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The Study Integrated Nutrient Management on Growth, Yield and Yield Attributes of Carrot (*Daucus Carota* L.)

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Abstract

The present investigation was planned and conducted at Department of Horticulture of Udai Pratap Autonomus College, Varanasi during the year 2014-15. To find out the response of various sources of integrated nutrient management on growth attributes with nine fallowing treatment viz. FYM @ 20ton/ha, vermicompost @ 4ton/ha, half FYM @ 10ton/ha + half vermicompost @2ton/ha, green leaf manure @ 5ton/ha + biofertilizer i.e. *Azotobacter* and phosphobacteria each at 5kg/ha, half FYM @ 10ton/ha + biofertilizer i.e. *Azotobacter* and phosphobacteria each at 5kg/ha, half recommended NPK + Half FYM @ 10ton/ha + biofertilizer i.e. *Azotobacter* and phosphobacteria each at 5kg/ha, half recommended NPK + green leaf manure @ 2.5ton/ha + biofertilizer i.e. *Azotobacter* and phosphobacteria each at 5kg/ha, half recommended NPK + half vermicompost @ 2ton/ha + biofertilizer i.e. *Azotobacter* and phosphobacteria each at 5 kg/ha, recommended dose NPK 80:60:60kg/ha respectively. The maximum height of plant at harvesting, length of leaves, number of leaves per plant and fresh weight of leaves were recorded in treatment T_7 (1/2 recommended NPK + ½ green leaf manure + biofertilizer i.e. *Azotobacter* and phosphobacteria each at 5kg/ha) followed by the application of T_9 (recommended dose of NPK @ 80:60:60kg/ha). The yield and yield attributes were significantly improved the various of integrated nutrient management. The maximum length of root, diameter of root, yield per plot (kg), yield per hectare (q) were recorded by the application of T_7 (1/2 recommended dose of NPK + ½ Green leaf manure + Biofertilizer i.e. *Azotobacter* and Phosphobacteria each at 5kg/ha) followed by the application of T9 (Recommended dose of NPK @ 80:60:60kg/ha) besides, improvement in quality parameter were observed by the various sources of integrated nutrient management. The maximum TSS content were recorded by the application of T7 (1/2 recommended dose of NPK + Green leaf manure + Biofertilizer i.e. *Azotobacter* and phosphobacteria each at 5kg/ha). However, the TSS was statistically non-significant.

Keywords: *Azotobacte*; Phosphobacteria; Manure; *Daucus carota*; Fertilizers

Introduction

Among the root crops, carrot (*Daucus carota* L.) is one of them, belongs to family Umbelliferae and richest source of carotene however, sucrose is the most abundant endogenous sugar, which is ten times higher than glucose and fructose. A large number of preparations are done with the carrot roots and are used as vegetables for soups, stews and pies and mostly used as salad in almost all kinds of diets. Tender roots are used as pickles. Gajar halwa is a delicious dish. Its tops can be used as good source for extraction leaf proteins. More ever, carrot tops are used as fodder and for preparation of poultry feeds. In recent years, the concepts of integrated nutrient supply, use or management systems involves efficient and judicious supply of all the major components of plant nutrient sources chemical fertilizers in conjunction with animal manures, compost, green manures, legumes in cropping system, bio-fertilizer, crop residues, or recyclable waste and other locally available nutrient sources for sustaining soil fertility, health productivity. The integrated supply and use of plant nutrients from chemical fertilizers and organic manures have been proved to produce higher crop yields than when each is applied alone. This increase in crop productivity results from their combined effect, the synergistic effect chemical, physical and biological properties of the soil. Fertilizers and manures are the kingpins of improved

technology contributing about 50-60% increase in productivity of vegetables in India, irrespective of soil and agro-ecological zones. But without an integrated supply and use of plant nutrient from chemical fertilizers and organic sources, increased production is not possible. This emphasizes the necessity of an integrated nutrient supply and use with a harmonious combination of chemical fertilizer, organic manures and bio-fertilizers to maximize nutrient use efficiency and minimize their losses and leakage, to achieve the goals of improving and sustaining, the soil fertility, soil water and their quality, as well as socio-economic conditions of the farmers. In order to supply the demand of vegetables for rising population of 21st century, one should be causes to manage nutrients for proper growth of the plant and soil fertility as well. The Integrated nutrient management in carrot cultivation is to obtain better growth attribute carried out during the year 2014-2015 in agro-climatic condition of Varanasi district is hopes that results of these investigations might prove some importance towards successful cultivation of carrot.

