Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; SP4: 102-105

Rajanbir Singh
Department of Agriculture
Khalsa College Amritsar,
Amritsar, Punjab, India

Gurbax Singh
Department of Agriculture
Khalsa College Amritsar,
Amritsar, Punjab, India

Amarinder Singh
Department of Agriculture
Khalsa College Amritsar,
Amritsar, Punjab, India

Nancy Sabharwal
Department of Agriculture
Khalsa College Amritsar,
Amritsar, Punjab, India

Correspondence
Rajanbir Singh
Department of Agriculture
Khalsa College Amritsar,
Amritsar, Punjab, India

(Special Issue- 4)
National Seminar
"Role of Biological Sciences in Organic Farming"
(March 20, 2019)

Effect of improved agronomic practices on yield of processable cultivar of potato (*Solanumtuberosum* L.) cv. Lady rosetta

Rajanbir Singh, Gurbax Singh, Amarinder Singh and Nancy Sabharwal

Abstract
The present investigation was carried out to study the effect of Improved Agronomic Practices on Yield of Processable Cultivar of Potato (*Solanumtuberosum* L.) cv. Lady rosetta at student research farm, Department of Agriculture, Khalsa College Amritsar. The soil of the experimental field had sandy loam texture with normal pH and electrical conductivity, low in organic carbon and available nitrogen, medium in available Phosphorus and high available Potassium. The filed was laid out in factorial randomized complete block design with three replications. There were total two factors Factor A was method of sowing and Factor B was method of irrigation. Method of sowing comprises 6 treatments B_1: 60cm bed, B_2: 75cm bed, B_3: 90cm bed single row, B_4: 90cm bed double row, B_5: 105cm bed double row, B_6: 105cm bed triple row whereas irrigation methods comprises drip irrigation: I_1 and furrow irrigation: I_2. The results revealed that growth parameters like plant height, number of stems per hill, leaf area index and dry matter accumulation were recorded maximum in 60cm bed sowing. Maximum yield was obtained in 60cm bed (246.3 qha^{-1}) whereas in irrigation system drip produced maximum yield (236.1qha^{-1}). Maximum yield through interaction was found in drip irrigated 105 cm triple row bed.

Keywords: Potato, Drip irrigation, Furrow irrigation, Bed.

Introduction
In Punjab, potato is cultivated on an area of 96.57 thousand hectares (5percent of total Indian area) with production of 24.94 lakh metric tons (Anonymous 2017) [1]. In Punjab, primarily potato belt is confined to Doaba region i.e. Hoshiarpur, Jalandhar, Kapurthala and Nawanshehar districts. To make the crop profitable and sustainable, cultivation of processing grade cultivars and establishment of agronomy for these new cultivars is essential. As, processing units require optimum size of tuber, there are many practices which influence quality and quantity of potato.

Inter row spacing plays an important role in the production of processable grade of tuber, similarly sowing of crop on the raised beds of specific size reduces the greening of tubers, which is undesirable character. Greening of potato occurs when tubers exposed to light. Inspite of planting on wide beds and crop geometry, method of irrigation is an important aspect. Water is the vital factor for the germination. To initiate the germination process optimum moisture is required. The earlier studies have highlighted the importance of economizing irrigation water by micro irrigation is 30 percent and improvement in crop yield by 15-20 percent over furrow method of irrigation (Singh and Sood 2012). As water application in furrows causes more soil cracking and it also produces more green heads and infested tubers. Therefore, an efficient irrigation systems and water saving techniques such as drip irrigation have been found useful to improve water productivity. Drip irrigation minimizes leaching losses due to which utilization of water and nutrients increases and water losses due to surface runoff and deep percolation is decreases. It also enhances the potato production and keeps productivity at high level. So, the present investigation is proposed to study the effect of bed size and irrigation methods on the yield and size of the tuber.

