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## Yield Dynamic in Potato in Relation to Variety and Row Spacing

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**Abstract:** An experiment on the yield of potato in relation to variety (Cardinal and Desiree) and spacing (50, 75 and 100 cm) was conducted during the autumn in Peshawar conditions. Variety Desiree was significantly early (20 days) in 50% emergence as compared to 22 days of Cardinal. Plant Vigor in terms of height and spread was significantly more only after 60 days through 80 days while only plant spread was significantly more after 40 days. Highest number of stems were in Cardinal (3.88) as compared to 2.41 in Desiree. The total tuber yield was significantly higher in Cardinal (12.76 tons/ha) as compared to 9.80 tons/ha of Desiree. Maximum total yield of 14.31 and 13.52 tons/ha was produced in 50 cm spacing while it was minimum 9.95 and 6.37 tons/ha at 100 cm in Cardinal and Desiree accordingly. The number of small (<20 mm), medium (20-40 mm) and large (>40 mm) size tubers followed comparable trends to that of total yield. The experiment demonstrate that there is no competition in plants at the minimum spacing of 50 cm, thus the yield at this row spacing increases as function of increasing plant population.

**Key words:** Potato, varieties, spacing

### Introduction

Potato is an important vegetable crop of Pakistan, ranking 3rd among the major cash crops in order of production. It is grown on 78.9 thousand hectare in the country with a total production of 1063.5 thousand tones. NWFP contribute 92.6 thousand tones with an area of 7.9 thousand hectare (Anonymous, 1996). In Pakistan potato is consumed as a vegetable as well as for processing. Thus, to meet the food demand of increasing population of the country, it is needed to increase potato yield which has the ability to produce 2 to 3 time more food material per unit area as compared to cereals (Hussain and Gillani, 1985). For this purpose extensive research work is required to exploit the existing potentials of variety, climates and soils in NWFP.

In crop management optimum plant population is the major contributing factor toward final tuber yield. Small plant population density may decrease the yield (Iman and Shuja, 1983) but produce large size tubers (Khan, 1988) and hence jeopardize a seed production attempt. By contrast large population density may not be desirable if the crop is intended for table purposes (Khan, 1993). Thus plant population studies have been an important aspect of potato research (Krishnappa, 1991; Hernandez *et al.*, 1993; Love *et al.*, 1993; Love *et al.*, 1995). This study was initiated to establish the effect of spacing on two varieties for seed and table potato production.

### Materials and Methods

The research studies on "Yield dynamic of seed and table potato in relation to variety and spacing" was conducted in the autumn season in Peshawar conditions. The seed for the experiment was obtained from a local vender at Peshawar. Two varieties Desiree and Cardinal were planted in three row spacing, 50, 75 and 100 cm with a uniform tuber to tuber spacing of 20 cm. All other cultural practices were carried out uniformly and plant protection measures were also adopted as required. The experiment was laid out in 2 x 3 factorial randomized Complete Block Design with 6 treatment and 4 replication.

### Results

**Days to 50% emergence and Percent Sprouting:** There was significant difference in days to 50% emergence between

varieties, Cardinal took 22.8 days as compared to 20.3 of not affected by row spacing. Maximum emergence (86.38%) was in variety Desiree as compared to 82.18% in variety Cardinal. In spacing the maximum sprouting (87.82%) was in 75 cm and minimum (82.13%) in 100 cm. As regard interaction between varieties and spacing, maximum sprouting (89.58%) was observed in Desiree at 75 cm and minimum sprouting (78.46%) in Cardinal at 50 cm. The difference in percent sprouting between the varieties, spacing and interaction between varieties and spacing was non-significant.

**Plant height and spread:** Plant height and spread were observed after 40, 60 and 80 days. The plant spread after 40 days was significantly greater (34.61 cm) in Cardinal as compared to 27.83 cm in Desiree. At this stage plant spread was slightly more in cardinal (27.17 cm) than Desiree (24.40 cm). Row spacing had nonsignificant effect on both of the growth parameters after 40 days (Fig. 1 and 2). After 60 days the plant height was significantly higher in Cardinal (34.83 cm) as compared to 28.28 cm of Desiree (Fig. 1). Variety cardinal was also superior in plant spread with 51.54 cm as compared to 37.72 cm of Desiree (Fig. 2). Spacing in both varieties had non significant effect on both the growth parameters after 60 days. Data recorded on plant height and spread after 80 days revealed significant differences in plant height and spread between the varieties with 40.52 cm and 59.65 cm for Cardinal and 31.37 cm and 43.56 cm for Desiree accordingly (Fig. 1 and 2).