Material and Methods

The experiment was conducted during Rabi season of 2014-2015 at main experiment station this farm is situated in main campus of the college at left side of Varanasi-Jaunpur road. The experiment was laid out in a Randomized Block Design and replicated thrice. There were nine treatments and each treatment were allocated randomly in each plot during the year of experimentation.

Application of green leaf manure

Required quantity of green leaves of So-babul was collected from horticultural garden. Required quantity of leaves was incorporated in the plots. After incorporation the whole plots were irrigated, to facilitate the decaying of leaves.

Seed treatment with biofertilizers

Jaggary solution was prepared by dissolving 25g of jaggary in 250ml of water, 50g each of *Azotobacter* and phosphobacteria were added to this solution. Solution was spread on the seeds and mixed thoroughly with the hands to obtain uniform coating. Treated seeds were kept in shade for complete drying. After drying, were sown in experimental plots immediately.

Application of FYM, vermicompost, N, P and K

Well decomposed FYM and vermicompost were applied in required plots before sowing of seeds. It was mixed well in each plot by the light ploughing. In addition to this half quantity of nitrogen and full dose of phosphorus and potassium were applied in plots and remaining quantity of nitrogen were applied in two split doses.

Seed sowing and thinning

After land preparation the seeds are sown in rows in each plot manually. After sowing of seeds, a light irrigation was given to each plot, to facilitate the germination of seed. After germination of seeds, thinning was done in each plot manually, to maintain the required plant population and spacing. The observations were recorded to study the different characters of plants grown in different treatments in each replication. The following characters were studied:

A-Growth attributes

a) Height of plants (cm): After harvesting the height of whole plant were measured by a measuring scale and then the mean height of plants at harvesting was calculated for each plot.

b) Length of leaves (cm): After harvesting the length of leaves of three plants were measured from the base to end of the leaves by a measuring scale and the mean length of leaves was calculated for each plot.

c) Number of leaves/plants: After harvesting the number of leaves of three plants was counted and the mean number of leaves per plant was calculated for each plot.

d) Fresh weight of leaves/plant (gm): After harvesting the weight of three plants leaves were measured by a pan balance and the mean weight of the leaves was calculated for each plot.

B- Yield Attributes

a) Length of roots (cm): After harvesting the length of root of three plants were measured from the base to the marked apex by a measuring scale and the mean length of roots was calculated for each plot.

b) Diameter of root (cm): After harvesting the diameter of root of three plants were measured at the middle portion approximately 2.0 cm. below the shoulder by a verneer calipers and the mean diameter of root was calculated for each plot.

c) Yield per plot (kg): After harvesting and cleaning of roots, weight of roots was taken for each plot by a pan balance in terms of kg.

d) Yield of roots (q/ha): After harvesting and cleaning of roots, weight of roots taken for each plot. The total yield of the experimental area is then converted into q/ha.

C- Quality attributes

a) TSS (%): A hand refractometer was used for the determination of TSS of roots. The hand refractometer was thoroughly washed and cleaned with distilled water and subsequently with early alcohol. After drying, the observed shadow level is adjusted to zero (0) marks with a drop of water and it was then blatted out TSS in degree brix of the provided carrot juice was recorded.

b) Statistical analysis: Statistical analysis of data recorded in all observation were carried out by method of analysis of variance and treatments were compared with the help of critical difference, following the techniques described by Panse and Sukhatme [1] and results were evaluated at 5% level of significance.

