield (t/ha)	Marketable yield (t/ha)	Total yield (t/ha)	Marketable yield (t/ha)	Dry Matter (%)	Total yield (t/ha)	Marketable yield (t/ha)	Dry Matter (%)
	60 days		75 days			90 days		
MS/6-1947	20.63	18.25	30.48	34.63	16.21	42.41	44.71	17.41
PS/06-88	14.47	13.55	22.34	26.82	17.12	28.73	33.29	18.15
K Khyati	19.24	18.74	28.73	34.06	16.40	39.73	43.14	17.90
K Pukhraj	18.13	16.46	26.81	31.00	17.05	40.26	42.95	17.70
SEd	1.25	1.92	2.40	3.54	1.53	3.41	6.02	0.76
CD (0.05)	3.12	NS	NS	NS	NS	8.52	NS	NS
CV (%)	8.46	11.48	10.85	11.18	9.16	11.07	14.69	4.29

TRIAL WITH TABLE POTATO HYBRIDS

The data obtained over locations was pooled across zones for 3 traits viz., total tuber yield (t/ha), marketable tuber yield (t/ha) and dry matter content (%).

NORTHERN PLAINS: Four hybrids viz., J/6-182, MS/07-645, MS/08-1148 and PS/05-75, and 3 controls viz., K. Pukhraj, K. Khyati and K. Himalini were evaluated at 3 locations viz., Hisar, Jalandhar and Modipuram for 2 crop durations i.e. 75 and 90 days. At 75 days crop duration, K. Pukhraj was the best control for both total and marketable yields. Only MS/07-645 could yield statistically at par with the best control. Regarding dry matter content, K. Himalini was the best control and hybrids, J/6-182 and PS/05-75 had at par dry matter (Table 18).

At 90 days crop duration (Table 19), K. Khyati was the best control for both total and marketable yields and none were statistically at par with the best control. Regarding dry matter content, K. Himalini was the best control and all 4 hybrids, J/6-182, MS/07-645, MS/08-1148 and PS/05-75 had at par dry matter content.

Table 18 : Evaluation of Advanced hybrids for table purposes at 75 days after planting

Hybrids/ Locations	Hisar	Jalandhar	Modipuram	Means
		Total Yield (t/ha)		
J/6-182	31.80	38.98	28.80	33.19
MS/7-645	30.73	42.64	37.49	36.96
MS/8-1148	21.55	44.08	37.01	34.21
PS/5-75	16.87	36.76	31.16	28.27
K Himalini	27.83	45.84	34.17	35.94
K Khyati	28.97	50.01	34.99	37.99
K Pukhraj	26.31	49.73	38.46	38.16
K Sadabahar	22.70	41.49	28.86	31.01
Mean	25.85	43.69	33.87	
CD (5%)	Location = 1.38,	Varieties= 2.26	Location X Varieties= 3.91	

Marketable yield (t/ha)				
J/6-182	28.22	37.60	26.29	30.70
MS/7-645	27.49	40.19	31.12	32.93
MS/8-1148	19.85	41.95	31.72	31.17
PS/5-75	16.73	34.59	28.71	26.68
K Himalini	26.61	44.73	30.28	33.87
K Khyati	27.35	48.24	31.53	35.71
K Pukhraj	24.79	48.48	34.44	35.90
K Sadabahar	20.89	39.91	26.59	29.13
Mean	23.99	41.96	30.09	
CD (5%)	Location = 1.16,	Varieties= 1.90	Location X Varieties= 3.28	
Dry matter content (%)				
J/6-182	15.50	17.43	16.00	16.31
MS/7-645	13.06	14.53	15.07	14.22
MS/8-1148	12.37	14.53	14.35	13.75
PS/5-75	16.15	15.93	18.51	16.87
K Himalini	17.78	15.77	16.60	16.72
K Khyati	15.66	14.90	13.26	14.61
K Pukhraj	15.03	15.20	14.34	14.86
K Sadabahar	18.48	14.83	14.36	15.89
Mean	15.51	15.39	15.31	
CD (5%)	Location = NS,	Varieties= 0.82	Location X Varieties= 1.42	

Table 19 : Evaluation of Advanced hybrids for table purposes at 90 days after planting

Hybrids/ Locations	Hisar	Jalandhar	Modipuram	Means
Total Yield (t/ha)				
J/6-182	32.02	45.93	45.41	41.12
MS/7-645	34.09	50.88	59.02	48.00
MS/8-1148	36.36	45.74	52.67	44.92
PS/5-75	29.12	45.93	45.38	40.14
K Himalini	42.12	50.37	47.29	46.60
K Khyati	39.31	61.07	55.20	51.86
K Pukhraj	37.75	60.60	57.09	51.82
K Sadabahar	29.22	49.87	43.45	40.84
Mean	35.00	51.30	50.69	
CD (5%)	Location = 2.20	Varieties= 3.59	Location X Varieties= 6.22	
Marketable yield (t/ha)				
J/6-182	30.41	43.99	38.75	37.72
MS/7-645	34.84	48.66	49.93	44.48
MS/8-1148	33.79	43.75	44.77	40.77
PS/5-75	27.93	43.06	40.42	37.13
K Himalini	40.87	48.52	41.35	43.58
K Khyati	37.79	59.50	49.00	48.76
K Pukhraj	36.14	58.62	49.48	48.08
K Sadabahar	27.51	48.75	39.22	38.50
Mean	33.66	49.36	44.11	
CD (5%)	Location = 2.04	Varieties= 3.32	Location X Varieties= 5.76	

Dry matter content (%)				
J/6-182	15.85	19.20	16.84	17.30
MS/7-645	15.88	15.93	15.86	15.89
MS/8-1148	14.65	16.23	15.39	15.42
PS/5-75	17.50	18.20	19.01	18.24
K Himalini	18.04	16.13	17.41	17.20
K Khyati	16.60	15.50	15.26	15.79
K Pukhraj	16.96	16.20	17.52	16.89
K Sadabahar	18.50	15.57	15.89	16.65
Mean	16.75	16.62	16.65	
CD (5%)	Location = NS	Varieties= 0.67	Location X Varieties= 1.16	

EASTERN PLAINS

Four hybrids viz., J/6-182, MS/07-645, MS/08-1148 and PS/05-75 and 5 controls viz., K. Ashoka, K. Khyati, K. Lalima, K. Lalit and K. Pukhraj, were evaluated at 3 locations viz., Faizabad, Jorhat and Kalyani during 3 crop durations i.e. 60, 75 and 90 days. At 60 days crop duration (Table 20), K. Pukhraj was the best control for both tuber yields. Only MS/07-645 could yield statistically at par with the best control. Regarding dry matter content, K. Lalit was the best control and none had at par dry matter. At 75 days crop duration (Table 21), K. Pukhraj was the best control for both total and marketable yields and none could yield statistically at par with the best control. Regarding dry matter content, K. Lalit was the best control and none had at par dry matter content. At 90 days crop duration (Table 22), K. Pukhraj was the best control for both total and marketable yields and none could yield statistically at par with the best control. Regarding dry matter content, K. Lalima was the best control and hybrid, J/6-182 had significantly high dry matter content than the best control. Besides, MS/08-1148 and PS/05-75 also had at par dry matter content.

Table 20 : Evaluation of Advanced hybrids for table purposes at 60 days after planting

Hybrids/ Locations	Faizabad	Jorhat	Kalyani	Means
Total Yield (t/ha)				
J/6-182	14.69	15.25	18.89	16.27
MS/7-645	16.56	14.67	22.06	17.76
MS/8-1148	14.32	6.67	18.61	13.20
PS/5-75	4.78	13.74	17.73	12.08
K Ashoka	16.22	14.54	20.78	17.18
K Khyati	15.11	16.71	20.11	17.31
K Lalima	14.54	13.68	19.34	15.85
K Lalit	16.55	7.58	20.50	14.88
K Pukhraj	14.91	21.20	19.50	18.54
Mean	14.19	13.78	19.73	
CD (5%)	Location = 1.03	Varieties= 1.79	Location X Varieties= 3.10	

Marketable yield (t/ha)				
J/6-182	11.78	11.86	18.39	14.01
MS/7-645	13.24	12.63	21.39	15.75
MS/8-1148	11.46	5.71	18.28	11.82
PS/5-75	3.77	11.18	17.06	10.67
K Ashoka	13.01	12.54	20.45	15.33
K Khyati	12.11	14.54	19.89	15.52
K Lalima	11.64	11.88	19.06	14.19
K Lalit	13.24	5.04	20.22	12.84
K Pukhraj	11.90	17.10	18.95	15.98
Mean	11.35	11.39	19.30	
CD (5%)	Location = 0.95	Varieties= 1.65	Location X Varieties= 2.85	
Dry matter content (%)				
J/6-182	14.07	16.90	18.97	16.64
MS/7-645	13.47	16.10	15.63	15.07
MS/8-1148	14.00	16.23	18.13	16.12
PS/5-75	14.17	14.77	18.97	15.97
K Ashoka	13.63	15.20	14.67	14.50
K Khyati	14.07	18.30	18.30	16.89
K Lalima	13.93	17.53	15.30	15.59
K Lalit	14.17	18.00	20.17	17.44
K Pukhraj	14.27	15.87	14.37	14.83
Mean	13.97	16.54	17.17	
CD (5%)	Location = 0.35	Varieties= 0.60	Location X Varieties= 1.04	

Table 21 : Evaluation of Advanced hybrids for table purposes at 75 days after planting

Hybrids/ Locations	Faizabad	Jorhat	Kalyani	Means
Total Yield (t/ha)				
J/6-182	26.02	15.33	26.95	22.77
MS/7-645	29.49	16.09	25.51	23.70
MS/8-1148	25.56	6.08	28.23	19.95
PS/5-75	3.06	14.72	33.73	17.17
K Ashoka	29.01	15.83	29.40	24.74
K Khyati	26.99	16.13	26.06	23.06
K Lalima	26.00	16.37	23.89	22.09
K Lalit	28.45	8.20	27.12	21.26
K Pukhraj	26.58	24.12	27.90	26.20
Mean	24.57	14.76	27.64	
CD (5%)	Location = 1.13	Varieties= 1.96	Location X Varieties= 3.40	

Marketable yield (t/ha)				
J/6-182	22.90	13.61	26.73	21.08
MS/7-645	26.02	12.48	25.06	21.19
MS/8-1148	22.50	2.74	27.84	17.69
PS/5-75	2.69	12.89	31.01	15.53
K Ashoka	25.51	14.25	29.17	22.98
K Khyati	23.78	14.31	25.51	21.20
K Lalima	22.90	14.65	23.67	20.41
K Lalit	25.03	7.49	27.06	19.86
K Pukhraj	23.36	21.64	27.62	24.21
Mean	21.63	12.67	27.08	
CD (5%)	Location = 0.76	Varieties= 1.31	Location X Varieties= 2.26	
Dry matter content (%)				
J/6-182	16.90	16.60	19.47	17.66
MS/7-645	16.17	17.20	16.20	16.52
MS/8-1148	16.83	17.90	18.07	17.60
PS/5-75	17.02	17.67	19.00	17.89
K Ashoka	16.38	18.33	14.20	16.31
K Khyati	16.90	18.83	17.33	17.69
K Lalima	16.72	19.37	19.57	18.55
K Lalit	17.02	19.33	19.70	18.68
K Pukhraj	17.15	16.60	16.27	16.67
Mean	16.79	17.98	17.76	
CD (5%)	Location = 0.30	Varieties= 0.52	Location X Varieties= 0.90	

Table 22 : Evaluation of Advanced hybrids for table purposes at 90 days after planting

Hybrids/ Locations	Faizabad	Jorhat	Kalyani	Means
Total Yield (t/ha)				
J/6-182	31.23	11.53	30.56	24.44
MS/7-645	35.35	11.33	29.68	25.45
MS/8-1148	30.63	3.78	31.56	21.99
PS/5-75	10.32	10.38	34.06	18.25
K Ashoka	34.47	11.00	31.78	25.75
K Khyati	32.43	16.78	30.12	26.44
K Lalima	31.09	8.58	28.17	22.61
K Lalit	35.45	5.21	32.12	24.26
K Pukhraj	31.76	18.66	32.28	27.57
Mean	30.30	10.81	31.15	
CD (5%)	Location = 0.99	Varieties= 1.72	Location X Varieties= 2.97	

Marketable yield (t/ha)				
J/6-182	28.68	10.34	30.23	23.08
MS/7-645	32.46	10.10	29.45	24.00
MS/8-1148	28.15	3.18	31.06	20.80
PS/5-75	9.52	9.29	33.73	17.51
K Ashoka	31.67	10.17	31.23	24.35
K Khyati	29.79	15.48	29.45	24.91
K Lalima	28.66	7.09	27.90	21.22
K Lalit	32.64	4.71	31.78	23.05
K Pukhraj	29.22	16.75	31.62	25.86
Mean	27.87	9.68	30.72	
CD (5%)	Location = 0.91	Varieties= 1.58	Location X Varieties= 2.73	
Dry matter content (%)				
J/6-182	18.30	16.90	21.80	19.00
MS/7-645	18.20	17.67	15.67	17.18
MS/8-1148	18.50	16.37	17.30	17.39
PS/5-75	18.68	17.17	17.43	17.76
K Ashoka	18.20	16.70	16.93	17.28
K Khyati	18.08	17.23	15.80	17.04
K Lalima	18.44	18.97	15.87	17.76
K Lalit	18.59	18.80	14.13	17.17
K Pukhraj	18.67	17.37	16.23	17.42
Mean	18.41	17.46	16.80	
CD (5%)	Location = 0.33	Varieties= 0.57	Location X Varieties= 0.99	

CENTRAL PLAINS

Three hybrids viz., J/6-182, MS/07-645 and MS/08-1148, and 4 controls viz., K. Gaurav, K. Himalini, K. Khyati and K. Pukhraj were evaluated for 3 crop durations i.e. 60, 75 and 90 days. The data was pooled for 3 locations viz., Chhindwara, Gwalior and Raipur for yield at 60 DAP, for 5 locations viz., Chhindwara, Deesa, Gwalior, Kanpur and Raipurfor yield at 75 DAP and 6 locations i.e. Kota as additional location for 90 days yield.

At 60 days crop duration, K. Pukhraj was the best control for both total and marketable yields and none could yield statistically at par with the best control (Table 23). Regarding dry matter content, K. Gaurav was the best control and J/6-182 had at par dry matter. At 75 days crop duration, K. Khyati was the best control for both tuber yields and MS/08-1148 could yield statistically at par with the best control (Table 24). Regarding dry matter content, K. Himalini was the best control and all 3 hybrids had at par dry matter content. At 90 days crop duration, K. Khyati was the best control for both total and marketable yields and none could yield statistically at par with the best control (Table 25). Regarding dry matter content, K. Himalini was the best control and all hybrids had at par dry matter content.

Table 23 : Evaluation of Advanced hybrids for table purposes at 60 days after planting

Hybrids/ Locations	Chhindwara	Gwalior	Raipur	Means
Total Yield (t/ha)				
J/6-182	19.82	10.44	9.19	13.15
MS/7-645	21.44	8.41	15.24	15.03
MS/8-1148	20.88	9.30	19.87	16.69
K Gaurav	25.23	13.85	15.48	18.19
K Himalini	19.17	8.17	6.71	11.35
K Khyati	22.48	19.05	11.98	17.84
K Pukhraj	23.98	18.67	15.09	19.25
Mean	21.86	12.56	13.37	
CD (5%)	Location = 1.13	Varieties= 1.73	Location X Varieties= 2.99	
Marketable yield (t/ha)				
J/6-182	15.85	9.01	9.19	11.35
MS/7-645	17.15	7.59	15.24	13.33
MS/8-1148	16.71	7.54	19.87	14.71
K Gaurav	20.19	12.15	15.48	15.94
K Himalini	15.33	6.95	6.71	9.66
K Khyati	18.32	16.30	11.98	15.53
K Pukhraj	19.19	16.37	15.09	16.88
Mean	17.53	10.85	13.37	
CD (5%)	Location = 1.02	Varieties= 1.55	Location X Varieties= 2.68	
Dry matter content (%)				
J/6-182	16.57	16.74		16.66
MS/7-645	16.55	14.10		15.32
MS/8-1148	16.60	13.38		14.99
K Gaurav	17.00	16.87		16.93
K Himalini	14.82	16.55		15.68
K Khyati	16.50	16.81		16.66
K Pukhraj	16.77	15.66		16.21
Mean	16.40	15.73		
CD (5%)	Location = NS	Varieties= 1.32	Location X Varieties= 1.87	

Table 24 : Evaluation of Advanced hybrids for table purposes at 75 days after planting

PS/5-75 in place of J/6-182 at Kanpur
K Garima & K Bahar in place of K Gaurav & Himalini at Gwalior
K Garima in place of K Gaurav at Deesa

Hybrids/ Locations	Chhindwara	Deesa	Gwalior	Kanpur	Raipur	Means
Total Yield (t/ha)						
J/6-182	23.40	35.48	16.85	10.65	17.86	20.85
MS/7-645	24.29	39.87	19.06	28.47	18.62	26.06
MS/8-1148	25.00	40.19	25.08	25.00	28.16	28.69
K Gaurav	29.73	38.96	22.26	26.85	14.65	26.49
K Himalini	22.78	27.01	23.02	27.78	17.61	23.64
K Khyati	29.76	47.43	22.49	31.02	19.38	30.02
K Pukhraj	25.14	43.11	27.77	31.48	17.56	29.01
Mean	25.73	38.87	22.36	25.90	19.12	
CD (5%)	Location = 2.18		Varieties= 2.57		Location X Varieties= 5.76	
Marketable yield (t/ha)						
J/6-182	20.59	32.97	13.57	6.71	17.29	18.23
MS/7-645	21.37	37.57	17.14	20.14	18.62	22.97
MS/8-1148	21.84	38.42	18.38	17.60	26.36	24.52
K Gaurav	26.16	36.29	19.22	22.59	14.25	23.70
K Himalini	20.05	25.04	20.70	23.66	17.61	21.41
K Khyati	25.39	45.41	18.27	24.54	19.38	26.60
K Pukhraj	22.12	41.56	24.10	26.86	17.56	26.44
Mean	22.50	36.75	18.77	20.30	18.72	
CD (5%)	Location = 2.03		Varieties= 2.41		Location X Varieties= 5.38	
Dry matter content (%)						
J/6-182	18.47	18.20	17.83	13.40		16.98
MS/7-645	18.33	17.17	15.82	12.57		15.97
MS/8-1148	18.53	17.45	17.93	12.87		16.69
K Gaurav	18.13	16.30	17.96	13.47		16.46
K Himalini	17.47	17.32	18.07	13.27		16.53
K Khyati	17.37	15.36	14.97	12.97		15.17
K Pukhraj	17.93	16.54	18.85	12.77		16.52
Mean	18.03	16.90	17.35	13.04		
CD (5%)	Location = 0.61		Varieties= 0.80		Location X Varieties= 1.60	

Table 25 : Evaluation of Advanced hybrids for table purposes at 90 days after planting
PS/5-75 in place of J/6-182 at Kanpur
K Garima & K Bahar in place of K Gaurav & Himalini at Gwalior
K Garima in place of K Gaurav at Deesa

Hybrids/ Locations	Chhindwara	Deesa	Gwalior	Kanpur	Kota	Raipur	Means
Total Yield (t/ha)							
J/6-182	25.14	49.71	26.26	13.19	12.96	19.64	24.48
MS/7-645	30.17	57.37	20.56	33.52	13.52	30.44	30.93
MS/8-1148	27.91	48.04	24.53	28.80	15.51	31.69	29.41
K Gaurav	31.67	51.15	23.13	29.17	18.24	26.19	29.92
K Himalini	25.92	35.36	24.14	29.63	15.97	23.28	25.72
K Khyati	35.11	59.96	27.52	35.65	19.59	33.01	35.14
K Pukhraj	31.03	53.70	27.02	37.04	13.01	24.98	31.13
Mean	29.57	50.75	24.74	29.57	15.54	27.03	
CD (5%)	Location = 3.00		Varieties= 3.24		Location X Varieties= 7.94		
Marketable yield (t/ha)							
J/6-182	23.83	47.73	22.96	9.72	11.67	19.48	22.57
MS/7-645	28.20	55.36	18.83	13.66	9.49	30.37	25.99
MS/8-1148	26.51	46.69	19.09	23.61	14.21	31.37	26.91
K Gaurav	30.07	49.01	20.77	24.96	16.76	25.62	27.87
K Himalini	24.64	33.95	20.85	25.00	14.49	23.15	23.68
K Khyati	33.35	58.40	24.96	27.32	17.13	32.85	32.33
K Pukhraj	29.48	52.31	23.59	22.97	11.58	24.88	27.47
Mean	28.01	49.06	21.58	21.03	13.62	26.82	
CD (5%)	Location = 3.10		Varieties= 3.35		Location X Varieties= 8.19		
Dry matter content (%)							
J/6-182	18.83	19.01	21.95	14.43	18.80		18.61
MS/7-645	19.10	18.70	17.48	13.53	19.20		17.60
MS/8-1148	19.10	19.25	19.95	13.93	19.73		18.40
K Gaurav	18.70	18.18	22.24	13.97	19.37		18.49
K Himalini	18.67	17.84	20.50	14.47	20.37		18.37
K Khyati	18.67	16.67	19.12	14.07	20.10		17.73
K Pukhraj	18.57	17.42	19.42	13.77	19.37		17.71
Mean	18.81	18.15	20.10	14.02	19.56		
CD (5%)	Location = 0.69		Varieties= NS		Location X Varieties= 1.84		

TRIAL WITH PROCESSING HYBRIDS

NORTHERN PLAINS

In northern zone the data over 2 locations viz., Hisar and Modipuram with common three hybrids viz., MP/04-816, MP/09-901, MP/06-39 and four controls viz., Kufri Chipsona-4, Atlantic, K. Chipsona-1 and K. Chipsona-3 was pooled. Both the total and marketable yield differences among hybrids and controls were significant across locations, genotypes and location × genotype (Table 26). At both 75 and 90 days crop durations, K. Chipsona-3 and K. Chipsona-4 were the best controls, respectively. Hybrid, MP/06-39 statistically out-yielded the best control for both total and marketable tuber yields at both crop durations, while MP/09-901 was statistically at par with the best control. At 110 days crop duration, hybrid MP/09-901 was not common for both the locations. K. Chipsona-3 was the best control and MP/06-39 statistically out-yielded the best control for both total and marketable tuber yields.

Table 26 : Evaluation of Advanced hybrids for processing purposes at 75, 90 & 110 days after planting

Hybrids/ Locations	MP/4-816	MP/9-901	MP/6-39	K Chip-4	Atlantic	K Chip-1	K Chip-3	Mean
Total Yield (t/ha) at 75 days								
Hisar	14.95	23.56	33.82	17.03	15.44	11.78	20.45	19.58
Modipuram	28.35	24.23	32.59	25.29	21.34	25.50	27.09	26.34
Mean	21.65	23.90	33.21	21.16	18.39	18.64	23.77	
CD (5%)	Location = 1.05		Varieties= 1.96		Location X Varieties= 2.77			
Marketable yield (t/ha) at 75 days								
Hisar	10.65	19.26	25.95	14.92	13.86	8.41	16.83	15.70
Modipuram	22.27	18.67	25.99	20.55	18.10	17.81	19.11	20.36
Mean	16.46	18.97	25.97	17.74	15.98	13.11	17.97	
CD (5%)	Location = 0.88		Varieties= 1.65		Location X Varieties= 2.34			
Total Yield (t/ha) at 90 days								
Hisar	23.36	29.04	43.09	25.66	19.49	19.45	25.46	26.51
Modipuram	35.15	33.31	38.49	32.06	24.87	32.43	32.18	32.64
Mean	29.25	31.17	40.79	28.86	22.18	25.94	28.82	
CD (5%)	Location = 1.54		Varieties= 2.87		Location X Varieties= 4.06			
Marketable yield (t/ha) at 90 days								
Hisar	16.65	23.73	33.04	22.49	17.48	13.89	21.05	21.19
Modipuram	27.31	27.54	29.32	25.71	20.98	24.05	24.27	25.60
Mean	21.98	25.64	31.18	24.10	19.23	18.97	22.66	
CD (5%)	Location = 1.32		Varieties= 2.46		Location X Varieties= 3.48			
Total Yield (t/ha) at 110 days								
Hisar	43.43		60.29	36.56	27.05	32.38	34.78	39.08
Modipuram	43.25		44.28	37.06	33.52	37.05	40.23	39.23
Mean	43.34		52.28	36.81	30.29	34.72	37.50	
CD (5%)	Location = NS		Varieties= 2.95		Location X Varieties= 4.17			
Marketable yield (t/ha) at 110 days								
Hisar	30.87		46.25	32.01	24.32	23.14	28.59	30.86
Modipuram	35.42		35.39	29.88	29.73	29.92	33.04	32.23
Mean	33.15		40.82	30.95	27.03	26.53	30.82	
CD (5%)	Location = NS		Varieties= 2.55		Location X Varieties= 3.61			

CENTRAL PLAINS

In the central zone the data over 5 locations viz., Chhindwara, Gwalior, Kanpur, Kota and Raipur with common three hybrids viz., MP/04-816 and MP/06-39 and three controls viz., Kufri Chipsona-4, K. Chipsona-1 and K. Chipsona-3 were pooled. Both the total and marketable yield differences among hybrids and controls were significant across locations, genotypes and location × genotype. At both 75 and 90 days crop (Table 27) durations, K. Chipsona-4 was the best control and none of the hybrids could out-yield the best control though hybrid, MP/06-39 yielded at par with the best control at 90 days crop duration. At 110 days crop duration, K. Chipsona-4 was the best control for total tuber yield and MP/06-39 statistically out-yielded the best control. Regarding dry matter content, K. Chipsona-4 was the best control for all crop durations and none of the hybrids recorded higher dry matter than the best control.

Table 27 : Evaluation of Advanced hybrids for processing purposes at 75 days after planting

Hybrids/ Locations	MP/4-816	MP/6-39	K Chip-4	K Chip-1	K Chip-3	Mean
Total Yield (t/ha)at 75 days						
Chhindwara	27.05	28.95	28.52	32.01	28.94	29.09
Gwalior	22.07	23.44	30.03	23.85	24.05	24.69
Kanpur	20.19	14.83	18.47	18.06	25.00	19.31
Kota	11.44	11.39	13.20	11.44	10.51	11.59
Raipur	8.24	9.14	11.72	8.81	4.22	8.43
Mean	17.80	17.55	20.39	18.83	18.54	
CD (5%)	Location = 1.34		Varieties= 1.34		Location X Varieties= 2.99	
Marketable yield (t/ha) at 75 days						
Chhindwara	16.23	17.46	17.11	19.23	17.37	17.48
Gwalior	8.22	10.54	10.92	10.38	7.58	9.53
Kanpur	14.50	12.14	13.72	13.89	20.97	15.04
Kota	9.35	9.54	12.08	9.45	9.40	9.96
Raipur	5.80	7.15	8.72	7.10	3.31	6.42
Mean	10.82	11.36	12.51	12.01	11.73	
CD (5%)	Location = 0.93		Varieties= 0.93		Location X Varieties= 2.07	
Dry matter content (%)at 75 days						
Chhindwara	16.95	17.03	17.20	17.08	16.88	17.03
Gwalior	21.11	19.86	21.91	20.88	18.98	20.55
Kanpur	13.15	13.60	14.33	13.85	15.08	14.00
Kota	20.30	20.13	20.10	20.20	19.77	20.10
Mean	17.88	17.65	18.38	18.00	17.68	
CD (5%)	Location = 0.65		Varieties= NS		Location X Varieties= 1.45	
Total Yield (t/ha)at 90 days						
Chhindwara	33.23	36.24	33.36	34.43	30.55	33.56
Deesa	25.53	34.92	32.26	31.54	33.96	31.64
Gwalior	27.91	28.84	33.45	29.41	27.24	29.37
Kanpur	26.56	18.50	24.72	24.33	31.86	25.19
Kota	14.91	13.66	17.18	12.32	12.69	14.15
Raipur	15.16	11.43	15.75	13.07	12.03	13.49
Mean	23.88	23.93	26.12	24.18	24.72	
CD (5%)	Location = 1.47		Varieties= 1.34		Location X Varieties= 3.29	

Marketable yield (t/ha) at 90 days						
Chhindwara	23.00	25.33	23.30	24.35	21.34	23.46
Deesa	16.32	29.12	24.91	25.29	29.10	24.95
Gwalior	8.74	11.95	11.95	10.06	11.02	10.74
Kanpur	21.97	14.11	19.03	19.94	28.45	20.70
Kota	13.43	11.16	15.42	10.65	11.34	12.40
Raipur	11.74	8.23	11.79	10.30	7.54	9.92
Mean	15.87	16.65	17.73	16.76	18.13	
CD (5%)	Location = 1.23		Varieties= 1.12		Location X Varieties= 2.75	
Dry matter content (%) at 90 days						
Chhindwara	18.48	18.63	18.55	18.55	18.73	18.59
Deesa	18.71	17.75	21.67	20.19	20.83	19.83
Gwalior	25.18	24.19	24.96	26.67	23.45	24.89
Kanpur	13.15	13.60	14.33	13.85	15.08	14.00
Kota	21.80	22.20	21.97	21.80	21.00	21.75
Mean	19.46	19.27	20.30	20.21	19.82	
CD (5%)	Location = 0.83		Varieties= NS		Location X Varieties= 1.85	
Total Yield (t/ha) at 110 days						
Chhindwara	35.23	38.41	35.80	36.41	32.82	35.73
Deesa	30.58	43.15	39.36	40.68	47.48	40.25
Gwalior	37.79	39.59	37.43	31.90	34.78	36.30
Kanpur	28.78	20.83	26.94	19.30	26.91	24.55
Raipur	34.42	18.43	14.67	17.95	22.43	21.58
Mean	33.36	32.08	30.84	29.25	32.88	
CD (5%)	Location = 2.16		Varieties= 2.16		Location X Varieties= 4.82	
Marketable yield (t/ha) at 110 days						
Chhindwara	22.39	18.03	28.18	30.75	28.64	25.60
Deesa	29.12	26.25	24.85	39.28	34.19	30.74
Gwalior	36.47	44.10	11.74	12.93	12.49	23.54
Kanpur	11.17	11.69	22.64	15.05	20.28	16.16
Raipur	13.56	20.97	29.50	14.20	11.51	17.95
Mean	22.54	24.21	23.38	22.44	21.42	
CD (5%)	Location = 1.53		Varieties= 1.53		Location X Varieties= 3.42	
Dry matter content (%) at 110 days						
Chhindwara	19.08	19.25	19.18	19.08	19.23	19.16
Deesa	20.26	19.63	22.89	21.88	21.54	21.24
Gwalior	22.95	21.10	22.98	24.64	22.25	22.78
Kanpur	13.15	13.60	14.33	13.95	13.85	13.78
Mean	18.86	18.40	19.84	19.89	19.22	
CD (5%)	Location = 0.54		Varieties= 0.60		Location X Varieties= 1.20	

EASTERN PLAINS

In the eastern zone the data over 3 locations viz., Bhubaneshwar, Jorhat and Kalyani with two common hybrids viz., MP/04-816 and MP/06-39 and three controls viz., Atlantic, Kufri Chipsona-4, K. Chipsona-1 and K. Chipsona-3 was pooled. Both the total and marketable yield differences among hybrids and controls were significant across locations, genotypes and location × genotype. At 75 days crop durations (Table 28), Atlantic was the best control for tuber yields and both the hybrids yielded at par with the best control. At 90 days crop durations, hybrid, MP/04-816 was common across 4 locations viz., Bhubaneshwar, Dholi, Faizabad and Kalyani. K. Chipsona-3 was the best control for both total and marketable yields and hybrid, MP/04-816 outyielded the best control in both total and marketable yields (Table 29). Also at 90 days crop duration, hybrid, MP/09-901 was common across 4 locations viz., Faizabad, Jorhat, Kalyani and Pasighat. K. Chipsona-1 was the best control for both total and marketableyields. At 110 days crop duration, hybrids, MP/04-816 and MP/09-901 were common across 2 locations viz., Faizabad and Kalyani. K. Chipsona-1 was the best control for both total and marketable yields and none of the hybrid could outyield the best control in both total and marketable yields (Table 30).

Table 28 : Evaluation of Advanced hybrids for processing purposes at 75 days after planting in Eastern plains

Hybrids/ Locations	MP/4-816	MP/6-39	K Chip-4	Atlantic	K Chip-1	K Chip-3	Mean
Total Yield (t/ha)							
Bhubaneswar	6.52	12.01	6.87	11.40	5.36	5.68	7.97
Jorhat	13.17	13.30	11.60	11.28	13.62	12.23	12.53
Kalyani	25.67	19.89	24.67	21.28	23.78	23.12	23.07
Mean	15.12	15.07	14.38	14.65	14.26	13.68	
CD (5%)	Location = 0.38		Varieties= 0.54		Location X Varieties= 0.94		
Marketable yield (t/ha)							
Bhubaneswar	4.62	10.95	6.25	10.58	4.72	4.38	6.92
Kalyani	25.28	19.56	24.23	20.95	23.34	22.89	22.71
Mean	14.95	15.25	15.24	15.77	14.03	13.63	
CD (5%)	Location = 0.34		Varieties= 0.59		Location X Varieties= 0.83		
Dry matter content (%)							
Bhubaneswar	20.17	20.22	22.01	18.64	19.54	16.35	19.49
Jorhat	21.10	21.37	22.50	21.93	20.73	20.67	21.38
Kalyani	20.30	18.27	20.27	21.33	17.30	24.67	20.36
Mean	20.52	19.95	21.59	20.63	19.19	20.56	
CD (5%)	Location = 0.33		Varieties= 0.46		Location X Varieties= 0.80		

Table 29 : Evaluation of Advanced hybrids for processing purposes at 90 days after planting

Hybrids/ Locations	MP/4-816	MP/6-39	K Chip-4	Atlantic	K Chip-1	K Chip-3	Mean
Total Yield (t/ha)							
Bhubaneswar	8.31		6.05	8.30	4.89	8.09	7.12
Dholi	9.36		5.45	4.33	5.53	7.08	6.35
Faizabad	25.40		23.59	22.79	26.79	23.44	24.40
Kalyani	28.95		27.90	25.01	27.67	26.51	27.21
Mean	18.00		15.74	15.11	16.22	16.28	
CD (5%)	Location = 0.44		Varieties= 0.49		Location X Varieties= 0.98		
Marketable yield (t/ha)							
Bhubaneswar	6.21		5.49	7.81	3.92	6.94	6.07
Dholi	8.00		4.65	3.58	4.72	6.36	5.47
Faizabad	20.33		18.79	18.22	21.39	18.74	19.49
Kalyani	28.51		27.51	24.78	27.28	26.28	26.87
Mean	15.76		14.11	13.60	14.33	14.58	
CD (5%)	Location =		Varieties=		Location X Varieties=		
Dry matter content (%)							
Bhubaneswar	20.29		22.53	18.60	19.62	16.44	19.50
Dholi	20.48		18.28	21.15	18.45	20.05	19.68
Faizabad	20.30		20.50	20.17	20.25	20.33	20.31
Kalyani	20.63		19.23	19.30	20.73	19.77	19.93
Mean	20.42		20.14	19.80	19.76	19.15	
CD (5%)	Location = 0.12		Varieties= 0.14		Location X Varieties= 0.28		

Table 30 : Evaluation of Advanced hybrids for processing purposes at 110 days after planting

Hybrids/ Locations	MP/4-816	MP/9-901	K Chip-4	Atlantic	K Chip-1	K Chip-3	Mean
Total Yield (t/ha)							
Faizabad	28.22	29.91	26.02	25.24	29.56	25.78	27.45
Kalyani	30.12	26.95	30.01	27.67	29.23	29.28	28.88
Mean	29.17	28.43	28.01	26.46	29.39	27.53	
CD (5%)	Location = 0.55		Varieties= 0.94		Location X Varieties= 1.33		
Marketable yield (t/ha)							
Faizabad	22.61	23.91	20.79	20.24	23.72	20.68	21.99
Kalyani	29.73	26.62	29.73	27.45	28.95	28.45	28.49
Mean	26.17	25.26	25.26	23.84	26.34	24.57	
CD (5%)	Location = 0.49		Varieties= 0.85		Location X Varieties= 1.20		
Dry matter content (%)							
Faizabad	20.68	20.85	20.90	20.57	20.65	20.73	20.73
Kalyani	19.53	15.93	18.30	19.47	21.40	18.50	18.86
Mean	20.11	18.39	19.60	20.02	21.03	19.62	
CD (5%)	Location = 0.09		Varieties= 0.15		Location X Varieties= 0.21		

ON-FARM TRIALS WITH PROCESSING HYBRIDS

NORTHERN PLAINS

In northern plains, the data was pooled over 2 locations viz., Hisar and Modipuram for both 90 and 110 days crop durations. The yield and dry matter (%) differences among genotypes were non-significant. Kufri Chipsona-1 was the best control for total tuber yield while K. Frysona was the best for French Fry grade yield. Hybrid, MP/04-578 yielded higher French Fry grade yield at 90 days crop duration and total tuber yield at 110 days crop duration (Table 31).