Materials and Methods

A field experiment was conducted at the Students' Research Farm, Khalsa College, Amritsar during autumn season of 2017-18. Amritsar is located at 31°-63' North and 74°-83' East and altitude of234 meters above sea level. This place is characterized by semi humid climate, where both winters and summers are extreme. The soil of the experimental field had sandy loam texture with normal pH and electrical conductivity, low in organic carbon and available nitrogen, medium in available Phosphorus and high available Potassium. The field was laid out in factorial randomized complete block design with three replications. There were total two factors Factor A was method of sowing and Factor B was method of irrigation. Method of sowing comprises 6 treatments B_1: 60cm bed, B_2: 75cm bed, B_3: 90cm bed single row, B_4: 90cm bed double row, B_5: 105cm bed double row, B_6: 105cm bed triple row whereas irrigation methods comprises drip irrigation: I_1 and furrow irrigation: I_2.The field was prepared by ploughing once with tractor drawn disc harrow and two times with cultivator followed each time by planking. The planting of crop was done manually on 14th October, 2017 using normal seed rate of 30-35 q/ha seed size tubers (35-50g). Seed tubers were treated with Monceren @ 2.5ml per liter of water for 10 minutes and kept at room temperature for two weeks until sprouting occurred. After that sprouted tubers were planted according to the treatments. Fertilizers (Urea, SSP and MOP) were applied according to recommendation. In furrow irrigation total 8 irrigations were applied throughout the growing period. On the other hand drip irrigation was applied according to the following schedule:-

Month	Time of irrigation (min)
October	20
November	25
December	45
January	20

Earthing up was done 25 days after planting (DAP) and second weeding was done 45 days after planting. Dehaulming was done 10 days before digging of potatoes and were spread on the ridges to protect the half-naked tubers from direct sunlight in order to control greening of tubers. Digging of potatoes done manually on February 2, 2018. Statistical analysis of the data recorded was done as per split plot design using EDA 1.1 software developed by PAU, Ludhiana.

Results and Discussion

Growth

Data showed (table 1) that the growth attributes viz. plant height, number of stems/hill, leaf area index and haulm dry matter accumulation differ significantly due to different sowing methods. Maximum growth was recorded in treatments B_1 bed size 60 cm which was significantly differ from other treatments, which was supported by leaf area index and haulm dry matter accumulation. Whereas bed size 90 cm double row, 105 cm double row and 105 cm triple row attained significantly high growth thus 75 cm and 90 cm single row, which was at par with each other. This might be due to the presence of higher competition for sunlight among plants. As with the change in row spacing growth due to the presence of minimum competition due to which plants absorbed the sufficiently available resources and more light which increased their photosynthetic efficiency that further increased the growth of the plant. (Getachew *et al.* 2012) [3] observed the same results.

While in irrigation treatments drip irrigation attained significantly higher growth as compared to the furrow irrigation. This might be due to proper availability of moisture throughout the growth period and efficient utilization of fertilizers develops proper growth of plant. It might be due to optimum availability of soil moisture and fertilizer nutrients in the plant root zone during entire period of crop growth. (Singh and Sood 2016) [6]

The data presented in table 3 showed that interaction due to irrigation and bed size significantly influenced the growth of the plant. Drip irrigated 105 cm triple row bed (I_1B_6) had attained high growth viz. plant height, leaf area index, haulm dry matter accumulation as compare furrow irrigated 105 cm triple row bed I_2B_6 and other combinations of irrigation and bed size. This might be due to availability of optimum moisture and nutrients throughout the growth periodin the drip irrigated combinations as compare to the furrow irrigation. (Kumari 2012) [5]

Yield attributes

The data in table 2 revealed that maximum number of tubers per plant 7.8 was recorded in treatment B_1 followed by treatments B_2, B_5, and B_3. The treatments B_1 were B_2 were statistically at par with each other. Whereas Maximum tuber weight was achieved in 105cm triple row (B_6) bed followed by 90cm double row (B_4) and 105cm double row (B_5) bed. All these treatments were statistically at par with each other. This might be due to intra row competition.