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Results

Growth attributes

Height of plants (cm): An examination of data displayed in Table-1 suggested that treatment T_7 (1/2 NPK + ½ Green Leaf Manures + Biofertilizer i.e. *Azotobacter* and Phosphobacteria each at 5kg/ha.) was recorded maximum height of plant i.e. 61.38cm. Which was significantly superior over the treatments T_1, T_2, T_3, T_4, T_5 and at par with T_6, T_8 and T_9 during the year Figure 1.

Table 1: Effect of integrated Nutrient Management on Growth, yield and yield attributes of Carrot. T_1=FYM @20t/ha, T_2=Vermicompost @ 4t/ha, T_3=$^1/_2$ FYM + $^1/_2$ Vermicopost, T_4=Green Leaf Manure @ 5t/ha + Biofertilizers, T_5=$^1/_2$ FYM + Biofertilizers, T_6=$^1/_2$ NPK + $^1/_2$FYM + Biofertilizers, T_7=$^1/_2$NPK + $^1/_2$Green leaf manure + Biofertilizers, T_8=$^1/_2$NPK + $^1/_2$vermicompost + Bio-fertilizers, T_9=Recommended dose of NPK @ 80:60:60kg/ha

Treatments	Plant Height (cm)	Length of Leaves (cm)	Number of Leaves/ Plants	Weight of Leaves per Plant (g)	Length of Root (cm)	Diameter of Root (cm)	Yield per Plot (kg)	Yield of Roots (q/ha)	TSS (%)
T_1	45.46	31.18	8.25	17.42	14.28	2.43	11.14	154.77	7.89
T_2	45.85	31.71	8.47	18.08	14.47	2.53	11.85	162.66	7.74
T_3	44.87	30.73	8.56	17.91	14.14	2.47	11.17	150.05	7.79
T_4	51.07	35.95	9.33	20.16	15.01	2.57	11.95	165.97	7.81
T_5	42.96	28.66	8.3	16	14.3	2.43	10.82	150.35	7.64
T_6	55.59	40.65	10.57	22.41	14.83	2.62	12.21	169.63	7.93
T_7	61.38	45	12.08	25.91	16.37	2.84	15.32	212.84	8.06
T_8	56.41	41.1	11.3	23.33	15.24	2.64	12.8	177.78	7.86
T_9	58.51	43.09	11.43	25.33	15.38	2.69	13.42	186.39	7.44
C.D. at 1%	0.19	0.25	0.27	0.48	0.27	0.14	0.19	0.05	0
C.D. at 5%	0.14	0.18	0.2	0.35	0.2	0.1	0.14	0.07	0

Length of leaves (cm): Data assembled due to influence of various sources of integrated nutrient management on length of leaves (cm) are presented in Table 1 and graphically presented in Fig.-2. The maximum length of leaves i.e. 45.00cm was recorded in treatment T7 (1/2NPK + ½ Green Leaf Manure + Biofertilizer *Azotobacter* and phosphobacteria each at 5 kg/ ha) during the year Further, it was noticed that, this treatment was significantly superior over T_1, T_2, T_3, T_4, and T_5 and at par with T_6, T_8 and T_9 treatments Figure 2.