Table 31 : Evaluation of Advanced hybrids for processing purposes at 90 &110 days after planting

Hybrids	Total yield (t/ha)	French fry grade yield (t/ha)	Dry matter (%)	Total yield (t/ha)	French fry grade yield (t/ha)	Dry matter (%)
	90 days			110 days		
MP/4-578	29.30	23.51	18.82	34.79	28.75	20.01
K Chipsona-1	31.01	23.38	20.18	33.37	26.04	21.44
K Frysona	26.66	21.43	20.00	33.23	29.60	22.75
CD (0.05)	NS	NS	NS	NS	NS	NS
SEd	1.59	2.37	0.63	2.32	4.90	1.61
CV (%)	5.48	10.39	3.22	6.87	17.43	7.52

EASTERN PLAINS

In the eastern zone the data was pooled over 5 locations viz., Bhubaneshwar, Dholi, Faizabad, Kalyani and Patna for 90 crop duration and 110 days for Faizabad, Kalyani and Patna. The yield and dry matter (%) differences among genotypes were non-significant and Kufri Chipsona-1 recorded the highest yield and dry matter (%) at both crop durations (Table 32).

Table 32 : Evaluation of Advanced hybrids for processing purposes at 90 &110 days after planting

Hybrids	Total yield (t/ha)	French fry grade yield (t/ha)	Dry matter (%)	Total yield (t/ha)	French fry grade yield (t/ha)	Dry matter (%)
	90 days			110 days		
MP/4-578	17.37	15.06	21.24	24.39	22.19	20.44
K Chipsona-1	23.19	20.30	21.42	27.55	25.35	20.74
K Frysona	19.76	17.35	21.74	25.14	22.39	20.72
CD (0.05)	NS	NS	NS	NS	NS	NS
SEd	3.07	2.63	0.42	1.63	1.65	0.87
CV (%)	24.16	23.67	3.07	7.76	8.65	5.18

CENTRAL PLAINS

In central plains also data was pooled over 4 locations viz., Chhindwara, Deesa, Kota and Raipur for 90 crop duration and 110 days for all locations except Kota. The yield and dry matter (%) differences among genotypes were non-significant (Table 33).

Table 33 : Evaluation of Advanced hybrids for processing purposes at 90 &110 days after planting

Hybrids	Total yield (t/ha)	French fry grade yield (t/ha)	Dry matter (%)	Total yield (t/ha)	French fry grade yield (t/ha)	Dry matter (%)
	90 days			110 days		
MP/4-578	23.20	14.65	21.78	29.60	18.75	21.45
K Chipsona-1	24.87	13.83	20.45	30.39	16.94	21.09
K Frysona	26.19	15.28	20.83	31.91	18.81	21.52
CD (0.05)	NS	NS	NS	NS	NS	NS
SEd	1.94	1.53	0.86	2.32	1.96	0.24
CV (%)	11.10	14.80	5.80	9.28	13.20	1.38

TRIAL FOR HEAT TOLERANCE

At 60 days crop duration (Table 34) the data of hybrid HT/7-1105 along with Kufri Surya and local control was pooled over 4 locations viz., Bhubaneshwar, Chhindwara, Hisar and Raipur. Similarly, data was pooled over 6 locations viz., Bhubaneshwar, Chhindwara, Deesa, Kalyani, Hisar and Raipur centres at 75 days (Table 35) and 8 locations viz., Bhubaneshwar, Chhindwara, Deesa, Kalyani, Hisar, Kota, Modipuram and Raipur centres at 90 days crop durations (Table 36). The hybrid significantly out-yielded the best control at all the three crop durations in all traits viz., total tuber yield, marketable yield, plant vigour and dry matter content (%).

Table 34:Evaluation of Advanced hybrids for heat tolerance purposes at 60 days after planting

Hybrids/ Locations	HT/7-1105	K Surya	Local control	Mean	HT/7-1105	K Surya	Local control	Mean
	Total yield (t/ha)				Marketable yield (t/ha)			
Bhubaneswar	13.72	9.70	10.91	11.45	11.91	8.51	9.06	9.83
Chhindwara	16.99	16.37	17.04	16.80	15.54	14.22	14.37	14.71
Hisar	20.62	9.54	11.81	13.99	17.19	7.62	9.70	11.50
Raipur	13.66	9.53	17.37	13.52	13.54	9.09	17.26	13.30
Mean	16.25	11.28	14.28		14.54	9.86	12.60	
CD (5%)	Location = 1.25 Varieties= 1.08 Location X Varieties= 2.16				Location = 1.22 Varieties= 1.06 Location X Varieties= 2.12			
	Dry matter (%)				Plant vigor (1-5 scale)			
Bhubaneswar	17.69	17.27	15.45	16.80	5.00	4.25	4.00	4.42
Chhindwara	17.50	17.38	17.23	17.37	4.75	4.63	4.63	4.67
Hisar	14.72	14.70	15.52	14.98	4.75	3.00	3.50	3.75
Raipur	18.48	18.05	17.80	18.11	4.25	4.00	3.50	3.92
Mean	17.10	16.85	16.50		4.69	3.97	3.91	
CD (5%)	Location = 0.46 Varieties= 0.40 Location X Varieties= 0.80				Location = 0.38 Varieties= 0.33 Location X Varieties= 0.66			

Table 35 : Evaluation of Advanced hybrids for heat tolerance purposes at 75 days after planting

Hybrids/ Locations	HT/7-1105	K Surya	Local control	Mean	HT/7-1105	K Surya	Local control	Mean
	Total yield (t/ha)				Marketable yield (t/ha)			
Bhubaneswar	14.11	18.01	17.91	16.67	12.80	16.62	16.59	15.34
Chhindwara	25.65	23.67	23.00	24.10	24.17	22.06	21.11	22.45
Deesa	43.59	33.63	42.78	40.00	42.22	32.49	40.66	38.46
Hisar	30.04	17.03	14.60	20.56	26.00	15.16	13.97	18.38
Kalyani	19.29	16.50	13.72	16.50	16.81	12.33	10.51	13.22
Raipur	17.00	13.97	18.96	16.64	16.34	13.58	18.96	16.29
Mean	24.95	20.47	21.83		23.06	18.70	20.30	
CD (5%)	Location = 1.85 Varieties= 1.31 Location X Varieties= 3.20				Location = 1.89 Varieties= 1.34 Location X Varieties= 3.27			
	Dry matter (%)				Plant vigor (1-5 scale)			
Bhubaneswar	18.55	18.79	15.56	17.63	4.25	3.25	3.25	3.58
Chhindwara	18.05	18.63	18.05	18.24	4.88	4.88	4.63	4.79
Deesa	17.38	16.72	15.40	16.50	5.00	4.00	5.00	4.67
Hisar	17.19	16.73	17.09	17.00	5.00	3.25	3.75	4.00
Kalyani	19.69	17.53	16.23	17.82	4.75	4.25	3.00	4.00
Raipur	20.05	19.85	19.52	19.81	4.00	4.00	4.00	4.00
Mean	18.49	18.04	16.97		4.65	3.94	3.94	
CD (5%)	Location = 0.41 Varieties= 0.29 Location X Varieties= 0.72				Location = 0.28 Varieties= 0.20 Location X Varieties= 0.49			

Table 36 : Evaluation of Advanced hybrids for heat tolerance purposes at 90 days after planting

Hybrids/ Locations	HT/7-1105	K Surya	Local control	Mean	HT/7-1105	K Surya	Local control	Mean
	Total yield (t/ha)				Marketable yield (t/ha)			
Bhubaneswar	14.20	17.53	14.06	15.26	13.38	16.41	12.32	14.03
Chhindwara	29.06	26.81	25.74	27.20	28.27	25.92	24.85	26.34
Deesa	48.64	41.89	47.25	45.92	46.58	39.97	45.76	44.10
Hisar	38.07	14.39	19.73	24.06	34.13	13.43	18.42	21.99
Kalyani	23.96	18.91	15.53	19.47	20.52	15.65	12.04	16.07
Kota	17.73	15.19	15.05	15.99	15.84	13.47	13.84	14.38
Modipuram	35.02	25.11	33.46	31.20	30.97	22.57	30.14	27.89
Raipur	26.07	18.31	21.24	21.87	24.03	17.29	21.24	20.85
Mean	29.09	22.27	24.01		26.71	20.59	22.33	
CD (5%)	Location = 2.58 Varieties= 1.58 Location X Varieties= 4.46				Location = 2.54 Varieties= 1.55 Location X Varieties= 4.39			
	Dry matter (%)				Plant vigor (1-5 scale)			
Bhubaneswar	19.43	18.84	16.79	18.35	2.00	1.00	1.00	1.33
Chhindwara	18.75	19.03	18.53	18.77	5.00	4.88	4.75	4.88
Deesa	17.92	18.87	17.20	18.00	4.75	3.25	4.75	4.25
Hisar	19.91	16.02	18.09	18.00	5.00	3.25	3.75	4.00
Kalyani	19.92	17.85	17.18	18.32	5.00	4.75	3.50	4.42
Kota	23.67	23.17	20.30	22.38	4.83	4.50	5.00	4.78
Modipuram	16.19	18.26	17.21	17.22	4.88	4.00	4.00	4.29
Raipur	21.93	20.91	20.43	21.09	3.88	4.00	3.75	3.88
Mean	19.71	19.12	18.22		4.42	3.70	3.81	
CD (5%)	Location = 0.63 Varieties= 0.39 Location X Varieties= 1.09				Location = 0.25 Varieties= 0.15 Location X Varieties= 0.43			

ON FARM TRIAL FOR HEAT TOLERANCE

The data over locations viz., Bhubaneshwar, Chhindwara and Raipur at 60 days (Table 37), Bhubaneshwar, Chhindwara, Deesa, Kalyani, Hisar and Raipur at 75 days (Table 38) and Bhubaneshwar, Chhindwara, Deesa, Kalyani, Hisar, Kota, Modipuram and Raipur at 90 crop durations (Table 39) were pooled. Differences among all genotypes were non-significant across all locations. K. Surya was the best control at 75 and 90 days crop durations while at 60 days the local control was better. CP 4054 yielded higher total and marketable yields than the best control at 90 days crop duration and only marketable yield at 60 days crop. Hybrid CP4054 had the highest dry matter content at 75 and 90 days crop durations.

Table 37:Evaluation of Advanced hybrids for heat tolerance purposes at 60 days after planting
Centers: BHN, CHN & RPR

Hybrids	Emergence (%)	Plant Vigor (1-5 scale)	Total yield (t/ha)	Marketable yield (t/ha)
CP-4054	91.83	4.21	11.95	11.01
K Surya	91.90	4.47	11.74	10.70
K Khyati	92.17	4.34	12.01	10.62
CD (0.05)	NS	NS	NS	NS
SEd	0.71	0.31	1.77	1.54
CV (%)	0.77	7.25	18.26	17.49

Table 38:Evaluation of Advanced hybrids for heat tolerance purposes at 75 days after planting
Centers: BHN, CHN, DES, HIS, KAL, MDP & RPR

Hybrids	Emergence (%)	Plant Vigor (1-5 scale)	Foliage senescence (%)	Total yield (t/ha)	Marketable yield (t/ha)	Dry matter (%)
CP-4054	89.24	4.71	33.38	21.62	20.42	18.13
K Surya	87.11	4.34	49.00	22.48	20.94	17.71
K Khyati	85.92	3.93	50.83	21.26	19.48	16.82
CD (0.05)	2.46	NS	13.72	NS	NS	NS
SEd	1.09	0.32	6.08	1.03	0.81	0.46
CV (%)	2.16	12.75	23.71	8.84	7.47	4.17

Table 39:Evaluation of Advanced hybrids for heat tolerance purposes at 90 days after planting
Centers: BHN, CHN, DES, HIS, KAL, KTT, MDP & RPR

Hybrids	Emergence (%)	Plant Vigor (1-5 scale)	Foliage senescence (%)	Total yield (t/ha)	Marketable yield (t/ha)	Dry matter (%)
CP-4054	92.59	4.78	64.57	31.64	30.29	19.66
K Surya	91.10	4.44	76.04	26.61	24.67	19.30
K Khyati	92.12	4.35	75.57	26.80	24.59	18.28
CD (0.05)	NS	NS	NS	NS	4.25	NS
SEd	0.98	0.26	5.34	2.16	1.96	0.70
CV (%)	2.00	10.79	13.87	15.24	14.81	6.83

The total and marketable tuber yield and dry matter (%) data of three years at Deesa, Hisar and Kalyani were pooled (Table 40). The genotypic effects were significant while year and interaction of year and genotype were non-significant for all the three traits. CP 4054 yielded significantly higher than the best control, K. Surya for both total and marketable tuber yields. regarding dry matter content (%) also the hybrid recorded the highest dry matter but the differences were non-significant.

Table 40: Three year pooled of Advanced hybrids for heat tolerance purposes
Locations: Dessa (Ladol), Hisar (Karnal), Kalyani (Burdwan)

Year/Hybrids	Marketable yield (t/ha)			Total yield (t/ha)			Dry Matter (%)		
	CP-4054	K Surya	Means	CP-4054	K Surya	Means	CP-4054	K Surya	Means
2013-14	42.17	30.44	36.31	42.90	31.95	37.42	18.03	17.37	17.70
2014-15	42.98	30.89	36.93	45.30	33.51	39.41	18.32	18.44	18.38
2015-16	40.80	31.31	36.06	41.98	33.42	37.70	18.87	17.54	18.21
Mean	41.99	30.88		43.39	32.96		18.41	17.78	
CD Year	NS			NS			NS		
CD Varieties	7.37			6.81			NS		
CD (Year x Variety)	NS			NS			NS		

ON FARM EVALUATION OF TPS POPULTION

One TPS population, PT/08-109 with control 92-PT-27 was evaluated at Patna for 75 and 90 days crop durations. Emergence (%), foliage maturity (%), plant vigor, tuber uniformity, total and marketable tuber yield and dry matter content (%) of TPS population, PT/08-109 was higher than the control, 92-PT-27 at both 75 and 90 days crop durations. Late blight disease did not appear in both population and control variety. The leaf spot disease was a little higher (2%) in TPS population in comparison to the control (1%).

VARIETAL EVALUATION TRIAL TO IDENTIFY TOP THREE PROMISING VARIETIES OF THE REGION

To identify the top promising potato varieties of the region, 8 potato varieties viz. Kufri Jyoti, Kufri Bahar, Kufri Sadabahar, Kufri Gaurav, Kufri Garima, Kufri Pushkar, Kufri Khyati and Kufri Pukhraj in north zone; 10 varieties viz., Kufri Jyoti, Kufri Bahar, Kufri Badshah, Kufri Gaurav, Kufri Garima, Kufri Pushkar, Kufri Surya, Kufri Khyati, Kufri Pukhraj and Kufri Laukar in central zone; 13 varieties viz., Kufri Jyoti, Kufri Himalini, Kufri Shailja, Kufri Gaurav, Kufri Garima, Kufri Lalima, Kufri Khyati, Kufri Pukhraj, Kufri Ashoka, Kufri Pushkar, Kufri Bahar, Kufri Sadabahar and Kufri Giriraj in eastern zone; 8 varieties viz., Kufri Jyoti, Kufri Surya, Kufri Ashoka, Kufri Bahar, Kufri Pushkar, Kufri Lauvkar, Kufri Pukhraj and Kufri Khyati in plateau region were evaluated through front line demonstration in 48 trials at 18 AICRP centres viz., Bhubaneswar, Chhindwara, Deesa, Dholi, Gwalior, Hisar, Jalandhar, Jorhat, Faizabad, Kanpur, Kota, Modipuram, Patna, Pantnagar, Pasighat, Pune and Raipur for 60, 75 and 90 days crop durations. At Deesa, Dholi and Kota the trial was conducted for 90 days crop duration only.

NORTHERN PLAINS

To identify the best suited three varieties for northern region, 7 varieties viz., Kufri Bahar, Kufri Garima, Kufri Jyoti, Kufri Khyati, Kufri Pukhraj, Kufri Pushkar and Kufri Sadabahar

were evaluated at Hisar, Modipuram and Pantnagar centres at 60, 75 and 90 days. Total and marketable yield was high of Kufri Khyati, Kufri Pukhraj and Kufri Pushkar at 60 and 75 days and of Kufri Khyati, Kufri Garima and Kufri Pushkar at 90 days. At 75 and 90 days dry matter content was highest in Kufri Bahar and Kufri Garima, respectively (Table 41).

Table 41 : Evaluation of varieties to identify top three promising varieties

Hybrids/ Location	Kufri Bahar	Kufri Garima	Kufri Jyoti	Kufri Khyati	Kufri Pukhraj	Kufri Pushkar	Kufri Sadabahar	Mean
Total yield (t/ha) at 60 days								
Hisar	16.48	22.08	12.32	33.86	19.53	27.80	19.84	21.70
Modipuram	22.29	22.22	18.35	21.60	24.61	25.35	17.34	21.68
Pantnagar	21.77	20.29	20.65	26.62	23.44	21.18	23.18	22.45
Mean	20.18	21.53	17.11	27.36	22.53	24.78	20.12	
CD (5%)	Location = NS			Varieties= 4.28		Location X Varieties= 7.41		
Marketable yield (t/ha) at 60 days								
Hisar	14.40	19.12	10.92	22.69	17.29	22.88	17.73	17.86
Modipuram	18.58	17.75	13.86	17.94	19.46	20.75	14.72	17.58
Pantnagar	20.43	18.70	18.84	25.57	22.07	20.22	21.99	21.12
Mean	17.80	18.52	14.54	22.07	19.60	21.28	18.15	
CD (5%)	Location = 1.28			Varieties= 1.95		Location X Varieties= 3.39		
Total yield (t/ha) at 75 days								
Hisar	33.05	29.53	19.32	34.89	33.55	36.43	24.14	30.13
Modipuram	29.99	33.18	22.65	31.89	33.20	35.81	26.78	30.50
Pantnagar	23.34	21.70	22.40	28.16	24.54	22.98	24.62	23.96
Mean	28.79	28.14	21.46	31.65	30.43	31.74	25.18	
CD (5%)	Location = 2.51			Varieties= 3.83		Location X Varieties= 6.64		
Marketable yield (t/ha) at 75 days								
Hisar	24.63	26.61	18.08	32.82	30.01	30.95	21.54	26.38
Modipuram	27.42	29.76	19.19	29.38	27.78	28.60	22.92	26.44
Pantnagar	21.98	20.09	20.61	26.46	23.28	21.27	19.44	21.88
Mean	24.68	25.49	19.30	29.55	27.02	26.94	21.30	
CD (5%)	Location = 1.81			Varieties= 2.77		Location X Varieties= 4.79		
Dry matter (%)at 75 days								
Hisar	17.44	16.50	15.16	16.31	15.89	12.94	17.41	15.95
Modipuram	16.36	16.52	16.82	14.06	15.62	14.31	16.49	15.74
Mean	16.90	16.51	15.99	15.19	15.76	13.63	16.95	
CD (5%)	Location = NS			Varieties= 1.16		Location X Varieties= 1.64		
Total yield (t/ha) at 90 days								
Hisar	34.86	41.10	31.41	43.64	27.18	46.23	28.75	36.17
Modipuram	36.38	38.47	30.30	36.25	38.83	43.45	35.03	36.96
Pantnagar	24.61	22.93	23.53	29.26	25.77	24.03	25.94	25.15
Mean	31.95	34.17	28.41	36.38	30.59	37.90	29.91	
CD (5%)	Location = 2.09			Varieties= 3.19		Location X Varieties= 5.52		

Marketable yield (t/ha) at 90 days								
Hisar	33.52	36.09	29.81	40.15	24.46	40.81	25.91	32.97
Modipuram	33.13	34.23	25.73	32.78	32.67	38.86	30.47	32.55
Pantnagar	23.20	21.37	22.14	27.53	24.22	22.72	24.26	23.64
Mean	29.95	30.57	25.90	33.49	27.12	34.13	26.88	
CD (5%)	Location = 1.90			Varieties= 2.90		Location X Varieties= 5.02		
Dry matter (%)at 90 days								
Hisar	17.71	18.71	15.48	16.73	16.59	13.31	18.77	16.76
Modipuram	17.75	19.09	18.65	15.15	17.74	17.17	15.96	17.36
Mean	17.73	18.90	17.07	15.94	17.16	15.24	17.37	
CD (5%)	Location = NS			Varieties= 1.39		Location X Varieties= 1.97		

EASTERN PLAINS

In the eastern zone the data of Bhubaneswar, Faizabad, Jorhat, Kalyani, Kanpur and Pasighat locations was pooled for 6 varieties viz., Kufri Garima, Kufri Gaurav, Kufri Jyoti, Kufri Khyati, Kufri Pukhraj and Kufri Pushkar for all 3 crop durations. At 60 days crop duration, Kufri Garima, Kufri Khyati and Kufri Pukhraj had the highest total yield while marketable tuber yield was the highest in Kufri Garima, Kufri Khyati and Kufri Pushkar. Varieties Kufri Jyoti, Kufri Khyati and Kufri Pukhraj at 75 days and Kufri Khyati, Kufri Pukhraj and Kufri Pushkar at 90 days were the best for total and marketable tuber yields (Table 42).

Table 42: Evaluation of varieties to identify top three promising varieties

Hybrids/ Location	Kufri Garima	Kufri Gaurav	Kufri Jyoti	Kufri Khyati	Kufri Pukhraj	Kufri Pushkar	Mean
Total yield (t/ha) at 60 days							
Bhubaneswar	9.52	6.35	11.20	10.63	10.65	11.57	9.99
Faizabad	17.70	15.57	17.78	19.28	18.41	15.66	17.40
Jorhat	8.96	9.48	9.98	8.65	10.96	11.48	9.92
Kalyani	18.34	12.89	12.95	14.34	14.23	13.06	14.30
Kanpur	20.77	19.36	21.00	21.05	20.83	19.67	20.45
Pasighat	37.16	37.55	36.61	35.85	34.72	37.37	36.54
Mean	18.74	16.87	18.25	18.30	18.30	18.13	
CD (5%)	Location = 0.98		Varieties= 0.98		Location X Varieties= 2.41		
Marketable yield (t/ha) at 60 days							
Bhubaneswar	8.78	6.05	10.47	9.30	9.62	10.23	9.08
Faizabad	14.17	12.44	13.43	15.39	14.67	12.55	13.77
Jorhat	5.42	5.81	6.26	5.35	6.86	7.50	6.20
Kalyani	16.95	12.17	11.84	13.39	13.12	11.67	13.19
Kanpur	16.86	15.17	15.41	16.31	15.34	16.55	15.94
Pasighat	36.47	36.30	35.34	34.88	33.61	36.54	35.52
Mean	16.44	14.66	15.46	15.77	15.54	15.84	
CD (5%)	Location = 0.66		Varieties= 0.66		Location X Varieties= 1.62		
Dry matter (%) at 60 days							
Bhubaneswar	15.53	18.21	15.30	12.75	14.92	13.75	15.08
Faizabad	14.70	14.60	15.47	14.73	14.78	14.50	14.80
Jorhat	18.29	18.20	16.13	19.97	17.33	15.93	17.64
Kalyani	19.97	16.13	19.23	18.17	10.87	17.33	16.95

Kanpur	12.58	12.38	13.10	13.30	12.90	13.05	12.88
Pasighat	22.03	19.24	20.67	19.75	21.52	20.12	20.55
Mean	17.18	16.46	16.65	16.44	15.39	15.78	
CD (5%)	Location = 0.38		Varieties= 0.38		Location X Varieties= 0.94		
Total yield (t/ha) at 75 days							
Bhubaneswar	11.41	9.68	17.36	16.59	14.52	10.99	13.42
Faizabad	29.50	25.94	27.78	32.11	30.68	26.11	28.69
Jorhat	14.29	13.60	14.96	13.01	15.14	14.67	14.28
Kalyani	23.06	19.28	20.23	25.45	24.62	23.45	22.68
Kanpur	28.22	28.55	31.08	33.83	34.72	30.19	31.10
Pasighat	37.86	37.14	36.73	37.37	36.39	38.21	37.28
Mean	24.06	22.37	24.69	26.39	26.01	23.94	
CD (5%)	Location =1.24		Varieties= 1.24		Location X Varieties= 3.04		
Marketable yield (t/ha) at 75 days							
Bhubaneswar	10.49	8.57	15.71	15.33	13.16	9.48	12.12
Faizabad	25.94	22.83	24.44	28.24	27.00	22.98	25.24
Jorhat	8.48	7.94	9.10	7.52	9.08	8.79	8.49
Kalyani	24.73	19.17	19.78	25.73	21.56	22.23	22.20
Kanpur	22.47	23.33	24.75	27.50	28.41	24.39	25.14
Pasighat	39.05	26.49	23.97	37.31	35.57	38.30	33.45
Mean	21.86	18.06	19.62	23.60	22.46	21.03	
CD (5%)	Location = 2.05		Varieties= 2.05		Location X Varieties= 5.02		
Dry matter (%) at 75 days							
Bhubaneswar	18.94	18.57	15.87	16.49	16.01	15.04	16.82
Faizabad	17.30	17.15	17.38	17.32	17.37	17.00	17.25
Jorhat	18.23	17.10	16.83	17.93	17.10	17.33	17.42
Kalyani	17.30	15.27	18.62	17.53	16.13	15.43	16.71
Kanpur	17.33	17.43	16.79	17.05	17.60	17.50	17.28
Pasighat	22.03	19.87	20.24	19.84	21.27	20.17	20.57
Mean	18.52	17.56	17.62	17.70	17.58	17.08	
CD (5%)	Location = 0.38		Varietie s= 0.38		Location X Varieties= 0.93		
Total yield (t/ha) at 90 days							
Bhubaneswar	7.24	6.44	12.15	8.66	9.50	13.94	9.65
Dholi	11.03	3.72	10.19	14.58	7.89	11.28	9.78
Faizabad	33.89	29.83	31.98	36.94	35.27	30.00	32.98
Jorhat	18.42	17.85	19.62	17.94	18.76	20.60	18.86
Kalyani	29.91	23.28	26.28	31.28	26.34	26.84	27.32
Kanpur	31.61	31.80	34.36	37.25	38.41	33.75	34.53
Pasighat	39.05	36.39	38.05	39.72	37.44	39.16	38.30
Patna	29.76	29.16	31.86	36.86	37.82	30.36	32.64
Mean	25.11	22.31	25.56	27.90	26.43	25.74	
CD (5%)	Location = 1.18		Varieties= 1.02		Location X Varieties= 2.89		
Marketable yield (t/ha) at 90 days							
Bhubaneswar	6.63	5.79	10.47	7.95	8.26	12.40	8.58
Dholi	10.25	3.14	8.78	12.61	5.56	8.33	8.11

Faizabad	31.11	27.44	29.44	34.02	32.46	27.55	30.34
Jorhat	10.15	9.25	10.87	9.52	10.35	11.83	10.33
Kalyani	29.40	22.95	25.90	30.90	25.95	26.56	26.94
Kanpur	26.08	27.36	27.89	29.69	31.14	27.16	28.22
Pasighat	37.87	34.89	36.65	38.87	35.92	37.65	36.97
Patna	22.90	23.80	25.77	27.81	27.29	24.59	25.36
Mean	21.80	19.33	21.97	23.92	22.12	22.01	
CD (5%)	Location = 0.98		Varieties= 0.85		Location X Varieties=		2.40
Dry matter (%) at 90 days							
Bhubaneswar	19.62	18.85	16.02	16.47	16.17	16.36	17.25
Dholi	16.80	20.40	20.15	15.85	17.68	18.43	18.22
Faizabad	19.20	19.00	19.30	19.20	19.30	18.80	19.13
Jorhat	16.70	17.03	18.03	17.83	17.70	17.37	17.44
Kalyani	17.33	15.43	19.23	14.83	16.00	20.17	17.17
Kanpur	17.55	17.28	17.90	17.98	18.35	18.30	17.89
Pasighat	20.44	20.40	19.18	20.56	21.71	20.20	20.42
Patna	18.65	19.33	18.43	18.40	18.78	18.80	18.73
Mean	18.29	18.46	18.53	17.64	18.21	18.55	
CD (5%)	Location = 0.35		Varieties= 0.30		Location X Varieties= 0.85		

CENTRAL PLAINS

In central zone the data of 4 locations viz., Chhindwara, Gwalior, Kanpur and Raipur for 5 varieties viz., Kufri Bahar, Kufri Garima, Kufri Jyoti, Kufri Khyati, Kufri Pukhraj and Kufri Pushkar was pooled for the total and marketable yields. Kufri Khyati, Kufri Pukhraj and Kufri Pushkar recorded the highest total tuber yield at all the three crop durations, while Kufri Garima, Kufri Khyati and Kufri Pukhraj recorded the maximum marketable yield at 75 days. Dry matter was maximum in Kufri Bahar, Kufri Garima and Kufri Jyoti at 75 and 90 days and Kufri Pushkar, Kufri Garima and Kufri Jyoti at 60 days (Table 43).

Table 43: Evaluation of varieties to identify top three promising varieties

Hybrids/ Location	Kufri Bahar	Kufri Garima	Kufri Jyoti	Kufri Khyati	Kufri Pukhraj	Kufri Pushkar	Mean
Total yield (t/ha) at 60 days							
Chhindwara	17.24	20.84	20.02	21.60	22.44	22.90	20.84
Gwalior	11.12	13.67	20.64	27.50	23.57	23.19	19.95
Kanpur	21.30	20.77	21.00	21.05	20.83	19.67	20.77
Raipur	15.39	13.16	13.99	17.48	15.57	12.25	14.64
Mean	16.26	17.11	18.91	21.91	20.60	19.50	
CD (5%)	Location = 1.44		Varieties= 1.76		Location X Varieties= 3.52		
Marketable yield (t/ha) at 60 days							
Chhindwara	11.26	15.36	14.34	16.51	17.46	17.80	15.46
Gwalior	9.90	12.10	18.65	24.60	22.39	19.60	17.88
Kanpur	18.06	16.86	15.41	16.31	15.34	16.55	16.42

Raipur	15.15	12.91	13.82	17.24	15.38	12.07	14.43
Mean	13.59	14.31	15.56	18.67	17.64	16.51	
CD (5%)	Location = 1.21		Varieties= 1.48		Location X Varieties= 2.95		
Dry matter (%) at 60 days							
Chhindwara	14.75	14.65	17.35	17.18	16.83	16.70	16.24
Gwalior	16.99	17.76	16.96	13.44	14.64	16.08	15.98
Kanpur	12.78	12.58	13.10	13.30	12.90	13.05	12.95
Mean	14.84	15.00	15.80	14.64	14.79	15.28	
CD (5%)	Location = 0.45		Varieties= 0.63		Location X Varieties= 1.10		
Total yield (t/ha) at 75 days							
Chhindwara	21.94	25.24	23.27	34.22	31.30	29.31	27.55
Gwalior	24.05	34.23	27.36	40.25	34.11	31.81	31.97
Kanpur	27.55	28.22	31.08	33.83	34.72	30.19	30.93
Raipur	24.68	21.24	21.08	27.21	29.75	19.86	23.97
Mean	24.56	27.23	25.69	33.88	32.47	27.79	
CD (5%)	Location = 2.11		Varieties= 2.58		Location X Varieties= 5.16		
Marketable yield (t/ha) at 75 days							
Chhindwara	17.77	21.07	19.10	30.04	27.12	25.14	23.37
Gwalior	24.47	35.53	28.39	42.14	34.87	33.19	33.10
Kanpur	22.94	22.47	24.75	27.50	28.41	24.39	25.08
Raipur	22.45	20.28	19.36	23.53	26.65	16.47	21.46
Mean	21.91	24.84	22.90	30.80	29.26	24.80	
Dry matter (%) at 75 days							
Chhindwara	16.80	16.13	17.60	17.68	17.35	17.00	17.09
Gwalior	16.48	17.22	17.10	14.78	15.16	16.52	16.21
Kanpur	17.05	17.33	16.79	17.05	17.60	17.50	17.22
Mean	16.78	16.89	17.16	16.50	16.70	17.01	
CD (5%)	Location = 0.49		Varieties= NS		Location X Varieties= 1.21		
Total yield (t/ha) at 90 days							
Chhindwara	25.17	39.23	28.01	38.32	36.48	39.00	34.37
Deesa	36.62	59.11	34.84	63.68	63.61	67.10	54.16
Gwalior	26.65	36.63	34.74	47.99	42.73	37.80	37.76
Kanpur	30.86	31.61	34.36	37.25	38.41	33.75	34.37
Kota	12.96	15.97	13.52	13.01	18.24	19.59	15.55
Raipur	22.43	22.69	21.48	26.08	23.95	25.14	23.63
Mean	25.78	34.21	27.82	37.72	37.24	37.06	
CD (5%)	Location = 1.80		Varieties= 1.80		Location X Varieties= 4.40		
Marketable yield (t/ha) at 90 days							
Chhindwara	23.57	34.53	26.16	34.08	32.83	34.36	30.92
Deesa	35.95	56.22	30.60	61.50	61.25	62.46	51.33
Gwalior	24.91	35.13	32.63	46.81	41.07	35.71	36.04
Kanpur	25.03	26.08	27.89	29.69	31.14	27.16	27.83
Kota	11.67	14.49	9.49	11.58	16.76	17.13	13.52
Raipur	22.43	22.69	21.48	26.08	23.95	25.14	23.63
Mean	23.93	31.52	24.71	34.96	34.50	33.66	
CD (5%)	Location = 1.60		Varieties= 1.60		Location X Varieties= 3.91		

Dry matter (%) at 90 days							
Chhindwara	18.08	17.28	18.05	18.58	17.60	18.18	17.96
Deesa	18.27	19.23	19.32	17.59	17.49	17.61	18.25
Gwalior	18.60	20.30	17.24	15.79	16.03	17.59	17.59
Kanpur	17.55	17.55	17.90	17.98	18.35	18.30	17.94
Mean	18.12	18.59	18.13	17.48	17.37	17.92	
CD (5%)	Location = NS		Varieties= 0.56		Location X Varieties= 1.13		

VARIETAL EVALUATION FOR PRODUCTION OF BABY/SALAD POTATOES (SPECIALITY POTATO)

Three varieties viz., Kufri Himsona, Kufri Khyati and Kufri Shailja were evaluated for production of specialty potatoes by using the control of the region i.e., Kufri Pukhraj, Kufri, Pushkar, Kufri Bahar and Kufri Badshah in central plains; Kufri Pukhraj, Kufri Ashoka, Kufri Pushkar, Kufri Arun and Kufri Jyoti in eastern plains at 60, 75 and 90 days crop durations at Bhubaneshwar, Chhindwara and Raipur centres of AICRP (P) during *Rabi* season.

The percent tuber yield (10-25g, 25-50g and >50g) significantly varied, across locations and varieties, at all crop durations. At 60 days crop, Kufri Himsona had the highest 10-25g tuber percent, Kufri Pushkar was best for 25-50 g tuber percent while >50g tuber percent was the highest in Kufri Pukhraj. Total yield and dry matter content was the maximum in Kufri Pushkar (Table 44).

At 75 days crop duration, % baby tuber (10-25 g and 25-50 g) was the highest in Kufri Himsona while >50 g grade tubers was highest in Kufri Pukhraj. Total yield was also highest in Kufri Pukhraj with maximum dry matter content in Kufri Khyati (Table 45).

At 90 days crop duration also, Kufri Himsona recorded the highest % baby tubers (10-25 g tubers), the % baby tuber of 25-50 g were maximum in Kufri Shailja and Kufri Pushkar had the highest tube grade yield of >50 g. Kufri Pushkar was the highest yielding variety and Kufri Khyati had the highest dry matter content (Table 46).

