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Prospect of Early Planting of Potato Seed Crop in Central India

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ABSTRACT

A field experiment was conducted to study the prospect of early planting (5th October) in relation to present planting time (20th October) with four popular cultivars *viz*. Kufri Lauvkar, Kufri Chandramukhi, Kufri Chipsona-1 and Kufri Sindhuri grown under Gwalior region of central India for seed production. Days to first emergence was delayed by 5 days in early planting (5th October) than normal planting (20th October). Significantly higher yield (28.73 t/ha) was recorded in normal planting (20th October) over early planting (5th October). Water use efficiency was significantly higher in normal planting (114.92 kg/ha-mm) over early planting (59.65 kg/ha-mm). Higher incidence of insect-vectors i.e. thrips and whiteflies and necrosis disease were observed in 5th October planted crop than 20th October planted crop. Hence planting of potato as seed crop in Gwalior region of central India cannot be recommended before 20th October. It needs further refinement of planting date after the 20th October.

Keywords: Early planting, Insect-pest, Seed production, Stem necrosis

INTRODUCTION

Potato is grown in many parts of North-Central and North-Western plains of India as early and main crop. However, potato as a seed crop is grown only in main crop season during October-March under low insect-vector activity, resulting in almost no incidence of viral diseases. Potato being a vegetative propagated is subjected to attack by a large number of diseases and insect-pests, resulting in deterioration of quality seed production. Seed quality is very important, but there are a number of other factors that also influence seed performance. Germination and plant development are greatly affected by environmental factors such as temperature, rainfall and sunlight, which are not controlled by growers. One of the most important grower controlled factors is the decision on when to plant (Thornton and Nolte 2005).

The growth cycle of potato can be roughly divided into five stages; sprout development, vegetative growth, tuber initiation, tuber bulking and maturation. Growth and quality of potato is influenced by environmental factors such as temperature, moisture, light, soil type and nutrients. Many factors such as length of growing season, air and soil temperatures, light intensity and duration, humidity and wind influencing potato growth are largely uncontrollable. Other factors that influence growth of the crop can be managed by the growers *viz.* variety of potato, size of mother seed tubers, planting operation, plant stand, stem population, moisture, nutrition, disease and insect pest management, planting date and harvest dates. Since tuber initiation occurs early in the season, optimum soil temperature (16-19°C) is needed, while tuber development requires temperature of 20°C. Yields are highest when average daytime temperatures are about 21°C (Khan et al. 2011).

Every production region has an "optimum" planting window during which climatic conditions are most favorable for producing the highest potential yield in a given season. Planting before optimum window tends to reduce yields by exposing the crop to abiotic and biotic stresses, such as unfavorable soil conditions and insect vectors particularly thrips and whiteflies which tend

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to reduce yield. Likewise, planting after the optimum window also reduces potential yield by reducing the days available for plant growth and tuber bulking (Thornton and Nolte 2005). Length of the bulking period can be increased by advancing planting by few days, which may increase their potential yields. Stress during early bulking has been strongly associated with defects such as sugar ends. Early planting of mini-tubers causes the plant infection and perhaps the uncommon decrease of their seed class (Hassanpanah et al. 2009).

Thrips (*Thrips palmi*) and whitefly *(Bemisia tabaci*) are important vectors of stem necrosis and apical leaf curl virus disease respectively in potato crop (Bhatnagar 2007 and 2008). With the increasing temperature due to global climate change, the incidence of insect-pests and diseases is expected to increase on potato. As the Central India is fit for quality breeder seed production due to low vector activity from October to December, earlier recommendation of seed crop was for planting from 20th October to 5th November in the central India (Anonymous 2011). However,it was thought to conduct a field experiment and evaluate the possibilities of advancing planting of potato seed crop under Gwalior region of central India without compromising health standards.

MATERIALS AND METHODS

A field trial was conducted at Central Potato Research Station, Gwalior during 2011-12 under two date of planting 5th October (Early) and 20th October (Normal) with four popular cultivar of the region i.e. Kufri Lauvkar, Kufri Chandramukhi (Early maturing), Kufri Chipsona-1 (Medium maturing) and Kufri Sindhuri (Late maturing) which are largely grown for seed production at the station.