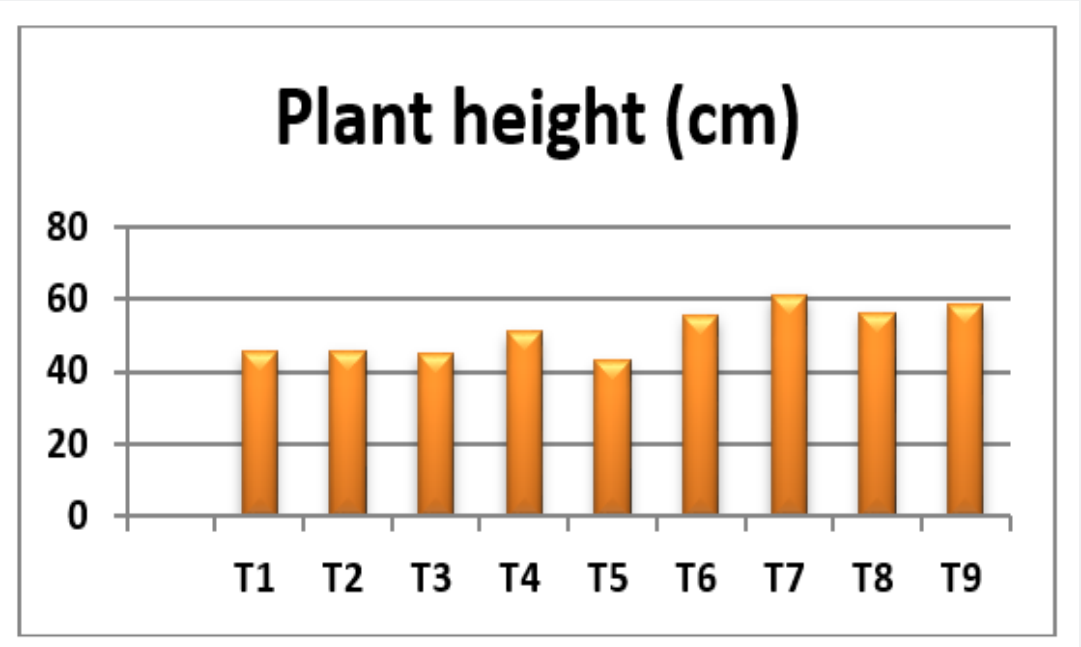

Figure 1: Effect of Integrated Nutrient Management on height of plants (cm).

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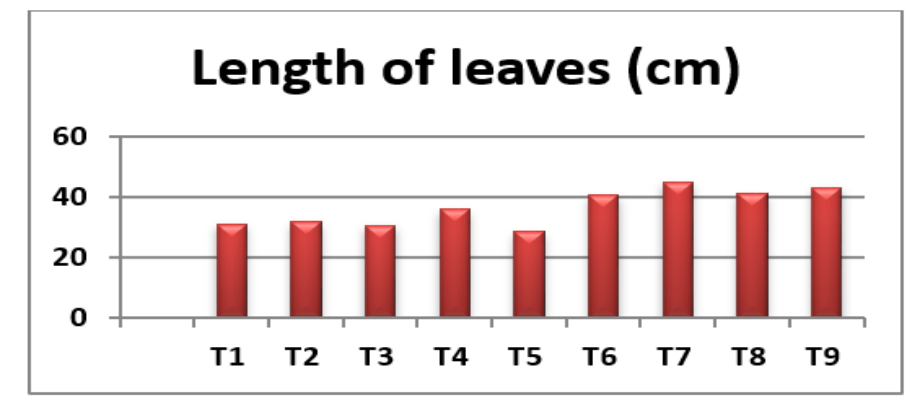

Figure 2: Effect of Integrated Nutrient Management on length of leaves (cm).

Number of leaves/plants: The perusal of data clearly indicated that treatment T_7 (1/2 NPK + ½ Green Leaf Manure + Biofertilizer *Azotobacter* and Phosphobacteria each at 5 kg/ha) was recorded maximum number of leaves/plant i.e. 12.08 followed by treatment T_9 (11.43, Recommended doses NPK @ 80:60:80kg/ha). However, the values were statistically in significant during the year it was presented in Table 1 graphically represented in Figure 3.

