

**Article history :**

Received : 22.12.2015

Revised : 29.04.2016

Accepted : 09.05.2016

## Performance of potato varieties under different moisture management systems and planting geometry

■ A.C. MISHRA AND VIVEK PANDEY<sup>1</sup>

**Members of the Research Forum**

**Associated Authors:**

<sup>1</sup>Department of Vegetable Science,  
College of Forestry, Veer Chandra  
Singh Garhwali Uttarakhand  
University of Horticulture and  
Forestry, Ranichauri, TEHRI-  
GARHWAL (UTTARAKHAND) INDIA

**ABSTRACT :** Present investigation was conducted during summer-rainy season (March-July) of 2013 in the temperate hills of Tehri-Garhwal, Uttarakhand (2000 m altitude, 78°24' E longitude and 30°18' N latitude). Among the treatments planting geometry e.g. single row (60x20 cm) and paired rows (15 cm apart paired rows at 60 x20 cm) and irrigation systems viz., furrow and drip with or without dried grass mulching were tested in all possible combinations across the varieties viz., Kufri Girdhari and Kufri Himalini. In paired row planting, tubers of 20±5 g weight were planted in 15 cm apart paired-rows on ridges spaced at 60x20cm (centre to centre) as against seed tubers of 40-50 g in single row planting geometry at 60x20 cm spacing and thus, the seed rate in all treatments was kept constant (20 q/ha). Results indicated that Kufri Himalini was found to be promising for tuber yield (30.7 t/ha) as affected by combination of planting geometry and irrigation system. Among the cultural practices, paired row planting geometry accompanied with furrow irrigation system (T<sub>5</sub>) was found to be the best cultural combination for tuber yield (35.2 t/ha). The combination of paired row planting geometry and drip irrigation system (T<sub>7</sub>) was second most important treatment (33.1 t/ha). When cultivars and cultural combination are considered simultaneously, Kufri Himalini exhibited maximum tuber yield in paired row planting system accompanied with furrow irrigation (36.3 t/ha) followed by at par values of Kufri Girdhari in paired row planting system accompanied with furrow irrigation (34.0 t/ha). Based on the results it could be concluded that two varieties of potato Kufri Girdhari and Kufri Himalini responded well to paired row planting geometry. Among the cultural packages paired row planting + furrow irrigation was most promising combination for tuber yield (35.2 t/ha) followed by paired row planting + drip irrigation (33.1 t/ha) in temperate Himalayas.

**KEY WORDS :** Paired- row, Planting geometry, Drip irrigation system, Moisture imbibition, Furrow irrigation, Mulching

**HOW TO CITE THIS ARTICLE :** Mishra, A.C. and Pandey, Vivek (2016). Performance of potato varieties under different moisture management systems and planting geometry. *Asian J. Hort.*, 11(1) : 154-158, DOI : 10.15740/HAS/TAJH/11.1/154-158.

Potato (*Solanum tuberosum* Linn.) ranks fourth among the major food crops of the world. It is the staple food of almost half of the world's population. The global area under potato during 2009 was about 18.28 million ha, with a total production of 343.91 million t. India ranks 3<sup>rd</sup> in area and 2<sup>nd</sup> production of in the world.

The present area under this vegetable in India is about 1.6 million ha, producing 26.28 million t of tuber, with the productivity of 16.42 t/ha (Saxena and Mathur, 2013). Different technological interventions viz., improved varieties, seed size, seed rate, planting distance, irrigation schedules (Bisht *et al.*, 2012), quality and quantity of

fertilizers and pest management (Kumar and Trehan, 2012; Singh and Lal, 2012 and Verma *et al.*, 2013) have contributed in achieving present status of production and productivity of this crop.

The potato is grown on an extensive area of Uttarakhand particularly in hills under rainfed or irrigated conditions. Due to off-season nature of the produce (March-July), potato cultivation leads to lucrative returns to the farmers particularly in mid hill conditions. However, productivity of this crop in rainfed hills is quite low as compared to irrigated areas. Some innovative resource conservation technologies may be expected to raise the productivity and profit in potato cultivation. Intercropping of potato with different compatible crops has been in practice to increase profitability (Imam *et al.*, 1990). Planting and soil moisture management techniques are foremost important to influence the plant development and tuberization (Murti *et al.*, 1976). Planting of seed tubers on ridges is widely followed method with some modifications from place to place. As against single-row geometry of planting on each ridge, paired-row planting on ridges at different spacing has also been tested keeping constant or variable seed rates (Singh, 1981 and Mishra, 2013). Some of the results of some of the earlier works were not convincing because of unsuitable soil structure or texture presumably because of restricted water movement to the centre of ridges on sandy soil (Singh, 1981). However, paired-row geometry was found dependable in sandy loams with high humus content in soil conditions (Mishra, 2013). Potato crop has been found to exhibit variable responses to irrigation systems. Furrow irrigation is widely practiced in irrigated areas. However, surface sprinkling and drip irrigation are other systems for moisture supply in potato crop particularly in areas with scarcity of irrigation water. The importance of drip system in potato cultivation has been well documented (Anonymous, 2012). Planting geometry accompanied with irrigation systems and soil moisture conservation technique across the varieties may lead to commendable conclusions for the potato growers of hilly areas.