Among irrigation treatments, data demonstrated in table 2 that number of tubers per plant and tuber weight was significantly higher under drip irrigation in comparison to furrow method of irrigation. It might be due to optimum availability of soil moisture and fertilizer nutrients in the plant root zone during entire period of crop growth in drip method of irrigation. Above results were in accordance with the findings of Singh and Sood (2016) [6].

Tuber yield

Yield of a crop is the final output of successful completion of growth and development of its individual plant which in turn depends upon rate of carbon assimilation and converts into harvestable products. Tubers collected from each of the experimental treatment plots were hand graded into processing (40-75mm) and non-processing (<40mm/>75mm) tuber grades. Bed size and irrigation both factors showed their effect on plant yield. Yield of each grade and total yield are presented in Table 4.8 and Fig.4.8.

Processable yield (40-75mm)

Regarding bed size, the data presented in table 2 showed that maximum processable tuber yield 178.6 qha^{-1} was obtained in treatment B_1(60cm bed) which was significantly higher than treatments B_6(105cm triple row bed) (165.7qha^{-1}), B_4(90cm double row)(162.3qha^{-1}), B_3(90cm single row bed)(159.1qha^{-1}), B_5(105cm double row bed)(158.9qha^{-1}) and B_2(75cm single row bed)(158.1qha^{-1}). The treatments $B_6 > B_4 > B_3 > B_5 > B_2$ in the same trend were statistically at par with each other. Similar result was observed by Kumar *et al.* (2011) [4].

Regarding irrigation treatments, maximum processable yield 168.2$qha^{-1}$was achieved in treatment I_1(drip irrigation)and minimum was recorded 159.4qha^{-1} in treatment I_2(furrow irrigation). The treatment I_1(drip irrigation) was significantly higher than treatment I_2(furrow irrigation). Above results were in accordance with Singh and Sood (2016) [6].

Non-processable yield (<45/>75mm)

The data presented in table 2 showed that bed size has its own effect on non-processable tuber yield. Maximum tuber yield was recorded in 68.7 qha^{-1}in treatment B_5(105cm double row) followed by treatments B_4(90cm double row) (68.2qha^{-1}), B_1(60cm single row) (67.7qha^{-1}) which were significantly at par with each other. Whereas, minimum processable yield 55.7qha^{-1} was obtained in B_2 (75cm bed) which was significantly differ from the treatment B_5, B_4 and B_1. Treatment B_5 was 23.4per cent higher than B_2. Similar result was observed by Kumar *et al.* (2011) [4].

Data regarding irrigation treatments presented in table 2 in which maximum non processable yield 68.1qha^{-1} was observed in treatment I_1(drip irrigation)andminimum was observed 55.4qha^{-1} in treatment I_2(furrow irrigation). The treatment I_1(drip irrigation) was 23.1per cent higher from treatment I_2(furrow irrigation). Above results were in accordance with Singh and Sood (2016) [6].

Total tuber yield

The data revealed that maximum total tuber yield 246.3qha^{-1} was obtained in treatment B_1 (60cm) which was significantly higher than bed size 90 cm (B_3 and B_4) and 105cm (B_5 and B_6) where treatments B_3, B_4, B_5 and B_6 were statistically at par with each other. The percent increase of total tuber yield in treatment B_1 was 14.5 per cent, 6.7 per cent, 8.1 per cent and 10.8 per cent over treatments B_3, B_4, B_5 and B_6 respectively. Ridge planting with drip irrigation attributed highest tuber yield. Singh and Sood (2016) [6] reported the same results.

Among irrigation treatments, highest total tuber yield 236.1qha^{-1} was recorded in treatment I_1(drip irrigation)and lowest was observed 214.8qha^{-1} in treatment I_2(furrow irrigation). The treatment I_1(drip irrigation) was significantly differed from treatment I_2(furrow irrigation). The percentage increase of tuber yield in treatment I_1(drip irrigation) was 9.8per cent over treatment I_2(furrow irrigation). Above results were in accordance with Singh and Sood (2016) [12].