The experiment was conducted in a split plot design with date of planting as main plots and cultivars as subplots and replicated thrice. Recommended doses of fertilizers for seed crop @ 150 kg N, 80 kg P and 100 kg K/ha was applied. Half of N and full P and K were placed in bands below seed tubers at the time of planting and remaining half dose of N @75 kg/ha at the time of earthing up. A total of 7 and 5 irrigations of 50 mm each were applied to early and normal planted crop respectively.

Observations on plant emergence, plant height, number of shoots and leaves per plant were recorded at 45 days after planting (DAP). Haulm killing was done after 80 days of planting. Water use efficiency (WUE) was also worked out using following formula (Reddy and Reddi 2002).

$$WUE = \frac{\text{Tuber yield kg/ha}}{\text{Water applied through irrigation (mm)}}$$

The population of thrips was recorded from the top portion of potato plants by shaking plant on white paper fixed on cardboard (20 x 20 cm) at weekly interval on 10 randomly selected plants. Similarly, whitefly population was also recorded on 10 randomly selected plants from upper, middle and lower leaves after appearance of whitefly population. The population of thrips and whitefly were separated with the help of zero number brush and preserved in a mixture of 10 parts of 60% ethyl alcohol + one part of glycerin + one part of acetic acid. The incidence of insect-pest was recorded in succession till the physiological maturity of the crop. The stem necrosis incidence (%) was also recorded from total and diseased plants when crop was 60 and 70 days old.

RESULTS AND DISCUSSION

Growth attributing parameters

Among the varieties, days to first emergence were significantly higher (11 days) in all the three varieties over Kufri Chipsona-1 (10 days). There was no significant difference as far as emergence was concerned. In case of number of stems per plant, Kufri Chipsona-1 recorded highest stems/ plant (5.3) which was significantly higher over Kufri Lauvkar (3.5). Plant height in Kufri Sindhuri (94 cm) and Kufri Chipsona-1 (75 cm) was significantly higher over Kufri Lauvkar (60 cm). Compound leaves/plant of Kufri Chipsona-1 (126) was significantly higher over Kufri Lauvkar (94). Days to first emergence was significantly delayed in case of early planting (13 days) than normal planting (8 days). For all other parameters like germination percent, plant height, number of stems and compound leaves, there was non-significant difference among early planting and normal planting (Table 1). However the interaction effect

of varieties and planting date was significant for most of the growth attributing parameters except compound leaves per plant.

Yield attributing parameters

Among varieties, Kufri Sindhuri recorded significantly higher total tubers number over other varieties, but in case of weight/plant, no significant difference was recorded among the varieties (Table 1). Normal planting (20th October) recorded non significant but higher tuber number as well as weight per plant over early planting (5th October) (Table 1).

Among varieties, tuber number per hectare was highest in Kufri Sindhuri (301 thousand, 316 thousand and 670 thousand/ha) in <25g, 25-125g and total tuber category, respectively. Tuber yield (t/ha) of Kufri Sindhuri was also significantly higher in all category over other varieties (Table 2).

Normal planting (20th October) recorded significantly higher tuber number over early planting (5th October) in 25-125g tuber category. For other category and total tuber number, the difference was non significant. Seed production in different category *viz.* <25g, 25-125g and >125g were statistically on par though higher in normal planting than early planting. Normal planting recorded significantly higher total tuber yield (28.73 t/ha) over early planting (19.39 t/ha) (Table 2). Performance of K. Sindhuri in terms of total yield was significantly higher (29.54 t/ha) over all other varieties on 20th October planting as campared to early planting. Ezikel (1997) reported that higher temperature during the growth of the seed crop (16th September planting date) caused 15-19% reduction in the yielding ability of progeny tubers compared with lower temperature (in 3rd November planting date) at Modipuram, Uttar Pradesh.

Water use efficiency:

Normal planting (20th October) recorded higher WUE (114.92 kg/ha-mm) where 5 irrigations were applied over early planting (5th October) (59.65 kg/ha-mm) in which 7 irrigations were applied. Recent investigation reported that water use efficiency was 210 kg/ha-mm in control (irrigation at critical stages) as compared to irrigation scheduling at 20 CPE (105 kg/ha-mm) where 8 irrigations were applied (Sadawarti et al. 2013). Among varieties Kufri Sindhuri recorded significantly higher WUE (107.44 kg/ha-mm) over other three cultivars (Table 2).

