GAU Research Journal 44 (4) : 206-209 (October, 2019)

Effect of spacing and fertility levels on growth and yield of carrot (*Daucus carrota L.*) cv. GDC 1

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Received: 23 August, 2018 Accepted: 26 August, 2019

ABSTRACT

Carrot is one of the major vegetable crops grown throughout the world and considered to be an important economical vegetable as it has large yield per unit area. The inclusion of carrots in human diet is highly appreciated due to high nutritional and positive impact on human health and immunity systems. This is cheaply available and is equally consumed by poor and rich people in India. The popularity of carrot is increasing day by day due to its high nutritive values and adaptability in diversified agriculture. Plant spacing is one of the important factors for the increased production of carrot. To augment the potential yield of carrot, nutrient management plays a vital role. Different types of fertilizer affect the yield and nutritional quality of carrot. Crop sown at 15 and 30 cm row spacing recorded statistically an equal root length but significantly longer than broadcasting. Carrot sown at 30 cm row spacing confirmed significantly the maximum root girth and it was the lowest when carrot sown by broadcasting. Application of 80 % RDF recorded the maximum root length as well as girth and was at par with 100 % RDF but these both the levels were significantly superior to the maximum fertility level i.e. 120 % of RDF. Both the line sowings were at par and recorded significantly higher root yield than broadcasting on pooled basis. Application of 80 % RDF recorded the significantly the maximum root yield of carrot and remain at par with 100 % of RDF. The root weight augmentation could be due to the increased vegetative growth and hence increased food production and assimilation into parts. But with excess application of N-fertilizer more of above ground vegetative growth is favored than root growth, so that low root weight could result at higher level of N fertilizers. However, narrow spacing and higher fertility levels increased fodder yield. Application of 80% RDF recorded the maximum gross (Rs.2,12,800/ha) and net profit (Rs.1,67,588/ha) as well as BCR (3.71) values.

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Carrot (*Daucus carota L.*) is one of the most important root vegetables of both tropical and temperate countries. It produce an enlarge fleshy taproot that is edible and possesses high nutritive value. The popularity of carrot is increasing day by day due to its high nutritive values and adaptability in diversified agriculture. Carrot is used as salad, cooked as vegetables preferably with potatoes and peas. Carrot juice is becoming popular day by day. A special type of beverage known as kanji is prepared from black carrot and used as appetizer. It is used in making pickles and sweets. Orange coloured roots of carrot contain more carotenes than red colored type and rich in thiamine and riboflavin.In north Gujarat region, the farmers of patan taluka widely grown carrot. Sowing time and spacing are non cash inputs for remunerative production of carrot. Plant spacing is one of the important factors for the increased production of carrot. Carrot yield is also adversely affected by planting density. McCollum *et al*. (1986) reported that there is positive correlation between the number of plants and yield of carrot. But many workers have reported that different plant densities have different effect for marketable yield of carrot (Dragland, 1986). Soils of North Gujarat are light in texture which is in generaly poor in fertility and water holding capacity. To augment the potential yield of carrot, nutrient management plays a vital role. The cost of chemical fertilizer has been enormously increasing to an extent that they are out of reach of

the small farmers. Different types of fertilizer affect the yield and nutritional quality of carrot. Nitrogen (N) is not only an important element for the growth of but carrot but it also affects the nutritional quality of the carrot roots (Kansal, 1981). No scientific information for the region on these aspects regarding newly developed variety i.e. GDC 1. Hence, an experiment was planned at SSRS, SDAU, Jagudan to evaluate the optimum spacing and nutrient requirement of carrot cv.GDC 1.

MATERIALS AND METHODS

To find out the effect of spacing and fertility levels on growth, yield and quality of carrot (*Daucus carrota L.*) cv. GDC 1, an investigation was carried out at Seed Spices Resarch Station, Sardarkrushinagar Dantiwada Agricultural University, Jagudan during rabi 2014-15 to 2016-17. Soil texture was loamy sand in nature with low in organic carbon (0.18 %) and nitrogen as well as medium in available phosphorus and potassium. Two factors viz., spacing: 15 cm, 30 cm and broadcasting as well as fertility levels: 80 % RDF, 100 % RDF and 120 % RDF were studied and laid out in Factorial Randomized Block Design with three replication. The carrot seeds were sown manually at about 2-3 cm deep in furrow for line sowing and spread by hand in broadcasting method. The entire quantity of phosphorus and half of nitrogen in the form of DAP and urea were manually applied as basal dose. All the recommended package of practices was performed during the crop period as per need.

RESULTS AND DISCUSSION

Growth and yield attributes:

Effect of spacing

As compared to broadcasting, line sowing improved the growth and yield attributes of carrot significantly except number of tillers per plant (Table 1) on pooled data basis. The tallest plants were recorded with 15 cm spacing and was at par with broadcasting these both were significantly superior when carrot sown at 30 cm row spacing. Crop sown at 15 and 30 cm row spacing recorded statistically an equal root length but significantly longer than broadcasting. Carrot sown at 30 cm row spacing recorded significantly the maximum root girth and it was the lowest when carrot sown by broadcasting method. This might be because the wider spacing reduced the competition for soil nutrients, moisture, carbon dioxide and light among the plants. This probably enhanced photosynthesis which resulted in the production of more leaves and wider canopies. This result is in agreement with the results of Appiah *et al* (2017) reported that wider spacing i.e. 25 cm improved the vegetative growth and yield attributes of carrot.