Table 44: Evaluation of varieties forproduction of baby/salad potatoes at 60 days after planting

Hybrids/ Locations	Kufri Himsona	Kufri Shailja	Kufri Khyati	Kufri Pukhraj	Kufri Pushkar	Mean
Yield of tubers 10-25g (t/ha)						
Bhubaneswar	1.43	1.39	2.41	2.07	2.34	1.93
Chhindwara	4.62	4.42	5.93	6.13	4.85	5.19
Raipur	4.65	3.46	2.11	1.17	0.80	2.43
Mean	3.56	3.09	3.48	3.12	2.66	
CD (5%)	Location = 0.22		Varieties= 0.29		Location X Varieties= 0.50	
Yield of tubers 25-50g (t/ha)						
Bhubaneswar	4.52	6.01	6.45	6.18	8.02	6.24
Chhindwara	6.45	6.36	8.92	9.75	9.28	8.15
Raipur	1.35	1.13	6.63	7.81	11.39	5.66
Mean	4.11	4.50	7.33	7.91	9.56	
CD (5%)	Location = 0.30		Varieties= 0.38		Location X Varieties= 0.66	

Yield of tubers >50g (t/ha)						
Bhubaneswar	2.54	4.89	4.15	4.56	3.41	3.91
Chhindwara	1.38	4.05	6.14	7.94	7.71	5.44
Raipur	2.48	1.57	2.28	4.94	5.67	3.39
Mean	2.13	3.50	4.19	5.81	5.60	
CD (5%)	Location = 0.31		Varieties= 0.40		Location X Varieties= 0.69	
Total Yield >50g (t/ha)						
Bhubaneswar	8.49	12.28	13.01	12.81	13.77	12.07
Chhindwara	12.44	14.82	20.99	23.82	21.83	18.78
Raipur	8.79	6.35	11.75	14.61	18.76	12.05
Mean	9.91	11.15	15.25	17.08	18.12	
CD (5%)	Location = 0.55		Varieties= 0.71		Location X Varieties= 1.23	
Dry matter (%)						
Chhindwara	16.05	16.20	16.93	16.60	16.88	16.53
Raipur	16.71	16.61	17.31	17.41	17.55	17.12
Mean	16.38	16.41	17.12	17.00	17.21	
CD (5%)	Location = 0.18		Varieties= 0.28		Location X Varieties= NS	

Table 45 : Evaluation of varieties for production of baby/salad potatoes at 75 days after planting

Hybrids/ Locations	Kufri Himsona	Kufri Shailja	Kufri Khyati	Kufri Pukhraj	Kufri Pushkar	Mean
Yield of tubers 10 -25g (t/ha)						
Bhubaneswar	1.45	1.68	3.07	3.06	2.22	2.30
Chhindwara	5.23	5.12	6.76	7.21	5.01	5.86
Raipur	3.02	2.96	6.86	5.35	7.23	5.08
Mean	3.23	3.25	5.56	5.21	4.82	
CD (5%)	Location = 0.23		Varieties= 0.30		Location X Varieties= 0.52	
Yield of tubers 25 -50g (t/ha)						
Bhubaneswar	3.92	6.04	7.39	7.22	5.56	6.03
Chhindwara	7.11	8.66	10.20	11.85	13.20	10.20
Raipur	6.39	4.59	3.66	6.28	7.41	5.66
Mean	5.81	6.43	7.08	8.45	8.72	
CD (5%)	Location = 0.33		Varieties= 0.43		Location X Varieties= 0.75	
Yield of tubers >50g (t/ha)						
Bhubaneswar	3.35	5.87	7.40	8.59	6.18	6.28
Chhindwara	3.67	5.87	7.91	9.87	9.62	7.39
Raipur	2.04	4.23	2.06	4.64	4.51	3.50
Mean	3.02	5.32	5.79	7.70	6.77	
CD (5%)	Location = 0.43		Varieties= 0.56		Location X Varieties= 0.97	
Total Yield >50g (t/ha)						
Bhubaneswar	8.72	13.59	17.86	18.87	13.96	14.60
Chhindwara	16.01	19.13	24.88	28.92	27.84	23.35
Raipur	11.81	13.48	14.50	18.74	19.15	15.53
Mean	12.18	15.40	19.08	22.17	20.31	
CD (5%)	Location = 0.72		Varieties= 0.93		Location X Varieties= 1.61	

Dry matter (%)						
Chhindwara	17.65	17.55	17.73	17.40	17.65	17.60
Raipur	18.34	18.38	19.70	19.81	19.67	19.18
Mean	18.00	17.96	18.71	18.60	18.66	
CD (5%)	Location = 0.25		Varieties= 0.39		Location X Varieties= 0.55	

Table 46 : Evaluation of varieties for production of baby/salad potatoes at 90 days after planting

Hybrids/ Locations	Kufri Himsona	Kufri Shailja	Kufri Khyati	Kufri Pukhraj	Kufri Pushkar	Mean
Yield of tubers 10-25g (t/ha)						
Bhubaneswar	1.39	1.70	2.68	2.65	2.19	2.12
Chhindwara	6.07	5.13	5.21	6.01	5.00	5.48
Raipur	4.65	3.20	3.72	3.89	2.65	3.62
Mean	4.03	3.34	3.87	4.18	3.28	
CD (5%)	Location = 0.26		Varieties= 0.34		Location X Varieties= 0.59	
Yield of tubers 25-50g (t/ha)						
Bhubaneswar	4.02	6.37	6.93	6.41	5.64	5.87
Chhindwara	9.37	9.24	9.57	10.13	13.01	10.26
Raipur	1.35	5.86	5.52	4.98	5.79	4.70
Mean	4.91	7.16	7.34	7.17	8.14	
CD (5%)	Location = 0.32		Varieties= 0.41		Location X Varieties= 0.72	
Yield of tubers >50g (t/ha)						
Bhubaneswar	3.68	6.51	7.24	8.19	6.70	6.47
Chhindwara	5.57	9.20	14.10	16.20	18.21	12.65
Raipur	2.48	7.40	13.50	13.24	12.81	9.88
Mean	3.91	7.70	11.61	12.54	12.57	
CD (5%)	Location = 0.39		Varieties= 0.51		Location X Varieties= 0.88	
Total Yield >50g (t/ha)						
Bhubaneswar	9.08	14.58	16.85	17.25	14.52	14.46
Chhindwara	21.03	23.57	29.02	32.13	36.24	28.39
Raipur	8.79	18.29	23.73	22.83	21.64	19.05
Mean	12.96	18.81	23.20	24.07	24.13	
CD (5%)	Location = 0.68		Varieties= 0.87		Location X Varieties= 1.51	
Dry matter (%)						
Chhindwara	18.38	18.30	18.75	17.88	18.33	18.33
Raipur	20.17	20.66	21.39	21.24	20.68	20.83
Mean	19.27	19.48	20.07	19.56	19.50	
CD (5%)	Location = 0.37		Varieties= NS		Location X Varieties= NS	

STANDARDIZATION OF TPS TECHNOLOGY

For seedling tuber production

Two methods of seedling tuber production viz., brick bed method and normal nursery method were compared for various traits using two TPS varieties viz., D-150 and 92-PT-27 at Patna. The results showed that plant emergence, seedling vigor and tuber uniformity was higher or at par in brick method. Grade-wise total tuber yield was also higher in brick method.

Ware potato production using seedling tubers

Trial was conducted at Patna and the results showed that D-150 performed better for plant emergence (%), seedling vigor and dry matter (%) under brick method. Grade-wise total tuber yield of D-150 was higher in both brick bed method and nursery bed method but seedling vigor and tuber uniformity of 92-PT-27 was higher in nursery bed method.

TRIALS WITH SPECIALITY POTATO

HYBRIDS (Red Skinned)

One specialty potato hybrid, MS/08-1565 with controls viz., Kufri Lalima, Kufri Sindhuri and Kufri Lalit was evaluated at 75 and 90 days crop durations at 8 AICRP centres i.e. Hisar, Jalandhar, Kalyani, Kanpur, Modipuram, Pantnagar, Patna and Raipur during *rabi* season in the plains (Table 47).

Plant emergence was normal at all the locations in hybrid and controls. Late blight disease did not appear at any centre. Leaf spot disease appeared at Kalyani (6.50-9.00%) and viral diseases appeared at Hisar (1.55-2.77%) and Kalyani (8.55-11.30%). For both total and marketable tuber yields, Kufri Lalit was the best control at all locations except where K. Lalima was the best control at Modipuram and Patna at 90 days and at Pantnagar at 75 and 90 days crop durations.

The hybrid, MS/08-1565 yielded significantly higher for both total and marketable tuber yields than the best control at 75 and 90 days crop duration at Modipuram, Pantnagar and Patna at both 75 and 90 days crop durations, while at Raipur for 90 days crop duration only. In dry matter content (%) the hybrid, MS/08-1565 was at par to the controls.

The data of specialty potato hybrid, MS/08-1565 along with controls viz., Kufri Lalima, Kufri Sindhuri and Kufri Lalit evaluated at 75 and 90 days crop durations at 8 AICRP centres i.e. Hisar, Jalandhar, Kalyani, Kanpur, Modipuram, Pantnagar, Patna and Raipur during *rabi* season in the plains was pooled.

The plant emergence was normal. At 75 days crop duration, in both total and marketable tuber yields the best control variety was K. Lalit and hybrid was statistically at par with the best control. The foliage senescence of all hybrid and controls was at par to each other.

At 90 days crop duration, in both total and marketable tuber yields the best control variety was K. Lalit and hybrid was statistically better than the best control. The foliage senescence of the hybrid was higher than the best control, K. Lalit. K. Lalima was the best control for dry matter content (%).

Table 47 : Evaluation of hybrids to identify high yielding red skinned hybrid

Hybrids/ Locations	MS/08-1565	K Lalima	K Sindhuri	K Lalit	Mean
Total yield (t/ha) at 75 days					
Hisar	38.82	19.17	32.19	39.28	32.37
Jalandhar	32.78	34.54	30.00	33.66	32.75
Kalyani	21.96	21.78	21.89	24.15	22.44
Kanpur	27.95	26.98	25.49	28.86	27.32
Modipuram	37.14	33.88	29.06	32.80	33.22
Pantnagar	31.97	30.59	28.22	26.81	29.40
Patna	41.99	37.05	35.79	38.08	38.23
Raipur	18.48	15.95	14.77	19.93	17.28
Mean	31.39	27.49	27.17	30.45	
CD (5%)	Location = 1.51	Varieties= 1.06	Location X Varieties= 3.01		
Marketable yield (t/ha) at 75 days					
Hisar	33.98	16.79	23.80	36.40	27.74
Jalandhar	31.16	31.99	27.92	32.36	30.86
Kalyani	21.41	21.48	21.37	23.03	21.82
Kanpur	21.53	21.32	18.06	22.89	20.95
Modipuram	29.34	28.64	21.36	28.23	26.89
Pantnagar	30.07	28.97	26.70	25.10	27.71
Patna	36.35	31.60	28.37	31.79	32.03
Raipur	18.42	15.82	14.74	19.68	17.16
Mean	27.78	24.58	22.79	27.44	
CD (5%)	Location = 1.32	Varieties= 0.93	Location X Varieties= 2.64		
Dry Matter (%) at 75 days					
Hisar	14.61	15.44	16.36	15.75	15.54
Jalandhar	16.07	17.97	18.13	16.67	17.21
Kalyani	16.30	19.03	19.67	19.67	18.67
Kanpur	14.50	14.20	13.73	13.83	14.06
Modipuram	15.21	17.25	17.27	14.90	16.15
Patna	19.23	18.87	17.67	19.03	18.70
Mean	15.99	17.13	17.14	16.64	
CD (5%)	Location = 0.41	Varieties= 0.33	Location X Varieties= 0.81		
Total yield (t/ha) at 90 days					
Hisar	52.54	33.52	46.00	43.02	43.77
Jalandhar	44.82	43.34	42.87	48.71	44.93
Kalyani	28.11	29.48	29.03	31.96	29.64
Kanpur	34.05	32.30	28.30	35.66	32.58
Modipuram	45.72	41.95	38.71	38.86	41.31
Pantnagar	33.41	32.01	29.54	28.51	30.87
Patna	48.94	41.22	38.17	40.60	42.23
Raipur	37.35	20.52	20.16	22.24	25.07
Mean	40.62	34.29	34.10	36.20	
CD (5%)	Location = 2.31	Varieties= 1.63	Location X Varieties= 4.61		

Marketable yield (t/ha) at 90 days					
Hisar	45.09	29.07	37.81	40.05	38.00
Jalandhar	42.27	40.79	40.75	46.90	42.68
Kalyani	27.22	28.70	29.00	30.26	28.79
Kanpur	27.22	25.80	21.60	29.38	26.00
Modipuram	39.03	36.35	28.07	33.55	34.25
Pantnagar	31.48	30.55	28.10	26.76	29.22
Patna	39.97	33.37	31.43	33.70	34.62
Raipur	37.27	20.49	18.33	22.03	24.53
Mean	36.19	30.64	29.39	32.83	
CD (5%)	Location = 2.20		Varieties= 1.55	Location X Varieties = 4.39	
Dry Matter (%) at 90 days					
Hisar	15.36	18.35	18.14	17.58	17.36
Jalandhar	16.87	19.10	18.73	17.37	18.02
Kalyani	16.00	16.53	19.97	13.87	16.59
Kanpur	15.50	15.33	14.55	14.70	15.02
Modipuram	17.63	19.88	18.07	15.90	17.87
Patna	20.30	19.60	18.43	19.57	19.48
Mean	16.94	18.13	17.98	16.50	
CD (5%)	Location = 0.44		Varieties= 0.36	Location X Varieties= 0.88	

TRIALS IN KHARIF/HILLS SEASON

EVALUATION OF POTATO GERMPLASM

a) Evaluation for adaptability and yield in *Kharif* at Dharwad

Nine tuberosum accessions were evaluated in replicated trial at Dharwad (Karnataka) under *Kharif* season for adaptability and yield. The top three highest yielding accessions were viz., J-10-83, J-10-61 and J-10-131 with total yield of 2.64 t/ha, 1.88 t/ha and 1.88 t/ha, respectively. The incidence of late blight were high in all the three accessions (>20%).The shoot borer infestation was also >10% in all the tested accessions.

b) Evaluation for adaptability and yield in *Kharif* at Hassan

Seventy-one tuberosum accessions were evaluated in replicated trials at Hassan (Karnataka) under *kharif* season for adaptability and yield. Three highest yielding accessions were viz., CP-2314, CP-2192 and CP-2280 and total yield 16.5 t/ha, 16.08 t/ha and 15.83 t/ha total yield respectively. All these three accessions were resistant (20% incidence) to late blight disease.There was higher incidence of viral diseases (>45%) in all the accessions.

REGION SPECIFIC BREEDING PROGRAMMES AT SAU BASED CENTERS

a) In the SAU based breeding at Srinagar station the selected F_1C_1 clones of 2014 were reevaluated in 2015 and in F_1C_2 generation, 50 clones of six different crosses were evaluated and 14 clones were selected.

b) In F_1C_3 generation, 1 clone of cross CP2378 x Local Pahalgam (AICRPSK-11) was evaluated and selected whilst, in F_1C_4 generation single genotype was evaluated and selected.

c) In hybridization at Kufri, seventy-three crosses were attempted.

d) In late blight evaluation at CPRS, Kufri of 11 HAU, Hisar advanced hybrids, 2 hybrids viz., HIS/13-8 and HIS/13-87 were highly

resistant, while one clone HIS/11-93-11was resistant.

ON-FARM TRIAL WITH EARLY AND MEDIUM MATURING HYBRIDS

Hybrids, J/100-152, 2002-P-14, MS/5-1543, MS/99-1871 with controls, Kufri Pukhraj, Kufri Pushkar, Kufri Jyoti, Kufri Lalima, Kufri Surya and Kufri Himalini were evaluated in on- farm trials at 3 locations viz., Dharwad during 90 days crop duration, Hassan during 75, 90 & 105 days crop duration and Pune during 60 and 75 days crop durations. The plant emergence was normal at all three locations except for J/100-152 (73 %) and MS/99-1871 (64 %) during 75 dayscrop at Hassan.

Kufri Himalini was the best control total and marketable tuber yields at all the 3 locations and in all crop durations. None of the advanced hybrid could outyield the best control at Dharwad and Pune. At Hassan, 2 hybrids viz., MS/99-1871 and MS/5-1543 outyielded the best control at 90 and 105 days crop duration, respectively for total tuber yield. In late blight incidence, all hybrids and controls had almost similar incidence ranging from 23-36%, while at Hasan, K. Himalini had the least incidence (36.3%) and all hybrids had incidence ranging from 44-66%. Pune recorded very low incidence of late blight in all hybrids and controls. Virus incidence was high at Hasan, ranging from 5-35% with highest in 2002-P-14. Leaf spot disease was recorded only at Pune (12-24%). Storage studies were conducted at only at Hassan and the total weight loss due to sprouting and rottage after 3 months of storage was 10 % (MS/5-1543), 11 % (2002-P-14) and 12 % (MS/99-1871) in hybrids compared to the best control, K. Jyoti (10%).

TRIAL WITH TABLE POTATO HYBRIDS

The data obtained for five hybrids viz., J/2-14, MS/7-645, MS/6-1947, J/6-182 and MS/8-1148 and four controls Kufri Pukhraj, Kufri Jyoti, Kufri Surya and Kufri Himalini was pooled over two locations viz., Hassan and Pune (Table 48). At both crop durations the tuber yield differences among hybrids and controls were significant across locations, genotypes and location × genotype. Kufri Himalini was the best control during both crop durations. Hybrid, MS/6-1947 yielded higher than the best control at both crop durations but the yields were statistically at par with the best control. None of the other hybrids yielded at par with the best control.

Table 48: Evaluation of Advanced hybrid for table purpose at 75 & 90 days

Hybrids/ Locations	Hassan	Pune	Mean	Hassan	Pune	Mean
	Marketable Yield (t/ha)			Total Yield (t/ha)		
J/2-14	6.65	8.78	7.71	11.74	9.72	10.73
MS/7-645	10.93	8.98	9.96	12.46	10.07	11.27
MS/6-1947	17.98	11.33	14.66	19.15	12.26	15.70
J/6-182	8.39	9.96	9.18	11.26	10.95	11.11
MS/8-1148	6.08	9.15	7.62	8.31	10.33	9.32
K Pukhraj	8.47	11.22	9.84	12.40	12.39	12.39
K Jyoti	11.75	9.52	10.64	15.07	10.63	12.85
K Surya	9.41	10.43	9.92	11.77	11.37	11.57
K Himalini	15.44	11.76	13.60	17.69	12.70	15.19
Mean	10.57	10.13		13.32	11.16	
CD (5%)	Location = NS Varieties= 1.71 Location X Varieties= 2.42			Location = 0.75 Varieties= 1.58 Location X Varieties= 2.23		

	Marketable Yield (t/ha)			Total Yield (t/ha)		
J/2-14	9.81	11.84	10.83	13.65	13.10	13.38
MS/7-645	15.73	10.10	12.92	17.61	11.19	14.40
MS/6-1947	18.80	12.31	15.56	20.02	13.55	16.79
J/6-182	10.70	11.48	11.09	12.83	12.63	12.73
MS/8-1148	6.65	10.32	8.49	10.83	11.63	11.23
K Pukhraj	8.72	12.76	10.74	12.01	14.15	13.08
K Jyoti	16.81	11.20	14.01	18.13	12.44	15.29
K Surya	12.99	12.26	12.62	16.01	13.46	14.73
K Himalini	17.16	12.92	15.04	19.31	14.10	16.71
Mean	13.04	11.69		15.60	12.92	
CD (5%)	Location = 0.58 Varieties= 1.23 Location X Varieties= 1.75			Location = 0.51 Varieties= 1.08 Location X Varieties= 1.53		

TRIAL WITH HILL & KHARIF POTATO HYBRIDS

Five hybrids namely MP/9-723,SM/00-42, SM/00-120,VMT 5-1,LBY-17 with controls viz., Kufri Girdhari, Kufri Himalini, Kufri Jyoti, Kufri Pukhraj and Kufri Surya were evaluated at 75 & 90 days crop duration at Dharwad; 75, 90 & 105 day crop durations at Hassan; 120 days crop durations at Ooty, Ooty (Hassan) & Srinagar; 110 days crop duration at Kufri and 90 days crop durations at Pune & Ranichauri. The plant emergence was normal at all locations except for VMT 5-1 (71.67%) and Kufri Himalini (62.27%) at 75 days crop duration at Hassan and Ooty (ARS Hassan).

SM/00-42 significantly outyielded for both total and marketable tuber yields the best control, K. Himalini at Hasan at both 75 & 105 days crop durations and Kufri at 110 days crop duration. At Ranichauri, VMT 5-1, SM/00-42 and SM/00-120 had significantly higher yield and late blight resistance than Kufri Himalini at 90 days. Hybrid, SM/00-42 yielded higher than the best control at all other locations also except Pune.

Late blight incidence was recorded at all locations viz., Hasan, Kufri, Ooty (ARS, Hasan), Pune, Ranichauri and Srinagar. K. Himalini was the best control for late blight incidence at Hassan, Pune and Ranichauri, K. Girdhari was the best control at Kufri and Srinagar, while K. Pukhraj was the best at Ooty (ARS, Hassan). All 3 late blight resistant hybrids, SM/00-42, SM/00-120 and VMT 5-1 had either higher or at par resistance to the best controls at Kufri, Ooty (ARS, Hassan), Pune, Ranichauri and Srinagar. SM/00-42 and MP/09-723 recoded least late blight incidence at Hassan also.

Foliage senescence was recorded at 5 locations viz., Dharwad, Pune, Ooty (ARS, Hassan), Hassan and Srinagar. All hybrids and controls had almost at par senescence at all the locations. At Ooty the maturity of SM/00-42 was very early compared to all other hybrids/ controls. Storage

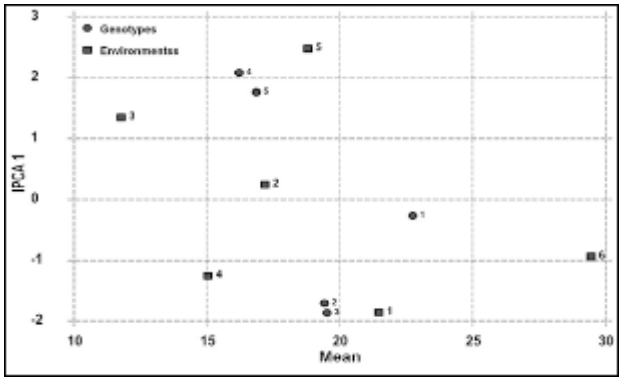


Fig.5. Adaptive specificities of potato genotypes for total tuber yield

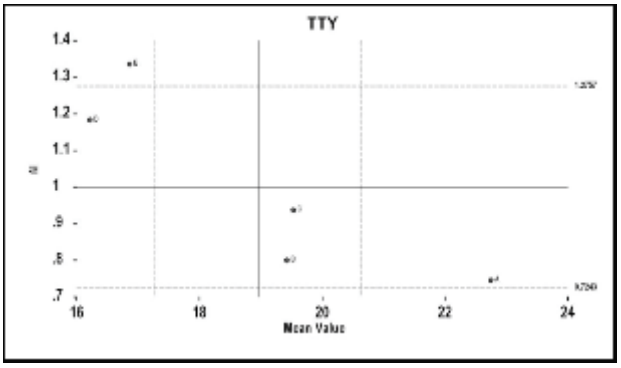


Fig.6. Bi plot (AMMI for total tuber yield

studies were conducted at Hassan, Ooty and Ooty (ARS, Hasan). All hybrids and controls had at par weight losses at all 3 locations.

The yield data over 6 locations viz., Hassan, Kufri, Ooty, Ooty (ARS, Hassan), Ranichauri and Srinagar for 3 hybridiz., SM/00-42, SM/00-12s v0 and VMT 5-1 and controls viz., K. Himalini and K. Jyoti was pooled and stability analysis was done. Hybrid SM/00-42 was best performer for total yield, while SM/00-120 and VMT 5-1 were moderate yielders and the control varieties were poor yielders. The variety and environment interactions are depicted in AMMI1 (IPCA1 vs. means). SM/00-42 had the highest stability among evaluated genotypes as well as the highest mean total tuber yield (Fig. 5 & 6). Srinagar is the most suitable location for tuber yield. The G×E interaction was maximum at Ranicahuri and least at Kufri. Also Kufri is the largest contributor to stability (Fig. 6) while Hassan and depicts the maximum G×E interactions.

TRIAL WITH PROCESSING HYBRIDS

Five processing hybrids viz., MP/4-816, MP/9-901, MP/4-578, MP/6-39 and controls viz., Atlantic, Kufri Chipsona-1, Kufri Chipsona-3, Kufri Chipsona-4 and Kufri Frysona were evaluated at Dharwad, Hassan, Pune and Srinagar for 75, 75 & 90, 90 and 120 days crop durations, respectively. Plant emergence was normal at all locations except in MP/9-901 and Kufri Chipsona-1at 75 and 90 days crop durations at Hassan.

Kufri Chipsona-4 was the best control at Dharwad and Srinagar, Kufri Chipsona-3 at Hassan and Kufri Chipsona-1 at Pune. None of the hybrid could outyield the best control at any location. Late blight incidence was recorded at all locations. K. Chipsona-4 was the best control for late blight at Dharwad and Srinagar, K. Chipsona-3 was best at Hassan, while Atlantic was best at Pune. Hybrid, MP/04-816 at Dharwad and Hassan and MP/9-901 at Hassan had high late blight incidence compared to the best control. Dry matter content (%) at 90 days crop duration was high (>20%) at Hassan in all hybrids and controls. location was while it was low at Srinagar. Storage studies were conducted at Hassan and the total weight losses ranged between 14-16% while at Srinagar weight loss was <10%. Foliage senescence was recorded at Dharwad, Hassan and Pune. K. Chipsona-4 at Dharwad, Atlantic at Hassan and K. Chipsona-1 had the maximum senescence. Hybrid, MP/09-901 had early maturity at Pune than the best control, while at all other locations the hybrids and controls had at par senescence.

TRIAL WITH FRENCH FRIES

French fry hybrid, MP/4-578 was evaluated with controls Kufri Frysona, Kufri Chipsona-1 and Kufri Himalini at Dharwad for 90 days, Hassan for 75 and 90 days and Srinagar for 110 days. At Hassan, hybrid, MP/06-39 was also evaluated. Plant emergence was normal at all locations except Kufri Frysona (48.33%) at Dharwad. K. Chipsona-1 and K. Frysona were the best controls for total and French fry grade yields and none of the hybrid could yield better than the best control. Both hybrids and controls had at par late blight incidence and keeping quality at Hassan and Srinagar.

TRIAL FOR HEAT TOLERANCE

Heat tolerant hybrid, CP4054 was evaluated at Dharwad and Pune for 90 days crop, and at Hassan at 75, 90 and 105 days crop duration with Kufri Surya and Kufri Himalini as controls. The plant emergence was normal at all locations except for Kufri Himalini (63.33%) at Hassan. At Hassan, CP-4054 reached 70 % senescence at 105 days, while Kufri Himalini had 90% senescence at this stage.

Kufri Surya was best control at Dharwad, while at Hassan Kufri Surya was best at 75 days and Kufri Himalini was best at 90 and 105 days crop durations.

Kufri Surya was best control at Dharwad while at Hassan at 75 days Kufri Surya outperformed as best control while at 90 and 105 days Kufri Himalini was best yielder. CP 4054 did not yield better than the best control at any crop duration and location. Late blight and shoot borer infestation in CP 4054 was more than 20 % at Dharwad while at Hassan, late blight infection in CP4054 (20 %) was significantly less than that of control varieties. In keeping quality studies the total weight loss of CP 4054 was at par (12%) to the best control, Kufri Surya (16%) and Kufri Himalini (11%).

EVALUATION OF TPS POPULATION

Three TPS populations viz., PT/15-4, PT/15-6 and PT/15-10 were studied for seedling survival (%), seedling vigour, tuber colour (1-5 scale) and tuber shape (1-5 scale) at Hassan. Seedling survival was normal (>75%) in all 3 populations.

The tuber colour was good in all 3 while, tuber shape was not up to the mark in later two populations. The total tuber yield (t/ha) was highest in PT/15-4 (4.97), followed by PT/15-6 (4.03) and PT/15-10 (3.50).

ON-FARM TRIAL WITH HYBRIDS HAVING COMBINED RESISTANCE TO LATE BLIGHT AND CYST NEMATODES

An on-farm trial was conducted in Ooty at 7 locations i.e summer crop in 4 locations and autumn crop in 3 locations with 2 hybrids viz., OS/01-516 and OS/01-497 and 5 controls viz., Kufri Neelima, Kufri Girdhari, Kufri Himalini, Kufri Swarna and Kufri Jyoti.

The average plant emergence of autumn crop was better than summer crop of all the genotypes. The emrgence was normal except in K. Neelima (63%) and K. Girdhari (53%) averaged over 4 locations. The total tuber yield (t/ha) and marketable tuber yield (t/ha) of summer crop was more than that of autumn raised crop. In summer crop, the average total and marketable yield of 7 locations was higher in hybrid, OS/01-497 compared to the best control, Kufri Swarna, while in autumn crop, K. Himalini was the best control. K. Himalini was the best control for marketable tuber yield in both crop seasons.

The average tuber dry matter of control Kufri Girdhari was highest (20.12%) and none of the hybrid had dry matter at par to the best control. In keeping quality studies, K. Girdhari was the best control (1.85%) and both the hybrids recorded high weight loss after 3 months storage i.e. OS/01-516 (23.60%) and OS/01-497 (20.30%). Kufri Girdhari was the best control for late blight incidence and both hybrids had high incidence. The PCN incidence was almost at par in both hybrids and controls.

VARIETAL EVALUATION TRIAL TO IDENTIFY TOP THREE PROMISING VARIETIES OF THE REGION

Varietal evaluation trial was conducted at three locations viz., Dharwad, Hassan and Pune to select the top three best suited varieties for kharif region. Ten varieties namely Kufri Jyoti, Kufri

Bahar, Kufri Gaurav, Kufri Garima, Kufri Pushkar, Kufri Badashah, Kufri Khyati, Kufri Pukhraj, Kufri Surya and Kufri Ashoka were evaluated at 90, 75 & 90 and 60, 75 & 90 crop duration, respectively. At 4th centre Srinagar varieties viz., Kufri Girdhari, Kufri Himalini, Kufri Shailja, Kufri Kanchan and Kufri Jyoti were screened at 120 days. Plant emergence was optimum at all testing locations and crop duration.

Kufri Bahar had high total and marketable tuber yield at all 3 centres. Kufri Surya had high total and marketable tuber yield at Dharwad and Pune. Other better performing varieties were Kufri Pushkar, Kufri Badshah for total yield and Kufri Badshah and Kufri Ashoka for marketable yield at Dharwad; Kufri Jyoti and Kufri Ashoka at both crop durations for total and marketable tuber yield at Hassan and Kufri Jyoti and Kufri Ashoka for total yield at Pune. In Srinagar centre, highest total and marketable tuber yield was obtained in Kufri Himalini and Kufri Jyoti (sprayed). Late blight incidence was high (>20%) at Hassan and Srinagar while infection was low (<20%) at Pune centre and for some varieties viz., Kufri Gaurav, Kufri Garima, Kufri Pushkar and Kufri Ashoka at Dharwad. Shoot borer damage (%) was low in varieties Kufri Bahar, Kufri Gaurav, Kufri Garima, Kufri Badashah and Kufri Khyati at Dharwad.

Foliage senescence was recorded at Hassan, Pune and Srinagar. K. Surya was the earliest variety at Hassan and Pune. K. Ashoka, K. Pushkar and K. Surya had almost at par maturity at Hassan, while all varieties were at par in maturity at Srinagar. Keeping quality studies were done only at Hassan and Srinagar and all varieties had at par weight loss after 3 month storage.

VARIETAL EVALUATION FOR PRODUCTION OF BABY/SALAD POTATOES (SPECIALTY POTATO)

In variety evaluation for suitability of baby/salad potatoes production, 9 varieties *viz.*, Kufri Himsona, Kufri Shailja, Kufri Khyati, Kufri Pukhraj, Kufri Pushkar, Kufri Lauker, Kufri Ashoka, Kufri Jyoti and Kufri Surya were evaluated at two centers i.e. Dharwad and Pune at 90 days. The plant emergence was optimum at both the testing centres (>90 %). The foliage senescence was >90% at Dharwad while at Pune >75 % was recorded. At Dharwad, the highest total and marketable tuber yielding variety was Kufri Surya followed by Kufri Shailja and Kufri Laukar while at Pune, the total tuber yield was highest in Kufri Pushkar followed by Kufri Surya and Kufri Laukar. Late blight infection was least in Kufri Himsona, Kufri Laukar and Kufri Ashoka and >20% in remaining varieties at Dharwad. At Pune late blight infection was <20 % while early blight was ≤ 20 % and virus infection was also <5 % with no infection in Kufri Khyati. Shoot borer infestation recorded at Dharwad was >10% in all varieties while weight of rotten tubers showed non-significant variations.

STANDARDIZATION OF TPS TECHNOLOGY

For standardization of TPS technology two hybrids viz., D-150 and 43-P-47 were evaluated at Hassan centre. The seedling survival, seedling vigour, tuber colour and tuber shape were optimum and at par. The total tuber yield was better of hybrid 43-P-47 (5.85 t/ha) compared to second hybrid D-150 (4.08 t/ha) while tuber rottage was high in D-150 (0.11 t/ha) at 90 days crop duration.

TRAIL WITH SPECIALTY POTATO HYBRIDS (Red skinned)

Single hybrid MS/08-1565 was evaluated alongwith controls Kufri Lalima, Kufri Sindhuri, Kufri Lalit, Kufri Shailjaand Kufri Pukhraj at 4 centres viz., Dharwad, Hassan, Pune and Srinagar for 75 and 90, 75 and 90, 90 and 120 days crop, respectively during *Kharif* season.

The plant emergence was optimum at all centres and cropdays except for Kufri Sindhuri at 90 days (73.34%) at Dharwad. The crop reached foliage senescence (>80%) at 75 days at Dharwad while at Hassan none of the genotypes reached senescence even at 90 days except for Kufri Shailja (85 %). At Pune centre all genotypes reached 70 % senescence at 90 days however at Srinagar senescence was low (<70%) even at 120 days. Kufri Lalima was the best total and marketable tuber yielding control both at 75 and 90 days at all centres and hybrid MS/08-1565 could not yield better than it. Late blight occurrence was >20% except in Kufri Lalima at Dharwad and Kufri Sindhuri at Hassan. The shoot borer damage was >10% at both crop duration recorded only at Dharwad centre. Weight of rotten tubers were significantly high in hybrid MS/08-1565 in 75 crop days at Dharwad and at 120 days at Srinagar. The percent weight loss was also high in hybrid MS/08-1565 compared to best control Kufri Lalima at Srinagar. At Hassan total weight loss after 3 months storage was minimum in Kufri Shailja. At Hassan dry matter content was at par among hybrid and control while at Srinagar significantly higher dry matter content was observed in control viz. Kufri Sindhuri compared to hybrid MS/08-1565.

CROP PRODUCTION

CROP PROSPECTS

Knowledge of the weather conditions during the season and how it would affect the crop is very important for planning its disposal strategy. Detailed yield forecasting methodology for potato using remote sensing, GIS and crop modelling has already been developed but it can be used only by large organizations which have the necessary personnel having expertise in analysis of satellite data and using crop models. Farmers want information about his crop prospects as well as that in his locality. Therefore, a simple protocol has been developed requiring minimal data inputs. The protocol for Potato Prospects estimation is based on the seasonal meteorological conditions integrating the effect of temperature, late blight severity and frost on the regional productivity. This protocol requires start of the season, end of the season and date of frost appearance if appeared as inputs. In addition, it also requires daily meteorological data viz maximum and minimum temperature, RH, solar radiation and rainfall for the current season as well as that of any previous year of the location. The tool computes the mean meteorological variables of the two seasons for which the data has been input and then uses it to compute the relative yields which is expressed as percent of the reference year (Fig 2.1). In the case of late blight the total number of late blight favourable days are calculated for both the seasons and again expressed as % of the reference year. As regards frost, the tool computes the yield upto the date of frost appearance and then expresses it as percent of the current season estimate without frost. Thus this tool quantifies the effect of the yield determining factors so that the users can make their own guestimates considering all the factors.

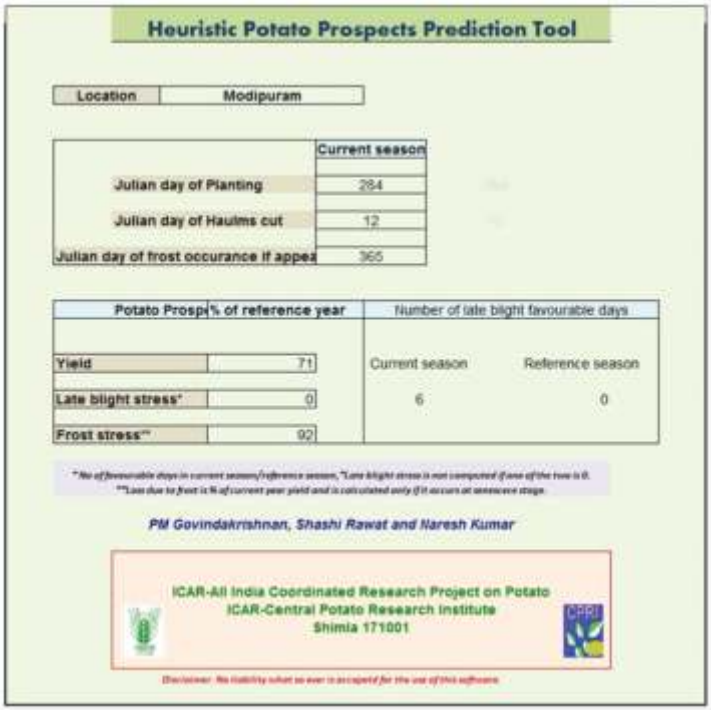


Fig. 2.1 : Screen Shot of Potato Prospects Prediction Tool

PRECISION NUTRIENT MANAGEMENT

One of the important features of green revolution technology is the use of high inputs since the varieties developed were highly responsive to inputs, especially fertilizers. Over the years, the yield improvement is marginal in most crops hence farmers are applying excessive and imbalanced fertilizers and other inputs to boost productivity, which is leading to deterioration of soil quality, build of P and other nutrients leading to problems due to nutrient imbalances etc. Thus, there is need for balanced fertilization. Two approaches have been studied under AICRP (Potato).One is for precise determination of nitrogen since it is the first limiting nutrient. The other is site specific nutrient management and these are discussed below.