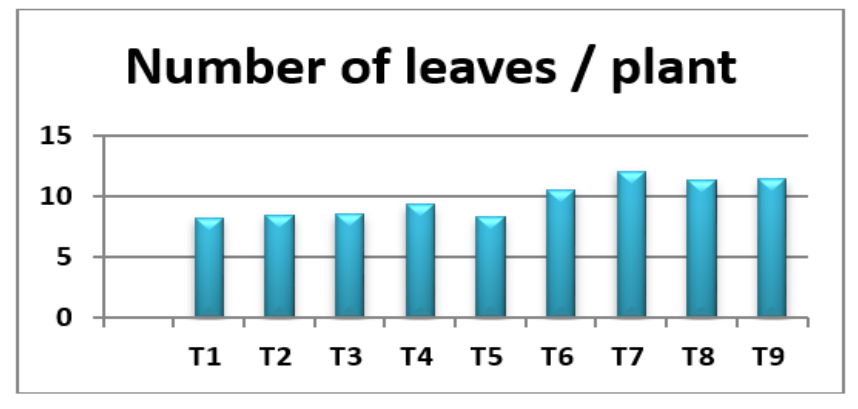

Figure 3: Effect of Integrated Nutrient Management on number of leaves/plants.

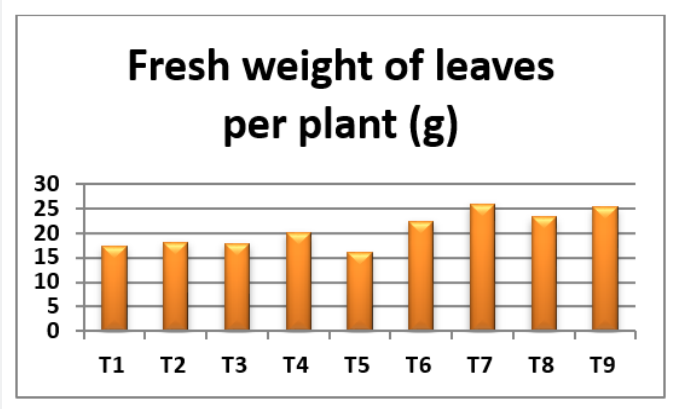

Figure 4: Effect of Integrated Nutrient Management on fresh weight of leaves/plants (g).

Fresh weight of leaves/plant (g): Observation were recorded on account of fresh weight of leaves per plant influenced by various sources of integrated nutrient management have been illustrated in Table 1 and graphically presented in Figure 4. Response of various sources of integrated nutrient management was better in improving the fresh weight of leaves per plant. The maximum fresh weight of leaves per plant i.e. 25.91g with the application of treatment T_7 (1/2 NPK + ½Green Leaf Manure + Biofertilizers

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Azotobacter and phosphobacteria each at 5kg/ha) followed by treatment T9 (25.33, Recommended doses NPK @ 80:60:80 kg/ha) which was significantly superior over the treatments T_1, T_2, T_3, T_4, T_5 and at par with the treatment T_6 and T_8 during the year of experiment.

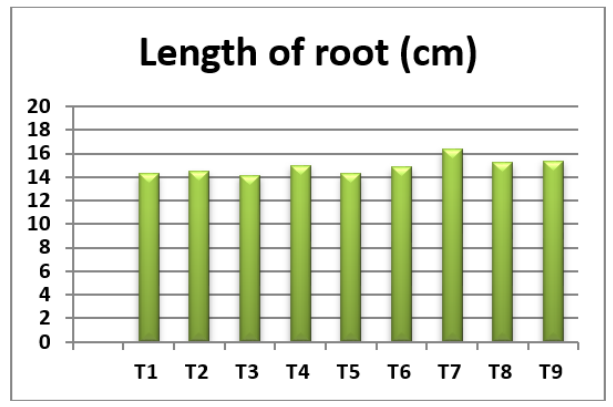

Figure 5: Effect of Integrated Nutrient Management on length of roots (cm).

Yield Attributes

Length of roots (cm): A critical analysis of data indicated that the treatment T_7 (1/2NPK + ½Green Leaf Manure + Biofertilizer *Azotobacter* and phosphobacteria each at 5kg/ha) was recorded highest length of root was 16.37cm. The difference between values were found significantly superior over rest of the treatments Figure 5.