Effect of fertility levels

Only root length and girth were significantly influenced by various fertility levels. Application of 80 % RDF recorded the maximum root length as well as girth and was at par with 100 % RDF but these both the levels were significantly superior than the maximum fertility level i.e. 120 % of RDF (Table 1). This might be due to the balanced supply of plant nutrients which provided better soil condition for more vegetative growth and development. Interaction effect between spacing and fertility levels was found non significant on growth and yield attributes of carrot.

Root and fodder yields

Effect of spacing

Both the line sowings were at par and recorded significantly higher root yield than broadcasting on pooled basis (Table 1). The widely spaced plants produced longer roots than the closely spaced plants. This might be due to reduced competition for essential soil nutrients and sunlight which probably promoted the accumulation of photosynthates in the roots. Norman (1992) observed that higher plant density per unit area or closer spacing increases the competition for essential growth factors among individual plants which do not attain their normal size. However, fodder yield was not influenced significantly by varying spacing treatments (Table 1).

Effect of fertility levels

On pooled data basis, increase in each

fertility levels from 80 to 120 % RDF decreased root yields significantly. Application of 80 % RDF recorded the significantly the maximum root yield of carrot and remain at par with 100 % of RDF (Table 1). Tanveer Ahmad *et al.* (2015) reviewed briefly the scope of application of chemical fertilizers for sustainable productivity and quality of carrot roots. The current result conform the indirect effect of N-fertilization for increased root weight in carrot. The root weight augmentation could be due to the increased vegetative growth and hence increased food production and assimilation into parts. But with excess application of N-fertilizer more of above ground vegetative growth is favored than root growth, so that low root weight could result at higher level of N fertilizers. Neither spacing nor fertility levels had positive effect on fodder yield during individual as well as on pooled data basis. However, narrow spacing and higher fertility levels increased fodder yield (Table1).The increase in carrot fodder yield might be attributed to excess N- fertilizer application could be associated with the enhanced vegetative growth of carrot rather than root development (Wudiri and Henderson,1985).

ECONOMICS

The maximum gross realization of Rs. 2,04,400 Rs/ha and net income Rs.1,56,891 /ha were obtained when carrot sown at 15 cm row spacing and closely followed by 30 cm spacing,but 30 cm row spacing recorded the maximum BCR value i.e. 3.32 (Table 4).Application of 80% RDF recorded the maximum gross (Rs.2,12,800/ha) and net profit (Rs.1,67,588/ha) as well as BCR (3.71) values(Table 2). From these results it can be concluded that cultivar GDC 1 performed better when sown at 30 cm row spacing with application of 80 % RDF i.e. 80:40:40 kg NPK/ha for getting the maximum root yield and net profit.

CONCLUSION

From the study, it can be concluded that carrot variety GDC 1 grown at 30 cm row spacing with 80 % RDF i.e. 80:40:40 kg NPK/ha for getting the maximum root yield and net profit.

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Table 1 Growth and yield attributes and yields of carrot as influenced by different spacings and fertility levels (Pooled data)

Sr. No.	Treatment	Plant height (cm)	No. of tillers per plant	Root length (cm)	Root girth (cm)	Carrot root yield (t/ha)	Carrot fodder yield (t/ha)
		Spacing					
1	15 cm	65.4	7.8	21.3	12.7	29.2	11.8
2	30 cm	60.2	7.9	20.8	13.2	28.4	11.3
3	Broadcasting	63.6	7.6	19.6	12.1	26.1	11.4
	S. Em.	0.8	0.1	0.26	0.15	0.47	0.16
	C. D. @5%	2.3	NS	0.7	0.44	1.33	NS
	C.V.%	6.9	6.1	6.4	6.3	8.7	7.3
		Fertility levels					
1	80 % RDF (80:40:40 NPK kg /ha)	63.8	7.8	21.1	13.1	30.4	11.0
2	100 % RDF (100: 50:50 NPK kg /ha)	62.0	7.8	21.0	12.9	27.5	11.7
3	120 % RDF (120: 60:60 NPK kg /ha)	63.4	7.7	19.5	12.0	25.8	11.9
	S. Em.	0.8	0.1	0.26	0.15	0.47	0.16
	C. D. @5%	NS	NS	0.7	0.44	1.33	NS
	C.V.%	6.9	6.1	6.4	6.3	8.7	7.3
Interaction (S x F)		NS	NS	NS	NS	NS	NS

Table 2 Economics of carrot as influenced by different spacing and fertility levels

Sr. No.	Treatment	Root yield (t/ha)	Gross realization (Rs/ha)	Cost of cultivation (Rs/ha)	Net Realization (Rs/ha)	BCR
		Spacing				
1	15 cm	29.2	2,04,400	47,508	1,56,891	3.30
2	30 cm	28.4	1,98,800	46,064	1,52,735	3.32
3	Broadcasting	26.1	1,82,700	47,508	1,35,191	2.85
		Fertility levels				
1	80 % RDF (80:40:40 NPK kg /ha)	30.4	2,12,800	45,212	1,67,588	3.71
2	100 % RDF (100: 50:50 NPK kg / ha)	27.5	1,92,500	46,064	1,46,435	3.18
3	120 % RDF (120: 60:60 NPK kg / ha)	25.8	1,80,600	46,917	1,33,683	2.85

Selling price of carrot: Rs.7/kg