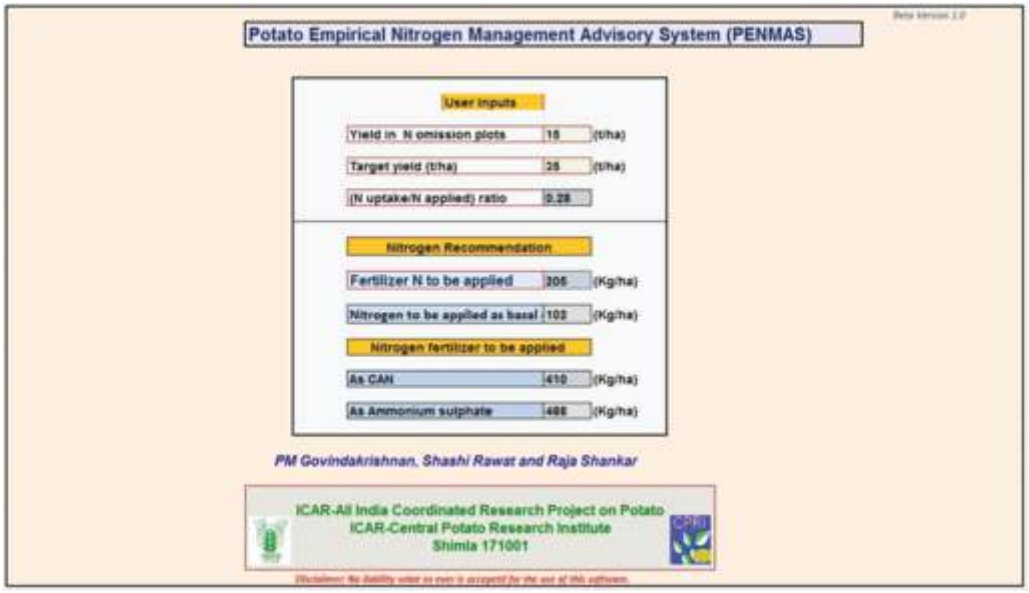


Fig. 2.2 : Screen Shot of PENMASS DSS

NITROGEN REQUIREMENT OF NEWLY RELEASED POTATO CULTIVARS

Kufri Surya is a recently released variety for the warmer potato growing regions of the country due to its heat tolerance characteristics. While extensive research has been done on N response of commercially cultivated varieties, response to nitrogen rates of this variety under different locations has not been studied. Hence, studies were conducted at nine locations varying in soil and climatic conditions for three years viz. 2013-14 to 2015-16. The treatments consisted of 5 Nitrogen levels viz N_0: 0, N_1: 75 kg N/ha, N_2: 150 kg N/ha, N_3: 225 kg N/ha and N_4: 300 kg N/ha. Observations on the growth and yield characters were recorded. The data were statistically analysed as per standard procedures.

The results (Table 2.1) show that the effect of N levels, location and their interaction on yield was significant, however, that of year was non-significant. As regards the effect of location, Pune had the lowest yield while Hisar had the highest yield followed by that at Faizabad. Pooled data over the years and locations revealed that K Surya responded to nitrogen application upto 150 kg/ha across the locations. As regards the interaction of location x N level, the table shows that the yields increased significantly upto 150 Kg N/ha at all the locations thereafter the increase, even if it occurred in some locations, was marginal. Thus, the results show that Kufri Surya responds to N upto 150 Kg N/ha.

Table 2.1: Total tuber yield (t/ha) at different locations as affected by N levels

Location	N_0	N_{75}	N_{150}	N_{225}	N_{300}	Mean
Bhubaneswar	13.83	16.31	19.86	20.85	19.10	17.99
Chhindwara	16.14	23.89	29.78	30.08	30.88	26.15
Deesa	18.11	22.57	26.84	28.90	29.15	25.11
Faizabad	18.35	29.45	35.82	37.34	36.00	31.39
Hisar	25.24	34.78	37.04	38.83	36.57	34.49
Kota	14.43	16.68	21.56	24.20	24.24	20.22
Pasighat	13.56	25.48	42.66	32.25	27.44	28.28
Pune	10.87	12.61	15.88	14.01	13.19	13.31
Raipur	19.30	27.32	33.53	38.21	39.50	31.57
Mean	16.65	23.23	29.22	29.41	28.45	
			CD (0.05%)	**SEd**		
Year			0.47	0.24		
Location			0.82	0.42		
Year X Location			1.42	0.72		
Nitrogen dose			0.61	0.31		
Year X Nitrogen dose			1.06	0.54		
Location X Nitrogen dose			1.83	0.93		
Year X Location X Nitrogen dose			3.17	1.61		

As regards the interaction effect of year and location (Table 2.2), no definite trend was observed. At Bhubaneshwar, Chhindwara, Hisar, Pune and Raipur the yield in 2015-16 was the lowest while in the others the lowest yield was in 2013-14. In the case of interaction of year with treatment(Table 2.3), the yield increased significantly upto 150 kg N/ha in all the years. These relations were programmed into a software (Fig. 2.2).

Experimental field at Deesa

Table 2.2 : Total tuber yield (t/ha)as affected by locations and Year

	Bhubaneswar	Chhindwara	Deesa	Faizabad	Hisar	Kota	Pasighat	Pune	Raipur	Mean
2013 -14	23.20	28.40	21.05	22.59	36.87	19.17	23.88	13.78	48.80	26.42
2014 -15	16.31	26.60	26.38	35.69	34.87	21.02	31.10	14.22	23.51	25.52
2015 -16	14.47	23.46	27.91	35.89	31.74	20.47	29.85	11.93	22.41	24.24
Mean	17.99	26.15	25.11	31.39	34.49	20.22	28.28	13.31	31.57	

Table 2.3 : Total tuber yield (t/ha)as affected by year and treatment

	N 0	N 75	N 150	N 225	N 300	Mean
2013 -14	16.79	24.11	30.05	30.85	30.27	26.42
2014 -15	16.90	23.74	29.58	29.02	28.37	25.52
2015 -16	16.25	21.85	28.02	28.35	26.72	24.24
Mean	16.65	23.23	29.22	29.41	28.45	

DEVELOP SITE SPECIFIC NPK REQUIREMENTS

Experiment to develop site specific recommendations for potato was conducted at 7 locations. Five treatments comprising of omission of N, P and K, an absolute control (no nutrient applied) and another with optimum dose of nutrients were selected for analysis in Randomized Block Design pooled over the years. The nutrient doses given to potato at different sites are summarized in Table 2.4 below.

Table 2.4: Total nutrient applied in potato at different sites (kg N, P_2O_5, K_2O/ha)

Treatment	Gwalior	Jorhat	Kanpur	Modipuram	Shillong	Srinagar	Faizabad
NPK	180:34.9:100	120:100:100	180:80:100	270:80:150	150:120:100	150:120:100	180:80:100
PK	0:34.9:100	0:100:100	0:80:100	0:80:150	0:120:100	0:120:100	0:80:100
NK	180:0:100	120:0:100	180:0:100	270:0:150	150:0:100	150:0:100	180:0:100
NP	180:34.9:0	120:100:0	180:80:0	270:80:0	150:120:0	150:120:0	180:80:0
Control	0	0	0	0	0	0	0

The yield differences among fertilizer treatments were used to determine the yield losses caused by omission of N, P or K. The nutrient uptake in omission plots is an estimate of the indigenous nutrient supplying capacity of the nutrient in question. The apparent nutrient recoveries were calculated as below:

1. Apparent N Recovery (AR-N) = $(U_{NPK} - U_{PK})$/ Na
2. Apparent P Recovery (AR-P)= $(U_{NPK} - U_{NK})$/ Pa
3. Apparent K Recovery (AR-K)=$(U_{NPK} - U_{NP})$/ Ka

where U_{NPK}, U_{PK}, U_{NK}, and U_{NP} are the nutrient uptake in the biomass (in the suffixed treatment plot), and Na, Pa, and Ka are the fertilizer nutrient application rates in these treatments.

Fertilizer computations for targeted yield

Fertilizer N/P/K requirement(kg/ha) = ($U_{N/P/K}$ – $INS_{N/P/K}$) / AR(%), where $U_{N/P/K}$ is the plant N/P/K uptake requirement for the yield goal (kg/ha), $INS_{N/P/K}$ is the indigenous N/P/K supply measured as plant N/P/K uptake in a 0 N, 0 P and 0 K plots, respectively. AR (%) is the apparent

recovery efficiency of respective nutrients (Doberman and Fairhurst, 2000)

Results

Growth and biomass production were strongly affected by the indigenous nutrient supply and the nutrients supplied through fertilizers. Nutrient omissions significantly influenced the yield of potato across the locations (Table 2.5). The reduction in tuber yield was strongly related to the N supply, omission of which resulted in 26.9% reduction in tuber yield. The reduction in the tuber yield was 17.1 and 15.4% due to P and K omission, respectively. Thus N is the most limiting nutrient and P is becoming progressively limiting in potato. The reduction in tuber yield due to P omission was higher than K omission plots, but remained almost the same at most of the centers.

N uptake in tuber and haulm as well as the total N uptake were significantly affected by N omission treatments (Table 2.6). Total N uptake ranged from 65.3 kg/ha in the control plots, 75.4 kg/ha in the N omission plots to 127.3 kg/ha in the optimally fertilized plots. Lowest N uptake was recorded in the control plots at most of the centers except at Gwalior and Jorhat where it was in N omission plots. Total P uptake was significantly reduced due to P omission at most of the locations; it was more so in the N omission plots (Table 2.7), however the lowest P uptake was noticed in control plots at all the locations. Similarly, Potassium uptake was significantly reduced due to K omission at all the centers, however lowest K uptake was noticed in control plots (Table 2.8).

Apparent recovery of nutrient

The average apparent N recovery(Table 2.9) was 29.8% irrespective of location. Among different locations, the apparent recovery of N was maximum at Kanpur (56.9%) and minimum at Srinagar (20.5%). However, it was around 20 to 30 percent at most of the centres. The apparent recovery of N reduced due to omission of P and K also. The average apparent recovery of P (Table 2.10)was 11.5% and it ranged from 5.9% (Shillong) to 22.9 % (Kanpur). The apparent recovery of P was reduced due to N and K omission. The apparent recovery of K (Table 2.11) was 28.4% and it was minimum (16.0%) at Gwalior and maximum at Kanpur (56.2%). It was also reduced due to N and P omission. Thus, the apparent recovery of N, P and K reduced due to omission of nutrients. Agronomic efficiencies of applied nutrients were different for different values of indigenous soil nutrient supply.

Fertilizer requirement for targeted Tuber yield

A significant and linear relationship between tuber yield (dependent variable) and uptake of N, P and K in biomass (independent variables) was observed. High degree of positive and significant relationship existed between the tuber yield and N (R^2 = 0.96), P (R^2 = 0.86), and K (R^2 = 0.92) uptake. The apparent nutrient recovery (AR %), N, P and K uptake (U_{NPK}) in the optimum nutrition and respective omission plots were used for fertilizer doses calculations for targeted tuber yield (Table 2.12). The N:P_2O_5:K_2O dose needed to attain a target yield at different centers was worked out and is given in Table 2.12. It is observed that for the same target yield of 35 t/ha, the requirement of N is 202, 225.5 and 177.6 kg/ha at Gwalior, Kanpur and Srinagar, respectively. The P and K requirements were 64.09 and 120.8, 155 and 149 and 122 & 123 kg/ha, respectively, at Gwalior, Kanpur and Srinagar.

Conclusion

In potato, compared to the full application of all macro elements, the omission of N significantly decreased the tuber yields, whereas the omission of P and K had relatively lesser effect. The results show that different rates of fertilizer application

are required for different soils with different indigenous soil nutrient supplying capacities. The coefficients used to quantify indigenous soil nutrient supply and parameterization of nutrient requirements of potato would help to recommend different NPK combinations for different soils with different values of indigenous soil nutrient supply for targeted potato yields instead of applying blanket fertilizer recommendation.

Table 2.5: Total tuber yield (t/ha) of potato at different sites

Treatment	Gwalior	Jorhat	Kanpur	Modipuram	Shillong	Srinagar	Faizabad
NPK	31.5	18.9	31.6	42.1	16.4	34.8	27.1
PK	25.0	15.8	19.7	27.4	10.9	31.8	17.6
NK	27.6	15.6	25.7	38.2	7.5	31.2	22.3
NP	30.2	15.3	24.1	36.9	10.4	31.3	23.1
Control	24.8	13.1	15.8	21.5	5.7	27.6	14.8
SE(m)	0.68						
CD(P=0.05)	2.10						

Table 2.6: Total nitrogen uptake (kg/ha) by potato at different sites

Treatment	Gwalior	Jorhat	Kanpur	Modipuram	Shillong	Srinagar	Faizabad
NPK	168.0	92.2	209.1	157.3	70.9	89.9	103.7
PK	112.0	51.7	106.6	95.2	37.4	59.2	65.8
NK	123.0	76.6	149.3	141.2	29.1	75.2	83.8
NP	162.0	68.3	158.2	135.3	43.6	73.8	83.6
Control	121.5	56.4	88.2	70.5	22.4	45.7	52.2
SE(m)	9.34						
CD(P=0.05)	28.8						

Table 2.7: Total Phosphorous uptake (kg/ha) by potato at different sites

Treatment	Gwalior	Jorhat	Kanpur	Modipuram	Shillong	Srinagar	Faizabad
NPK	9.1	37.9	87.6	28.5	11.1	27.5	26.3
PK	4.7	28.7	67.1	19.0	7.3	21.9	17.1
NK	4.4	24.7	69.3	22.4	4.0	19.7	17.4
NP	5.7	34.7	83.0	26.2	6.6	22.4	18.5
Control	5.6	22.0	47.9	12.1	2.3	16.0	11.1
SE(m)	2.12						
CD(P=0.05)	6.5						

Total 2.8 : Total Potassium uptake kg/ha) by potato at different sites

Treatment	Gwalior	Jorhat	Kanpur	Modipuram	Shillong	Srinagar	Faizabad
NPK	52.0	102.9	179.3	218.1	61.8	142.1	118.8
PK	33.0	85.8	121.4	134.8	40.9	115.2	78.7
NK	41.5	84.2	153.3	194.1	26.8	124.1	96.1
NP	36.0	68.4	123.1	184.7	34.3	122.8	96.1
Control	35.5	60.1	77.9	94.9	19.7	90.5	62.7
SE(m)	8.14						
CD(P=0.05)	25.1						

Table 2.9: Apparent Recovery fraction of applied nitrogen in potato at different sites

Treatment	Gwalior	Jorhat	Kanpur	Modipuram	Shillong	Srinagar	Faizabad
NPK	31.1	33.8	56.9	23.0	22.3	20.5	21.1
PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NK	6.1	20.8	23.7	17.1	-5.5	10.7	10.0
NP	27.8	13.9	28.6	14.9	4.1	9.7	9.9
Control	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SE(m)	1.2						
CD(P=0.05)	3.8						

Table 2.10: Apparent recovery fraction of applied phosphorous in potato at different sites

Treatment	Gwalior	Jorhat	Kanpur	Modipuram	Shillong	Srinagar	Faizabad
NPK	13.3	13.3	22.9	7.6	5.9	6.5	11.1
PK	0.7	4.0	-2.7	-4.3	2.7	1.9	-0.3
NK	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NP	3.7	10.0	17.1	4.7	2.2	2.3	1.5
Control	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SE(m)	1.8						
CD(P=0.05)	5.5						

Table 2.11: Apparent recovery fraction of applied potassium in potato at different sites

Treatment	Gwalior	Jorhat	Kanpur	Modipuram	Shillong	Srinagar	Faizabad
NPK	16.0	34.6	56.2	22.2	27.5	19.4	22.7
PK	-3.0	17.4	-1.7	-33.3	6.7	-7.5	-17.5
NK	5.5	15.8	30.3	6.2	-7.5	1.4	-0.0
NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SE(m)	6.2						
CD(P=0.05)	19.2						

Table 2.12: Nitrogen, phosphorous and potassium fertilizer requirement for targeted yield of potato at different sites

Locations	Target yield (t/ha)	Estimated Nutrient requirement (kg/ha)			INS (kg/ha)		
		N	P	K	N	P	K
Gwalior	35	174.9	12.9	55.3	112.0	4.4	36
Jorhat	20	112.4	46.6	117.1	51.7	24.7	68.4
Kanpur	35	235.0	104.9	207.2	106.6	69.3	123.1
Modipuram	45	169.2	31.0	237.1	95.2	22.4	184.7
Shillong	20	86.6	14.4	75.8	37.4	4.0	34.3
Srinagar	35	95.5	27.6	146.6	59.2	19.7	122.8
Faizabad	30	114.7	29.0	129.9	65.8	17.4	96.1

Table 2.12: Continued…..

Locations	Net nutrient requirement (kg/ha)			Apparent recovery (%)			Actual Nutrient requirement (kg/ha)		
	N	P	K	N	P	K	N	P	K
Gwalior	62.9	8.5	19.3	31.1	13.3	16.0	202.2	64.1	120.8
Jorhat	60.7	21.9	48.7	33.8	13.3	34.6	179.9	165.4	140.8
Kanpur	128.4	35.7	84.1	56.9	22.9	56.2	225.5	155.4	149.7
Modipuram	74.0	8.6	52.4	23.0	7.6	22.2	321.6	112.9	222.1
Shillong	49.2	10.4	41.5	22.3	5.9	27.5	220.5	175.5	150.8
Srinagar	36.3	8.0	23.9	20.5	6.5	19.4	177.7	122.3	123.3
Faizabad	48.9	11.7	33.8	21.1	11.1	22.7	231.9	105.0	149.9

ROLE OF BORON IN REDUCING TUBER CRACKING IN PROCESSING VARIETY KUFRI CHIPSONA-3

The experiment to study the effect of Boron in reducing cracking in K. Chipsona-3 was conducted at Bhubaneshwar, Chhindwara, Deesa, Kalyani, Kota and Raipur. The experiment involved different levels of boron in combination with recommended dose of fertilizers as per details below.

T1: RDF of NPK only T2: RDF of NPK + 2.0 kg B/ha as soil application T3: RDF of NPK + 0.1% boric acid as foliar application at 40 DAP T4: RDF of NPK + 0.1% boric acid as foliar application in two equal splits at 40 and 60 DAP T5: RDF of NPK + 0.1% boric acid as foliar application in three times at 40, 50 and 60 DAP.

K Chipsona-3 is a variety with good processing quality but the main defect is that it has high proportion of cracked tubers. Boron is associated with cracking and hence the experiments aimed at reducing cracking through application of B was conducted. The results showed that the total yield was significantly affected by location, treatments and their interaction (Table 2.13). As regards the effect of locations, the yield was lowest at Bhubaneswar followed by that at

Raipur while it was highest at Deesa followed by Kota and Kalyani. In the case of treatments, the treatments receiving boron gave significantly higher yield than that receiving only recommended doses of fertilizers (Table 2.13). As regards the interaction effect, response to Boron was found only at Chhindwara in T2 (RDF of NPK + 2.0 kg B/ha as soil application) and at Kalyani where all the Boron treatments significantly increased the yield over control.

Experimental field at Kanpur

Table 2.13: Total yield (t/ha) & number of tubers (000'/ha) at different locations under different boron levels

	Total yield (t/ha)						Total number of tubers (000'/ha)					
	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
Bhubaneswar	15.06	16.37	15.57	16.23	16.41	15.93	352	352	350	385	390	366
Chhindwara	25.70	30.78	28.10	28.39	29.75	28.54	441	532	494	518	546	506
Deesa	56.00	58.51	56.84	57.98	57.26	57.32	627	659	640	657	663	649
Kota	32.32	31.03	35.11	31.35	30.32	32.02	404	408	443	411	396	413
Raipur	16.16	17.60	16.15	16.54	16.66	16.62	449	500	481	493	484	481
Kalyani	25.41	30.32	30.75	33.36	35.16	31.00	316	406	379	413	446	392
Mean	28.44	30.77	30.42	30.64	30.93		432	476	465	479	488	
				CD (0.05)						CD (0.05)		
Year				NS						NS		
Location				1.28						28.59		
Year X Location				NS						40.43		
Boron dose				1.17						26.10		
Year X Boron dose				NS						NS		
Location X Boron dose				2.86						NS		
Year X Location X Boron dose				NS						NS		

Table 2.14 : Total yield of cracked tubers (t/ha) & total number of cracked tubers (000'/ha) at different locations under different boron levels

	Total yield of cracked tuber (t/ha)						Total number of cracked tubers (000'/ha)					
	T1	T2	T3	T4	T5	Mean	T1	T2	T3	T4	T5	Mean
Bhubaneswar	3.29	3.42	3.00	3.30	2.96	3.19	17	14	13	11	10	13
Chhindwara	4.68	4.13	4.34	3.85	3.78	4.16	63	71	73	87	76	74
Deesa	0.35	0.23	0.31	0.21	0.20	0.26	179	147	159	149	143	156
Kota	1.21	1.88	1.25	1.43	1.59	1.47	3	2	2	1	2	2
Raipur	1.89	2.10	1.54	1.44	1.49	1.69	10	16	11	12	11	12
Mean	2.29	2.35	2.09	2.05	2.00		54	50	52	52	48	
				CD (0.05)			CD (0.05)					
Year				NS			6.07					
Location				0.23			9.60					
Year X Location				0.33			13.57					
Boron dose				0.23			NS					
Year X Boron dose				NS			NS					
Location X Boron dose				NS			NS					
Year X Location X Boron dose				NS			NS					

The yield of cracked tubers was highest in Chindwara and lowest in Deesa (Table 2.14). The influence of B treatments on yield of cracked tubers was also significant and it was lowest in T5 (RDF of NPK + 0.1% boric acid as foliar application in three times at 40, 50 and 60 DAP) followed by that in T3 and T4. Thus the study shows that overall there is some effect of B in reducing the yield of cracked tubers but the results are not conclusive.

RESPONSE OF POTATO TO ZINC APPLICATION

Field experiments to study the response to Zn application in potato were conducted at different centres with the following treatments:

T1: RDF of NPK T2: RDF of NPK + 1.5kg Zn/ha T3: RDF of NPK + 3.0 kg Zn/ha T4 : RDF of NPK + 4.5 kg Zn/ha T5 : RDF of NPK + 6.0 kg Zn/ha

The results (Table 2.15) show that mean response to Zn over locations was significant. However, the interaction of location and treatment was also significant and significant response to Zn application above 3.0 Kg Zn/ha was obtained at Chhindwara, Hisar, Jorhat, Pantnagar and Pasighat. At Patna the response was observed only at 4.5 and 6.0 Kg Zn/ha while at Faizabad and Kanpur it was observed only at 6.0 kg Zn/ha.

Table 2.15: Total Tuber yield (t/ha)at different locations as affected by different Zinc levels

Locations	T1	T2	T3	T4	T5	Mean
Bhubaneswar	13.4	18.6	14.0	13.2	12.6	14.4
Chindwara	23.4	25.1	30.0	31.4	31.5	28.2
Deesa	61.9	60.7	59.6	61.9	60.7	61.0
Dholi	17.4	21.1	19.6	26.9	25.9	22.2
Faizabad	28.3	29.1	30.5	32.5	34.8	31.0
Gwalior	30.6	31.5	33.3	29.4	28.1	30.6
Hisar	32.1	35.2	38.3	40.8	38.5	37.0
Jorhat	14.8	17.4	18.7	18.5	20.2	17.9
Kalyani	25.6	26.0	27.0	27.9	28.8	27.1
Kanpur	26.6	25.7	28.0	29.4	31.7	28.3
Kota	31.2	30.1	30.2	30.3	32.5	30.8
Modipuram	42.8	43.7	43.1	44.0	42.9	43.3
Pantnagar	31.3	32.7	33.4	33.3	32.9	32.7
Pasighat	17.3	28.8	41.8	33.7	33.7	31.1
Patna	35.4	36.6	37.6	39.5	42.0	38.2
Pune	18.9	22.3	18.8	16.8	15.8	18.5
Raipur	18.9	20.1	21.9	21.9	20.8	20.7
Mean	27.6	29.7	30.9	31.3	31.4	
CD	Location = 1.6	Treatment = 0.9		Location X Treatment = 3.5		
SEd	Location = 0.79	Treatment = 0.43		Location X Treatment = 1.77		

EVALUATION OF POTATO -TRANSPLANTED ONION SEQUENCE

Experiments to standardize the date of planting and harvesting of potato in potato-onion sequence was conducted at four centres in the eastern plains *viz*.Dholi, Faizabad, Kalyani and Patna. The treatments comprised of 3 dates of planting viz. optimum, 10 days before and 10 days after optimum and two dates of harvesting viz. 80 and 90 days after planting. The results showed that date of planting and harvesting significantly affected the yield (Table 2.16). The mean yield over locations was significantly higher at the optimum date of planting than the 10 days before and 10 days after dates of planting which were non-significant between themselves. As regards date of harvesting, the later date *i.e.* at 90 DAP gave significantly higher yield than the earlier date. The effect of these treatments on onion is being studied.

Table 2.16: Tuber yield (t/ha) as affected by date of planting and harvesting in different locations

Dates of planting	H1	H2	Mean
D1	21.9	25.6	23.8
D2	23.4	27.0	25.2
D3	21.9	25.2	23.5
Mean	**22.4**	**26.0**	

Table 2.17: Tuber yield (t/ha) as affected by Location X date of planting and Location X harvesting in different locations

Locations	Location X date of planting			Mean	Location X harvesting	
	D1	D2	D3		H1	H2
Dholi	17.5	16.0	15.0	**16.2**	12.7	19.6
Faizabad	25.3	28.9	24.6	**26.3**	24.7	27.9
Kalyani	24.2	26.2	27.1	**25.8**	25.5	26.1
Patna	28.0	29.7	27.5	**28.4**	26.6	30.2
Mean	**23.8**	**25.2**	**23.5**		**22.4**	**26.0**

Factors	CD	SEd
Location	0.8	0.39
Date of planting	0.7	0.34
Location X Date of planting	1.4	0.68
Harvesting	0.6	0.28
Location X Harvesting	1.1	0.56
Date of planting X Harvesting	NS	0.48
Location X Date of planting X Harvesting	NS	0.96

EFFECT OF DRIP FERTIGATION ON GROWTH AND YIELD OF POTATO.

Among the common irrigation methods drip irrigation is the most efficient in terms of water as well as nutrient use efficiency because it is possible to apply the exact amount of water and nutrients required by the crop thus reducing wastage of water as well as that of nutrients through leaching. At the same time drip irrigation has been reported to increase the productivity of the crop, therefore, there is need to work out the exact nutrient requirement especially of N under drip irrigation so as to meet the enhanced requirement of the crop due to higher yield as well as lesser leaching so that soil quality is maintained. Therefore, experiment was conducted at Hisar with different Nitrogen levels viz. T1 60%, T2 80%, T3 100%, T4 120%, T5 140% of the recommended dose (RDF) of N and another with RDF N as basal dose under Furrow irrigation (T6). The results showed that upto 120% RDF the yields were at par and significantly higher than that in T6. The yield at 140% RDF though significantly higher than that in T6 was lower than the yield at lower doses. Thus, the results show that under drip irrigation T1 and T2 i.e. 60 and 80% RDF is sufficient to meet the N needs.

Table 2.18: Tuber yield (t/ha) as affected by irrigation treatments in different years

	T1	T2	T3	T4	T5	T6	Mean
2014-15	33.8	31.2	28.4	28.4	27.0	22.6	28.6
2015-16	26.4	30.9	32.6	32.3	31.2	23.0	29.0
Mean	30.1	31.0	30.5	30.4	29.1	22.8	
CD	Year = 0.7		Treatment = 1.2		Year X Treatment = 1.7		
SEd	Year = 0.35		Treatment = 0.60		Year X Treatment = 0.85		

DEVELOPMENT OF POTATO BASED ORGANIC FARMING SYSTEM

To develop organic farming systems in potato the effect of different organic manures were evaluated for their potential to meet the nutrient needs of potato so that they can be integrated into the organic farming system. The experiment was conducted at Dholi, Faizabad, Gwalior, Hisar, Jorhat, Ooty, Pasighat and Srinagar with the following treatments.

T1: Absolute control T2: Inorganic practices standard technology T3: Crop residue based: compositing of available cheaper crop/weed residues (like NADEP method) + Crop residue incorporation (Main crop/catch/green manuring/bio-fumigation crop) + biofertilizer (*Azotobacter* and Phosphobacteria) + microbial culture to decompose crop residues T4: T3 + FYM @ 25 t/ha T5 : T3 + Vermicompost 7.5 t/ha

The results showed that location, treatments and their interaction significantly affected the yield. The highest yield was obtained in the treatment with standard inorganic practices, however, the yields under T4 and T5 though significantly lower than T2 was still significantly higher than the other treatments. At Hisar however, the yield under these two treatments were at par to the inorganic treatment. The results show that T4 and T5 have got high potential for meeting the nutrient needs under organic farming systems in potato.

Table 2.19: Tuber yield (t/ha) at different locations in different years

	Faizabad	Hisar	Pasighat	Dholi	Mean
2014 -15	22.7	35.4	18.6	19.6	24.1
2015 -16	23.7	27.6	27.8	18.9	24.5
Mean	23.2	31.5	23.2	19.2	

Table 2.20:Tuber yield (t/ha) in different treatments at different locations

	T1	T2	T3	T4	T5	Mean
Faizabad	15.0	33.5	18.5	23.7	25.4	23.2
Hisar	27.8	33.4	29.5	35.2	31.8	31.5
Pasighat	18.6	30.3	22.6	22.4	22.0	23.2
Dholi	11.0	24.3	18.0	20.0	22.9	19.2
Mean	18.1	30.4	22.1	25.3	25.5	
Factors			**C.D.**		**SE(d)**	
Year			NS		0.25	
Location			0.7		0.35	
Year X Location			1.0		0.50	
Treatment			0.8		0.40	
Year X Treatment			NS		0.56	
Location X Treatment			1.6		0.79	
Year X Location X Treatment			2.2		1.12	

DEVELOPMENT OF MICRONUTRIENT FORMULATION FOR POTATO

Micronutrients are very important in the production of potato throughout the country. They influence both yield and quality. A potato specific micronutrient formulation was developed at ICAR-IIHR by the "National Network on Management of Micronutrients in Horticultural crops for Yield and Quality".

Experiment to develop a micronutrient formulation for potato was taken up at sixteen locations viz. Bhubaneshwar, Chhindwara, Deesa, Dharwad, Dholi, Faizabad, Gwalior, Hassan, Hisar, Jalandhar, Jorhat, Kalyani, Kanpur, Kota, Modipuram, Pantnagar, Pasighat, Pune, Patna, Raipur, Srinagar and Shillong. The recommended varieties of the area were used in the trial. The treatment details are given below.

Treatments

Treatment Details

T1 : Recommended fertilization practices followed in the region

T2 : T1+ Foliar spray of boron as per details given below

T3 : T1+ Foliar spray of zinc as per details given below

T4 : T1+ Foliar spray of zinc + boron as per details given below

T5 : T1 + Foliar vegetable special of IIHR, Three sprays at different growth stages

T6 : T1 + Potato Specific nutrient formulation, Three sprays at different growth stages

Spray schedule: Spray schedule is common to all the treatments

First spray : Plant establishment stage (vegetative growth stage)

Second spray : Tuber initiation stage

Third spray : Tuber bulking stage If the duration of variety exceeds 80 days then one more spray can be given between second and third stage of the crop

Spray concentrations: Foliar vegetable special of IIHR @ 5 g/ litre with pH adjustment to 6.2-6.5 using either citric acid or lime juice and suitable sticker

Potato Specific nutrient formulation @ 4 g/ litre with pH adjustment to 6.2-6.5 using either citric acid or lime juice and suitable sticker

For boron alone treatment: Use boric acid at 50 ppm concentration (50 mg/litre).

For zinc alone treatment: Use $ZnSO_4.7H_2O$ at 150 ppm concentration (150 mg per litre). Adjust the pH to 6.2 to 6.5 using citric acid/ lime juice or sodium hydroxide as the case may be.

Table 2.22 : Tuber yield (t/ha) under different treatments at different locations

Location/Treatments	T1	T2	T3	T4	T5	T6	Mean
Bhubaneswar	19.9	20.6	21.3	19.1	23.7	19.5	20.7
Chhindwara	23.4	25.0	26.2	27.5	28.4	28.8	26.5
Deesa	44.7	41.9	40.0	40.8	45.0	42.4	42.5
Dholi	14.3	16.3	16.4	19.3	19.0	19.0	17.4
Faizabad	32.5	33.1	33.6	33.6	33.5	33.8	33.4
Gwalior	29.3	31.6	29.2	30.0	28.8	28.0	29.5
Hisar	35.9	38.0	38.9	40.7	39.1	41.9	39.1
Jorhat	13.0	13.7	15.6	17.7	19.6	19.0	16.4
Kalyani	23.2	26.2	23.9	28.4	30.1	32.7	27.4
Kanpur	27.7	29.7	29.1	30.7	25.2	26.1	28.1
Modipuram	45.6	46.1	43.5	45.5	48.1	42.6	45.2
Pantnagar	31.2	33.1	35.8	37.0	27.8	29.3	32.4
Pasighat	19.4	31.0	24.0	21.8	20.5	34.6	25.2
Patna	31.1	35.7	34.7	36.3	40.6	35.3	35.6
Pune	16.0	18.4	17.5	19.5	21.9	20.3	18.9
Raipur	15.6	16.5	16.0	17.1	17.0	17.6	16.6
Mean	26.4	28.6	27.9	29.1	29.3	29.4	
CD	Location = 1.4		Treatment = 0.9		Location X Treatment = 3.4		
SEd	Location = 0.71		Treatment = 0.44		Location X Treatment = 1.75		

Out of the sixteen locations response to IIHR micronutrient formulation and potato special formulation was observed in six locations viz Chindwara, Dholi, Jorhat, Kalyani, Patna and Pune. At all these locations except Pune, significant response to Boron and Zinc application was also observed.

Experimental field at Kalyani

YIELD AND YIELD COMPONENTS

Per cent dry matter content

The application of recommended practices with potato specific (19.60 %) nutrient formulation @ 4g/l with 3 sprays at different growth stages (T_6) recorded highest per cent dry matter followed by recommended practices with foliar vegetable special (19.39 %) of IIHR @ 5g/l with 3 sprays at different growth stages (T_5) and recommended practices with combination (T_4) of foliar spray of $ZnSO_4.7H_2O$ @ 150 ppm concentration and boric acid @ 50 ppm concentration (19.53 %). Among the treatments, the recommended practices (T_1) followed in the region (18.77 %) showed slightly less per cent dry matter compared to other treatments.

Tuber yield on dry weight basis (t ha^{-1})

The highest tuber yield on dry weight basis was recorded in recommended practices with combination (T_4) of foliar spray of $ZnSO_4.7H_2O$ @ 150 ppm concentration and boric acid @ 50 ppm concentration (5.82 t ha^{-1}) followed by recommended practices with potato specific (5.74 t ha^{-1}) nutrient formulation @ 4g/l with 3 sprays at different growth stages (T_6) and foliar vegetable special (5.69 t ha^{-1}) of IIHR @ 5g/l with 3 sprays at different growth stages (T_5). The recommended practices (T_1) followed in the region (5.06 t ha^{-1}) showed less yield compared to rest other treatments.

Total tuber yield (t ha^{-1})

The total tuber yield was highest (29.43 t ha^{-1}) in treatment with potato specific nutrient formulation @ 4g/l with 3 sprays at different growth stages than the check (IIHR Vegetable Special) (29.26 t ha^{-1})

Very Small grade tuber yield (0-25g t ha^{-1})

Very small grade potatoes yield was very low in plots treated with potato special (2.1 t ha^{-1}) compared to the check, IIHR vegetable special (2.47 t ha^{-1}) and other treatments. The highest very small grade tuber yield was noticed in recommended practices with foliar vegetable special (T_5) of IIHR @ 5g/l with 3 sprays at different growth stages followed by other treatments (2.33, 2.28, 2.26 and 2.23, respectively) compared to recommended practices (T_1) followed in the region (2.10 t ha^{-1}).

