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Effect of nitrogen on growth and yield of beet root (*Beta vulgaris*)

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Abstract

A field experiment was conducted to study the effect of nitrogen on growth and yield of beet root (*Beta vulgaris*) during *rabi* season 2020-21 at S.K.N. College of Agriculture, Jobner (Rajasthan). The experiment consisted of Twelve treatment combinations including four nitrogen levels (control, 30 kg N/ha, 60 kg N/ha and 90 kg N/ha) and three treatments of plant geometry (15 cm x 10 cm, 30 cm x 10 cm and 45 cm x 10 cm) were under taken in a factorial randomized block design with three replications. The application of 60 kg nitrogen was significantly. However, 60 kg nitrogen significantly increased plant height (42.47 cm), No. of leave plant (16.53 cm leaf area, (cm^2) (1.05), chlorophyll content (mg/100 g) (5.14g), yield per plot (26.16 kg), yield (261.60 q), net return (Rs/ha) 174 601.21/ ha and B: C ratio (2.01)

Key words: Geometry, Nitrogen, Growth , Yield, Plant height

Beet root (*Beta vulgaris* L.) is additionally referred to as garden beet or table beet. It is one of the major root vegetable crop within the chenopodiaceae family with chromosome number of 2n=18. Beet root originated in Mediterranean region and North Africa region wherever they were cultivated to feed humans and eutherian mammal. It is vital cool season annual root crop whereas biennial for seed production. Beet root is grown mostly in northern and southern parts of India. The beetroot growing was found to be profitable compared to the existing cropping systems within the post rainy season in Rajasthan, Punjab, Haryana, Maharashtra and North Karnataka (Kulkarni *et al.*, 2013). Beetroot contain between 16-18 percent sucrose and have a vital role within the sucrose industry (Harveson, 2011). It have the natural food that boosts the energy in athletes because it contains one of the highest nitrates and sugar contents.

In India, beet root is mostly grown in September to November in northern plains whereas in southern plains the sowing is done from July to November while March and July in hills. The seeds are planted at a depth of about 2.5 cm to confirm good germination with 45-60 cm x 8-10 cm distance. Nitrogen plays important role physiological and chemical characteristics of the crop. So nitrogen may cause fascinating impact on sugar beet growth and yield characters (Kadam *et al.,* 2018). Nitrogen has the best effects on root yield and quality of sugar beet (Sincik M. and Canigenis T., 2016).Nitrogen is the macronutrient needed for sugarbeet growth and the second most limiting nutrient in crop production (Hergert, 2012). Plant nitrogen demand largely with inorganic N equipped by the soil, biological fixation, or by the applying of commercial fertilizers (Galloway *et al.*, 2003). Therefore, an experiment was conducted.

The experiment comprised 12 treatment combinations, *viz,* four nitrogen levels, viz. control (N_1), 30 kg/ha (N_2), 60 kg/ha (N_3) and 90 kg/ha (N_4) and three levels of plant spacing *viz.,* 15 cm x 10 cm (S_1), 30 cm x 10 cm (S_2) and 45 cm x 10 cm (S_3). As per treatments nitrogen was applied through urea in three doses. The half dose of nitrogen was given of at the time of planting, while remaining was administered 20 days after sowing (DAS). The applications of nitrogen was done as control (N_1), 30 kg/ha (N_2), 60 kg/ha (N_3) and 90 kg/ha (N_4) through urea. The plant height was measured from soil surface up to tip of leaves with the help of measuring scale and average was worked out. Height of the five randomly selected and tagged plants were measured at 45 days after planting and at harvesting stage.

The number of leaves from five randomly selected plants of each plot was counted 45 days after sowing and at harvesting stage. The average was computed and expressed as number of leaves per plant. The five tagged plants were also used for leaf area measurement 45 days after sowing. The leaf area was measured with the help of leaf area meter. The average leaf area (cm^2) was recorded as mean value to calculate total leaf area (cm^2) per plant. The chlorophyll content of leaves was determined 45. The representative fresh leaf samples were taken. These were washed with distilled water and dried with blotting paper. Out of this, 100 mg fresh leaves were taken in mortar and ground well by pestle with 5 ml 80 per cent acetone and centrifuged at 2000 rpm for 10 minutes and filtered through Whatman filter paper No. 1. Volume of supernatant was made to 10 ml with 80 per cent acetone.

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The resultant intensity of colour was measured on Spectronbic-20 at Absorance (A) of 652 nm.

Total chlorophyll content was calculated with the help of following formula and expressed in mg g^{-1} fresh weight of leaves (Arnon, 1949).

$$\text{Total chlorophyll (mg/g leaf weight)} = \frac{A(652) \times 29 \times \text{Total volume (ml)}}{\alpha \times 1000 \times \text{Weight of sample (g)}}$$

where,

α is the path length = 1 cm.

After cutting leaves, roots were weighed on digital balance and root yield per net plot was recorded in kilogram. Per (q/ha) after cutting the leaves, roots were weighed on digital balance and root yield per net plot was recorded in kilogram which was converted into quintal per hectare of the economics of the treatments is the most important consideration for making any recommendation to the farmer for its wide adoption. To calculate economics, the average treatment yield along with prevailing market rates of the produce and cost of inputs were used. The net return was calculated by subtracting cost of cultivation for each treatment from gross return gained from the economic yield. B:C ratio was computed by dividing net return by cost of cultivation for each treatment.