**Number of stems of per plant:** The number of stems per plant in Cardinal and Desiree was 3.88 and 2.41 respectively. The effect of spacing and interaction between variety and spacing on number of stems/plant was nonsignificant, however maximum number of stems/plant (3.40) as found in 50 cm and minimum (2.83) in 100 cm spacing (Table 1).

**Total yield:** Variety Cardinal produced significantly high total yield of 12.76 t ha<sup>-1</sup>, while the total yield for Desiree was 8.78 t ha<sup>-1</sup>. (Table 1). The yield of both varieties showed an inverse relation with plant population density. The maximum yield 13.91 and 13.52 t ha<sup>-1</sup> in cardinal and Desiree was at 50 cm spacing which decreased to 11.76 t ha<sup>-1</sup> and 8.18 t ha<sup>-1</sup> in Cardinal and 9.5 t ha<sup>-1</sup> & 6.37 t ha<sup>-1</sup> in Desiree with 75 and

Table 1: Effect of row spacing on stems/plant and yield/ha of Cv. Cardinal and Desires.

Spacing (cm)	Stems/plant			Tuber yield/ha (Ton)		
	Desiree	Cardinal	Mean	Desiree	Cardinal	Mean
50	2.58 *	4.23	3.40 <sup>NS</sup>	13.52	14.31	13.91A
75	2.45	3.95	3.20	9.50	14.02	11.76B
100	2.20	3.45	2.83	6.37	9.95	8.16C
Mean	2.41 B	3.88A		9.80 B	12.76A	

\*Means followed different letters are significant at 5% level of significant.

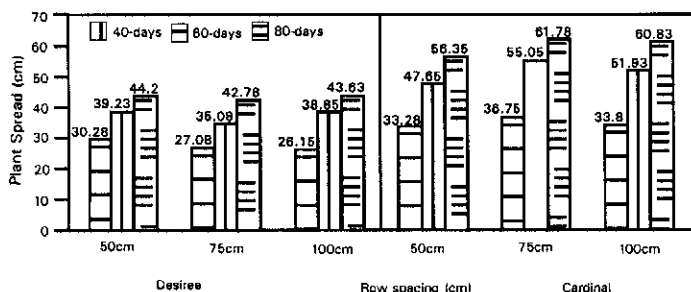


Fig. 1: Effect of row spacing on plant height of Desiree and Cardinal Varieties of potato

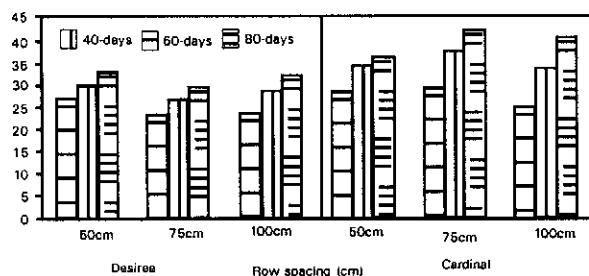


Fig. 2: Effect of row spacing on plan spread in Desiree and Cardinal varieties of potato

100 cm spacing (Table 1).

**Tuber grades:** The weight of small size tubers/plot (< 20 mm) was 2.08 kg in Cardinal while Desiree produced 1.47 kg/plot. The difference, however, was non significant. Both the varieties produced significantly higher weight of small size tubers at 50 cm spacing with 2.99 and 2.53 kg/plot for variety Cardinal and Desiree respectively. The number of small size tubers decreased to 0.98 and 0.7 kg/plot in Cardinal and Desiree accordingly as spacing was increased to 100 cm. The weight of medium size tubers (20-40 mm) followed comparable trends. It was more with 50 cm spacing, 64.68 and 60.08 kg/plot in variety Cardinal and Desiree respectively (Table 2). Data presented in Table 2 reveals that the weight of large size tubers (> 40 mm) was dependent on population density. It was highest in 50 cm spacing (6.68 kg/plot) while lowest 4.49 kg/plot in 100 cm row spacing. Cardinal produced significantly higher large size tubers (6.57 kg/plot) as compared to 4.24 kg/plot in Desiree.

**Discussion**

**Days to 50% emergence and percent sprouting:** Variety Desiree was significantly early by 2.5 days than Cardinal variety Desiree was significantly early by 2.5 days than

Cardinal in reaching 50% emergence (Data not shown) but row spacing did not affected this parameter. Similarly per cent emergency was numerically higher in variety Desiree (86.38%) as compared to 82.18% of Cardinal. Spacing and interaction, however have no significant effect on percent emergence. It is as expected because at the early stage of growth of the plant is dependent primarily on nutrients from the tubers and there would be little competition to affect the emergence of the plants.