Large grade tuber yield (> 75 g t ha^{-1})

The yield of potato tubers weighing more than 75 grams was significantly high in the treatment with potato special compared to check. However, foliar spray with zinc sulphate and boric acid also yielded highest yield.

Tuber numbers

The number of tubers based on the grade was influenced by different micronutrient treatments.

Very Small number of tubers (0-25g 000 ha^{-1})

Foliar application of potato special yielded very less (26.72,000) small tubers (0-25g 000 ha-1).

This is followed by individual micronutrient sprays (T_4) (135.80 000 ha^{-1}), T_5 check (IIHR Vegetable Special) (134.37 000 ha^{-1}) and T_3 (129.71 000 ha^{-1}) treatments

Large number of tubers (> 75g 000 ha^{-1})

Both potato special (T6) (94.24 t ha^{-1}) and individual micronutrient sprays (T4) (96.23 000 ha^{-1}) yielded significantly higher large size (> 75g 000 ha-1) tuber yield compared to IIHR Vegetable special and other treatments.

Haulm yield on dry weight basis (t ha^{-1})

The recommended practices with potato specific nutrient formulation @ 4g/l with 3 sprays at different growth stages (T_6) gave highest haulm yield on dry weight basis (3.23 t ha^{-1}) followed by recommended practices with combination (T_4) of foliar spray of $ZnSO_4.7H_2O$ @ 150 ppm concentration and boric acid @ 50 ppm yield of potato tubers weighing more than 75 grams was significantly high in the treatment with potato special compared to check. However, foliar spray with zinc sulphate and boric acid also yielded highest yield.

Tuber numbers

The number of tubers based on the grade was influenced by different micronutrient treatments.

Very Small number of tubers (0-25 g 000 ha^{-1})

Foliar application of potato special yielded very less (26.72,000 ha^{-1}) small tubers (0-25g 000 ha-1).

This is followed by individual micronutrient sprays (T_4) (135.80 000 ha^{-1}), T_5 check (IIHR Vegetable Special) (134.37 000 ha^{-1}) and T_3 (129.71 000 ha^{-1}) treatments

Large number of tubers (> 75g 000 ha^{-1})

Both potato special (T6) (94.24 t ha^{-1}) and individual micronutrient sprays (T4) (96.23 000 ha^{-1}) yielded significantly higher large size (> 75g 000 ha-1) tuber yield compared to IIHR Vegetable special and other treatments.

Haulm yield on dry weight basis (t ha^{-1})

The recommended practices with potato specific nutrient formulation @ 4g/l with 3 sprays at different growth stages (T_6) showed highest haulm yield on dry weight basis (3.23 t ha^{-1}) followed by recommended practices with combination (T_4) of foliar spray of $ZnSO_4.7H_2O$ @ 150ppm concentration and boric acid @50 ppm

concentration (3.22 t ha^{-1}) and foliar vegetable special (3.20 t ha^{-1}) of IIHR @ 5g/l with 3 sprays at different growth stages (T_5).

Content of micronutrients

The data pertaining to the content of zinc, iron, copper, manganese and boron in potato crop as influenced by micronutrient treatments is given below:

The highest concentration of Zn (38.33 mg kg^{-1}), Fe (489.69 mg kg^{-1}) and B (86.01 mg kg^{-1}) in potato crop was recorded in recommended practices with potato specific (T_6) nutrient formulation @ 4g/l with 3 sprays at different growth stages followed by recommended practices with combination (T_4) of foliar spray of $ZnSO_4.7H_2O$ @ 150 ppm concentration and boric acid @ 50 ppm concentration (Zn – 34.48 mg kg^{-1}) and foliar spray (T_3) of $ZnSO_4.7H_2O$ @ 150 ppm concentration (Fe – 456.37 mg kg^{-1} & B – 78.64 mg kg^{-1}). Compared to all other treatments, the least concentration of Zn (30.57 mg kg^{-1}), Fe (420.70 mg kg^{-1}) and B (70.54 mg kg^{-1}) was recorded in recommended practices (T_1) followed in the region. There were no significant differences between treatments in copper and manganese concentrations.

Conclusion

- This study on development of a potato specific nutrient formulation shows that instead of spraying individual micronutrients like zinc sulphate and boric acid separately, a single formulation with all micronutrients in balanced proportion is more useful and economical.
- Potato special developed by ICAR-IIHR is performing better than the check (ICAR-IIHR vegetable special) in terms of total yield, per cent dry matter content and haulm yield on dry weight basis
- Potato Special has reduced the yield of very small tubers and enhanced the yield of very large size tubers.
- Potato special has enhanced the concentration of zinc and boron content in both plant and tubers over check.
- Generally the treatment Potato Special (T_6) showed the good growth parameters, yield, colour and concentration of nutrient in potato crop followed by check(T_5).
- Potato Special is used at 4g per litre compared to IIHR vegetable special(Check) used at 5 grams per litre. Hence potato special is superior to IIHR vegetable special both in terms of growth, yield and quality and also in terms of economics.

Table 2.23: Mean effect of micronutrient formulations on emergence (%), yield of tubers (t/ha)and tuber & haulm yield on dry weight basis (t/ha)

Treatments	Emergence (%)	Grade wise yield of tubers (t/ha)					Yield on dry weight basis (t/ha)	
		0-25g	25-50g	50-75g	>75g	Total	Tuber	Haulm
T1	93.27	2.10	6.41	9.24	8.82	26.44	5.06	2.95
T2	93.35	2.28	6.36	10.30	9.78	28.56	5.42	3.12
T3	93.31	2.33	6.86	9.48	9.37	27.85	5.47	3.01
T4	93.08	2.26	6.67	9.51	10.88	29.06	5.82	3.22
T5	93.97	2.47	6.64	10.04	10.26	29.26	5.69	3.20
T6	92.19	2.23	6.99	10.00	10.45	29.43	5.74	3.23

Table 2.24: Mean effect of micronutrient formulations on no of tubers (000'/ha) and dry matter content (%)

Treatments	Grade wise number of tubers (000'/ha)					Dry Matter Content (%)
	0-25g	25-50g	50-75g	>75g	Total	
T1	123.20	134.54	106.91	79.72	444.38	18.77
T2	124.85	133.70	112.20	88.12	458.87	19.01
T3	129.71	141.52	115.04	86.38	472.65	19.21
T4	135.80	140.56	113.75	96.23	486.34	19.53
T5	134.37	140.63	116.48	90.33	481.80	19.39
T6	126.72	141.49	112.22	94.24	474.68	19.60

Table 2.25: Mean effect of micronutrient formulations on quality attributes

Treatments	Quality attributes (mg/kg)					Colour (1-5 scale)
	Zn	Cu	Fe	Mn	B	
T1	30.57	17.17	420.70	107.43	70.54	3.48
T2	32.20	13.61	446.47	104.73	76.99	3.93
T3	32.49	13.77	456.37	156.09	78.64	3.56
T4	34.48	14.00	436.42	105.14	77.96	4.14
T5	33.98	13.76	433.68	98.27	76.38	4.04
T6	38.33	14.64	489.69	117.59	86.01	3.72

WEED MANAGEMENT IN POTATO (Kharif season)

Studies to quantify the yield loss and competition for nutrients by weeds in potato were conducted at Shillong and Srinagar. The results showed that weeds caused significant yield loss in potato. The weed free treatment had the highest yield flowed closely by weed control with Metribuzin both as pre emergence application and as post emergence application at Shillong. At Srinagar, however, the yields were adversely affected by weed control with Metribuzin and all the manual weed control treatments gave significantly higher yield over weedy check and were only marginally lower than the weed free check.

Treatments

T1 Weedy check

T2 Weed free

T3 Hand weeding at 30 days and weed free upto maturity

T4 Hand weeding at 40 days and weed free upto maturity

T5 Hand weeding at 50 days and weed free upto maturity

T6 Herbicides (Metribuzin @ 0.75 kg/ha) pre-emergence

T7 Herbicides (Metribuzin @ 0.75 kg/ha) as post emergence at 10% of plant emergence

SHILLONG

Table 2.26: Number of weeds (000'/ha), grade-wise yield (t/ha), yield loss (%) by most prevalent weed, dry matter production of weed (t/ha), concentration in haulm, tubers & weeds (%) and uptake by potato crop, weeds & total (kg/ha)

Treatments	No of weeds (000'/ha)*		Grade-wise yield (t/ha)					Yield loss (%) by most prevalent weed	Dry matter production of weed (t/ha) at		
	Dicot	Monocot	0-25g	25-50g	50-75g	>75g	Total		30 DAP	50 DAP	60 DAP
T1	1,971.49	1,708.82	3.03	3.61	2.12	0.56	9.33	59.05	0.08	0.54	0.59
T2	0.00	0.00	2.78	7.70	7.07	5.25	22.79	0.00	0.00	0.00	0.00
T3	0.00	0.00	2.54	5.40	5.54	4.02	17.50	23.13	0.08	0.00	0.00
T4	0.00	0.00	2.49	4.73	4.73	3.84	15.79	30.70	0.07	0.00	0.00
T5	0.00	0.00	2.59	4.77	4.57	3.73	15.66	31.23	0.07	0.45	0.00
T6	197.44	50.95	2.53	7.03	6.51	4.83	20.89	8.20	0.00	0.00	0.00
T7	203.62	45.94	2.35	5.64	6.87	4.85	19.71	13.58	0.00	0.00	0.00
SEd	16.61	22.35	0.20	0.42	0.39	0.35	0.62	2.61	0.01	0.01	0.01
CD(0.05)	35.16	47.32	NS	0.88	0.82	0.75	1.31	5.53	0.02	0.02	0.02
CV%	6.93	12.25	10.57	10.56	10.24	12.92	5.02	15.60	28.56	7.76	16.92

* **Name of dicot weeds:** *Spergulaarvensis,Plantago major, Hydrocotylejavanica, Oxalis corniculata.*

** **Name of monocot weeds:***Cyperuscyperoides, Imeratacylindrica, Arthraxon species, Arundinellanepalensis, Digitariaadscendens,Paspalumorbiculare, Brachiariareptans*

Table contd.....

Treatments	Concentration in haulm (%)			Concentration in tubers (%)			Concentration in weeds (%)		
	N	P	K	N	P	K	N	P	K
T1	2.98	0.21	2.19	1.34	0.24	1.12	1.87	0.45	1.74
T2	3.31	0.29	2.53	1.87	0.29	1.56	1.89	0.50	1.84
T3	3.45	0.27	2.51	1.75	0.31	1.54	1.90	0.48	1.81
T4	3.40	0.25	2.47	1.70	0.29	1.45	2.02	0.46	1.79
T5	3.37	0.26	2.28	1.66	0.28	1.44	1.90	0.46	1.85
T6	3.75	0.29	2.55	1.79	0.29	1.52	1.92	0.45	1.85
T7	3.70	0.27	2.53	1.81	0.28	1.52	1.93	0.46	1.86
SEd	0.12	0.02	0.09	0.04	0.02	0.04	0.05	0.02	0.06
CD(0.05)	0.24	0.04	0.19	0.08	NS	0.09	NS	NS	NS
CV%	4.76	9.94	5.13	3.09	10.45	4.02	3.94	5.65	4.70

Table contd.....

Treatments	Uptake by potato crop (kg/ha)			Uptake by potato weeds (kg/ha)			Total Uptake (kg/ha)		
	N	P	K	N	P	K	N	P	K
T1	40.51	5.21	32.79	61.73	14.47	55.75	100.31	21.22	86.81
T2	111.88	14.86	90.67	0.00	0.00	0.00	111.88	15.43	90.67
T3	90.67	12.35	77.16	0.00	0.00	0.77	92.59	15.43	77.16
T4	77.16	10.22	61.73	7.72	1.54	6.37	82.95	13.50	69.44
T5	75.23	10.03	57.87	7.72	2.31	8.68	82.95	13.50	67.51
T6	111.88	14.28	84.88	7.72	1.73	6.56	119.60	15.43	92.59
T7	106.10	12.93	82.95	7.72	1.93	8.11	115.74	15.43	90.67
SEd	4.35	0.91	3.89	1.68	0.36	1.65	4.75	1.88	3.89
CD(0.05)	9.21	1.92	8.23	3.56	0.76	3.49	10.06	3.98	8.23
CV%	7.02	11.25	7.89	18.00	16.13	18.90	6.66	16.94	6.70

SRINAGAR

Table: Grade-wise yield (t/ha), yield of tubers & haulm, concentration in tubers & haulm (%) and uptake by tubers, haulm & total (kg/ha)

Treatments	No of weeds Dicot/Monocot (no/ha)	Yield loss (%)	Grade-wise yield (t/ha)				
			0-25g	25-50g	50-75g	>75g	Total
T1	18432	23.07	0.49	4.61	9.11	15.19	29.39
T2	0.00	0.00	0.27	3.42	12.85	21.67	38.21
T3	6495	3.92	0.27	3.98	13.16	19.57	36.99
T4	8676	8.00	0.21	3.62	13.05	18.27	35.15
T5	7498	2.93	0.38	4.55	9.97	22.18	37.09
T6	16743	13.13	0.28	3.52	11.84	17.56	33.19
T7	13248	10.30	0.21	3.74	12.40	17.92	34.27
SEd			0.01	0.11	0.42	1.75	1.94
CD(0.05)			0.01	0.23	0.89	3.69	4.07
CV%			5.97	4.05	5.07	13.12	7.85

Weeds prevalent during the cropping period were Chinopodium album, Amaranthus wild spp. and Partulaca.

Table contd.....

Treatments	Concentration in tubers (%)			Concentration in haulms (%)			Uptake by tubers (kg/ha)		
	N	P	K	N	P	K	N	P	K
T1	0.93	0.64	1.491	0.92	0.35	0.69	27.54	10.57	50.20
T2	1.76	0.84	3.00	1.94	0.57	1.79	51.04	15.15	99.35
T3	1.19	0.99	1.79	1.19	0.89	1.17	38.98	17.04	67.50
T4	1.25	0.65	2.14	1.38	0.38	1.23	39.16	11.77	72.74
T5	1.03	0.74	1.57	1.13	0.51	0.85	33.35	13.31	61.53
T6	1.45	0.88	2.59	1.52	0.69	1.46	40.75	15.52	74.31
T7	**1.68**	**0.96**	**2.93**	**1.59**	**0.74**	**1.59**	**46.45**	**16.34**	**86.64**

Table contd.....

Treatments	Uptake by haulms (kg/ha)			Total uptake (%)		
	N	P	K	N	P	K
T1	22.25	8.75	28.25	49.79	19.32	78.45
T2	35.21	9.19	37.48	86.25	24.34	136.83
T3	26.82	12.24	28.26	65.80	29.28	95.76
T4	30.55	8.96	34.62	69.71	20.73	107.36
T5	24.88	8.52	26.94	58.23	21.83	88.47
T6	31.84	10.68	34.28	72.59	26.20	108.59
T7	32.35	11.84	37.28	78.80	28.18	123.92

CROP PROTECTION

MONITORING OF LATE BLIGHT AND A2 MATING TYPE OF PHYTOPHTHORA INFESTANS IN STANDING CROP AND TUBERS AT HARVEST AND AFTER COLD STORAGE

Table 3.1: Late blight appearance date and incidence at different days after appearance

Centre	Date of 1st appearance of LB	Incidence (%) at days				Intensity (%) at days			
		7	14	21	28	7	14	21	28
Faizabad	Did not appear								
Jorhat	D1:07.01.16	35	60	100	100	15	59	100	100
	D2:10.01.16	30	70	100	100	10	56	100	100
	D3:10.01.16	25	55	100	100	10	44	96	100
Kalyani	D1:30.01.16	25	42	60	90	16	29	39	48
	D2:30.01.16	34	43	63	91	22	32	41	49
	D3:30.01.16	39	63	96		28	50	62	
Kanpur	D1:20.11.15	18	21	40	45	15	28	38	45
	D2:28.11.15	11	20	34	43	10	21	28	38
	D3:15.12.15	7	15	26	38	13	21	28	38
Kota	Did not appear								
Pantnagar	D1:12.12.15	10	20	40	60	5	10	20	45
	D2:08.12.15	10	30	60	80	5	15	35	50
	D3:14.12.15	5	10	20	40	5	10	15	30
Patna	D1:16.01.16	12	38	66	100	22	46	71	88
	D2:20.01.16	15	30	72	100	11	35	59	70
	D3:20.01.16	10	25	60	100	9	23	40	52
Pasighat	D1:27.12.15	6	9	12	17	6	13	20	20
	D2:10.01.16	9	15	17	19	9	9	12	20
	D3:24.01.16	24	23	34	36	27	22	30	20
Pune	D1:16.01.16	42	52	65	69	16	38	44	46
	D2:16.01.16	28	38	47	52	11	24	32	39
	D3:16.01.16	47	63	64	72	18	36	42	47
Shillong	D1:08.05.15	-	-	-	-	25	60	90	100
	D2:06.05.15	-	-	-	-	25	70	90	100
	D3:06.05.15	-	-	-	-	10	50	70	100
Srinagar	D1:11.06.15	8	16	26	30	4	7	9	18
	D2:05.07.15	13	19	36	39	9	15	22	26
	D3:21.07.15	18	28	39	45	11	17	25	32

Contd....

Centre	Date of 1st appearance of LB	Incidence (%) at days					Intensity (%) at days				
		7	14	21	28	35	7	14	21	28	35
Hassan	D1: 24.06.15	16	22	39	73	96	10	20	35	65	75
	D2: 06.07.15	31	45	62	89	98	20	35	50	65	75
	D3: 14.07.15	34	55	76	100	100	20	35	65	75	90

The Appearance, Incidence & Intensity of late blight at different centres are given in Table 3.1

Late blight symptom in Potato

SURVEILLANCE OF IMPORTANT POTATO PESTS IN THE REGION (PEST CAPTURE PLOTS)

Monitoring of pests and diseases in pest capture plots is a very important activity of AICRP(Potato). This would help to know the regional distribution of pests and diseases and also the changes over time. The information on occurrence of pests/diseases at a location can also be used to determine the potential distribution of the pests/diseases at other locations through ecological niche modeling techniques. During the year under report, the data on occurrence of late blight, early blight, leaf roll and common scab over the past five years were compiled and their potential distribution across the country was determined using the bioclim model. The results have been presented in figures 3.1 to 3.4 and discussed below.

Late blight

Perusal of the figure 3.1 shows that the tarai belt of Uttar Pradesh in the Indo -Gangetic plains is very highly suitable for late blight occurrence while a narrow strip below the tarai belt is highly suitable. North as well as eastern Bihar and most of the Jharkhand are very highly suitable. As regards West Bengal, most of north Bengal is either very highly suitable or highly suitable while most of the other areas are in the not suitable category. Another interesting finding is that most of Jharkhand and southern Odisha are very highly suitable for late blight occurrence.

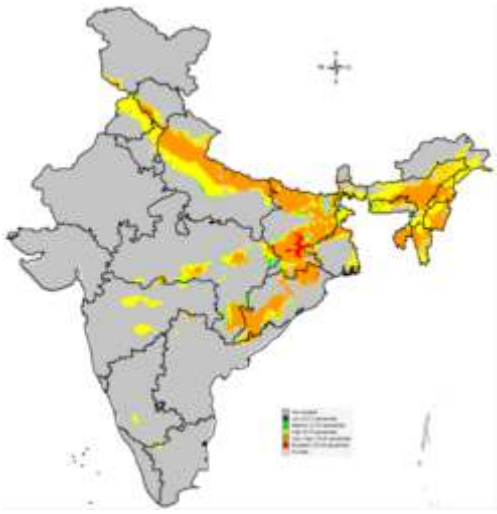


Fig 3.1: Suitability classification of climate for Late Blight

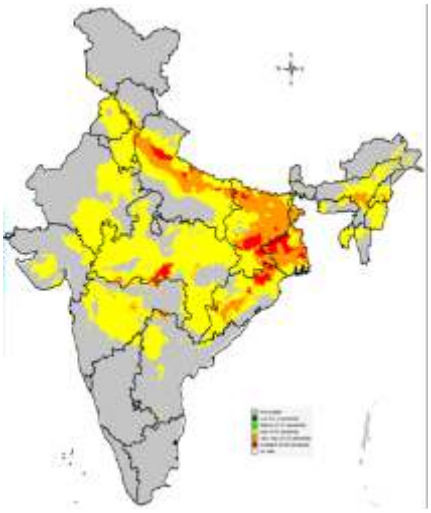


Fig 3.2: Suitability classification of climate for Early Blight

Early Blight

As regards early blight, the analysis shows that the very highly suitable category follows a similar trend as in the case of late blight except that it is below the very highly suitable category belt for late blight (Fig 3.2). Moreover, it is more widespread in the eastern plains. Further, large areas in the central, eastern and western zone are in the highly suitable category indicating that early blight is more widespread than late blight especially in warmer regions.

Leaf Roll

The highly/very highly suitablezones for leaf roll more or less overlap that of early blight in Uttar Pradesh and Bihar but in the west and south it is confined to the Madhya Pradesh border with Rajasthan and Maharashtra (Fig 3.3). There is a large rectangular area in central plains which is expected to be not suitable for leaf roll.

Common scab

Most parts of Uttar Pradesh, Bihar, West Bengal, Odisha and Madhya Pradesh are in the highly suitable category for common scab (Fig 3.4). Significantly most parts of Gujarat, the southern and north-eastern states are in the not suitable category for common scab.

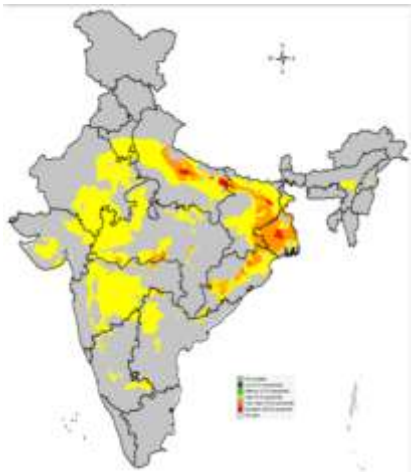


Fig 3.3: Suitability classification of climate for Leaf Roll

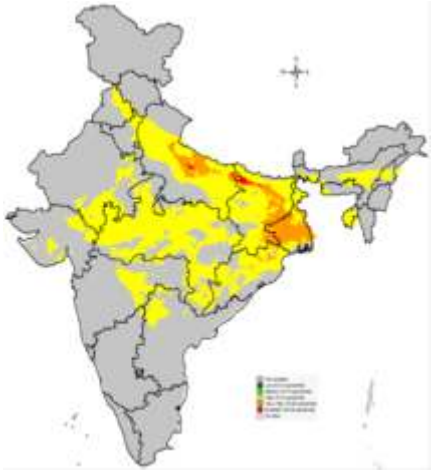


Fig 3.4: Suitability classification of climate for Common scab

LATE BLIGHT MANAGEMENT

Late blight forecasting

During the year under report, the INDO-BLIGHTCAST model was operationalised through the AICRP(Potato) and IMD centres.The centers input the meteorological data of their location on real time basis. During the year, six centres used the model to forecast late blight appearance and issue agro-advisories. The forecast of late blight appearance by the model was within the limits of accuracy set in the model (Table 3.2).

Table 3.2: Performance of INDO-BLIGHTCAST late blight forecasting model during 2015-16

Location	Prediction date of late blight	Actual date of late blight appearance
Shimla (HP)	25.06.2015	07.07.2015
Ludhiana (Punjab)	06.12.2015	12.12.2015
Modipuram (UP)	15.11.2015	27.11.2015
Kalyani (WB)	26.01.2016	30.01.2016
Pantnagar (Uttarakhand)	05.12.2015	08.12.2015
Jorhat (Assam)	18.01.2016	22.01.2016

SCHEDULING OF FUNGICIDE APPLICATION FOR THE MANAGEMENT OF LATE BLIGHT

OOTY

Studies to develop an effective fungicidal spray schedule for management of late blight was conducted at Ooty during summer season with Kufri Jyoti and autumn season with Kufri Swarna. The treatments evaluated were as below.

Treatments

T1 : Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% + need based subsequent sprays with mancozeb @ 0.2%

T2 : Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% + need based subsequent sprays with cymoxanil + mancozeb @ 0.3% and mancozeb @ 0.2%

T3 : Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% + need based subsequent sprays with fenamidone + mancozeb @ 0.3% and mancozeb @ 0.2%

T4 : Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% + need based subsequent sprays with dimethomorph + mancozeb @ 0.3% and mancozeb @ 0.2%

T5 : Control.

The results showed that the disease severity was high in both the seasons but in the autumn season it was significantly higher than in the summer season. The treatment schedules also affected the disease severity significantly with the highest being in control (T5) followed by T1 i.e. Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% + need based sprays with mancozeb @ 0.2% but the difference between them were non-significant. The differences in severity values between the seasons and treatments were reflected in the AUDPC values which shows that the polynomial equation best described this relationship (R^2=0.76).

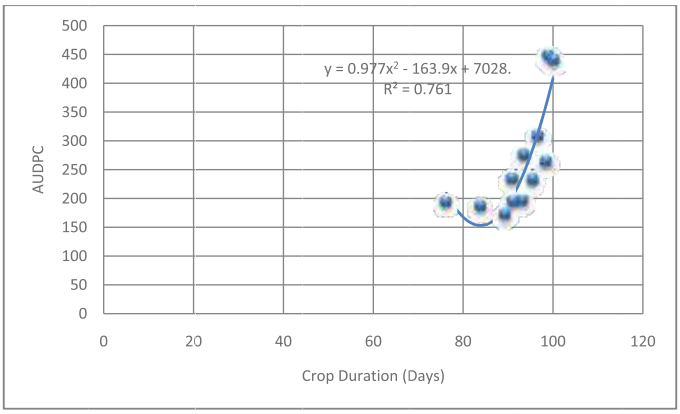


Fig3.5:Progression curve of AUDPC at different durations of crop growth

As regards yield, the effect of seasons, treatments and their interaction were significant. The summer season gave significantly higher yield as compared to the autumn season while in the case of treatments the control treatment had the lowest mean yield (3 t/ha) while T4 (Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% + need based subsequent sprays with fenamidone + mancozeb @ 0.3% and mancozeb @ 0.2%) gave significantly higher yield than the other treatments. The season X treatment interaction was also significant in the case of yield. In the summer season T3 (Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% + need based subsequent sprays with fenamidone + mancozeb @ 0.3% and mancozeb @ 0.2%) and T4 (Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% + need based subsequent sprays with fenamidone + mancozeb @ 0.3% and mancozeb @ 0.2%) gave similar yields while in autumn season T4 gave similar yields and T3 yielded significantly lower than the other treatments. As regards the relationship between AUDPC values and tuber yields it was observed that the tuber yields decreased exponentially as the AUDPC values increased (Fig 3.6).

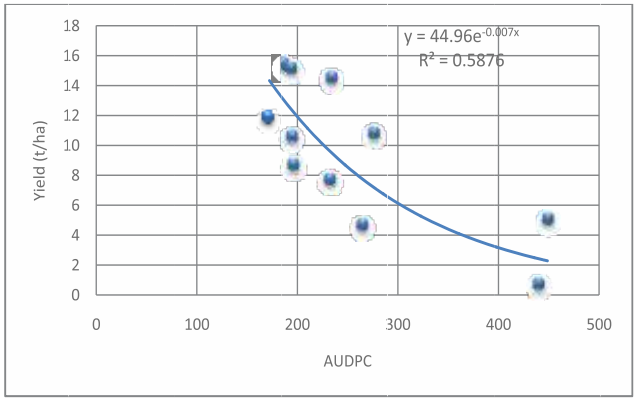


Fig3.6:Relationship between AUDPC and tuber yield

Table 3.3: Effect of different fungicides on Late blight incidence, severity and area under the disease progress curve (AUDPC) during summer and autumn seasons.

Treatments	Incidence % (75 DAP)			Severity % (75 DAP)			AUDPC		
	Summer	Autumn	Mean	Summer	Autumn	Mean	Summer	Autumn	Mean
T1	99.3	100.0	99.6	96.5	98.3	97.4	309.5	264.5	287.0
T2	100.0	100.0	100.0	93.3	95.3	91.3	276.1	232.6	254.3
T3	99.3	100.0	99.6	90.8	93.0	91.9	234.3	196.4	215.3
T4	100.0	100.0	100.0	83.8	91.0	87.4	186.7	194.8	190.8
T5	98.0	100.0	99.0	98.8	100.0	99.4	448.7	439.8	444.2
Mean	99.6	100.0		92.6	95.5		291.1	265.6	

Factor	Season	Treatment	Season x Treatment	Season	Treatment	Season x Treatment		
SEd	0.17	0.27	0.47	1.71	2.71	4.75		
CD	0.35	NS	NS	NS	5.56**	NS		

Table 3.4: Effect of different fungicides on yield parameters during summer and autumn seasons.

Treatments	< 25 gm			25-75 gm		
	Summer	Autumn	Mean	Summer	Autumn	Mean
T1	4.9	1.3	3.1	4.6	3.0	3.8
T2	5.9	1.7	3.8	4.9	5.2	5.0
T3	5.8	1.7	3.7	8.6	5.9	7.3
T4	6.4	1.4	3.9	8.8	6.9	7.9
T5	4.3	0.7	2.5	0.8	0.1	0.5
Mean	5.5	1.4		5.5	4.2	
Factor	Season	Treatment	Season x Treatment	Season	Treatment	Season x Treatment
SED	0.15	0.23	0.32	0.18	0.29	0.41
CD	0.3**	0.47**	0.67**	0.37**	0.60**	0.84**

Table continued.....

Treatments	> 75 gm			Total Yield (t/ha)		
	Summer	Autumn	Mean	Summer	Autumn	Mean
T1	0.0	0.4	0.2	9.6	4.7	7.2
T2	0.0	0.8	0.4	10.8	7.7	9.2
T3	0.1	1.1	0.6	14.5	8.7	11.6
T4	0.2	2.3	1.3	15.4	10.6	13.0
T5	0.0	0.0	0.0	5.1	0.8	3.0
Mean	0.07	0.93		11.08	6.51	
Factor	Season	Treatment	Season x Treatment	Season	Treatment	Season x Treatment
SED	0.06	0.09	0.13	0.27	0.43	0.61
CD	0.12**	0.18**	0.26**	0.56**	0.88**	1.25**

Conclusion : The studies thus showed that the prophylactic spray with mancozeb @ 0.2% and subsequent sprays with dimethomorph + mancozeb @ 0.3% and mancozeb @ 0.2% at weekly interval alternatively can be followed for management of late blight insusceptible cultivars during summer and autumn seasons in southern hill region.

HASSAN

Studies to develop an effective fungicidal spray schedule for management of late blight were also conducted at Hassan for three years from 2013 to 2015 in the *kharif* season with variety Kufri Jyoti. The treatment schedules evaluated are given below

Treatments

T1 : Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2% followed by two more sprays at weekly intervals.

T2 : Prophylactic spray (just at the time of canopy closure) with mancozeb followed by three more sprays at weekly intervals.

T3 : Prophylactic spray (just at the time of canopy closure) with mancozeb followed by cymoxanil + mancozeb @ 0.3% and one more spray with mancozeb.

T4 : Prophylactic spray (just at the time of canopy closure) with mancozeb followed by fenamidone + mancozeb @ 0.3% and one more spray with mancozeb.

T5 : Prophylactic spray (just at the time of canopy closure) with mancozeb followed by dimethomorph + mancozeb @ 0.3% followed by mancozeb.T6: Control.

The results showed that late blight appeared in all the three years but was more serious in the first and second year. The lowest incidence was in T4 followed by T5 but the differences between the two were non- significant (Table 3.5). The incidence of the disease increased with time in all the treatments and was highest in control and lowest in T4 in all the dates of observation (Fig 3.7).

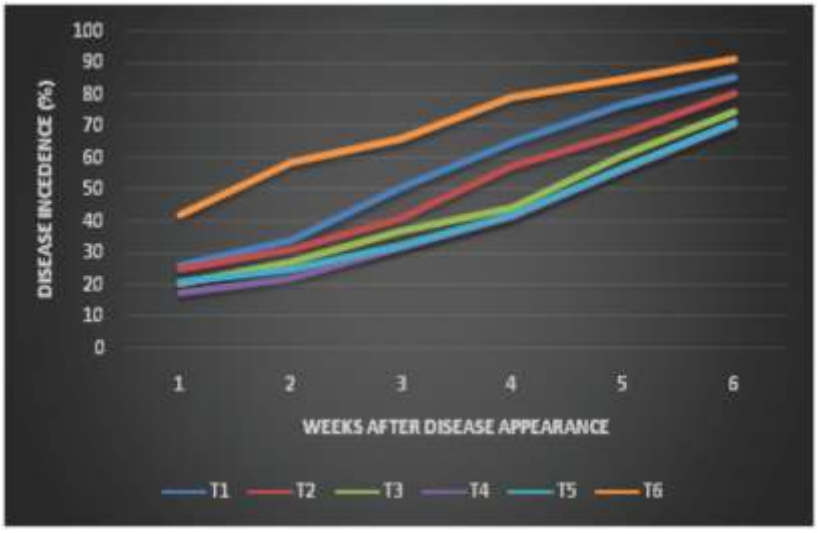


Fig 3.7: Time course of disease intensity in different treatments

The disease incidence also affected the tuber yield (Table 3.6). The table shows that mean tuber yield was highest in T4 followed by T5 but the difference between them were non-significant. The third best treatment was T3 but the difference in yield between T3 and T5 was non-significant. It is therefore concluded that treatment T4 (Prophylactic spray (just at the time of canopy closure) with mancozeb @ 0.2 % followed by fenamidone + mancozeb @ 0.3% and one more spray with mancozeb @ 0.2 % gives the best control of late blight at Hassan. However, T5 (Prophylactic spray (just at the time of canopy closure) with mancozeb followed by dimethomorph + mancozeb @ 0.3% followed by mancozeb) is equally effective.

Table 3.5 : Incidence of Late Blight at 42 days after first appearance (%) as affected by management schedule

Year	T1	T2	T3	T4	T5	T6	Mean
2013	96.50	91.00	89.50	88.50	82.50	100.00	91.33
2014	94.65	91.40	83.69	77.94	81.79	100.00	88.25
2015	64.96	59.52	50.12	44.87	49.04	73.38	56.98
Mean	85.37	80.64	74.44	70.44	71.11	91.13	
CD (0.05)	Year = 1.69		Treatment = 2.40		Year x Treatment = 4.15		
SEd	Year = 0.84		Treatment = 1.19		Year x Treatment = 2.06		

Table 3.6 : Tuber yield (t/ha) as affected by management schedule

Year	T1	T2	T3	T4	T5	T6	Mean
2013	19.44	20.79	24.64	25.12	26.77	11.37	21.35
2014	4.44	5.42	7.10	10.87	9.63	2.91	6.73
2015	14.40	15.88	16.43	18.74	17.06	10.73	15.54
Mean	12.76	14.03	16.05	18.24	17.82	8.33	
CD (0.05)	Year = 1.22		Treatment = 1.72		Year x Treatment = 2.98		
SEd	Year = 0.61		Treatment = 0.86		Year x Treatment = 1.48		

EVALUATION OF VARIETIES FOR RESISTANCE AGAINST STEM NECROSIS DISEASE

Ten varieties viz.Kufri Gaurav, Kufri Chipsona 4, Kufri Pukhraj, Kufri Bahar, Kufri Pushkar, Kufri Sutlej, Kufri Surya, Kufri Sadabahar, Kufri Khyati and Kufri Anand were evaluated at Deesa, Kota and Chindwara for three years viz. 2012-13 to 2014-15. The results showed that only at Kota the disease incidence was high ranging from 1.67% to 61.67% and hence affected the yield significantly while at Deesa and Chindwara the thrips population and consequently the disease incidence were low. The pooled analysis of the data of Kota showed that stem necrosis incidence as well as yield were significantly affected by variety, year and their interaction. As regards the effect of variety, Kufri Chipsona 4 and Kufri Sadabahar had very low incidence of stem necrosis and the differences between them were also non- significant (Table 3.7). Kufri Gaurav also had low incidence of stem necrosis but was significantly higher than in the other two. Kufri

Surya, Kufri Khyati and Kufri Anand had high incidence of stem necrosis but the differences among the three varieties were non- significant. All the other varieties had very high incidence of stem necrosis (>32%). As regards the effect of years, the overall mean over the varieties was lowest in the second year (18.97) but in the other two years it was slightly higher but statistically significant. As regards yield, Kufri Bahar gave significantly lower yield than other varieties. The yield trend was similar to the trend of incidence of stem necrosis but the difference in yield between the varieties was small (Table 3.8).