Insect-pest and diseases incidence:

Thrips and whitefly caused severe damage to potato crop by sucking the sap directly from the tender parts of potato plant and transmitting important viruses like groundnut bud necrosis and apical leaf curl, respectively (Bhatnagar 2007;

Table 1: Effect of date of planting and varieties on growth and yield attributing parameters and yield in potato breeder seed crop

Parameters	Yield attributing parameters					Number of tubers/plant				Wt of tubers/plant (g)			
	Days to first emergence	Emergence (%)	Stem / plant	Plant height (cm)	Compound leaves / plant	< 25 tuber	25-125	>125 g	Total	< 25 tuber	25-125	>125 g	Total
Kufri Lauvkar	11	92.86	3.5	60	94	4.1	6.6	0.7	11.4	38	396	143	577
Kufri Sindhuri	11	94.41	4.8	94	122	8.5	9.9	0.6	19.0	71	541	99	711
Kufri Chandramukhi	11	95.00	4.0	69	98	3.7	5.7	1.2	10.5	33	363	202	597
Kufri Chipsona-1	10	94.52	5.3	75	126	4.2	7.9	0.2	12.3	49	440	40	528
CD (0.05)	0.75	NS	1.70	9.2	31.7	4.61	3.34	0.71	6.28	NS	165.7	136.7	NS
5th Oct. (Early planting)	13	93.16	4.3	76	127	5.4	6.2	0.6	12.2	44	340	95	479
20th Oct. (Normal planting)	8	95.24	4.6	73	93	4.8	8.9	0.7	14.4	51	530	147	727
CD (0.05)	0.62	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction (Varieties x date of planting)	0.28	4.89	0.91	13.9	NS	4.66	3.56	0.28	8.99	NS	NS	NS	NS

Table 2: Effect of date of planting and varieties on yield in potato breeder seed crop

Parameters	No. of tubers (000/ha)				Yield of tubers (t/ha)				Water Use Efficiency (Kg/ha- mm)
	< 25	25-125	>125g	Total	< 25	25-125	>125g	Total	
Kufri Lauvkar	125	206	41	371	1.44	13.77	5.43	20.64	75.08
Kufri Sindhuri	301	316	53	670	4.05	17.64	7.85	29.54	107.44
Kufri Chandramukhi	134	207	38	379	1.93	15.11	6.63	23.66	85.41
Kufri Chipsona-1	238	270	35	543	3.29	14.71	4.40	22.39	81.21
CD (0.05)	**80.4**	**49.8**	**NS**	**94.5**	**1.43**	**3.77**	**3.34**	**3.78**	**12.56**
5th Oct. (Early planting)	200	205	37	441	2.54	11.93	4.91	19.39	59.65
20th Oct. (Normal planting)	199	295	46	540	2.81	18.68	7.24	28.73	114.92
CD (0.05)	**NS**	**72.6**	**NS**	**NS**	**NS**	**NS**	**NS**	**5.92**	**16.07**
Interaction (Varieties x date of planting)	**341.9**	**NS**	**NS**	**NS**	**0.77**	**5.10**	**2.73**	**3.96**	**21.89**

Khurana et al. 1997). The data from the present study revealed that incidence of insect-pest and stem necrosis disease in normal and early planting differed significantly. The population of thrips on early planting varied from 1.3 to 19.5/plant with two peaks during crop growth as compared to normal planting (0.0 to 16.10/plant). Almost similar trend of whitefly incidence was recorded on early and normal planting of potato crop. Significantly high incidence of stem necrosis (19.51%) was recorded in early planted crop as compared to normal planting (12.13%) at 70 days of planting. The stem necrosis incidence was low at 60 days after planting in both the crops but increased very fast and reached to about two times in normal planting and about five times in early planting within next 10 days. Incidence of insect-pest and stem necrosis disease differed in popular cultivars when planted normal or early. Incidence of thrips, whitefly and stem necrosis disease were more in other cultivars as compared to Kufri Sindhuri (Late maturing). The highest incidence of stem necrosis disease (21.93%) was recorded in potato cv. Kufri Chandramukhi followed by Kufri Lauvkar (17.39%) and Kufri Chipsona-1 (16.17%), which was almost at par (Table 3). These findings are in agreement of earlier findings reported by Bhatnagar (2007 and 2008).