**Plant height and spread:** Plant height and spread represent vegetative growth of the plant. Cardinal has higher significantly greater plant spread after 40 days of sowing while the plant height became significant only after 60 days. After 80 days of sowing both plant height and spread were significantly higher (40.52 and 59.65 cm) in Cardinal as compared to 31.37 and 43.56 cm in Desiree. Neither the spacing nor interaction has any significant effect on height and spread. These results indicated that variety Cardinal was superior in vegetative features than Desiree. Moreover, the minimum spacing provided in this experiment (50 cm spacing) seems to exert no competition. Because if the plants were in competition, the decreasing the row spacing to spacing to 50 cm would have caused poor vegetative growth than larger row spacing.

**Number of stems per plant:** Variety Cardinal was superior in number of stems per plant. There was a numerical difference of 1.37 in number of stems per plant in Cardinal and Desiree. The effect of spacing and interaction between variety and spacing on number of stems/plant was non-significant. As expected from the growth data, there is no evidence of plant competition in 50 cm spacing to affect the performance of the plants.

**Total yield:** Various varieties differ in their yield potential Shuja (1987) and thus yield differently under similar agro-climatic conditions. Data presented in Table 1 reveals that Cardinal is superior than Desiree in yield potential. It produced significantly high yield (12.76 t ha<sup>-1</sup>) as compared to Desiree (8.78 t ha<sup>-1</sup>). The yield of both varieties showed an inverse relation with plant population density. The maximum yield 13.91 and 13.52 t ha<sup>-1</sup>, in Cardinal and Desiree was at 50 cm spacing which decreased by 2.15 and 3.60 tones in Cardinal and 4.02 and 3.13 tones in Desiree with row spacing of 75 and 100 cm (Table 1). Thus as row spacing was increased to 100 cm. The overall decrease in yield relative to 50 cm spacing in Cardinal and Desiree was 5.75 and 7.15 tones t ha<sup>-1</sup> respectively. These results confirm the earlier reports of Iman and Shuja (1983). As could be predicted from the plant growth data that the minimum spacing (50 cm) used in this experiment did not show any negative affect on the vegetative performance of the plant (Table 1). It indicate that there was no competition even in the minimum spacing (50 cm). The yield seems to be in inverse relation with population density. Decreasing row spacing to 50 cm increased the number of plant and yield/ha. accordingly. Similarly when there were small number of plants in 100 cm spacing, it resulted in decreased yield. It is also reasonable to assume that in the absence of competition in plant at narrow spacing (50 cm), high population density may have actually improved the soil moisture situation. Thus two factors (large number plants per unit land and good moisture conservation) contributed to the high yield in 50 cm spacing. By contrast the lower yield in 100

Table 2: Effect of row spacing on weight of different grades of potato cv. Cardinal and Desiree

Spacing (cm)	Weight for small tubers/plot (kg)			Weight of medium size tubers/plot (kg)			Weight of large size tubers/plot (kg)		
	Desiree	Cardinal	Mean	Desiree	Cardinal	Mean	Desiree	Cardinal	Mean
50	2.06	2.99*	2.53 A	3.56A	2.98AB	3.27A	6.44	6.91	6.68 <sup>NS</sup>
75	1.64	2.01	1.82 A	2.41BC	3.40A	2.90A	4.68	7.21	5.94
100	0.71	1.25	0.98 B	1.63D	2.12CD	1.88B	3.39	5.58	4.49
Mean	1.47	2.08		2.53	2.83		4.24B	6.57A	

Means followed different letters are significant at 5% level of significant.

cm spacing is caused by the above mentioned factors operating in opposite direction.

**Tuber grades:** The size of the tuber affect the growth and yield of potato crop. Medium size tubers are required as seed potato (Krishnappa 1991) while relatively large size is generally used for table purposes. The small size tubers are undesirable for both seed and table purposes. Potato tubers are generally graded into small (< 20 mm), medium (20-40 mm) and large size (>40 mm). Such grading is important to adjust to the grower choice depending on the use of tuber potato for seed or table purposes (Farid, 1990). Variety Cardinal produced the highest number of small size tubers were observed in 50 cm spacing in both varieties. The number of small size tubers decreased to 0.98 and 0.7 kg/plot in Cardinal and Desiree accordingly as spacing was increased to 100 cm. The weight of medium size tubers followed comparable trends. It was more with 50 cm spacing (Table 2). The tubers grades confirm our conclusion that there was no competition at 50 cm row spacing. Increasing row spacing beyond 50 cm simply decrease the land utilization and thus decrease the yield of the crop. Since increased row spacing to 100 cm decreased the yield and hence all grades of potato tubers. Thus the weight of various size tubers is a function of total yield in each spacing. These results clearly indicate that potato can be grown at 50 cm spacing without serious effects of competition. The said row spacing may help in full utilization of land. Increasing row spacing with the assumption to improve the available nutrients,

in soil conditions of Peshawar, is not cost effective. By contrast it decrease plant population density that may decrease the yield of potato crop.

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