Table 3.7: Incidence (%) of Stem necrosis in different varieties

Year/ Variety	Kufri Gaurav	Kufri Chip-4	Kufri Pukhraj	Kufri Bahar	Kufri Pushkar	Kufri Sutlej	Kufri Surya	Kufri Sadabahar	Kufri Khyati	Kufri Anand	Mean
2012-13	5.00	2.00	35.00	62.00	33.33	41.67	9.33	2.67	9.00	9.33	20.93
2013-14	3.67	1.00	31.67	59.33	30.00	38.33	8.00	1.67	8.33	7.67	18.97
2014-15	5.33	2.00	35.33	63.67	32.67	42.33	9.00	3.33	9.33	11.33	21.43
MEAN	4.67	1.67	34.00	61.67	32.00	40.78	8.78	2.56	8.89	9.44	20.44
CD (5%)	Year = 1.15			Varieties = 2.10			Year X Varieties = 3.63				
CV (%)	10.87										

Table 3.8: Total yield (t/ha) of different varieties in different years

Year/ Variety	Kufri Gaurav	Kufri Chip-4	Kufri Pukhraj	Kufri Bahar	Kufri Pushkar	Kufri Sutlej	Kufri Surya	Kufri Sadabahar	Kufri Khyati	Kufri Anand	Mean
2012-13	22.46	22.36	20.79	19.63	20.84	20.74	21.95	22.09	21.16	21.44	21.34
2013-14	24.82	24.03	22.64	20.74	23.29	22.50	23.47	23.66	23.47	23.29	23.19
2014-15	23.94	23.47	21.81	19.54	22.55	21.48	22.92	22.46	22.69	22.78	22.36
MEAN	23.74	23.29	21.75	19.97	22.22	21.58	22.78	22.73	22.44	22.50	22.30
CD (5%)	Year = 0.59			Varieties = 1.09			Year X Varieties = 1.88				
CV (%)	5.16										

Relationship between stem necrosis incidence and yield was also studied by computing the relative yield of the varieties as the ratio of the yield of the variety to the general mean of all the varieties in the respective year to remove the effect of variety and year. The results showed that yields decreased linearly (Fig 3.8) and that the degree of determination (R^2) was quite high (0.80). It can therefore, be concluded that Kufri Chipsona 4 and Kufri Sadabahar have comparatively lower incidence of stem necrosis and that disease incidence is negatively correlated with yield.

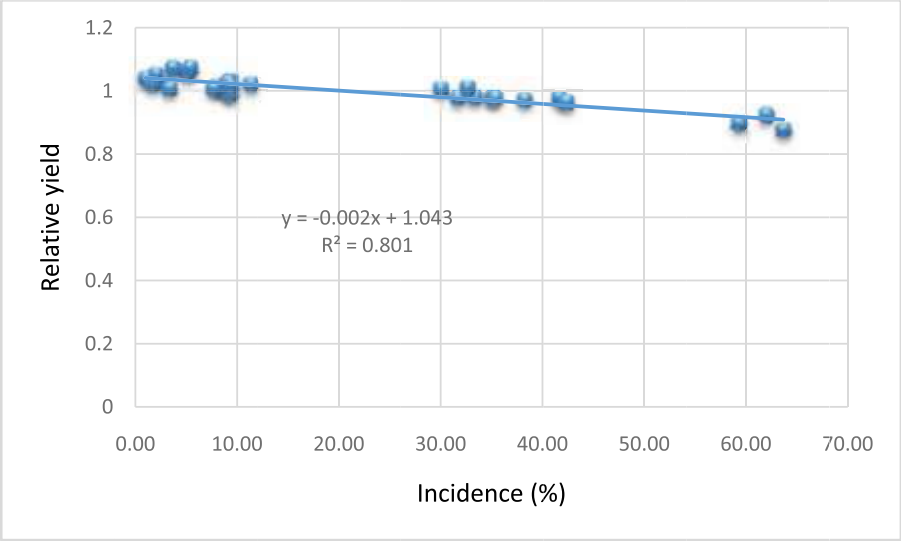


Fig 3.8: Relative yield of potato as affected by stem necrosis incidence

MANAGEMENT OF EARLY BLIGHT

Forecasting early blight appearance

Early blight is a serious disease of potato which occurs in regions which are relatively warm and humid. Among the fungal diseases of potato, it is next only to late blight worldwide as regards economic importance is concerned. Therefore, as in the case of late blight, forecasting systems have been developed for timely application of fungicides for effectively controlling the disease with minimum use of chemicals. No attempt has been made so far for forecasting early blight appearance in India. Therefore, using the data of the trial on early blight appearance and management conducted at AICRP (Potato) centres viz. Bhubaneshwar, Deesa and Pune over the last three years, some of the early blight forecasting models were tested and modified to suit Indian conditions. Two of the most common models used for scheduling fungicidal sprays in the case of early blight are the 1000 Growing Degree Days (GDD) model and the 300 P-days model. The 1000 GDD model advocates spray as soon as 1000 GDD has accumulated while in the case of P-days it is 300 P-days when P-days is calculated using 7, 21 and 30^{0}C as the cardinal temperatures. However, both the models did not forecast the appearance of early blight accurately under Indian conditions. Therefore, different cardinal temperatures for calculating the P-days were tested. The results (Table 3.9) showed that the disease appeared at accumulated P-days of 300 when P-days were calculated with the lower, optimum and maximum cardinal temperatures of *Alternaria* viz. 7.2, 25 and 35^{0}C, respectively. Thus, the results show that early blight appearance under Indian conditions could be forecast using the 300 P-days method, however, the cardinal temperatures for calculating P-days need to be changed.

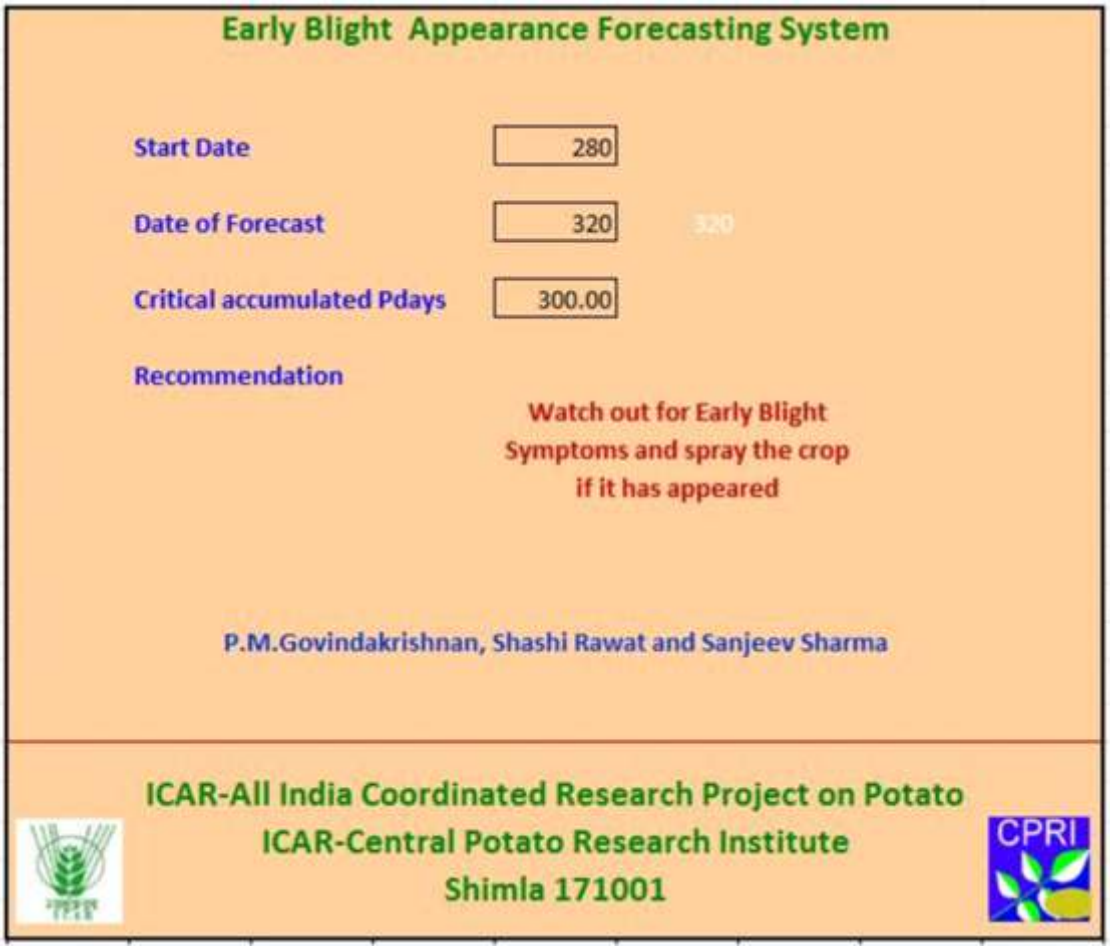


Fig 3.9: Screen shots of Early blight forecasting system

Table 3.9: Performance of early blight appearance forecasting model at different locations.

Year	Location	Date of Prediction	Date of appearance
2012-13	Bhubaneshwar	21.11.12	Did not appear
	Deesa	03.12.12	05.12.12
	Pune	04.08.13	13.08.13
2013-14	Bhubaneshwar	01.01.14	02.01.14
	Deesa	15.12.13	22.12.13
	Pune	06.18.14	08.08.14
2014-15	Bhubaneshwar	28.12.14	28.12.14
	Deesa	22.12.14	25.12.15
	Pune	30.07.15	14.08.15

The methodology was developed into an Early blight forecasting DSS (Fig 3.9). The user has to input the daily weather data in the software at the appropriate field and then enter the start date as well as the date of forecast. The software would compute the P-days accrued from the start date till the date of forecast according to the cardinal temperatures discussed above and then advise to look out for appearance of early blight and take control measures if symptoms are observed. The software advises adoption of control measures only if symptoms are observed because early blight does not spread as fast as late blight.

DEVELOPMENT OF FUNGICIDE SCHEDULE FOR CONTROL OF EARLY BLIGHT

Five management schedules along with control were evaluated for three years viz. 2013-2015 on variety Kufri Pukhraj at Pune where early blight is quite serious due to the hot and humid weather conditions. The schedules tested were as below.

Treatments

T1 : Control

T2 : Three sprays of mancozeb 75WP (0.25%) at 10 days interval*

T3 : Three sprays of chlorothalonil 75WP (0.25%) at 10 days interval

T4 : Three sprays of hexaconazole 5EC (0.05%) at 10 days interval

T5 : First spray of mancozeb 75WP (0.25%), second spray of hexaconazole 5EC (0.05%) and third spray of mancozeb 75WP (0.25%) at 10 days interval

T6 : First spray of chlorothalonil 75WP (0.25%), second spray of hexaconazole 5EC (0.05%) and third spray of chlorothalonil 75WP (0.25%) at 10 days interval

The disease incidence (Table 3.10) and intensity (Table 3.11) were recorded as per standard procedures and spraying was started with the first appearance of the disease. Pooled analysis of the data showed that the lowest intensity and incidence of early blight (10.67% and 14.61 %, respectively) was observed in treatment T6 followed by T5 (10.93% and 14.85%, respectively). In case of absolute control (treatment T1) the disease intensity was 30.87 percent while the incidence was 45.06 percent.

Table 3.10: Efficacy of fungicidal treatmentson intensity (%) of early blight (*Alternaria solani*) in the second week of September

Year	T1	T2	T3	T4	T5	T6	Mean
2013-14	24.08	15.00	13.52	15.46	10.09	8.71	14.48
2014-15	19.54	12.78	11.20	14.35	8.71	6.30	12.15
2015-16	49.00	21.00	22.00	19.00	14.00	17.00	23.67
Mean	30.87	16.26	15.57	16.27	10.93	10.67	
CD (0.05)	Year = 1.40		Treatment = 1.98		Year x Treatment = 3.43		
SEd	Year = 0.70		Treatment = 0.98		Year x Treatment = 1.71		

Table 3.11: Efficacy of fungicidal treatments on incidence (%) of Early Blight (*Alternaria solani*) in the second week of September

Year	T1	T2	T3	T4	T5	T6	Mean
2013-14	35.57	23.69	21.49	24.36	16.28	14.64	22.67
2014-15	36.30	23.66	21.21	23.58	15.57	14.76	22.51
2015-16	63.32	15.14	16.39	16.94	12.71	14.43	23.15
Mean	45.06	20.83	19.70	21.63	14.85	14.61	
CD (0.05)	Year = NS		Treatment = 2.31		Year x Treatment = 4.00		
SEd	Year = 0.81		Treatment = 1.15		Year x Treatment = 1.99		

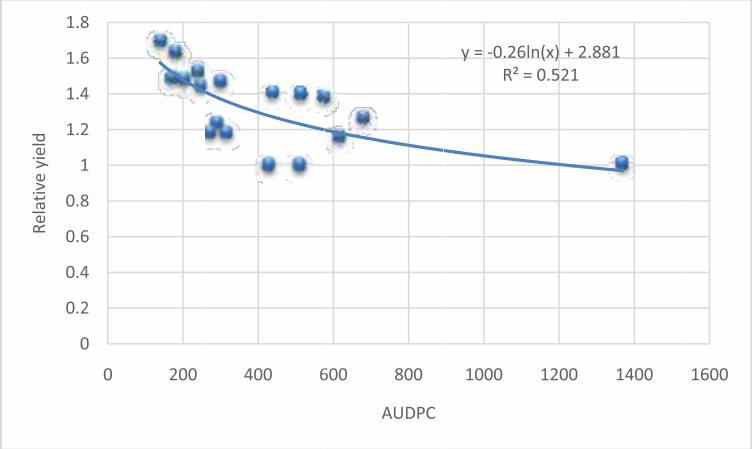


Fig 3.10: Relationship between relative yield and AUDPC values of early blight

The effect of variation in disease incidence and intensity were reflected in the AUDPC curve (Fig 3.10) as well as on the yield (Table 3.12). The yield was highest in T6 (20.14 t/ha) followed by T5 (19.97 t/ha). The difference between the two was however, non-significant. Thus, spray of chlorothalonil 75WP (0.25%) @ 2.5 gm/liter of water followed by hexaconazole 5 EC (0.05%) @ 0.5 ml/liter of water and one more spray with chlorothalonil 75WP (0.25%) @ 2.5 gm/liter of water at 10 days interval gave best control against early blight at Pune followed by the schedule of spray of mancozeb 75WP (0.25%) @ 2.5 gm/liter of water followed by hexaconazole 5EC @ 0.5 ml/liter of water and one more spray of mancozeb 75WP (0.25%) @ 2.5 gm/liter of water at 10 days interval.

Table 3.12: Effect of early blight management schedules on the yield of potato (t/ha)

Year	T1	T2	T3	T4	T5	T6	Mean
2013-14	12.76	15.80	15.10	15.07	18.94	19.05	16.12
2014-15	10.00	14.49	15.29	14.72	16.38	16.99	14.64
2015-16	17.51	24.17	22.16	20.28	24.59	24.38	22.18
Mean	13.42	18.15	17.52	16.69	19.97	20.14	
CD (0.05)	Year = 0.83		Treatment = 1.18		Year x Treatment = NS		
SEd	Year = 0.41		Treatment = 0.59		Year x Treatment = 1.02		

At Bhubaneswar and Deesa apart from early blight forecasting studies on developing management schedules was also taken up during 2015-16. The treatment details are given below.

T1: Control

T2: Spray of urea (1%) + mancozeb @0.25% at 40-45 days crop age and repeat at 8-10 days interval

T3: Spray of urea (1%) + mancozeb @0.25% at 40-45 days crop age and repeat at 8-10 days interval followed by one more spray of mancozeb

T4: First spray of mancozeb 75WP (0.25%), second spray of hexaconazole 5EC (0.05%) and third spray of mancozeb 75WP (0.25%) at 10 days interval

The pooled analysis of the results (Table 3.13) showed that disease severity was significantly affected by location, treatments and their interaction. The mean disease severity at 40 DAP was lesser at Deesa than at Bhubaneswar while in the case of treatments the disease severity was lowest in T4 (First spray of mancozeb 75WP (0.25%), second spray of hexaconazole 5EC (0.05%) and third spray of mancozeb 75WP (0.25%) at 10 days interval) followed by that in T3 (Spray of urea (1%) + mancozeb @0.25% at 40-45 days crop age and repeat at 8-10 days interval followed by one more spray of mancozeb).

Table 3.13: Severity of early blight as affected by location and management schedules.

Year	T1	T2	T3	T4	Mean
Bhubaneswar	31.15	23.95	17.25	11.15	20.88
Deesa	16.68	12.63	11.81	7.04	12.04
Mean	23.92	18.29	14.53	9.10	
CD (0.05)	Location = 1.74	Treatment = 2.47		Location x Treatment = 3.49	
SEd	Location = 0.83	Treatment = 1.18		Location x Treatment = 1.67	

Table 3.14: Total yield (t/ha)as affected by early blight at different locations and management schedules.

Year	T1	T2	T3	T4	Mean
Bhubaneswar	12.87	14.55	17.43	18.15	15.75
Deesa	42.88	46.32	49.10	52.94	47.81
Mean	27.87	30.44	33.27	35.54	
CD (0.05)	Location = 1.92	Treatment = 2.71		Location x Treatment = NS	
SEd	Location = 0.92	Treatment = 1.30		Location x Treatment = 1.83	

As is the case of disease severity, the total yield (Table 3.14) was significantly higher at Deesa than at Bhubaneswar and under treatments T4 (First spray of mancozeb 75WP (0.25%), second spray of hexaconazole 5EC (0.05%) and third spray of mancozeb 75WP (0.25%) at 10 days interval) followed by that in T3 (Spray of urea (1%) + mancozeb @0.25% at 40-45 days crop age and repeat at 8-10 days interval followed by one more spray of mancozeb).

MANAGEMENT OF COMMON SCAB

Studies during develop management schedules for control of common scab was conducted at Faizabad and Kanpur. The treatment details are given below.

T1 : Untreated diseased tubers (Control)

T2 : Tuber dip treatment with 3% boric acid for 20 minutes before storage

T3 : Biofumigation by incorporating one month old Indian Mustard crop (seed rate 5 kg/ ha) just before the planting of potato crop

T4 : T3 + compost culture to decompose Biofumigant

T5 : T3 + Tuber dip treatment with 1.5% boric acid for 20 minutes before storage

T6 : Pyrites @ 2.0 t/ha (soil application)

T7 : T3 + Pyrites @ 2.0 t/ha

The results showed that the effect of location, treatment and their interaction on disease severity was significant. The disease severity (Table 3.15) was low at Kanpur as compared to Faizabad while in the case of treatments it was lowest in T2 (Tuber dip treatment with 3% boric acid for 20 minutes before storage) and T5 (T3 + Tuber dip treatment with 1.5% boric acid for 20 minutes before storage), the difference between the two were non-significant. Biofumigation with Mustard was effective in reducing the disease index and in combination with seed treatment with boric acid or soil application of Pyrites reduced the disease index significantly.

As regards tuber yield, the results (Table 3.16) showed that highest yield was obtained in T5 (T3 + Tuber dip treatment with 1.5% boric acid for 20 minutes before storage). However, T5 (T3 + Tuber dip treatment with 1.5% boric acid for 20 minutes before storage) and T2 (Tuber dip treatment with 3% boric acid for 20 minutes before storage) gave equally good since the difference between them were not significant.

Table 3.15: Disease index (%) of common scab as affected by treatments at Kanpur and Faizabad

	T1	T2	T3	T4	T5	T6	T7	Mean
Faizabad	35.30	10.93	20.40	16.45	12.00	25.60	17.98	19.81
Kanpur	16.43	8.10	5.78	7.10	7.10	7.18	6.63	8.33
Mean	25.86	9.51	13.09	11.78	9.55	16.39	12.30	
CD (0.05)	Location = 0.76		Treatment = 1.43			Location x Treatment = 2.02		
SEd	Location = 0.38		Treatment = 0.70			Location x Treatment = 0.99		

Table 3.16:Total yield (t/ha) as affected by treatments at Kanpur and Faizabad

	T1	T2	T3	T4	T5	T6	T7	Mean
Faizabad	24.67	27.47	25.84	26.13	27.55	25.30	25.42	26.05
Kanpur	19.26	21.21	24.30	21.76	21.46	22.21	21.80	21.71
Mean	21.96	24.34	25.07	23.94	24.50	23.75	23.61	
CD (0.05)	Location = 0.66		Treatment = 1.23			Location x Treatment = 1.74		
SEd	Location = 0.32		Treatment = 0.61			Location x Treatment = 0.86		

MANAGEMENT OF BACTERIAL WILT OF POTATO

Studies to evaluate the efficacy of different bioagents to control bacterial wilt were initiated at Hassan. The treatment included bioagents viz *Bacillus, Pseudomonas* sp and two chemical along with control as given below.

Treatments

Treatment details

T1 : Soil application of *Bacillus megaterium* @ 5 kg/ha

T2 : Furrow application of *Bacillus megaterium* @ 5 kg/ha

T3 : Streptomycin sulphate 0.5g/lt in furrow drenching

T4 : Soil application of *Pseudomonas fluorescens* @ 5 kg/ha

T5 : Bacterinasak (2 Bromo-2 Nitro Propane-1, 3, Diol) 0.5g/lt for soil drenching

T6 : Control

Table 3.17: Plant emergence (%), Incidence of bacterial wilt (%), infected tuber at harvest and total tuber yield (t/ha)

Treatments	Emergence (%)	Incidente of bacterial wilt (%)	Infected tuber at harvest t/ha)	Total Yield (t/ha)
T1	88.50	42.93	0.98	6.41
T2	93.50	44.97	0.74	6.79
T3	90.00	40.13	0.52	7.73
T4	91.50	48.05	1.08	6.34
T5	89.00	43.33	1.19	5.96
T6	71.50	55.72	1.58	5.40
SEd	3.60	4.43	0.18	1.22
CD(0.05	7.67	9.45	0.38	2.59
CV %	5.82	13.67	25.19	26.73

All treatments significantly reduced bacterial wilt incidence (40.1 to 48.1%) compared to control (55.7%) but were statistically at par with each other (Table 3.17). The minimum infected tubers at harvest (0.52t/ha and 0.74t/ha) were observed in T-3 (*Streptomycin sulphate* 0.5g/litre in furrow drenching) and T-2 (furrow application of *Bacillus megaterium* @5kg/ha) treatments, respectively compared to control (1.58 t/ha). The next best treatment was T1 (soil application of *Bacillus megaterium* @5 kg/ha) and soil application of *Pseudomonas fluorescens* @ 5kg/ha) which recorded 0.98 and 1.08 t/ha infected tubers respectively.

MANAGEMENT OF LATE BLIGHT BY USING LEACHATES, BOTANICALS OIL AND BIO AGENTS

Studies to evaluate leachates, botanical and bio agents as per treatments below to control late bight was initiated at Hassan.

Treatments

T1 : Pongamia cake leachates @10g/lt

T2 : Pongamia cake leachates @15g/lt

T3 : Pongamia cake leachates @20g/lt

T4 : Neem cake leachates @10g/lt

T5 : Neem cake leachates @15g/lt

T6 : Neem cake leachates @20g/lt

T7 : Pongamia cake leachates @ 10g/lt + mancozeb @2.5g

T8 : Neem cake leachates @ 20g/lt + mancozeb @2.5g

T9 : Pongamia oil @20 ml/lt

T10: Neem oil @20 ml/lt

T11: Potassium Phosphate @4 ml/lt

T12: Mancozeb @ 0.25%

T13: Prophylactic spray (just at the time of canopy closure) with mancozeb followed by cymoxanil + mancozeb @ 0.3% and one more spray with mancozeb

T14: Control

Table 3.18: Incidence (%) of late blight

Treatments	Late blight Incidence (%) at weekly interval after appearance											
	Actual values						Arc sine transformed values					
	7	14	21	28	35	42	7	14	21	28	35	42
T1	27.0	31.8	41.8	48.3	66.4	82.3	31.3	34.3	40.3	44.1	54.6	66.4
T2	21.2	26.8	33.7	42.4	57.8	86.6	27.4	31.2	35.5	40.7	49.5	70.8
T3	19.0	25.9	30.1	36.7	53.5	87.7	25.8	30.6	33.3	37.3	47.0	70.6
T4	31.9	38.1	41.3	49.8	66.5	92.3	34.4	38.1	40.0	44.9	54.7	74.2
T5	26.1	28.4	33.3	44.9	57.5	93.0	30.7	32.2	35.3	42.1	49.4	75.7
T6	19.5	23.3	26.7	35.2	53.8	85.9	26.1	28.8	31.1	36.4	47.2	68.3
T 7	20.4	25.6	30.2	35.2	62.3	58.7	26.7	30.3	33.3	36.4	52.3	51.2
T 8	17.0	20.5	24.4	37.7	54.6	61.9	24.3	26.9	29.6	37.9	47.7	52.6
T 9	20.8	26.5	31.1	38.2	60.5	86.4	27.1	31.0	33.9	38.2	51.1	70.2
T 10	23.0	29.1	31.8	43.6	59.2	87.9	28.5	32.6	34.3	41.3	50.5	70.5
T 11	18.3	23.8	30.8	40.6	48.0	74.4	25.3	29.1	33.6	39.6	43.9	62.4
T 12	27.8	41.2	43.8	51.8	64.3	85.0	31.8	39.9	41.5	46.0	53.4	68.1
T 13	14.6	21.5	27.4	33.7	47.6	85.3	22.5	27.6	31.6	35.5	43.6	67.7
T 14	35.2	42.5	50.7	61.7	79.2	98.7	36.4	40.7	45.4	51.8	62.9	86.2
SEd	1.9	2.5	2.8	3.3	2.7	11.5	1.3	1.6	1.7	2.0	1.6	8.1
CD(0.05	3.9	5.2	5.7	6.8	5.5	23.6	2.7	3.3	3.4	4.0	3.2	17.7
CV %	10.2	10.7	9.9	9.5	5.5	16.9	5.7	6.1	5.8	5.8	3.8	15.5

Table 3.19: Date of first appearance of late blight and total & blighted tuber yield (t/ha)

Treatment	Date of first appearance of late blight	Total Yield (t/ha)	Blighted Tuber Yield (t/ha)
T1	16.07.15	10.00	0.71
T2	16.07.15	10.49	0.76
T3	16.07.15	10.58	0.53
T4	17.07.15	10.94	0.39
T5	17.07.15	11.16	0.42
T6	16.07.15	12.44	0.27
T7	17.07.15	12.50	0.62
T8	17.07.15	12.15	0.88
T9	17.07.15	10.97	0.26
T10	17.07.15	10.72	0.26
T11	17.07.15	13.50	0.36
T12	16.07.15	10.60	0.63
T13	16.07.15	14.70	0.32
T14	16.07.15	8.13	1.05
SEd		2.54	0.33
CD (0.05)		5.21	0.67
CV %		27.33	74.61

Out of 14 treatments tested, minimum incidence (59.0%) of late blight was recorded in treatment where Pongamia cake leachates @ 10g/lt + mancozeb @ 2.5g (T7) was applied followed by T8 (Neem cake leachates @ 20 g/lt + mancozeb @ 2.5 g) treatment and these two treatments did not differ significantly. However, the tuber yield was significantly higher in treatment where prophylactic spray (just at the time of canopy closure) with mancozeb followed by cymoxanil + mancozeb @ 0.3% and one more spray with mancozeb (T13) was applied followed by T11 (Potassium Phosphate @ 4 ml/lt) treatment over control (T 14) (Table 3.19).

ENTOMOLOGY

MONITORING OF APHIDS, WHITEFLIES, THRIPS, HOPPERS AND MITES IN UNSPRAYED CROP. APHIDS

The monitoring of aphids (*Myzus persicae* and *Aphis gossypii*) population on unsprayed potato crop at AICRP (Potato) centers was continued during the year.The data of two years (2011-12 and 2012-13) at Deesa, Dholi and of three years of Kalyani (2011-12 to 2013-14) were used to develop a thermal time model to represent the population buildup. The daily P-days were calculated using the lower, optimum and maximum cardinal temperatures for aphids reported in literature i.e. 6.5, 26.7, 37.3^{0}C respectively and were accumulated from the date of planting of the potato crop at each centre. The accumulated P-days were plotted against the aphid population recorded periodically at the centres. The results showed that the aphid population increased exponentially with increase in accumulated P-days at all the three centres (Fig 3.11 to Fig 3.13). However, there were some differences in the slope of the exponential curve which were duly reflected in the constants of the exponential curves. The degree of fit was also very high as indicated by the high R^2 values. This shows that prediction equations for each location could be developed. The relationship between accumulated P-days and aphid population combined over three locations was also exponential and was represented by the equation $y = 1.206e^{0.0092x}$ with R^2 of 0.7426 (Fig 3.14). Calculation of the aphid population with this equation shows that at accumulated P-days of 300 the aphid population would be just under 20 aphids per hundred compound leaves. Thus, this study indicates that up to accumulated P-days of 300 the aphid population is expected to be certainly below the critical limit and that we would have to rigorously monitor the aphid population and take control measures as soon as accumulated P-days reaches near about 300 P-days.

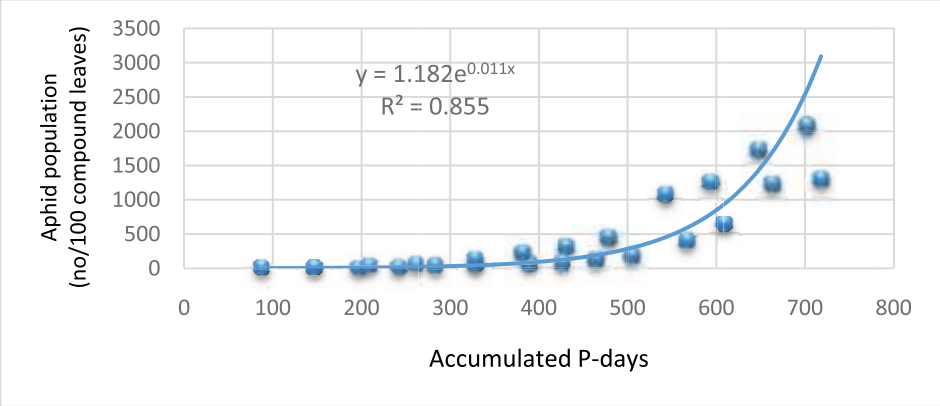


Fig 3.11:Aphid build up as function of P-days at DEESA

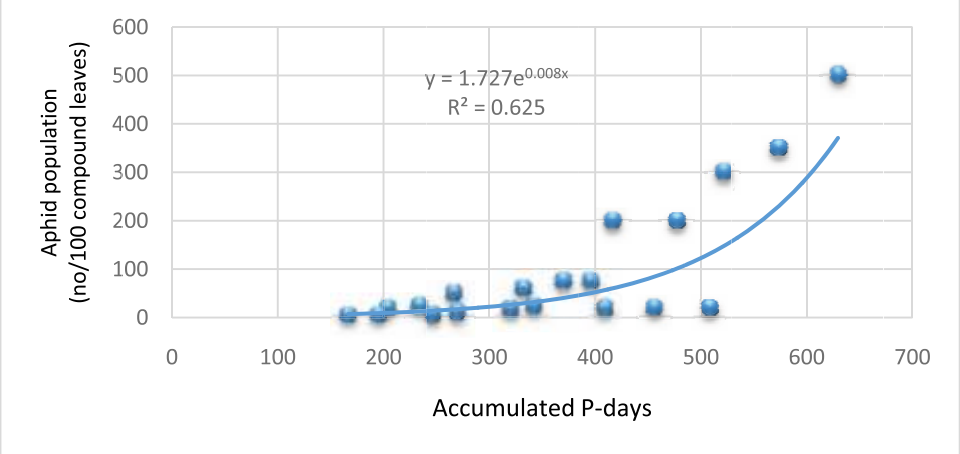


Fig 3.12: Aphid build up as function of P-days at Dholi

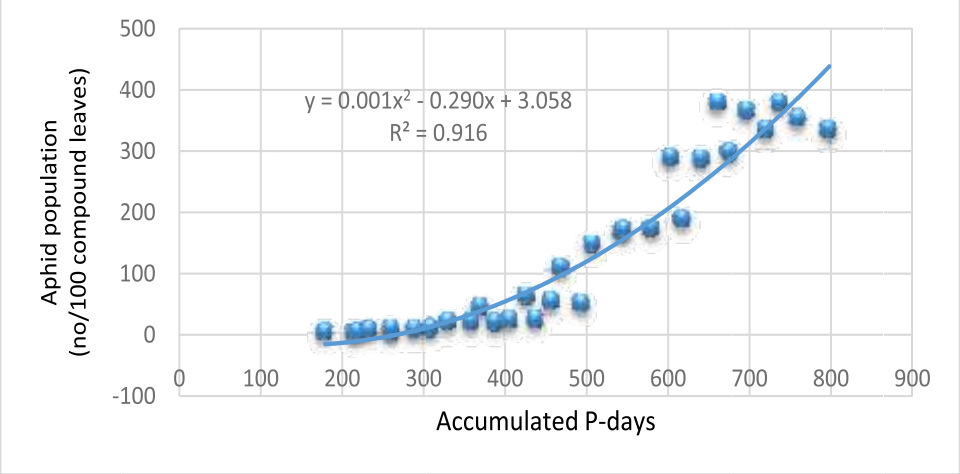


Fig 3.13: Aphid build up as function of P-days at Kalyani

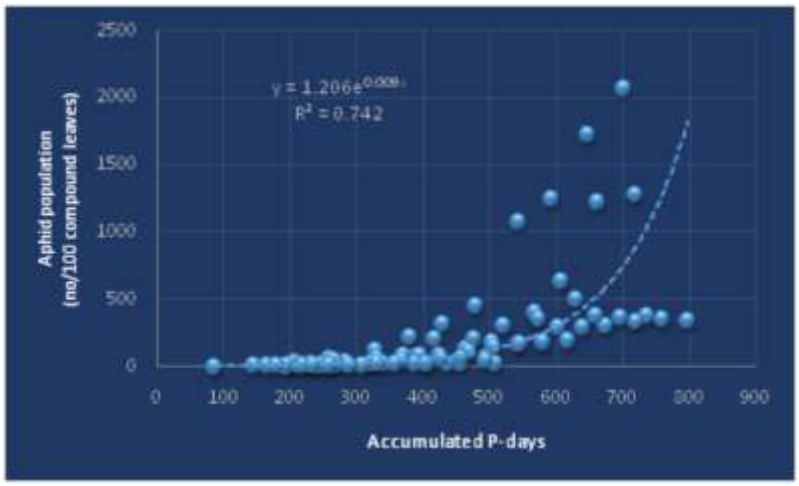


Fig 3.14: Aphid build up as a function of accumulated P-days at Deesa, Dholi and Kalyani

WHITEFLIES

The population of whiteflies, thrips, hoppers and mites are being monitored at many AICRP(Potato) centres. This information is vital for development of models for forecasting the first appearance of the pest as well as its build-up. Since the climatic condition of the AICRP(Potato) centres vary widely, the information on the appearance and build up can also be used for prognosis of the effect of climate change on these pests since some of the centres may be climate analog of other potato growing regions. The data on the population build up of white fly at Hisar during 2011-12 to 2014-15 were compiled and different thermal models were evaluated for their ability to forecast the population build-up. The study revealed that at Hisar, which is a hot spot for PALCV, the whitefly population could be described using the product of P-days and Vapour Pressure Deficit (VPD) accumulated weekly. P-days (with cardinal temperatures of 7.2, 25 and 40^{0}C) takes into consideration the effective temperatures affecting the growth of whitefly population while VPD takes into consideration the effect of humidity since whitefly is sensitive to RH and excess moisture is supposed to be detrimental for its build-up. The results show that the relationship between the meteorological index and whitefly population is a negative polynomial and that upto a value of 200 the whitefly population would be high and beyond that it would be quite low (Fig 3.15). The whitefly population at Kalyani and Pune were low hence were not considered for developing the relationship.

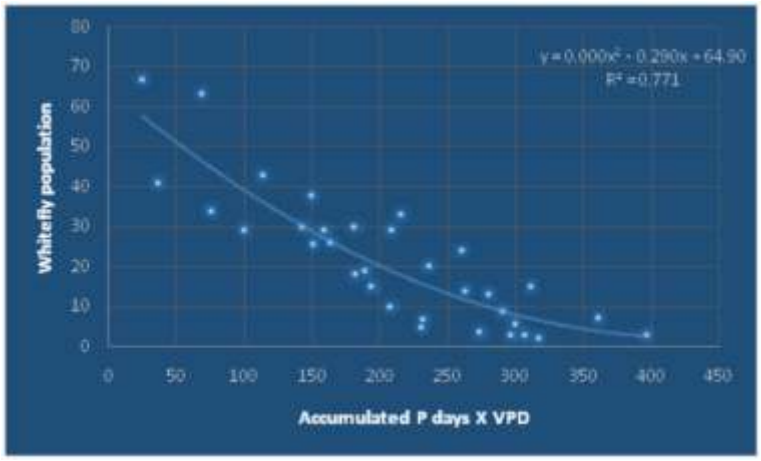


Fig 3.15: Relationship between whitefly population and product of P-days and VPD

MANAGEMENT OF SUCKING PESTS

The efficacy of different acaricides against mites on potato was tested for three years (2013-16) at Pune, Maharashtra. The incidence of mite was not observed during the crop growth period on potato during the *kharif* 2013-14. The acaricidal treatments were as below.

