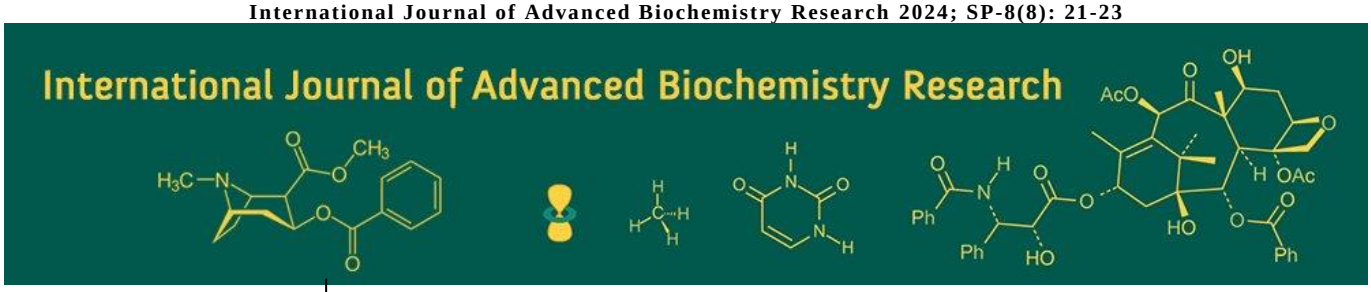

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Influences of inorganic fertilizer on yield of beet root (*Beta vulgaris* Subsp. vulgaris L.)

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Abstract
A field experiment was conducted to study the during *rabi* season of 2020-21 at Horticulture Farm, 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 & 90 kg N/ha) and three treatments of plant geometry (15 x 10 cm, 30 x 10 cm & 45 x 10 cm) were under taken in factorial randomized block design with three replications. The results of the study clearly indicated that application of 60 kg nitrogen to beetroot significantly. However, the level of 60 kg nitrogen was significantly increased Root length (15.27 cm), Root diameter (5.27 cm) Root: shoot ratio (1.05 cm^2) Fresh root weight (181.73 mg/100 g), followed by 90 kg nitrogen per ha as reported as at par with N_3 in beetroot.

Keywords: Beetroot, geometry, nitrogen, growth and yield

Introduction
Beetroot (*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. Beetroot 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. Beetroot 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) [10].

It was used as medicine in Indian ancient time specially to enhance the activity of steroid hormone. It was rank among the ten most potent vegetables with relevance to antioxidant property. Additionally, it is also used as a food colorant, notably betanin is used as red food colorants (To enhance the colour of tomato paste, souce, desserts, jam and jellies, ice-cream, sweets and breakfast cereals).

It is a biennial halophytic further more Na- salts scavenger C_3 plant containing up to 20 percent sugar on contemporary weight basis. The storage organ of this plant is usually called the root where 90 per cent is actually root derived and the remaining 10 per cent (the crown) is comes from the hypocotyls (Shrivastava *et al.*, 2013) [14].

Beetroot could be a made source of protein, carbohydrate, calcium, phosphorus and vitamin C. Hence, it is a perfect vegetable for health aware people (Deuter and Grundy, 2004) [2]. Red colour of roots is due to presence of beta nine pigment. It have many healthful properties and helps in reduction of cardiovascular diseases and peripheral vascular diseases. Beetroot helps to cut back blood pressure, prevents plaque formation and reduces bad cholesterol, keeps diabetes under check, treat anaemia, facilitate to alleviate fatigue, improve sexual health and stamina, protects from cancer etc. It is rich in vitamin and does not contain vital quantity of biological process factors like fat. Beetroot could be a made supply of carbohydrate (8.8 g), protein (1.7 g/100 g), calcium (200 mg), phosphorus (55 mg), minerals (0.8 g) and vitamin C (88 mg). Green leaves are rich in iron (3.1 mg), vitamin A (2100 I.U.), thiamine (110 µg) and ascorbic acid (50 mg/100 g) (Bhat, 2007) [1].

Beetroot contain between 16-18 percent sucrose and have a vital role within the sucrose industry (Harveson, 2011) [5]. 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.

The growth and yield of beet root is influence by many factors like environment, soil, nutritional, attack of pest and disease and cultivation practices. In the nutritional, nitrogen is vital and major nutrients has great role in its production. 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) [8]. Nitrogen has the best effects on root yield and quality of sugar beet (Sincik and Canigenis, 2016) [15].

Nitrogen is the most significant plant nutrient that is applied to beets in commercial production, because, it is a part possibly to be deficient in arable soils. Nitrogen is the macronutrient needed for sugarbeet growth and the second most limiting nutrient in crop production (Hergert, 2012) [6]. Nitrogen is absorbed by plants in the form of nitrate or ammonical element. It makes plant dark green, additional succulent and also the larger cells with dilutant walls. Additionally, nitrogen will increases the assembly of dry matter and reduces the proportion of calcium in plant tissues. Plant nitrogen demand largely with inorganic N equipped by the soil, biological fixation, or by the applying of commercial fertilizers (Galloway *et al*., 2003) [3].