Biological yield

The data presented in table 4.10 and Fig. 4.10 showed that bed size had a significant effect on the biological yield. Maximum biological yield 78.7qha^{-1} was observed in B_1 followed by B_4 (73.6qha^{-1}), B_5 (71.4qha^{-1}) and B_6 (71.4qha^{-1}). Treatment B_1 was significantly differed with treatments B_4, B_5 and B_6 whereas treatments B_4, B_5 and B_6 were statistically at par with each other. The trend of biological yield was $B_1 > B_4 > B_5 > B_6 > B_3$ and B_2.

Among irrigation treatments data presented in table 4.10 and Fig. 4.10 in which maximum biological yield 75.4qha^{-1} was observed in I_1 and minimum yield 68.6$qha^{-1}$was observed in treatment I_2. Treatment I_1 was significantly higher from treatment I_2. This might be due to low availability of soil moisture and nutrients during the period of crop growth under furrow irrigation as compared to drip irrigation Singh and Sood (2016) [6].

The data presented in the table 4 showed that interaction between irrigation and bed size was significant. Maximum yield was obtained in drip irrigated 105cm triple row (I_1B_6) bed followed by 60cm (I_2B_1) which were statistically at par with each other. It was due to the availability of proper moisture in the center of bed. Minimum yield was obtained in 105cm triple row (I_2B_6) bed with furrow irrigation. It was due to less moisture availability in the central part of the bed. The percentage increase in the tuber yield in the same bed with the change in irrigation system was 41.6 per cent. The results are in accordance with the results of Boujelben and M'barek (1997). Trend of biological yield in decreasing order was $I_1B_6 > I_1B_5 > I_2B_1 > I_1B_1 > I_1B_4 > I_2B_4 > I_2B_2 > I_2B_3 > I_1B_3 > I_1B_2 > I_2B_5 > I_2B_6 > I_1B_6$.

Conclusion

It was concluded that among various improved agronomic treatments, 60cm bed produces maximum yield (246.3qha^{-1}) whereas in irrigation treatments drip irrigation gives maximum yield (236.1qha^{-1}). Since this experiment is based on one year data, repetition of experiment for one more year along with multi-locational trials is advised.

Table 1: Effect of bed size and irrigation on growth of potato.

Treatments	Plant height (cm)	Leaf Area Index (LAI)	Haulm dry matter accumulation (g/plant)	No. of stems/hill
Bed size				
60cm (B_1)	61.1	3.69	13.6	6.1
75cm (B_2)	55.3	2.72	10.7	4.4
90cm single row (B_3)	56.4	3.01	11.1	5.1
90cm double row (B_4)	59.4	3.16	12.3	5.9
105cm double row (B_5)	59.6	3.13	12.6	5.5
105cm triple row (B_6)	59.3	3.08	12.7	5.1
CD (p=0.05)	2.5	0.22	0.9	0.8
Irrigation				
Drip irrigation (I_1)	59.3	3.26	12.7	6.1
Furrow irrigation (I_2)	57.7	3.00	11.6	4.6
CD(p=0.05)	1.4	0.12	0.5	0.4

Table 2: Effect of bed size and irrigation on yield attributing characters and tuber yield of potato

Treatments	No. of tubers/plant	Weight (g)	Processable tuber yield (qha^{-1})	Non Processable tuber yield (qha^{-1})	Total tuber yield (qha^{-1})	Biological yield (qha^{-1})
Bed size						
60cm (B_1)	7.8	48.9	178.7	67.7	246.3	78.7
75cm (B_2)	7.1	43.8	158.1	55.7	213.8	67.5
90cm single row (B_3)	5.7	46.2	159.1	56.1	215.1	68.1
90cm double row (B_4)	6.0	52.3	162.3	68.2	230.6	73.6
105cm double row (B_5)	6.3	51.1	158.9	68.7	227.7	72.8
105cm triple row (B_6)	5.6	54.4	165.7	57.5	223.3	71.4
CD (p=0.05)	0.80	5.9	11.8	9.6	13.6	4.3
Irrigation						
Drip irrigation (I_1)	6.7	52.3	168.2	68.1	236.1	75.4
Furrow irrigation (I_2)	6.0	47.2	159.4	55.4	214.8	68.6
CD(p=0.05)	0.46	3.42	6.8	5.5	7.9	2.5

Table 3: Effect of mean interaction between irrigation and bed size on growth of potato.