T_1 : Control

T_2 : Spray of Wettable Sulphur @ 4.00 g per litre of water.

T_3 : Spray of Emmamectin Benzoate 5 SG 50 g a.i.@ 0.50 gm per litre of water

T_4 : Spray of Spiromesifen 240 SC @ 48 g a.i. @ 1.00 ml per litre of water

T_5 : First spray of Emmamectin Benzoate 5 SG 50 g a.i.@ 0.50 gm per litre of water and second spray of Spiromesifen 240 SC @ 48 g a.i. @ 1.00 ml per litre of water after 15 days of first spray.

T_6 : Spray of Abamectin Benzoate 1.9 EC 12 ml a.i./ha @ 2.50 ml per litre of water

T_7 : First spray of Abamectin Benzoate 1.9 EC 12 ml a.i./ha @ 2.50 ml per litre of water and second spray of Spiromesifen 240 SC @ 48 g a.i. @ 1.00 ml per litre of water after 15 days of first spray

Observations on incidence of Red spider mite (*Tetranychus telarius)* was recorded on 5 randomly selected plants per treatment per replication at 10 days interval from the first appearance of mites till harvesting of the crop by rating on a 1 to 10 scale by visual observation on the basis of plant leaves and plant part affected.

Table 3.20: Final mite incidence under different treatments in different years.

	T1	T2	T3	T4	T5	T6	T7	Mean
2013 -14	5.90	7.28	7.18	7.28	7.36	7.12	7.14	7.04
2014 -15	6.34	8.24	7.62	8.58	8.84	7.52	8.40	7.93
2015 -16	6.48	7.76	8.24	7.52	9.20	8.00	8.48	7.95
Mean	6.24	7.76	7.68	7.79	8.47	7.55	8.01	
CD (0.05)	Location = 0. 23		Treatment = 0. 35			Location x Treatment = 0. 60		
SEd	Location = 0. 11		Treatment = 0.1 7			Location x Treatment = 0. 30		

The year, treatment and their interaction significantly affected mite incidence. The table (Table 3.20) shows that mite incidence was high in 2015-16 followed by that in 2013-14. It was very less in 2014-15. As regards the effect of treatments, mite incidence was the least in treatment T5 followed by T7 but the differences between them were non-significant. In the case of yield also, the effect of year, treatment and their interaction were significant. The highest yield was in T7 followed by T5 but the differences between them were non-significant. The lowest yield was in control which indicates that mites caused significant yield reduction in potato at Pune. However, spraying of Emmamectin Benzoate 5 SG 50 g a.i. @ 0.50 gm per litre of water immediately after appearance of mites on potato and second spray of Spiromesifen 240 SC @ 48g a.i. @ 1.00 ml per litre of water after 15 days of first spray effectively controlled the mites. First spray of Emmamectin Benzoate 5 SG 50 g a.i.@ 0.50 gm per litre of water and second spray of Spiromesifen 240 SC @ 48 g a.i. @ 1.00 ml per litre of water after 15 days of first spray is also equally effective in controlling mites.

Table 3.21: Effect of chemical control methods on tuber yield (t/ha)

	T1	T2	T3	T4	T5	T6	T7	Mean
2013-14	12.37	16.43	17.89	16.99	19.95	17.16	20.74	17.36
2014-15	9.60	10.85	14.10	13.46	15.29	13.12	16.44	13.27
2015-16	10.40	12.55	19.17	13.47	23.71	15.97	22.38	16.81
Mean	10.79	13.28	17.06	14.64	19.65	15.42	19.86	
CD (0.05)	Location= 0.95		Treatment= 1.45			Location x Treatment= 2.50		
SEd	Location= 0.48		Treatment= 0.73			Location x Treatment= 1.26		

INTEGRATED PEST AND DISEASE MANAGEMENT (IPDM) FOR EASTERN PLAINS OF INDIA

A protocol for Integrated Pest and Disease Management (IPDM) for eastern plains of India has been developed. The details are given in table 3.22 below

Table 3.22: Integrated pest and disease management protocol

Month	Plant protection practice (s)
April	**Week I, II, III and IV**
	Planting black gram/green gram during first week of April. or Plough the field deeply during third or fourth week to kill hibernating grubs/larvae/pupae (cutworms, *Helicoverpa armigera*, *Spodoptera litura*), different stages of pathogens (common scab, black scurf, bacterial wilt) by exposing to hot weather and to predation by birds where black gram/green gram is not planted in April.
May	**Week II, III**
	Plough the field deeply for the second time to kill hibernating grubs / larvae / pupae (cutworms, *Helicoverpa armigera*, *Spodoptera litura*), resting stages of pathogens (common scab, black scurf, bacterial wilt) by exposing to hot weather and to predation by birds where black gram/green gram is not planted in April.
June	**Week I, II**
	Preparation of paddy nursery and seedling raising.
	Green manuring with dhaincha, green gram, sunhemp etc. to reduce the infection by black scurf and common scab.
July	**Week I, II**
	Planting of rice field.
	Puddling and tillage operations at the time of planting rice can reduce insects such as white grubs, lepidopterans, mole crickets, termites by tunneling them deep into the soil.
August, September and October	
	Remove alternate hosts, weeds, solanaceous plants on field bunds and borders of the field which serve as reservoirs for pests and diseases and shifted to potato crop during December.
	Installation of light traps @1-2/ha to trap adult moths of cutworms, lepidopterans etc.
November	**Week I**
	Harvesting of preceding paddy crop.

	Planting two thick rows of maize or mustard around the field as a barrier crop or trap crop for aphid vectors.
	Week II, III and IV
	Procurement of disease free healthy certified seed of desired variety recommended for the region to overcome yield losses due to late blight, bacterial wilt, common scab, dry rot, soft rot, viral diseases etc.
	Choose/select varieties like Kufri Himalini, Kufri Jyoti, Kufri Chandramukhi, Kufri Chipsona-3, Kufri Pukhraj, Kufri Sutlej.
	Follow seed treatment with imidacloprid (200SL) @ 0.04% (4ml/10lit) for 10 minutes and shade dry before planting to give protection from aphids, whiteflies, leafhoppers up to one month after germination.
	Apply phorate 10G or carbofuran 3G @ 2.5-3.0 kg a.i./ha in furrows at planting or near plants base at the time of earthing up is more effective against cutworms, white grubs, aphids and whiteflies.
	Deep planting of tubers is recommended to avoid egg laying by potato tubermoth and to reduce its infestation in field.
	Installation of yellow water traps/yellow sticky traps @ 60/ha at equidistance for monitoring and mass trapping of aphid and whitefly vectors.
December	**Week I and II**
	Remove weeds *Lantana camara, Solanun nigrum, Hibiscus esculentus* and *Datura* sp., alternate hosts (solanaceous crops such brinjal, tomato, chillies etc.) from field and burn them as they serve as reservoir for diseases and pests such as bacterial wilt, viruses, aphids, whiteflies, cutworms etc.
	Rouging of off-types, disease infected plants from main potato field to reduce horizontal spread of fungal, bacterial and viral diseases.
	Apply stable bleaching powder @ 12 kg/ha along with recommended fertilizers in lines before planting to avoid bacterial wilt.
	Spray neem oil @ 5% or mineral oils @ 0.2% depending on the level of infestation to control whiteflies and PALCV.
	The egg masses and larvae of epilachna beetles can be collected and destroyed mechanically.
	Good control of epilachna beetles may be obtained by spraying the foliage thoroughly with chlorpyriphos (20EC) @ 2.5 ml/L when pest infestation is high.
	Week III
	Scouting of the field for identifying primary infection foci and their destruction by removal of the infected plants to control late blight.

	I spray: Spray the crop with contact fungicides like mancozeb 75%WP (0.2%) or chlorothalonil (0.2%) as soon as the weather conditions become congenial for late blight, or about a week in advance of canopy closure.
	II spray: As soon as the disease is noticed in the field, apply any of the systemic fungicides *viz*., cymoxanil+mancozeb or dimethomorph + mancozeb or fenamidone + mancozeb (0.3%) fungicides.
	III spray: Apply contact fungicides *viz*. mancozeb (0.2%), or chlorothalonil (0.2%) after 8-10 days of 2nd application of fungicides.
	Week IV
	Need based application of neem oil @ 5% or mineral oils @ 0.2% successfully protect potato plants from aphids and aphid transmitted potato viruses (PVY, PLRV). Installation of light traps @ 1-2/ha to capture adult moths of *Spodoptera litura* and other lepidopterans.
January	**Week 1**
	Second rouging of off-types, disease infected plants from potato fields to reduce infection by late blight, bacterial wilt and potato viruses.
	Application of neem oil @ 5% or mineral oils @ 0.2% as prophylactic measure can successfully protects potato plants from aphids and aphid transmitted potato viruses (PVY, PLRV).
	Week II, III and IV
	Late blight, early blight and leaf spots
	I spray: Spray the crop with contact fungicides like mancozeb 75%WP (0.2%) or chlorothalonil (0.2%) as soon as the weather conditions become congenial for late blight, or about a week in advance of canopy closure.
	II spray: As soon as the disease is noticed in the field, apply any of the systemic fungicides *viz*., cymoxanil+mancozeb or dimethomorph + mancozeb or fenamidone + mancozeb (0.3%) fungicides.
	III spray: Apply contact fungicides *viz*. mancozeb (0.2%), or chlorothalonil (0.2%) after 8-10 days of 2nd application of fungicides.
February	**Week I**
	Need based application of imidacloprid 17.8% S.L @ 0.03% to control aphid/whitefly vectors and viruses.
March	Cut the haulms 10-15 days before harvesting.
	Harvesting the crop only when the tuber skin is fully cured.
	Tubers should not be left exposed to egg-laying by moths in field during late afternoon or overnight to reduce tubermoth damage in stores.

	Tuber damage and injury must be avoided during harvest, transport, storage etc to prevent losses due to soft rot, dry rot.
	Storage of healthy, un-infested tubers in country stores/cold stores to avoid losses due to soft rot, black scurf, common scab and tuber moth.
	Use 2-2.5 cm thick layers of dried *Lantana* or eucalyptus leaves below and on the top of the potato heaps in stores to avoid losses due to potato tuber moth.

Front Line Demonstration under TSP Raipur Centre 2015-16

During the year under report activities under TSP were carried out at AICRP (Potato) Raipur Centre. It laid out Front Line Demonstration in the kharif season at Surguja which is a tribal District. Front Line Demonstration were laid out in farmers fields belonging to two different group in three villages (Annexure-I) namely Barima, Lurina and Junapara. The farmers were provided seed of varieties Kufri Pukhraj, Kufri Jyoti, Kufri Arun and Kufri Khyati. The area covered was about 8.00 acres. Planting was done in the 2nd week of July and advisory was recovered practices were given. The yield obtained on recommended 218 q/ha in Kufri Pukhraj and Kufri Khyati which were at par to each other. Kufri Jyoti and Kufri Arun did not perform well during the Kharif season.

During the Rabi season three farmers group belonging (Annexure-II) to two villages namely Bargadpara, Majhapara and Kesra were selected for Front Line Demonstration. The varieties namely Kufri Pukhraj, Kufri Jyoti, Kufri Arun were given to these farmers. Kufri Pukhraj yielded the highest (ranging from 222 to 272 q/ha).

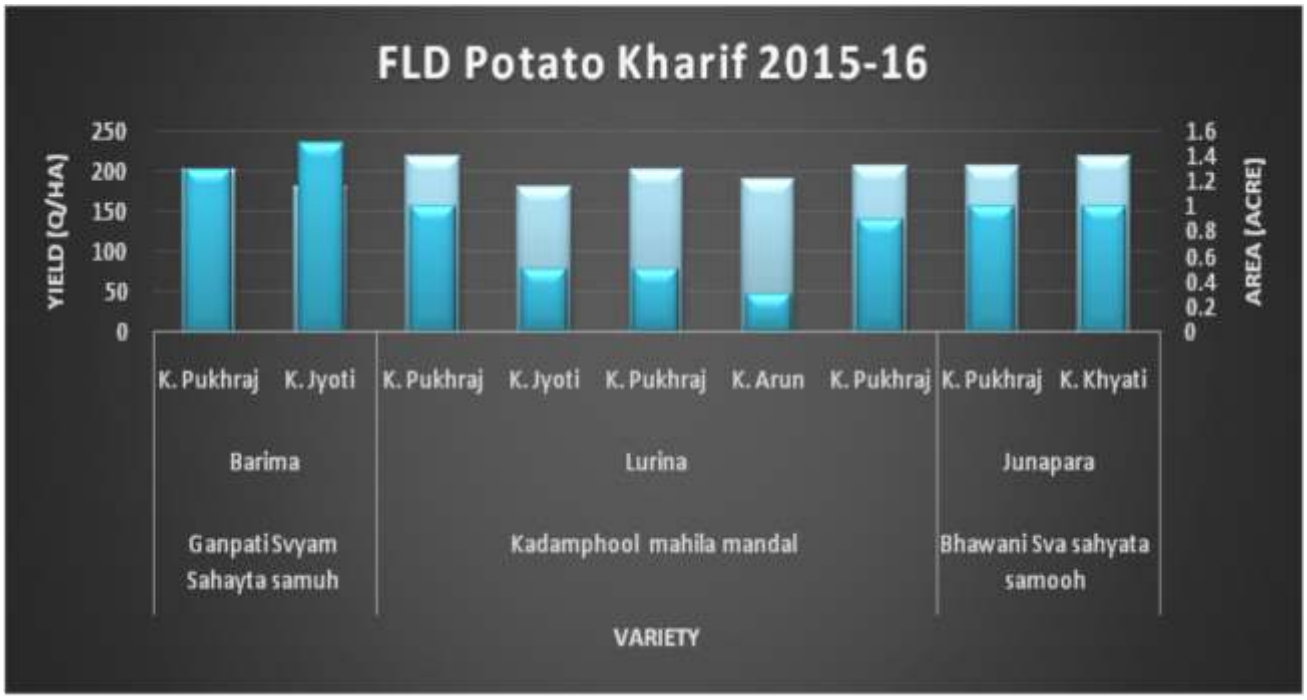


Fig1: Showing details of Kharif FLD 2015-16 including, name of place, variety, area and yield recorded for the demonstration.

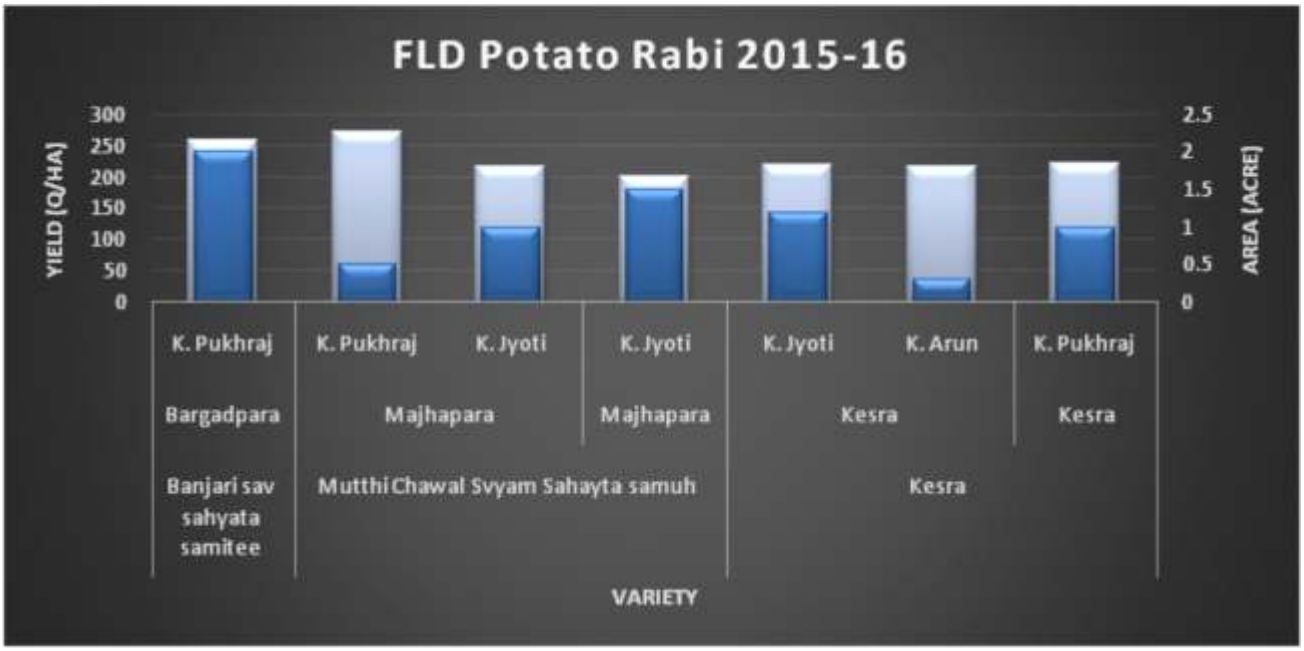


Fig 2: Showing details of Rabi FLD 2015-16 including, name of place, variety, area and yield recorded for the demonstration.

Time to time visit to farmers field was made in order to make them aware with the potato production technology and to rectify their problems encountered in potato cultivation particularly for plant protection measures in both the season.

Field view of FLD at Mainpat (Chhattisgarh)2015-16 (TSP

Annexure I

FRONT LINE DEMONSTRATION OF POTATO (KHARIF 2015)

S. No.	Farmers Name	Fathers Name	Cast	Area (Acre)	Variety	Seed Provided (q)	Yield (q/ha)
GANPATI SVYAM SAHAYTA SAMUH BARIMA MANPAT KHARIF-2015							
1	Savita	Shankar	ST	1.3	K. Pukhraj	15	203
2	Seema	Jeevan					
3	Sulekha	Ramprasd					
4	Rajkumari	Rajesh					
5	Urmila	Mulchand		1.5	K. Jyoti	15	180
6	Munia	Tandul					
7	Bhumari	Sumar					
8	Aabhavicha	Birbal					
9	Vinita	Ramkavar					
10	Rajkumari	Biaram					
KADAMPHOOL MAHILA MANDAL LURINA MANPAT							
1	Phululkumari	Mahesh	ST	1	K. Pukhraj	10	218
2	Sumitra	Karansai					
3	Bihani	Moharsai					
4	Rajanti	Laxman					
5	Anjela	Vishnu		1	K. Jyoti	5	180
6	Gurbari	Ramkanwar					
7	Udvasdhi	Jagannath			K. Pukhraj	5	202
8	Ratni	Daduram					
9	Kadmi	Raghuveer		1.2	K. Arun	3	189
10	Sonmani	Budhan			K. Pukhraj	10	208
BHAWANI SVA SAHYATA SAMOOH JUNAPARA MANPAT							
1	Shanti	Arvind	ST	1.0	K. Pukhraj	10	206
2	Bhagvati	Pawan					
3	Lakshmanisha	Dahar					
4	Anjani	Prakash					
5	Khulaso	Prasnat					
6	Meera	Kalpnath		1.0	K. Khyati	10	218
7	Gulabi	Ramdev					
8	Kamla	Sumannag					
9	Phuleshwari	Lalit					
10	Rajpati	Baleshwar					

Annexure-II

FRONT LINE DEMONSTRATION OF POTATO (RABI 2015-16)

S. No.	Farmers name	Fathers name	Cast	Area (acre)	Place	Variety	Seed provided (q)	Yield (q/ha)
BANJARI SAV SAHYATA SAMITEE BARIMA MANPAT								
1	Savita	Kanduram	ST	2.0	Bargadpara	K. Pukhraj	20	260
2	Maniharo	Bandhan						
3	Maniyaso	Ramchander						
4	Guruvari	Chaitram						
5	Raj Kumari	Parval						
6	Shabri	Ramsingh						
7	Chandrakanta	Amarsai						
8	Meera	Kuvarsai						
9	Sarita	Dharamprakash						
10	Mankuwar	Dularsai						
MUTTHI CHAWAL SVYAM SAHAYTA SAMUH								
1	Manju	Vijaynath	ST	1.5	Majhapara	K. Pukhraj	5	272
2	Tiharo	Ratan						
3	Sonkaliya	Bindra				K. Jyoti	10	218
4	Satmania	Rameshwar						
5	Ratni	Bhinsaria						
6	Manju	Bhinsaria	ST	1.5	Majhapara	K. Jyoti	15	202
7	Manashri	Sundar						
8	Basanti	Virsai						
9	Anita							
10	Muni	Vijaynath						
KESRA								
1	Dular Sai	Latti	ST	1.5	Kesra	K. Jyoti	12	220
2	Magaru	Motia				K. Arun	3	218
3	Govind	Lakhan						
4	Kola	Lagan						
5	Cheru	Phulsai						
6	Bodhiram	Dularsai	ST	1.0	Kesra	K. Pukhraj	10	222
7	Dinesh	Sukhan						
8	Krishna	Lakhan						
9	Kishun	Dular						
10	Gopal	Khilawan						

AICRP (POTATO) PUBLICATIONS, EXTENSION ACTIVITIES, TRAININGS ETC. DURING 2015-16

(A) RESEARCH PAPERS

HEAD QUARTER: AICRP (POTATO), SHIMLA

1. Raja Shankar, DN Nandekar, DK Diwvedi, SP Pathak, PC Bhagavati, Rajiv Khaiwal, RK Dubey, SH Khan 2016. Nitrogen fertilizer response to potato yield under climatic diversity of tropical condition a breeding perspective analysis. *Field Crop Research* (Communicated).
2. Raja Shankar, DN Nandekar, Narendra Singh, SP Pathak, AK Bhatia, SK Trivedi, RK Dubey, MR Deshmukh, Pravin Kumar, Dharminder Verma 2016. Multi-Locational efficiency analysis for efficient traditional seed tuber production in India. *Potato Research*.(Communicated).
3. Raja Shankar, KS Baswana, Raj Kumar, VK Gupta, SK Luthra, Dhirender Singh, PC Satpathy, LM Yadav, SP Pathak, MK Saikia, Ashis Chakraborty, RK Dubey, Shambhu Kumar, Rajiv Khaiwal, Dharminder Verma, PM Govindakrishnan 2016. Stability Analysis of tuber yield of new potato hybrid MS/5-1543 at multi-environmental conditions of India. *American Journal of Potato Research*. (Communicated).
4. Raja Shankar, AK Mishra, DN Nandekar, Dharminder Verma, PM Govindakrishnan 2016. Multivariate interaction analysis for enhanced baby potato production under tropical conditions. *Hort Science*. (Communicated).
5. Raja Shankar, Med Ram Verma, PC Sathpathy, LM Yadav, Raj Kumar, Zafar Ullah, Rajiv Khaiwal, R K Dubey, Shambhu Kumar, Dhirender Singh, MR Deshmukh, Dharminder Verma, PM Govindakrishnan 2016. Genotype by environmental interaction and yield stability of potato commercial cultivars for differential harvesting stage under tropical conditions. *Journal of Agricultural Science and Technology*. (Communicated).

DEESA

1. SK Chongtham, RN Patel, JK Patel, CK Patel, Dipak H Patel, CR Patel and DM Zapadiya. 2015. Yields, nutrient and water use efficiency and economics of potato variety KufriSurya as influenced by different nitrogen levels. *International Journal of Agriculture Sciences* 7(12): 785-787.
2. CK Patel, SK Chongtham, RN Patel, CR Patel and MN Maheshwari. 2016. Effect of calcium application on yield and post harvest qualities of potato. *GAU Research Journal*. 41(1): 28-31.
3. SK Chongtham, CK Patel, RN Patel, JK Patel, JM Patel, Dipak H Patel, CR Patel and DM Zapadiya. 2016. Growth, yield, economics, water and nutrient use efficiency of potato as influenced by different methods of drip fertigation and varieties. *International Journal of Agriculture Sciences* (Accepted).

HISAR

1. Manoj Kumar and Anil Gupta. 2015. Evaluation of potato germplasm against potato apical leaf curl virus. *International Journal of Tropical Agriculture* (IJTA). 33(3) 2227-28.

2. Manoj Kumar and Anil Gupta. 2015. Effect of weather variables on whitefly (*Bemisiatabaci* Gennadius) population in development of apical leaf curl virus disease in potato. Journal of Agrometerology. Accepeted for publication Vol. 18(2) 2016.

JALANDHAR

1. R Kumar, GS Kang, SK Pandey and J Gopal. 2015. Kufri Khyati (J.93-86): A new early maturing potato variety with late blight resistance. *Indian Farmers' Digest* 48(2) 13-14.

KALYANI

1. SK Das, H Banerjee, A Chakraborty and A Sarkar. 2015. Production potential of newly released potato (*Solanum tu berosum* L.) cultivars under different nitrogen levels. *SAARC J. Agri.*,13(2): 121-130.

2. Sahar Murmu, S Dey and A Chakraborty. 2015. Management of early blight of potato using bio control agents and plant extracts. *Journal of Applied and Natural Science*, 7(2): 860-864.

3. A Chakraborty, SK Mukhopadhyay, A Konar and H Banerjee. 2015. Production of disease free seed potatoes in plains of West Bengal. *J. Mycopathol. Res.* 53(2): 279-281.

4. A Chakraborty, BP Singh, Islam Ahmad and Sanjeev Sharma. 2015. Forecasting late blight of potato in plains of West Bengal using Jhulsacast Model. *Potato J.* 42(1): 50-57.

PANTNAGAR

1. G Chandra, M Raghav and U Kumar.2015 Performance of potato varieties with varying nitrogen levels for yield and yield contributing traits of tuber. *Annals of Plant and Soil Research* 17 (3):15-18.

2. U Kumar, M Raghav and G Chandra. 2015 Production potential of potato cv Kufri Sa dabhar as influenced by mode of nitrogen application. *Annals of Plant and Soil Research*17 (5):96-98.

3. RK Narollia, M Raghav, VK Singh and N Kumar.2015 Growth and yield response of potato to irrigation levels and mulching methods. *I J Basic & Applied Agri. Res.* 13(1):38-41

PUNE

1. MR Deshmukh, SA More, MB Khamkar, MM Katkar and SB Gurav. 2015. Varietal evaluation to identify promising potato varieties for Pune region. *J. Agric. Res. Techno.* 2015: 40(3):534-537

2. SA More, SB Kharbade and IA Ghonmode. 2016. Comparative Biology of *Malladaboninensis* (Okomoto) on Mangohoppers *Idioscopusniveosparsus* (Leth) and Ricemoth *Corcyra cephalonica* (Stainton). *Int. Res. J. of Multi Disciplinary Studies*, Vol.2 (2), Feb. 2016:1-4.

3. A Hamelpure, SA More and SB Kharbade. 2016. Efficacy of newer insecticides against aphids and jassids on potato. *Int. Res. J. of Multi Disciplinary Studies*, Vol.2(2), Feb. 2016:1-4.

RAIPUR

1. PK Sharma, PK Joshi, SK Verma, SB Rangare and V Yadav. 2015. Production Potential and Completion Indices in Potato (*Solanum tuberosum* L.) + Cabbage (*Brassica oleracia var. capitata*) and Clutser Bean (*Cyamopsis tetragonalobus*). *Trends in Biosciences* 8 (5): 1121-1125.

2. PK Sharma, PK Joshi., SK Verma, SB Rangare and V Yadav. 2015. Influence of Different Nitrogen Levels on Growth and Yield Attributes of Potato (*Solanum tuberosum* L.). *Trends in Biosciences* 8 (5): 1126-1127.

3. PK Joshi, PK Sharma, V Yadav and SB Rangare. 2015. Evaluation of Potato Genotypes under Different Maturity Groups in Chhattisgarh. *Trends in Biosciences* 8 (5): 1128-1130

4. B Patel PK Sharma, M Patanwa, C Banjare and P Patel. 2015. Effect of different levels of nitrogen, phosphorus and potassium on nutrient uptake by potato, available nutrient in plant and on soil fertility. *Research J. Ag. Sci.* 6(1): 134-137.

5. P Singh, PK Sharma, C Banjare, K Pradhan and R Sharma. 2015. Genetic variance and mean performance of potato genotypes evaluation on different potato genotypes in Chhattisgarh conditions. 2015. *Annals of Plant and Soil research* 17:170-177.

TECHNICAL/EXTENSION BULLETIN

HQ, AICRP (Shimla)

1. PM Govindakrishnan, Raja Shankar, Vinay Bhardwaj, Sanjeev Sharma, M Nagesh, VK Dua, J Sridhar, A Jeevalatha, V Venkateswaralu and Ravinder Kumar. 2015. "**Standard Operating Procedures for conducting field experiments in Potato"** under AICRP. AICRP (Potato) Bulletin No.5, ICAR- Central Potato Research Institute, Shimla 171 001. HP India 46pp..

JORHAT

1. PC Bhagawati, Zafur Ullah and MK Saikia–"Alu kheti TPS or byabahar"

2. PC Bhagawati, Zafer Ullah and MK Saikia – "Angshik po harar bh oralot alurbi jsan grakshan"

PANTNAGAR

1. RP Singh, J Kumar and Tewari Rashmi 2015. 'सब्जियों के प्रमुख रोगों की पहचान एवं रोकथाम' Directorate of Experiment Station, GBPUAT, Pantnagar, 80p.

POPULAR ARTICLES

BHUBANEWAR

1. Ashok Mishra. 2015. Aluchasareunnata kisamarabhumika (Role of improved varieties in potato cultivation). Vikas Barta (15.08.2015)

CHHINDWARA

1. DN Nandekar, SN Singh, B Choudharyand S Bakode. 2015. Agronomical practices for scientific Potato cultivation in MP".

2. DN Nandekar, SN Singh, B Choudhary and S Bakode. 2015. "Importance of seed treatment & optimum size of potato tuber on yield of Potato" .

3. DN Nandekar, SN Singh, B Choudhary and S Bakode. 2015. "Effect of manures & fertilizer for Potato production in satpura zone of MP".

DEESA

1. RN Patel, JK Patel, PP Chaudhary and SK Chongtham. 2015. "*Batata Ni Kheti Na Mahtav Na Mudda Ane Bhalamano*". Krushijivan November 2015: 05-08.

HASSAN

1. Vishnuvardhana, PS Prasad and Soumya Shetty. 2015. Improved Production practices in Potato (in kannada).

2. Vishnuvardhana, PS Prasad, J Venkatesh and Soumya Shetty. 2015. Potato Production Technology (in kannada).

3. PS Prasad, Vishnuvardhana, J Venkatesh and Soumya Shetty. 2015. Management of diseases and insect in Potato (in kannada)

HISAR

1. VPS Panghal, DS Duhan and M Lal. 2016.

"*Sabji Utpadan: Aawshyakata Evam Mahatav*". *Haryana Kheti*, 49**(4)**: 29-30

KALYANI

1. A Chakraborty, H Banerjee, A Konar, A Sarkar, R Roy and G Biswas. 2015. "Beej Alu Utpadanernatundisha Paschim Banga". Feere Asuk Sabuj. 2(3). Page-2.
2. A Chakraborty and H Banerjee. 2016. "Jyoti Alur Bikalpa Kufri Himalini". Ganashakti News Paper.
3. A Chakraborty. 2016. "Nabi Dhasa Pratikare Kichu Katha" Ananda Bazar Patrika. 3rd Feb. 2016.
4. A Chakraborty. 2016. "Himalini Alur Chas Kore Saffalya Bidhan Chandra Krishi Viswavidyalaya-er Bigyanider. Dainik Jugashankha. 14th March, 2016.

MODIPURAM

1. Sadawarti Murlidhar, VK Gupta, SP Singh, Satyajit Roy and BP Singh. 2015. Potato Varieties Suitable for Cultivation in Madhya Pradesh. Popular Kheti, Volume -3, Issue-2 (April-June), p38-43

PANTNAGAR

1. G Chandra, U Kumar andMRaghav. 2015.*Climate change: Impacts and opportunities for potato production. Indian Farmers' Digest* 48 (6): 25-26
2. M Raghav. Upendra Singh and Pramod Chauhan. 2015. *Improved agro techniques for potato production in Uttarakhand. Indian Farmer Digest* 48 (10): 15-16.

BOOKS CHAPTER

HQ, AICRP (Shimla)

1. PM Govindakrishnan, Raja Shankar, Shashi Rawat and SK Luthra. 2015. Potato growing Environments in India

HISAR

1. VK Batra and AK Bhatia. 2015. Potato seed production. In Training compendium of Nursery management and seed production of vegetable crops from 14-21 March, 2016 organized by RDS farms CCS HAU, Hisar, pp: 48-51.
2. VPS Panghal and DS Duhan**.** 2016. *Sabji Beej Utpadan Takneek*. In compendium: Sabji Faslon Ka Parvardhan Evam Beej Utpadan. Published by RDS Seed Farm, CCS HAU, Hisar. Chapter 19, pp: 92-96.

KALYANI

1. Agriculture: Innovation, Strategy and Technology in 21st Century (First Edition 2015, Volume-2) by K Jana, CK Kundu, SK Das, K Murmu, R Poddar, C Karak and AM Puste. (ISBN: 978-93-85640-01-8) book chapter entitled "Adaptation and Mitigation Strategies in Indian Agriculture under changed climate"

EXTENSION ACTIVITY

BHUBANEWAR

1. Ashok Mishra and D Ghosal. 2015. Verification of seed tuber stock in cold storages at Bhubaneswar, Balasore, Jalandhar, Karnal and Patna during July to October, 2015.
2. Ashok Mishra. 2016. Verification of farmers' fields of Balipatna and Dhauli under Bhubaneswar Block to suggest measures to control rotting and wilting on 08.01.2016.
3. D Ghosal. 2016. Display of tubers of elite potato cultivars in the Exhibition of National Seminar on 'Horticultural Diversity for Prosperity' at OUAT, Bhubaneswar from 10-12 February, 2016. The Exhibition was visited by more than 1000 farmers.

DEESA

1. RN Patel, SK Chongtham and JK Patel. 1st Mega Potato Summit was organized by Mahashakti Khadi Gramodhyog Trust, Gandhinagar in technical collaboration with Potato Research Station, SDAU, Deesa at AICRP Potato Center, Deesa on September 29-30, 2015. This event was attended by more than 700 farmer

2. RN Patel. "Potato production techniques and value addition" was organized by Aravalli Cold Storage, Modassa in technical collaboration with Potato Research Station, SDAU, Deesa at Aravalli Cold Storage, Modassa (Dist. Sabarkantha) on October 25, 2014. This Kisansangosthi was attended by more than 500 farmers.

HASSAN

1. PS Prasad participated in Supply of Potato Seed Tubers meeting organized by Lalbagh/M.S. Building, Bangalore on 13.04.15.
2. Vishnuvardhana participated monthly meeting in Potato, organized by DC office, Hassan during April, 2015 to March, 2016.
3. PS Prasad participated as SMS in Training programme organized by KVK, Kandali on 16.05.15.
4. PS Prasad participated in Potato meeting

organized by Dept. of Horticulture, Hassan on 19.05.15.

5. Vishnuvardhana participated in Potato meeting organized by Dept. of Horticulture, Beerur on 06.06.15.
6. Vishnuvardhana and PS Prasad participated in Potato meeting organized by Dept. of Horticulture, Hassan on 12.06.15.
7. PS Prasad participated as SMS in Krishi Abhiyaana programme organized by Dept. of Horticulture held at Halebeedu on 19.06.15.
8. Vishnuvardhana participated in Potato meeting organized by Dept. of Horticulture, Beerur on 04.07.15.
9. Vishnuvardhana participated in Supply of Potato Seed Tubers meeting organized by Dept. of Horticulture, Hassan on 03.08.15.

10. Vishnuvardhana and PS Prasad participated as SMS in Farmers awareness programme organized by KVK, Kandalion 07.08.15.

11. Vishnuvardhana participated in Supply of Potato Seed Tubers meeting organized by Lalbagh/M.S. Building, Bangalore on 10.08.15.

12. Vishnuvardhana and PS Prasad participated as SMS and presented about Potato cultivation and its disease management in Potato Field day held at Belur on 24.08.15.

13. Vishnuvardhana, PS Prasad and Soumya Shetty organized Potato field day on 03.10.15. Discussed about production and cultivation aspects of Potato and interacted with farmers and also displayed Varieties of Potato hybrids and disease specimen.

14. PS Prasad participated in Technology week organized by KVK, Kandali on 14.10.15. Promising potato varieties of Hassan region were displayed in the exhibition stall.