## RESEARCH METHODS

Present investigation was conducted during summer-rainy season (March-July) of 2013 in the Vegetable Research Block of Uttarakhand University of Horticulture and Forestry, Ranichauri Campus (2000 m altitude, 78°24' E longitude and 30°18' N latitude), Tehri-Garhwal, Uttarakhand. The experiment was laid

out in Randomised Block Design with three replications. The plot size was kept 12.0 m<sup>2</sup>. Among the treatments planting geometry *e.g.* single row (60x20 cm) and paired rows (15 cm apart paired rows at 60 x20 cm) and irrigation systems *viz.*, furrow and drip with or without dried grass mulching were tested in all possible combinations across the varieties *viz.*, Kufri Girdhari and Kufri Himalini. In paired row planting, tubers of 20±5 g weight were planted in 15 cm apart paired-rows on ridges spaced at 60x20cm (centre to centre) as against seed tubers of 40-50 g in single row planting geometry at 60x20 cm spacing. Thus, the seed rate in all treatments was kept constant (20 q/ha). The laterals of drip system were spread over the ridges along the plant row in single row system and in between rows in paired row geometry. This corresponded to single drip lateral placed on each ridge at 60 cm distance with inline drippers 16 mm OD/30 cm/ 2 lph. The drip system was opened for 30 minutes once in three days whereas furrow irrigation was given once in 10 days by flooding irrigation water in furrows up to half of the height of ridges (10-15 cm). After planting the seed tubers, dried grasses were spread in furrows in treatments with mulching. Rest of cultural practices for raising the crop were uniform for all the plots. The organic matter content of soils of experimental plots varied from 2.4-2.8 per cent. Data were recorded on plant height (cm), number of shoots per hill and yield of A, B and C-grade tubers (t/ha).

## RESEARCH FINDINGS AND DISCUSSION

Perusal of analysed data presented in Tables 1 and 2 indicated that both the varieties included in present investigation exhibited significant differences for all the plant growth and tuber yield traits studied. A series of eight combinations of cultural operations also exhibited variable effect on the cultivars for yield and contributing characters. As far as tuber yield is concerned, Kufri Himalini was found to be promising for tuber yield (30.7 t/ha) as affected by combination of planting geometry and irrigation system. Among the cultural practices, paired row planting geometry accompanied with furrow irrigation system (T<sub>5</sub>) was found to be the best cultural combination for tuber yield (35.2 t/ha). The combination of paired row planting geometry and drip irrigation system (T<sub>7</sub>) was second most important treatment (33.1 t/ha). Higher total tuber yield in T<sub>5</sub> and T<sub>7</sub> treatments was because of higher quantity of A (14.0 t/ha and 10.9 t/ha, respectively), B (13.3 t/ha and 12.1 t/ha, respectively)

and C- grade tubers (8.3 t/ha and 10.1 t/ha, respectively) with at par market values. When cultivars and cultural combination are considered simultaneously, Kufri Himalini exhibited maximum tuber yield in paired row planting system accompanied with furrow irrigation (36.0 t/ha) followed by at par values of Kufri Girdhari in paired row planting system accompanied with furrow irrigation

(34.0 t/ha). Paired row planting geometry invariably showed 25-30 per cent higher tuber yield over single row planting system. Corresponding to the results of present investigation, Mishra (2013) has noticed almost 36 per cent higher tuber yield in paired row planting and compared to conventional system of single row in Kufri Kanchan cultivar under irrigated plateaus. Singh *et al.*