Treatments	60cm single row (B_1)	75cm single row (B_2)	90cm single row (B_3)	90cm double row (B_4)	105cm double row (B_5)	105cm triple row (B_6)
Plant height						
Drip irrigation (I_1)	60.2	55.3	56.1	61.1	61.3	63.2
Furrow irrigation (I_2)	61.9	55.4	56.8	57.8	57.9	55.1
CD(p=0.05)	3.5					
Leaf area index						
Drip irrigation (I_1)	3.63	2.53	2.94	3.42	3.55	3.77
Furrow irrigation (I_2)	3.67	3.05	3.06	2.93	2.70	2.46
CD(p=0.05)	0.31					
Haulm dry matter accumulation (g/plant)						
Drip irrigation (I_1)	13.1	10.7	10.3	13.2	14.2	14.8
Furrow irrigation (I_2)	14.1	10.7	11.7	11.4	11.1	10.5
CD(p=0.05)	1.2					

Table 4: Effect of interaction between irrigation and bed size on yield characters of potato (qha^{-1})

Treatments	60cm single row (B_1)	75cm single row (B_2)	90cm single row (B_3)	90cm double row (B_4)	105cm double row (B_5)	105cm triple row (B_6)
Processable tuber yield						
Drip irrigation (I_1)	171.8	144.9	157.4	163.2	174.5	197.2
Furrow irrigation (I_2)	185.3	171.2	160.7	161.5	143.3	134.2
CD(p=0.05)	16.6					
Total Tuber Yield						
Drip irrigation (I_1)	244.7	204.3	209.1	240.5	255.6	262.2
Furrow irrigation (I_2)	247.8	218.3	217.4	220.5	200.1	185.1
CD(p=0.05)	19.36					
Biological Yield						
Drip irrigation (I_1)	78.2	65.3	66.8	76.9	81.7	83.8
Furrow irrigation (I_2)	79.2	69.7	69.5	70.4	63.9	59.1
CD(p=0.05)	6.1					

References

1. Anonymous. Package and practices for vegetables, Punjab Agriculture University, Ludhiana, Punjab, 2017.
2. Boujelben A, M'-barek K, Chartzoulakis KS. Potato crop response to drip irrigation system. Proceedings of the Second International Symposium on Irrigation of Horticultural Crops, Chania, Crete, Greece, 9-13 September 1996. Acta-Horticulturae. 1997; 449(1):241-243.
3. Getachew T, Belew D, Tulu S. Yield and growth parameters of potato as influenced by intra row spacing and time of earthing up: In Boneyadegam district, Central Highlands of Ethiopia. International Journal of Agricultural research. 2012; 7(5):255-256.
4. Kumar P, Pandey SK, Singh SV, Singh BP, Singh K, Kumar D *et al*. Effect of growth duration, N application and row spacing on productivity, profitability and processing quality of potato. Potato journal. 2011; 38(2):137-142.
5. Kumari S. Influence of drip irrigation and mulch on leaf area maximization, water use efficiency and yield of potato. Journal of Agricultural science, 2012, 4(1).
6. Singh N, Sood MC. Productivity of potato as influenced by wide raised bed planting patterns under drip irrigation. Progressive Agriculture. 2016; 16(1):93-97.
7. Singh N, Sood MC. Effect of wide raised bed planting patterns on potato production under furrow and sprinkler irrigation. Progressive Agriculture. 2016; 16(2):178-182.
8. Singh N, Sood MC. Water need and nutrient movement in potato based cropping systems under drip, sprinkler and furrow methods of irrigation. Annals of Horticulture. 2012; 5(1):74-79.