15. Vishnuvardhana participated as SMS in the Potato meeting organized by Lalbagh/M.S. Building, Bangalore on 02.12.15.

16. Vishnuvardhana and PS Prasad participated as SMS in Farmers Day celebration programme organized by KVK, Kandali on December 23,2015 at Somanahalli, Hassan and delivered lecture on Production Technology of Potato and interaction with farmers

17. Vishnuvardhana and PS Prasad participated as SMS at Consultancy service and AICRP on potato stall in Bruhat Udyana Mela-2015 organized by UHS, Bagalkot from December 19-21, 2015

18. Vishnuvardhana andPS Prasad participated as SMS in Farmers Awareness programme organized by KVK, Kandali on January 19, 2016. Varieties of Potato hybrids and disease specimen were displayed in the exhibition stall.

19. Vishnuvardhana, PS Prasad and Soumya Shetty participated in Vegetables exhibition in Fruits & flower show-2016 organized by Dept. of Horticulture, Hassan at Jubilee garden from January 26-28, 2016. Varieties of Potato hybrids and disease specimen were displayed in the exhibition stall.

20. Vishnuvardhana participated in Krishi Mela, 2015 organized by KVK Suttur math, Mysore from February 5-10, 2016. Varieties of Potato hybrids and disease specimen were displayed in the exhibition stall.

21. PS Prasad participated in Krishimela organized by Shri Kshetra Dharmasthala Rural Development Project (SKDRDP) held at Kushalnagar from March 03-05, 2016

22. Vishnuvardhana participated as SMS in Certified Seed distribution programme organized by KVK Kandali on 17.03.16.

HISAR

1. AK Bhatia, VPS Panghal and Anil Gupta attended and guided farmers in Kisan Mela in September, 2015 and March, 2016 organized by Directorate of Extension Education, CCS HAU, Hisar. This Kisan Mela was attended by more than 30

thousand farmers.

2. AK Bhatia delivered lectures to the farmers on *"Allu Ka Beej UtpaqdanVa Vegetable Nursery Mangement"* in the state level farmer training at village Akanwali (Fatehabad) "One day seminar on Vegetable Production Technique and Safe and Judicious use of Pesticides" organized by Department of Horticulture , Haryana on October 23, 2015.

3. AK Bhatia delivered lectures to the farmers on *"Safe Storage of Potato"* in the state level farmer training at village Dharnia (Fatehabad) "Protected cultivation and hybrid Vegetable production" organized by Department of Horticulture, Haryana on March 22, 2016.

4. AK Bhatia delivered lectures to the farmers in Training on 'Production technology of potato' organized by Training Centre of PNB Farmers Training Center, Sacha Khera, District Jind, Haryana on August 06, 2015.

5. VPS Panghal lecture delivered on 'Improved production technology in seasonal vegetables' in the farmers training programme organized by PNB Farmers Training Center, Sacha Khera, District Jind, Haryana on January 14, 2016.

6. VPS Panghal lecture delivered on 'Seed production of vegetable crops' in the training "Capacity building of Haryana farmers in quality seed production & testing" organized by SST section, CCS HAU, Hisar on March 3, 2016.

7. VPS Panghal lecture delivered on ''Production technology of potato" in the farmers training programme organized by PNB Farmers Training Center, Sacha Khera, District Jind, Haryana on October 5, 2015.

8. VPS Panghal lecture delivered on 'Cultivation of vegetables crops' in the training organized for the rural women of village Gawar and Burack organized by Department of EECM, COHS, CCS HAU, Hisar on October 14 and 19, 2015.

JORHAT

1. PC Bhagawati, ZUllah and MK Saikia."Popularization of TPS technology" in Majuli and Teok of Jorhat District

KALYANI

1. A Chakraborty, A Sarkar, SK Das, R Roy and G Biswas attended and actively participated and installed stall in Agriculture Fair from 13-15th Jan, 2016 at KVK, Gayeshpur, Nadia.

2. A Chakraborty, A Sarkar, SK Das, R Roy and G Biswas attended and actively participated and installed stall in Horticulture Fair from 28-29th Jan, 2016 at BCKV. This programme was attended by more than 500 farmers.

3. A Chakraborty, A Sarkar, SK Das, R Roy and G Biswas attended and actively participated

and installed stall in Rabi krishak sa mmelon o krishi prajukti sa ptaha- 2016 fair from 3-5th Feb, 2016 at KVK, Hooghly, Chinsurah, WB.

4. A Chakraborty, A Sarkar and SK Das imparted training to farmers on "Modern techniques of raising potato tuber and seed including pest and disease management" on

14.01.2016 organized by KVK, Chinsurah, Hooghly.

5. A Chakraborty, A Sarkar and SK Das imparted training to farmers on "Modern techniques of raising potato tuber and seed" on 29.01.2016 organized by IPM Institute, Kolkata.

MODIPURAM

1. VK Gupta delivered a lecture on Selection of suitable varieties for early and late planted potato crop in a farmers training programme on 'Potato seed production and marketing' was organized at CPRIC, Modipuram during September 26-30, 2015. This training was attended by 35 farmers.
2. VK Gupta delivered a lecture on Selection of suitable varieties for early and late planted potato crop in a farmers training programme on 'आलू फसल के लिए एकीकृत कीट व्याधी एवं पोषण प्रबन्धन' was organized at CPRIC, Modipuram during October 12-16, 2015. This training was attended by 35 state extension officers and progressive farmers.
3. VK Gupta attended and delivered a lecture on Potato varieties and production technologies at Kisan Mela and Krishi Pradarshni was organized by ATMA and DM Meerut on December 23, 2015. This Kisan Mela was attended by more than 2000 state agriculture and horticulture officers and farmers.
4. VK Gupta attended farmers meeting and deliberated on potato varieties for table and processing under Mera Gaon Mera Gaurav programme was organized by CPRIC, Modipuram at Village Mahmoodpur (Muzaffarnagar) on December 26, 2015. This meeting was attended by more than 50 farmers.
5. VK Gupta attended and delivered lecture on potato varieties for different uses and duration at 2 days Kisan Mela was organized by SHM, UP during February 12-13, 2016 at Panchal Ghat, Farukhabad (UP). This Kisan Mela was attended by more than 1000 farmers.
6. VK Gupta delivered a lecture on potato production technology and varieties for table and processing purpose was organized for farmers deputed by HAMETI, Jind, Haryana on March 18, 2016 at CPRIC, Modipuram. This training was attended by 20 farmers.
7. VK Gupta imparted training on botanical identifications of potato varieties and practical demonstration to supervisors of Merino Industries Ltd, Hapur on January 05, 2016 at CPRIC, Modipuram.

PANTNAGAR

1. RP Singh participated in farmers scientific interaction programme organized time by time by Dean, College of Agriculture time to time
2. M Raghav, RP Singh and Dhirendra Singh. Participated in farmer's scientific interaction programme organized time Kisan Sangosthi during Kisanmela three times during October 2015 & March, 2016.
3. M Raghav delivered a lecture on "Alu ut padan ki unnet tak nek" in farmers training programme organised by ATMA at Pantnagar on May 24, 2016.
4. M Raghav delivered a lecture on "Alu a vam tamator ki javik vidhise unnet kheti" in farmers training programme organised by ATMA at Pantnagar on June 13, 2016.

PUNE

1. MR Deshmukh attended farmers visit from

Koregaon Dist. Satara to NARP, Ganesh Khind and answered quires related to potato cultivation on 04.09.15.

2. MR Deshmukh attended farmers visit from Bhusawal Dist- Jalgaon to NARP, Ganeshkhind and answered quires related to potato cultivation on 23.03.16

3. SA More attended"Farmers Training Programme on Intergrated Pest Management" at Kanhormesai & Dhamori in Shirur District Pune on 03.07.15

4. SA More organized field visit at Kalaj, Ghadgemala District Satara on 05.09.15.

5. SA More organized field visit at Kodit, Soneri Saswad on 09.01.16

6. SA More attended Agril. Exhibition at Hindustan Antibiotics, Pune organized by Agro1 and MPKV, Rahuri on 28.10.15

7. SA More attended "Farmers Training" at Saskal and Vidni Tal. Phaltan District Satara on 22.01.2016

(F) TV/RADIO TALK

BHUBANEWAR

1. Ashok Mishra. Aluchasa (Potato cultivation: Phone-in) at Doordarsan Kendra (**DDK**), Bhubaneswar on November 6, 2015.

2. Ashok Mishra. Sarkararahitaalu (Sugar-free potato) at **News 7, Bhubaneswar** on December 9, 2015.

3. Ashok Mishra. 2016. Alu Amala, Sangrakshyanao' Bikribata (Potato harvest, storage and marketing) at **DDK**, Bhubaneswar on February 9, 2016.

CHHINDWARA

1. DN Nandekar, Radio talk on "Post harvest technology in potato on December 12, 2015 & record December 17, 2015.

2. DN Nandekar, Radio talk on "Potato crop save from frost in January 4, 2016 &record January 06, 2016.

DHOLI

1. LM Yadav, Aaloo kee vai gyanik kheti recording on November 12, 2015 ETV, Bihar

2. LM Yadav, Aaloo evam Makkakee Mishrit-kheti ka p rabandhan. recording on January 09,2016 ETV, Bihar

3. DK Dwivedi, Ageti Aloo ki vaigyanik kheti-recording on October 03, 2015 E.T.V., Bihar

4. DK Dwivedi, Jaivik Aloo ki kheti. recording on October 16, 2015, Doordarshan.

5. DK Dwivedi, Rabi Karmshala Aloo, Dalhan, Telhan Prashikshan-held on November 15, 2015 Organized by Krishi Vigyan Kendra, Samastipur.

HISAR

1. AK Bhatia. 2015. *Sabjion Kautpadan*. Phone in prog. Broadcasted by All India Radio, Rohtak.

2. AK Bhatia. 2015. *Poly house Me Sabjion Ka ut padan Aur Allu Ka Beej Utpadan*. Phone in prog. Broadcasted by All India Radio, Hisar.

3. AK Bhatia. 2015. Alloo *Ka utpadan*. Phone in prog. Broadcasted by All India Radio, Hisar.

4. AK Bhatia. 2015. *Sabjion Phaslo Ki Dekhbhal*. Phone in prog. Broadcasted by All India Radio, Hisar.
5. AK Bhatia. 2015. Potato cultivation Broadcasted by All India Radio, Hisar.
6. AK Bhatia. 2015. Potato cultivation Broadcasted by Doordarshan, Hisar
7. VPS Panghal. 2015. Batacheet - Aalu Ki Kast Va Savdhania. Radio talk delivered at AIR Rohtak on October 5, 2015.

HASSAN

1. Vishnuvardhana, "Precautionary measures of Potato cultivation"at AIR, Hassan on 29.04.15
2. Vishnuvardhana, "Research activities on Potato at HRES, Hassan" at AIR, Hassan on29.04.15
3. Vishnuvardhana "Late blight disease management" at AIR, Hassan on24.06.2015
4. Vishnuvardhana, Dr PS Prasad, and Mrs Soumya Shetty"Late blight disease management" at TV-9 news channel on 29.06.15
5. Vishnuvardhana, "Importance of seed treatment before Potato tuber planting" at Chandana TV on 10.10.15
6. Vishnuvardhana, "Production technology of Potato and varieties" at Chandana TV on 11.10.15

JORHAT

1. MK Saikia. "Sit kalinpasolir rog niantranvyavastha" AIR Jorhat on Nov 18. 2016

KALYANI

1. A Chakraborty delivered lecture at Akash Bani (AIR-A) at 10.15 PM on Zelatheke Zelaprogramme on the topic "Jyoti Alur Bikalpa Kufri Himalini".

MODIPURAM

1. VK Gupta. ALLO MEIN SAMYIK KARYA''under "HELLOKISAN" programmeat CPC, Door Darshan Khel Gaon, New Delhi on September 30, 2015 at 6.00 to 7.00 PM
2. VK Gupta. "ALLO KI DEKHBHAL" under "HELLOKISAN" under "HELLOKISAN" programme atCPC, Door Darshan Khel Gaon, New Delhi on December 30, 2015 at 6.00 to 7.00 PM
3. VK Gupta. 'ALLO KI KHUDAI AUR RAKHRKHAO' under "HELLOKISAN" programmeat CPC, Door Darshan Khel Gaon, New Delhi on January 27, 2016 at 6.00 to 7.00 PM

PANTNAGAR

1. RP Singh. "Älu, tamatormaijhulsa rog key karanavamroktham" at Communication Directorate, Pantnagar on October 15,2015.
2. M Raghav. "Alukiphasalmai honey wale sam- samaiakkarya" at Communication Directorate, Pantnagar on November 14,2015.
3. M Raghav. "Alukikhariphasal-kidekhbhal"at Communication Directorate, Pantnagar on December 10,2015.
4. Released four warning for Late Blight of Potato through Pantnagar Janwani and Local newspapers.

(G) CONFERENCES/SYMPOSIA/ WORKSHOP / TRAINING ATTENDED

SHIMLA

1. Training on Biosafety in Confined field trials-II organized by Ministry of

Environment & Forestry, during May24-26, 2015 at New Delhi (3 days)was attended by Raja Shankar

2. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September19-21, 2015 at GBPUA & T, Pantnagar was attended by Raja Shankar

BHUBANEWAR

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA&T, Pantnagar was attended bywas attended by Ashok Mishra and D Ghosal.
2. National Seminar on "Plant Genomics and Bio-technology: Challenges and opportunities" held at OUA & T, Bhubaneswar from January 23-24, 2016 was attended by Ashok Mishra and D Ghosal.
3. National Seminar on "Horticultural Diversity for Prosperity" held at OUAT, Bhubaneswar from 10-12 February, 2016 was attended by D Ghosal.
4. Meeting on "Sustainable intensification of potato in rice-based systems of Odisha for increasing productivity & profitability" in the Committee Room of the Principal Secretary (Agriculture), Govt. of Odisha on February 16, 2016 was attended by Ashok Mishra.

CHHINDWARA

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA&T, Pantnagar was attended by Dr SN Singh and DN Nandekar

DEESA

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA & T, Pantnagar was attended byRN Patel, SK Chongtham and JK Patel.

DHOLI

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA&T, Pantnagar was attended byLM Yadav, DK Dwivedi and Birender Singh.

FAIZABAD

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA &T, Pantnagar was attended by SP Pathak

GWALIOR

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA & T, Pantnagar was attended by S Roy and SP Singh.

HASSAN

1. Participated as SMS in training programme organized by KVK, Kandali on August 18, 2015. Discussion about Diseases of Potato and its control measures by PS Prasad.
2. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA &T, Pantnagar was attended by Vishnuvardhana and PS Prasad
3. Participated as SMS in training programme organized by KVK, Kandali on November 18, 2015. Discussion on disease management in Potato was carried out by PS Prasad.
4. District level Seminar on "Vegetable seed

production" held at KVK, Kandali on December 14, 2015 was attended by Vishnuvardhana

5. National Symposium on "Recent Trends in Plant Pathological Research and Education" held on January 05-06, 2016 at UAS Raichur was attended by PS Prasad.

HISAR

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA&T, Pantnagar was attended by AK Bhatia
2. Agricultural Officers Workshop – Rabi 2015 organized by Directorate of Extension Education at CCS HAU, Hisar attended by AK Bhatia and VPS Panghal.
3. Agricultural Officers Workshop – Kharif 2015 organized by the Directorate of Extension Education at CCS HAU, Hisar attended by AK Bhatia and VPS Panghal.
4. The Training & Visit monthly workshop for the month of Dec.,2015 for Extension functionaries organized by Regional Research Station, Rohtak, CCS HAU, Hisar participated as Resource person by AK Bhatia
5. 2nd International Conference on Agriculture, Horticulture and Plant Science held at Shimla from 26-28 December 26-28, 2015 attended by VPS Panghal.
6. The Training & Visit monthly workshop for the month of Jan.,2016 for Extension functionaries organized by Regional Research Station, Rohtak, CCS HAU, Hisar participated as Resource person by VPS Panghal.

JALANDHAR

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA & T, Pantnagar was attended by JS Minhas, Raj Kumar and Prince.

JORHAT

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA & T, Pantnagar was attended by PC Bhagawati, Z Ullah and MK Saikia.

KALYANI

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA&T, Pantnagar was attended by Ashis Chakraborty, A Sarkar and SK Das
2. 21 days winter school training on "Advances in organic production system and conservation agriculture" sponsored by ICAR was attended by Sanjib Kumar Das at AAU, Jorhat, Assam on 24.09.2015 to 14.10.2015.
3. National Seminar on "Sustainable Agriculture for food security and better environment *(SAFSBE)"* was attended by SK Das & A Sarkar at FACC, BCKV, Kalyani, Nadia, WB, during December 17-18, 2015.

KOTA

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA&T, Pantnagar was attended by SK Trivedi.

MODIPURAM

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at

GBPUA & T, Pantnagar was attended by SK Luthra, Kamlish Malik and VK Gupta.

2. Indo-German Bilateral Co-operation on seed sector and Joint workshop organized by PPVFRA and ICAR on DUS testing held at IARI, New Delhi was attended by VK Gupta.

PANTNAGAR

1. 6th International conference on "Plant Pathogens and People Challenges in Plant Pathology to benefit Humankind" is being organized by Indian Phytopathological Society at IARI, New Delhi from February 23-27. 2016.

2. 36th Annual Conference and National Symposium on "Challenges and Management Approaches for the Crop Disease of National Importance – Status and Prospects" organized by Indian Society of Mycology and Plant Pathology with TNAU, Madurai, Tamil Nadu from 12 – 14 February, 2015.

3. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA & T, Pantnagar was attended by M Raghav, RP Singh and Dhirendra Singh.

4. Attended national conference on Hill Agriculture in Perspective (HAP-2016) organized by Directorate of Experiment Station, GBPUAT, Pantnagar from February 26-28, 2016 at Pantnagar by M Raghav, RP Singh and Dhirendra Singh.

PASIGHAT

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA & T, Pantnagar was attended by RK Dubey

2. Attended National Conference on Horticulture in North Eastern Region from January16-18,2016 held at CHF, Pasighat was attended by SD Warade and RK Dubey.

PUNE

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA & T, Pantnagar was attended byMR Deshmukh and SA More

2. Attended ZREAC, Meeting kharif 2015 at Shirname Hall, AC, Pune on 24.6.2015 by MR Deshmukh and SA More

3. Attended the meeting of Joint Agresco at MPKV, Rahuri from May 27-30, 2015 by SA More

4. Attended the meeting on tribal sub plan under the chairmanship of Director of Research, MPKV, RahuriJuly 08, 2015 by SA More.

5. Attended Pre RRC meeting of Entomology under the chairmanship of Head, Department of Agril. Entomology, MPKV, Rahuri from January 07, 2016 by SA More

6. Attended the meeting 7thVegnet Monitoring Committee on Control of insect pests and diseases on export quality Vegetables under the chairmanship of Agril. Commissioner, M Sat MSAEC, Pune from February 15, 2016 by SA More

7. Attended the Research Planning meeting in Horticulture at MPKV, Rahuri under the chairmanship of Director of Research, MPKV, Rahuri. from march 10, 2016 by MR Deshmukh

8. Worked as an Officer for the successful implementation of TSP of Fig and CA, Jadhawadi at Bhagdari Tal. Akkalkuwa Dist.

Nandurbar from Feb and March 16.

PATNA

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA&T, Pantnagar was attended by Manoj Kumar, Shambhu Kumar, SK Singh and Rahul Bakade

RAIPUR

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA & T, Pantnagar was attended by PK Joshi and PK Sharma

SRINAGAR

1. 33nd Group meeting of AICRP (Potato) and Panel Discussion on Potato Breeding-Way Forward during September 19-21, 2015 at GBPUA &T, Pantnagar was attended by SH Khan and Faheema Mustaq

(H) PAPER PRESENTED IN CONFERENCES /SYMPOSIA/ SEMINARS/ OTHER FORUM

BHUBANEWAR

1. Ashok Mishra attended National Seminar on "Plant Genomics and Bio- technology: Challenges and opportunities" held at Orissa University of Agriculture & Technology, Bhubaneswar from January 23-24, 2016 and presented a paper on "Effect of pre and post maturity harvest on baby potato yield in the east coastal region of Odisha" authored by PC Satpathy, AMishra, D Ghosal and AK Mohanty.

CHHINDWARA

1. SN Singh, DN Nandekar, B Choudhary, and S Bakode, "Influence of Weatherparameters and different cultures on occurrence different Diseases &pests of potato" Forth National Symposium on "Transforming Indian Agriculture towards food and nutritional security" organized by The Society of Agricultural Professionals held at JSAVA & T, Kanpur (UP) on dated February 20-21, 2016.
2. DN Nandekar, B Choudhary and S Bakode,"Effect of planting dates and varieties on yield of potato in variability of weather parameters" Forth National Symposium on "Transforming Indian Agriculture towards food and nutritional security "organized by The Society of Agricultural Professionals held at JSAVA & T, Kanpur (UP) on dated February 20-21, 2016.
3. DN Nandekar, B Choudhary and S Bakode, "Studies on Nitrogen requirement of Variety K Surya with reference to Madhya Pradesh" National Conference on "Transforming Indian Agriculture towards food and nutritional on Global Research initiatives for sustainable Agriculture & allied sciences December12-13, 2015 held at RVSKVV, Gwalior (MP) page no.65-66.
4. DN Nandekar, B Choudhary and S Bakode, "Effect of different levels of NPK on yield of processing cultivar Kufri Chipsona-3 in Satpura Zone of MP" National Conference on "Transforming Indian Agriculture towards food and nutritional on Global research initiatives for sustainable Agriculture & allied sciences December 12-13, 2015 held at RVSKVV, Gwalior (MP) page no. 65-66.

HASSAN

1. PS Prasad, Vishnuvardhana, and Soumya Shetty 2016. "Management of late blight of potato incited by *Phytophthora in festans*"

presented in National Symposium on "Recent Trends in Plant Pathological Research and Education" held at UAS Raichur on January 5-6, 2016

HISAR

1. VPS Panghal attended 2nd International Conference on Agriculture, Horticulture and Plant Science held at Shimla from 26-28 December, 2015 and presented paper on "Response of garlic to foliar application of micro-nutrients".

KANPUR

1. AK Yadav, SS Yadav, Ramesh Singh. UC Mishra, NA Ansari, PK Yadav, Sandeep Singh and Alok Yadav, Studies of different germplasm of storage behavior at the room temperature of potato (*Solanum tuberosum*) pages-251. 4th Uttar Pradesh Agricultural Science Congress, March 02-04,2016 at the CSAUA &T, Kanpur .

KALYANI

1. A Chakraborty attended National Seminar on "Sustainable Agriculture for food security and better environment *(SAFSBE)"* at FACC, BCKV, Kalyani, Nadia, WB during December 17-18, 2015and presented a paper on "Studies on effect of different nitrogen and phosphorus combinations on potato early blight".
2. SK Das attended National Seminar on "Sustainable Agriculture for food security and better environment *(SAFSBE)"* at FACC, BCKV, Kalyani, Nadia, WB during December 17-18, 2015 and presented a paper on "Chemical weed management in pea".
3. A Sarkar attended National Seminar on "Sustainable Agriculture for food security and better environment *(SAFSBE)"* at FACC, BCKV, Kalyani, Nadia, WB during December 17-18, 2015and presented a paper on "Effect of planting dates on the incidence of whitefly, *Bemisia tabaci* Genn. on potato in eastern Gangetic plains of West Bengal".

MODIPURAM

1. SK Luthra and VK Gupta**.** 2016. National symposium on genomics & molecular breeding and Alumni meet 28-29 March, 2016 at CCS, Meerut. Dr Luthra Presented a paper on 'Breeding potatoes for food security'.

PANTNAGAR

1. RP Singh attended 6th International conference on. "Plant Pathogens and People Challenges in Plant Pathology to benefit Humankind" organized by Indian Phytopathological Society at IARI, New Delhi from Feb 23-27. 2016. presented a paper on "Adoption of farm technologies in Hill and Mountain Agro-ecosystem: Implications for Research Institutions".
2. U C Sati and M Raghav attended National conference on "Hill Agriculture in Perspective"(HAP-2016)organized by Directorate of Experiment Station, GBPUAT, Pantnagar from February26-28, 2016 and presented a paper on "Effect of different doses and method of potassium application on growth and yield of potato (*Solanum tuberosum* L.)".
3. Kailash Sati, M Raghav, Pooja Pandey, UC Sati and Lavesh attended National conference on "Hill Agriculture in Perspective"(HAP-2016)organized by Directorate of Experiment Station, GBPUAT, Pantnagar from February26-28, 2016 and presented a paper on "Role of zinc application on growth, yield and quality of potato (*Solanum tuberosum* L.) under footholls of Uttarakhand".

4. Pooja Pandey, M Raghav and Kailash Sati attended National conference on "Hill Agriculture in Perspective"(HAP-2016)organized by Directorate of Experiment Station, GBPUAT, Pantnagar from February26-28, 2016 and presented a paper on "Foliar feeding of urea in potato (*Solanum tuberosum* L.)".

PASIGHAT

1. Shiv Mangal Singh, RKDubey, KatonKartek and BP Mishra presented paper entitled 'Studies on Variability Components and genetic parameters in Potato (*S. tuberosum* L.) under Foot hills of Arunachal Pradesh' during National Conference on Horticulture in North Eastern Region from January 16-18,2016 held at CHF Pasighat.

2. Nellisha Ngourw Moyon, RK Dubey, Kanton Kartek and BP Mishra presented paper entitled 'Stability analysis for tuber yield and its components in Potato (*S. tuberosum* L.) during National Conference on Horticulture in North Eastern Region from January 16-18, 2016 held at CHF Pasighat.

(I) STUDENTS GUIDED

Name of the centre	Name of the student	Title of thesis	Degree	Name of the University
Bhubaneshwar	Miss Monalisa Jena	Genetic diversity among heat tolerant Potato genotypes for morpho-physiological traits	MSc	OUA&T, Bhubaneshwar
	Mr Debasis Martha	Response of Potato cultivar K. Ashoka as influenced by graded levels of Potassium	MSc	
	Miss Aiswariya Panda	Effect of zinc on tuber yield and quality of Potato	MSc	
Gwalior	Mr Dharmendra Gaur	Optimization of phosphorous requirement of potato (*Solanum tuberosum* L) through organic and inorganic sources under current scenario of P use by farmers	MSc	RVSKVV, Gwalior
	Mr Kamlesh Patel	Evaluation of potato (*Solanum tuberosum* L) varieties for growth, yield and quality in Grid region of Madhya Pradesh	MSc	RVSKVV, Gwalior

Hisar	Mr Udayvir	Effect of crop residue incorporation, organic manures and bio - fertilizer on potato production	MSc	HAU, Hisar
	Mr Devashri Mann	Effect of irrigation methods and different nitrogen levels on growth and yield ofpotato.	PhD	
	Mr Mohamad Taha	Effect of Nitrogen Source on Production and shelf life of potato	PhD	
Jorhat	Miss Roji Chutia	Integrated nutrient management in potato grown by TPS tuberlet and its residual effect on summer green gram	MSc	AAU, Jorhat
	Mr Manash Jyoti	Scheduling of copper fungicide against late blight under organic potato cultivation	MSc	
Kalyani	Mr. Dibakar Panda	Management of early blight of Potato by using non - conventional chemicals.	MSc	BCKV, Kalyani
	Mr Biswajit Lenka	Effect of Boron and Zinc on productivity and quality of Potato.	MSc	
	Mr Akshay Sardar	Overview of late blight of potato with special reference to pathogenecity, variability, host pathogen interaction and management.	PhD	
Pantnagar	Mr Lavlesh	Effect of manual and chemical methods of weed management on potato (*Solanum tuberosum* L.)	MSc	GBPUA&T, Pantnagar
	Mr Kailesh Sati	Effect of zinc sulphate application on growth, yield and quality of potato (*Solanum tuberosum* L.)	PhD	
Pune	Mr Hamelpure Anand	Management of sucking pests complex on potato (*Solanum tuberosum* L.)	MSc	MPKV, Rahuri
	Mr Nitin Prakashrao Lunge	Response of potato tuber moth (*phthorimaeaoperculalla* (zeller) to different potato varieties and its management	MSc	

FINANCIAL STATEMENT FOR THE YEAR 2015-16

(Rs in lakhs)

Name of Centre	Head wise RE allocation (ICAR 75% share)						
	Pay & allowances	TA	Recurring Contingency		TSP	Works	Total
			Research	Operational			
Bhubaneshwar	29.60	0.40	2.00				32.00
Chhindwara*	34.54	0.30	2.00		1.78		38.62
Deesa	19.70	0.30	2.00				22.00
Dharwad	7.70	0.30	2.00				10.00
Dholi	34.70	0.30	2.00				37.00
Faizabad	29.91	0.30	2.00				32.21
Hassan	21.22	0.40	2.00				23.62
Hisar	42.70	0.30	2.00				45.00
Jorhat	69.92	1.00	2.50				73.42
Kalyani	36.29	0.40	2.00				38.69
Kanpur	20.45	0.30	2.00	5.25			28.00
Kota	31.64	0.30	2.50				34.44
Pantnagar	39.70	0.30	2.00				42.00
Passighat**	7.50	0.50	2.50	7.50		15.00	33.00
Pune	12.45	0.30	2.00	5.25			20.00
Raipur	27.38	0.40	2.00		3.22		33.00
Srinagar	29.60	0.40	2.00				32.00
Total	**495.00**	**6.50**	**35.50**	**18.00**	**5.00**	**15.00**	**575.00**

* The RE allocation for Chhindwara under TSP may be used for AICRP field trials as well as demonstration, training and other activities.
** 100 % ICAR Share

Plan BE 2015-16 (ICAR Share)	**:**	**Rs 740.00 Lakhs**
Plan RE 2015-16 (ICAR Share)	:	**Rs 575.00 Lakhs**

LIST OF SCIENTISTS ASSOCIATED WITH AICRP (POTATO) AS ON 31.03.2016

Name	Designation	Discipline
PROJECT HEADQUARTER (CPRI, SHIMLA)		
Dr PM Govindakrishnan	Project Coordinator	Agronomy
Dr Raja Shankar	Sr Scientist	Vegetable Science
CENTRAL POTATO RESEARCH INSTITUTE BASED CENTERS		
Central Potato Research Institute, Shimla-171 001 (HP)		
Dr VK Dua*	Head, Division of Crop Production	Agronomy
Dr Vinay Bhardwaj*	Actg. Head, Div. of Crop Improvement	Genetics and Cytogenesis
Dr Sanjeev Sharma*	Actg. Head, Division of Crop Protection	Plant Pathology
Central Potato Research Institute Campus, Modipuram-250 110 (Uttar Pradesh)		
Dr Devender Kumar	Actg. Joint Director	Physiology
Dr (Mrs.) Kamlesh Malik	Principal Scientist	Entomology
Dr Sanjay Rawal	Principal Scientist	Agronomy
Dr VK Gupta	Senior Scientist	Plant Breeding
Central Potato Research Station, Post Box No.4, Morar, Gwalior- 474 006 (Madhya Pradesh)		
Dr Satyajit Roy	PS & Head	
Dr SP Singh	Principal Scientist	Agronomy
Dr Murlidhar Sadawarti	Scientist (SS)	Seed Technology
Central Potato Research Station, PO Model Town, PB No.1,Jalandhar 143 001 (Punjab)		
Dr JS Minhas	PS & Head	Physiology & Bio chemistry
Dr Raj Kumar	Principal Scientist	Plant Breeding
Central Potato Research Station, PO Sahaynagar, Patna-801 506 (Bihar)		
Dr Manoj Kumar	PS & Head	Soil Science
Dr Shambhu Kumar	Principal Scientist	Plant Breeding
Dr SK Yadav	Scientist	Agronomy
Sh Rahul R Bakade	Scientist	Plant Pathology
Central Potato Research Station, Shillong-793 009 (Meghalaya)		
Dr TK Bag	PS & Head	Plant Plant Pathology
Dr Clarissa Challam	Scientist	Bio technology

Central Potato Research Station, PO Muthorai-643 004 (Tamil Nadu)		
Dr EP Venkatsalam	Acting Head	Seed Technology
Dr R Sudha	Scientist	Horticulture
Dr Divya K Laxmanan	Scientist	Vegetable Science
Central Potato Research Station, Kufri, Shimla-171 012 (HP)		
Dr Vinod Kumar	Principal Scientist & Actg. Head	Plant Breeding
SAU BASED CENTERS		
AICRP on Potato, Research Wing, Orissa University of Agriculture & Technology, Adminis trative Building, Bhubaneshwar-751 003 (Odisha)		
Dr AK Mishra	Breeder	Plant Breeding
Mr Debasis Ghosal	Jr. Agronomist	Agronomy
Regional Agricultural Research Station, Jawaharlal Nehru Krishi Vishwavidyalya Chandangaon, Chhindwara-480 001 (Madhya Pradesh)		
Dr SN Singh	Principal Scientist	Horticulture
Dr DN Nandekar	Senior Scientist	Agronomy
Potato Research Station, Sardar Krushinagar Dantiwada Agricultural University, Deesa -385 535, Banaskantha (Gujarat)		
Dr RN Patel	Research Scientist	Plant Breeding
Dr Sunil Kumar Chongtham	Assistant Research Scientist	Agronomy
Sh JK Patel	Assistant Research Scientist	Plant Pathology
AICRP on Potato, Division of Horticulture, MARS, University of Agricultural Sciences, Dharwad-580 005 (Karnataka)		
Dr PR Dharmatti	Professor	Horticulture
Department of Horticulture, Trihut College of Agriculture, Rajendra Agricultural University Campus, Dholi-843 121, District Muzaffarpur (Bihar)		
Dr Lal Mani Yadav	Chief Scientist	Horticulture
Dr Birendra Kumar	Senior Scientist	Plant Pathology
Dr DK Diwedi	Senior Scientist	Agronomy
Mrs Pramila	Jr. Horticulturist	Horticulture
Division of Vegetable Crops, ND University of Agricultural & Technology, Narendra Nagar, PO Kumarganj, Faizabad-224 229 (Uttar Pradesh)		
Dr SP Pathak	Professor	Plant Pathology
Agricultural Research Station, Madenur, District Hassan-573 220 (Karnataka)		
Dr Vishnu Vardhana	Associate Professor	Horticulture
Dr PS Prasad	Assistant Professor	Plant Pathology

Department of Vegetable Sciences, CCS Haryana Agricultural University, Hisar - 125 004 (Haryana)		
Dr AK Bhatia	Principal Scientist	Plant Breeding
Dr Anil Gupta	Sr. Scientist	Plant Pathology
Dr VPS Panghal	Scientist	Agronomy
Department of Agronomy, Assam Agricultural University, Jorhat- 785 013 (Assam)		
Dr Promod C Bhagawati	Principal Scientist	Agronomy
Dr Md Zafar Ullah	Principal Scientist	Plant Breeding
Dr Mitul Kumar Saikia	Senior Scientist	Plant Pathology
Research Complex Building, BC Krishi Vishwavidyalaya, Kalyani -741 235 (Nadia) West Bengal		
Dr Ashis Chakraborty	Associate Professor	Plant Pathology
Dr Arnab Sarkar	Assistant Professor	Agronomy
Dr SK Das	Assistant Professor	Breeding
Department of Vegetable Science, CSA University of Agriculture & Technology, Kanpur - 208021 (UP)		
Dr Ramesh Singh	Jr. Virologist	Plant Pathology
Dr UC Mishra	Jr. Agronomist	Agronomy
Agricultural Research Station (MPUA&T), Umedganj Farm, PB No. 7, GPO Nayapura, Kaithoon Road, Kota-324 001 (Rajasthan)		
Dr SK Trivedi	Professor	Horticulture
Dr Ved Prakash Gupta	Associate Professor	Plant Pathology
Division of Vegetable Sciences, GB Pant University of Agriculture & Technology, Udham Singh Nagar, Pantnagar-263 145 (Uttarakhand)		
Dr Manoj Raghav	Professor	Agronomy
College of Horticulture & Forestry, Central Agricultural University, Pasighat - 791102 (Arunchal Pradesh)		
Dr SD Warade	Assistant Professor	
AICRP on Potato, National Agricultural Research Project, Ganeshkhind, Pune - 411007 (Maharashtra)		
Dr MR Deshmukh	Assistant Professor	Horticulture
Dr SA More	Assistant Professor	Entomology
Division of Plant Breeding and Genetics, GE Road, IG Krishi Vishwa Vidyalaya, Raipur - 492 012 (Chhattisgarh)		
Dr PK Joshi	Senior Scientist	Plant Breeding
Dr Parveen Kumar Sharma	Scientist	Agronomy

Division of Olericulture, Sher - e- Kashmir University Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar -191 121 (Jammu & Kashmir)		
Dr SH Khan	Associate Professor	Plant Breeding
Dr Faheema Mushtaq	Assistant Professor	Agronomy
SAU BASED VOLUNTARY CENTER		
Division of Vegetable Sciences, GB Pant University of Agriculture & Technology (Hill campus), Ranichauri-249 199 (Uttarakhand)		
Dr Akhilesh Chand Mishra	Associate Professor	Horticulture

Printed at : Azad Offset Printers, 144, Press Site, Ind. Area-1, Chandigarh
9814011543, 9814111543, 9914111543