**Table 1 : Performance of potato cultivars across the planting geometry and irrigation systems**

Sr. No.	Treatments	Plant height (cm)	Number of shoots/hill	A-Grade tubers(t/ha)	B-Grade tubers (t/ha)	C-Grade tubers t/ha)	Total tubers (t/ha)
<b>Varieties (A)</b>							
1.	Kufri Girdhari (A <sub>1</sub> )	39.1	3.5	7.6	11.6	7.7	26.8
2.	Kufri Himalini (A <sub>2</sub> )	47.0	3.2	9.4	12.9	8.4	30.7
	C.D. (P=0.05) (A)	2.4	0.5	0.5	0.5	0.5	0.7
<b>Cultural Packages (T)</b>							
1.	Single Row + Furrow irrigation (T <sub>1</sub> )	36.1	3.9	8.8	11.4	6.7	26.8
2.	Single Row + Furrow irrigation + Grass mulch (T <sub>2</sub> )	48.6	3.3	8.3	10.2	6.7	25.0
3.	Single Row + Drip irrigation (T <sub>3</sub> )	48.4	4.0	5.5	16.3	8.7	30.4
4.	Single Row + Drip irrigation + Grass mulch (T <sub>4</sub> )	50.3	3.8	4.8	10.5	7.5	22.5
5.	Paired Row + Furrow irrigation (T <sub>5</sub> )	34.6	2.3	14.0	13.3	8.3	35.2
6.	Paired Row + Furrow irrigation + Grass mulch (T <sub>6</sub> )	45.3	3.0	8.7	10.5	7.4	26.5
7.	Paired Row + Drip irrigation (T <sub>7</sub> )	37.5	3.5	10.9	12.1	10.1	33.1
8.	Paired Row + Drip irrigation + Grass mulch (T <sub>8</sub> )	43.8	3.1	7.1	13.7	9.3	30.1
	C.D. (P=0.05) (B)	4.7	0.96	0.9	1.1	0.9	1.4
<b>Interaction (A x B)</b>							
1.	A <sub>1</sub> x T <sub>1</sub>	30.5	4.5	4.2	9.0	7.9	21.1
2.	A <sub>1</sub> x T <sub>2</sub>	41.2	3.2	7.1	6.7	3.8	17.5
3.	A <sub>1</sub> x T <sub>3</sub>	48.5	4.7	5.8	16.0	8.3	30.0
4.	A <sub>1</sub> x T <sub>4</sub>	47.3	4.0	4.8	9.8	5.8	20.0
5.	A <sub>1</sub> x T <sub>5</sub>	30.2	2.0	16.5	12.7	6.8	36.0
6.	A <sub>1</sub> x T <sub>6</sub>	41.7	2.5	5.4	13.3	10.3	29.1
7.	A <sub>1</sub> x T <sub>7</sub>	32.7	4.0	10.8	11.8	9.3	31.9
8.	A <sub>1</sub> x T <sub>8</sub>	40.8	3.0	6.3	13.2	8.8	28.3
9.	A <sub>2</sub> x T <sub>1</sub>	41.7	3.3	13.5	13.8	5.3	32.6
10.	A <sub>2</sub> x T <sub>2</sub>	56.0	3.3	9.3	13.6	9.6	32.5
11.	A <sub>2</sub> x T <sub>3</sub>	48.3	3.3	5.1	16.5	9.0	30.7
12.	A <sub>2</sub> x T <sub>4</sub>	53.3	3.5	4.8	11.2	9.1	25.0
13.	A <sub>2</sub> x T <sub>5</sub>	39.0	2.7	11.5	13.8	9.1	34.3
14.	A <sub>2</sub> x T <sub>6</sub>	49.0	3.5	11.8	7.6	4.4	23.8
15.	A <sub>2</sub> x T <sub>7</sub>	42.3	3.0	11.1	12.4	10.8	34.3
16.	A <sub>2</sub> x T <sub>8</sub>	46.7	3.2	9.4	14.2	9.9	31.9
	CV (%)	9.3	14.3	7.6	6.1	8.2	4.1
	CD (AxB)	6.7	1.4	1.3	1.5	1.3	2.0

Note A-grade: >100g, B-grade: 50-100 g and C-grade: 30-50 g weight

(2010) have also reported higher total tuber yield in triple row and paired row planting geometry as compared to single row planting. However, Ahire *et al.* (2000) and Patel *et al.* (2005) reported higher total tuber yield in single row planting (18.49 t/ha and 39.3 t/ha, respectively) as compared to paired row planting geometry (19.66 t/ha and 32.6 t/ha, respectively). The beneficial effects of drip irrigation in potato production have been well documented in India (Singh and Singh, 2007; Anonymous, 2012 and Anonymous, 2014) with mentioned that this technology had ability to save irrigation water by 40-50 per cent, NPK fertilizer by 25-30 per cent and to increase tuber yield by 25-30 per cent as compared to conventional furrow system. In relation to tuber yield, it was observed that drip irrigation method was better system in single row planting geometry whereas furrow irrigation was better in paired row planting. The superiority of furrow irrigation over drip system within paired row planting geometry led to conclude that opening of drip system for half an hour in alternate days was not sufficient to maintain required level of soil moisture in the middle portion (rhizosphere) of thick ridges framed in paired row planting system. Singh *et al.* (2010) was also of opinion to open drip system for 1.5 hour in triple row and 1.25 hour for paired planting system of potato to realize optimum tuber yield.