These finding were reported by previous worker also indicated that suitable of nitrogen at split doses increased vegetative growth of plant by activation in physiological and biochemical process. Nitrogen plays an important role to stimulate growth and development *i.e.* vegetative growth, impart deep green colour of the leaves etc. that's why expanded quicker growth and more number of leaves with high chlorophyll content (Hussein and Hanan, 2014).This might be due to required quantity of nitrogen was supplied for proper development and foliage colour of beetroot because nitrogen elements is important and super molecule for chlorophyll development.

The positive effect of nitrogen on growth by providing balanced environment features both is soil and in plant system (Kandil *et al,*. 2004 and Dadashpour A and Jonk M. 2012). Plant density of 30 × 10 cm exhibited maximum plant height (23.90 cm and 41.96 cm at 45 DAS and at harvest), number of leaves per plant (9.80 and 15.90 at 45 DAS and at harvest), leaf area (193.60 cm^2) and chlorophyll content (4.98 mg/100g) followed by 45 × 10 cm plant spacing (S_3) as reported similar with S_2 in beetroot. Plants which are widely spaced produced more number of leaves and wider canopies. 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. When there is optimum spacing growth parameters also increase due to free availability of space, nutrient, air, water, sunlight and others. Canopy width is important to determine plant spacing for its contribution to total amount of light that plant intercepts for photosynthesis efficiency of crop. Plant density has been recognized as a significant consider decisive the degree of competition between plants (Sadre *et al.*, 2012).

Similarly the soil application of 60 kg nitrogen per ha significantly increased the yield and yield attributes like yield per plot and yield per hectare of beetroot followed by 90 kg nitrogen per ha as reported as at par with N_3 in beetroot.The significantly important in yield and yield attributes on account of application of important nitrogen fertilization might have attributed to the translocation of nutrient from soil, further, increased vegetative growth might have provide more sites of translocation of photosynthetes, which ultimately resulted increased in yield (Moniruzzaman *et al.* 2013). During this respect, increasing nitrogen application as soil chemical recorded considerably increase length, diameter and weight of roots. sowing of beetroot at 30 × 10 cm plant spacing significantly influenced the maximum yield attributes like), yield per plot (24.77 kg), yield per hectare (247.74 q) of beetroot followed by 45 × 10 cm of plant density (S_3) as reported as at par with S_2 in beetroot.

These results suggest that an ideal plant population is needed for proper distribution of photosynthetic rate, with consequent increase in root yield. The interaction effect between soil application of nitrogen and different levels of plant spacing on the maximum in yield and yield parameters on beetroot were reported effective under N_3S_2 treatment where 60 kg N per ha as soil application along with 30 x 10 cm plant spacing (Table 4.7 and 4.8). The maximum yield per plot (26.66 kg) and total yield per hectare (266.62 q) were recorded in N_3S_2. The interaction effect between soil application of nitrogen and different levels of plant spacing on the maximum in yield and yield parameters on beetroot were reported effective under N_3S_2 treatment where 60 kg N per ha as soil application along with 30 x 10 cm plant spacing (Table 4.7 and 4.8).

The maximum yield per plot (26.66 kg) and total yield per hectare (266.62 q) were recorded in N_3S_2.This treatment combination was reported best on production point of view. These results might be due to availability of adequate amount of essential nutrients as well as suitable sunlight, water, air and less of crop competition to the plants along with balanced form of nitrogen amount to the plant. Beetroots are produced good yield if they gain good nitrogen amount and spacing with in row (Fikru, 2017 and Gupta A K and Tripathi V K. 2012). These finding are close conformity with Desuki *et al.* (2005) in carrot, Khogli *et al.* (2012) in fodder beet and Tripathi *et al.* (2017) in radish.

Table 1: Effect of Nitrogen and plant geometry on yield attributes of beetroot.

Treatment	Yield per plot (kg)	Yield per ha (q)	Net return (Rs/ha)	B: C ratio
N1 (control)	20.56	205.60	120698.59	1.42
N2 (30 kg)	24.48	244.80	158232.32	1.83
N3 (60 kg)	26.16	261.60	174601.21	2.01
N4 (90 kg)	26.03	260.30	172567.22	1.97
SEm+	0.46	1.21	3807.87	0.04
CD (p=0.05)	1.31	3.47	10901.64	0.11
Plant spacing				
S1 (15 cm x 10 cm)	23.47	234.74	148171.50	1.71
S2 (30 cm x 10 cm)	24.77	247.74	161191.50	1.86
S3 (45 cm x 10 cm)	24.67	246.74	160211.50	1.85
SEm+	0.40	1.05	3297.71	0.03
CD (p=0.05)	1.13	3.00	9441.10	0.09

Table 2: Interactive effect of nitrogen and plant geometry on root yield (q/ha)

Treatment	N_1	N_2	N_3	N_4	Mean
S_1	198.53	236.39	252.61	251.35	234.72
S_2	209.55	249.50	266.62	265.30	247.74
S_3	208.72	248.57	265.57	264.25	246.77
Mean	205.60	244.82	261.60	260.30	
SEm±	4.57				
CD (p=0.05)	13.09				

CONCLUSION

Thus, it is concluded that application of nitrogen of 60 kg/ha with 30 cm x 10 cm plant spacing was best to obtain yield. A combination of treatment also showed maximum net return (Rs, 179, 624/ha) with highest B:C ratio (2.06) statistically.

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