CONCLUSION

Seed crop planted on 20th October in Gwalior region of central India gives higher yield and water use efficiency along with low incidence of insect-pest population and stem necrosis disease as compared to early planted seed crop (5th October). Hence, it is concluded that to avoid insect-pest and

Table 3: Effect of date of planting and varieties on incidence of whitefly, thrips and stem necrosis disease in potato breeder seed crop

Treatments	Mean incidence of thrips/plant							Mean incidence of whitefly /plant							SNI (%)	
Date of observations	25.10	05.11	15.11	25.11	05.12	16.12	26.12	25.10	05.11	15.11	25.11	05.12	16.12	26.12	60 d	70 d
Kufri Lauvkar	1.7	9.0	8.6	14.8	8.2	1.4	2.9	0.9	1.16	1.5	6.4	5.4	0.4	0.6	4.9	17.4
Kufri Sindhuri	1.4	8.3	7.3	14.3	7.8	0.9	3.0	0.8	0.98	0.8	5.2	4.3	0.4	1.0	5.4	7.8
Kufri Chandramukhi	1.8	9.9	6.7	18.1	7.4	1.9	4.0	1.1	1.08	1.4	5.8	5.2	0.8	0.9	6.3	21.9
Kufri Chipsona-1	2.5	11.7	7.6	14.3	8.7	3.8	5.2	1.9	1.06	1.6	5.8	4.2	0.4	0.9	4.7	16.2
CD (0.05)	0.91	4.09	1.93	3.87	NS	1.34	1.33	0.61	NS	0.74	NS	1.15	0.48	NS	NS	4.30
5th Oct. (Early planting)	3.7	19.5	8.5	14.6	8.3	1.3	3.3	2.4	2.14	1.5	5.9	4.9	0.4	0.9	4.2	19.5
20th Oct. (Normal planting)	0.0	0.0	6.6	16.1	7.7	2.6	4.2	0.0	0.0	1.1	5.6	4.6	0.7	0.8	6.5	12.1
CD (0.05)	0.64	2.89	1.36	NS	NS	0.95	NS	0.43	0.41	0.52	NS	NS	NS	NS	1.76	3.04
Interaction (Varieties x date of planting)	1.28	5.78	2.73	5.48	2.52	1.90	1.89	0.87	0.82	1.05	3.41	1.62	0.67	0.81	3.52	6.08

d- days after planting SNI: Stem necrosis incidence

disease pressure and to produce good quality seed material of potato, planting date cannot be preponed under present climatic scenario of Gwalior. Research should be initiated to delay the plating dates after 20th October for breeder seed production in present climate scenario of Gwalior region.

REFERENCES

Anonymous (2011). Annual report 2010-11, Central Potato Research Station, Gwalior, p 5

Bhatnagar A (2008). Management of thrips (*Thrips palmi*) activity on early potato (*Solanum tuberosum*). Indian Journal of Agricultural Sciences 78(9): 815-817

Bhatnagar A (2007). Incidence and succession of thrips, leafhopper and whitefly in combination of planting dates and potato varieties. Annals of Plant Protection Sciences 15(1): 101-105

Ezekiel R (1997). Effect of environmental and cultural factors during growth of seed potato (*Solanum tuberosum*) crop on subsequent performance of progeny tubers as seed. Indian J Agril Sci 67: 308-311

Hassanpanah D, Hosienzadeh AA, Allahyari N (2009). Evaluation of planting date effects on yield and yield components of Savalan and Agria cultivars in Ardabil region. J Food Agril Environ 7: 525-528

Khan AA, Jilani MS, Khan MQ, Zubair M (2011). Effect of seasonal variation on tuber bulking rate of potato. J Animal Plant Sci 21(1): 31-37

Khurana SMP, Pandey SK, Singh SK, Singh RB, Bhale V (1997). Spread and control of potato stem necrosis. Ind J Virology 13: 23-28

Reddy TY, Reddi GH (2002). Irrigation and water management. In: Principles of Agronomy. Kalyani Publishers, Rajendranagar, Ludhiana, pp 257-334

Sadawarti MJ, Singh SP, Kumar V, Lal SS (2013). Effect of mulching and irrigation scheduling on potato cultivar Kufri Chipsona-1 in Central India. Potato J 40: 65-71

Thornton M, Nolte P (2005). Risks associated with early potato planting. Paper presented at the Idaho potato conference on January 19, 2005. www.cals.uidaho.edu/.../Risks Associated With Early Potato Planting-05.pdfý