The cultural packages involving grass mulching exhibited decreased tuber yield as compared to unmulched counterparts (4.0-40.0%) probably because of removal of N and P from soil during microbial decay of grasses in ambient edaphic environment *i.e.* high moisture and temperature. There was no synergy in treatments in relation to tuber yield and vegetative growth. Maximum plant height was recorded in Kufri Himalini (47.0 cm) whereas cultural package single row + drip irrigation + mulch (T<sub>4</sub>) was promising for this trait (50.3 cm) followed by combinations single row + furrow irrigation + mulch (T<sub>3</sub>) (48.4 cm) and single row + drip irrigation (T<sub>2</sub>) (48.6 cm) with non-significant difference. As far as number of shoots per hill is concerned, the combination single row + drip irrigation (T<sub>3</sub>) exhibited significantly high value (4.0) in Kufri Girdhari cultivar (3.5).

Based on above results it could be concluded that two varieties of potato Kufri Girdhari and Kufri Himalini responded well to paired row planting geometry. Among the cultural packages paired row planting + furrow irrigation was most promising combination for tuber yield

(35.2 t/ha) followed by paired row planting + drip irrigation (33.1 t/ha) in temperate Himalayas.

## REFERENCES

- Ahire, N.R., Bhoi, P.G. and Solanke, A.V. (2000). Effect of row spacing and planting system on growth and yield of potato under surface and drip irrigation. *J. Indian Potato Assoc.*, **27**(1-2): 59-60
- Anonymous (2012). Annual Report 2011-12. Central Potato Research Institute, Shimla, 67 p.
- Anonymous (2014). Report of the Quinquennial Review Team on Central Potato Research Institute, Shimla and Aii India Coordinated Research Project on Potato (1 January, 2006 to 31 March, 2013). CPRI, Shimla. pp. 53-54.
- Bisht, P., Raghav, M. and Singh, V.K. (2012). Effect of different irrigation schedules on the growth and yield of drip irrigated potato. *Potato J.*, **39**(2): 202-04.
- Imam, S.A., Delwar Hossain, A.H.M., Sikka, L.C. and Midmore, D.J. (1990). Agronomic management of potato/sugarcane intercropping and its economic implications. *Field Crops Res.*, **25** (1-2): 111-22
- Kumar, M. and Trehan, S.P. (2012). Influence of potato cultivars and N levels on contribution of organic amendments to N nutrition. *Potato J.*, **39**(2): 133-44.
- Mishra, A.C. (2013). Increasing profitability and resource conservation through paired-row planting geometry in potato. *Potato J.*, **40** (2): 180-183.
- Murti, G.S.R., Singh, M., Saha, S.N. and Banerjee, V.N. (1976). Effect of night temperatures in the pre- and post-tuber initiation phases on development of potato under short days. *Indian J. Agric. Sci.*, **46**: 65-73.
- Patel, C. K., Sasani, G.V., Patel, R. N., Chaudhari, S. M., Patel, N.H. and Vihol, K.J. (2005). Effect of planting methods on yield and economics of potato under north Gujarat conditions. *Potato J.*, **32** (3-4): 121-25
- Saxena, R. and Mathur, P. (2013). Analysis of potato production performance and yield variability in India. *Potato J.*, **40** (1): 38-44
- Singh, B.P. and Singh, S.V. (2007). Potato cultivation in Western Uttar Pradesh. In: Souvenir: Potato production and utilization in India. XXVI Biennial Group Meeting of AICRP on Potato, September 7-9, 2007 at RAU, Pusa Bihar. pp. 123-127.
- Singh, M. (1981). Final report of the emeritus scientist scheme. Increasing the efficiency of the major inputs for potato production for the period 7.1.1976 to 6.1.1981. Punjab Agricultural University, Ludhiana.
- Singh, N., Sood, M.C. and Singh, S.P. (2010) Yield and

economics of potato (*Solanum tuberosum* L.) influenced by raised bed planting patterns and drip layout systems. *Prog. Agric.*, **10** : 29-34.

**Singh, S.K. and Lal, S.S (2012).** Effect of potassium nutrition

on potato yield, quality and nutrient use efficiency under varied levels of nitrogen application. *Potato J.*, **39**(2): 155-165.

**Verma, R.B. , Kumar, Arbind and Pathak, S.P. (2013).** Studies on nutrient management in potato. *Potato J.*, **40** (1): 72-75.

11<sup>th</sup>  
Year  
★★★★★ of Excellence ★★★★★