Materials and Methods

The study was conducted to study the during rabi season 2020-21 at Horticulture Farm, S.K.N. College of Agriculture, Jobner (Rajasthan). The experiment comprised of 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 x 10 cm (S_1), 30 x 10 cm (S_2) and 45 x 10 cm (S_3).

As per treatments nitrogen was applied through urea in three doses. First dose half quantity of urea at the time of sowing and remaining two doses of treatment were given at 20 DAS and 35 DAS. Nitrogen was given as treatment *viz*., Control (N_1), 30 kg/ha (N_2), 60 kg/ha (N_3) and 90 kg/ha (N_4) through urea.

Root length (cm)

The length of root of same plants was measured in centimeter with the help of meter scale from the proximal end of the roots to the last point of the tapered end of the root (distal end) in each treatment and average length of root was drawn.

Root diameter (cm)

The diameter of roots from the thickened portion of the plant was measured with the help of Vernier calipers at harvest stage.

Root: shoot ratio

The leaves of selected plants were removed and weight of leaves and roots, were recorded separately. The ratio of leaf to root per cent was calculated by dividing the weight of leaves by weight of roots.

Fresh root weight (g)

Weight of head of tagged plants was taken after removing stem and leaves from each plot and average weight of head per plant was calculated with the help of electronic weighing machine.

Results and Discussion

Yield and Yield attributes

Similarly the soil application of 60 kg nitrogen per ha significantly increased the yield and yield attributes like Root length (15.27 cm), Root diameter (5.27 cm) Root: shoot ratio (1.05 cm^2) Fresh root weight (181.73 mg/100 g) 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. During this respect, increasing nitrogen application as soil chemical recorded considerably increase length, diameter and weight of roots.

The result of previous review might have similar with Shalaby *et al.* (2003) [13] in sugarbeet, Trani *et al.* (2005) [17] in table beet, Jambukar and Wange (2006) [16] in beetroot, Jilani *et al.* (2010) [18] in radish and Moniruzzaman *et al.* (2013) [11] in carrot.

During this respect, increasing nitrogen application as soil chemical recorded considerably increase length, diameter and weight of roots. sowing of beetroot at 30 x 10 cm plant spacing significantly influenced the maximum yield attributes like), Similarly, sowing of beetroot at 30 x 10 cm plant spacing significantly influenced the maximum yield attributes like root length (14.52 cm), root diameter (5.06 cm), root to shoot ratio (1.00), fresh weight of root (176.25 g), Many reviewer have also shown that spacing altered the plant architecture, photosynthetic efficiency of leaves, root size and root production pattern. These results are close conformity with the finding of in fodder beet, Bauskar (2015) [19], Fikru *et al.* (2017) [20] and Kadam *et al.* (2018) [8] in beetroot.

Table 1: Effect of nitrogen and plant geometry on root length and root diameter of beetroot

Treatments	Root length (cm)	Root diameter (cm)
Nitrogen		
N_1 (Control)	12.13	3.68
N_2 (30 kg/ha)	14.07	4.87
N_3 (60 kg/ha)	15.27	5.27
N_4 (90 kg/ha)	15.20	5.22
S.Em±	0.27	0.09
CD (p=0.05)	0.77	0.27
Plant spacing		
S_1 (15 x 10 cm)	13.70	4.26
S_2(30 x 10 cm)	14.52	5.06
S_3(45 x 10 cm)	14.28	4.97
S.Em±	0.23	0.08
CD (p=0.05)	0.67	0.23

Table 2: Effect of nitrogen and plant geometry on fresh weight of root and root: shoot of beetroot

Treatments	Root weight (gm)	Root: Shoot ratio
Nitrogen		
N_1 (Control)	152.45	0.84
N_2 (30 kg/ha)	160.32	0.89
N_3 (60 kg/ha)	181.73	1.05
N_4 (90 kg/ha)	179.67	1.00
S.Em±	3.15	0.02
CD (p=0.05)	9.02	0.05
Plant spacing		
S_1 (15 x 10 cm)	156.85	0.89
S_2(30 x 10 cm)	176.25	1.00
S_3(45 x 10 cm)	172.52	0.96
S.Em±	2.73	0.02
CD (p=0.05)	7.81	0.04

Conclusion

On the basis of experimental results, it can be concluded that the application of nitrogen of 60 kg per hectare with 30 x 10 cm plant spacing was found best to obtain higher yield attributes Root length (15.27 cm), Root diameter (5.27 cm) Root: shoot ratio (1.05 cm^2) Fresh root weight (181.73 mg/100 g) of beetroot.

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