Diameter of root (cm): Data on account of diameter of root (cm) as affected by various sources of integrated nutrient management have been portrayed in Table-1 and graphically presented in Figure 6. The perusal of data was clearly indicated that treatment T_7 (1/2 recommended NPK +1/2 Green leaf manure + Biofertilizer *Azotobacter* and Phosphobacteria each at 5Kg/ha) has recorded maximum diameter of root i.e. 2.84 (cm). However, the values were significantly superior over the treatment T_1, T_2, T_3, T_4, T_5 and at par with treatment T_6, T_8 and T_9.

Yield per plot (kg): Observation the recorded-on account of root yield per plot as influenced by various sources of integrated nutrient management have been illustrated in Table 1 and graphically presented in Figure 7. The maximum yield per plot 15.32 kg was recorded in treatment T_7 (1/2 recommended NPK + ½ Green Leaf Manure + Biofertilizers *Azotobacter* and phosphobacteria each at 5kg/ha). Further, it was noticed that, this treatment was significantly superior over rest of the treatments.

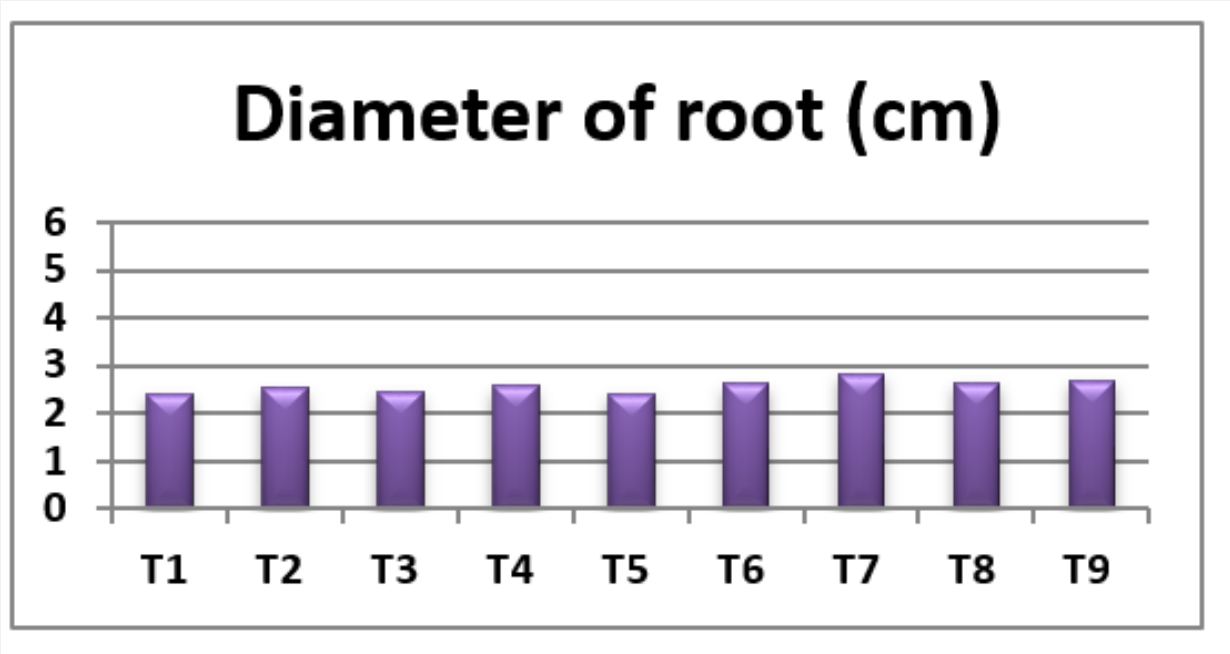

Figure 6: Effect of Integrated Nutrient Management on diameter of root (cm).

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Yield of roots (q/ha): Data gathered towards total yield of root per hectare due to influence of various sources integrated nutrient management have been displayed in Table-1 and graphically represented in Figure 8. A critical analysis of data presented in above table indicated that the different sources of integrated nutrient management significantly improved the yield of root per hectare. The maximum yield of root per hectare was recorded in treatment T_7 (1/2 NPK + ½ Green Leaf Manure + Biofertilizers *Azotobacter* and Phosphobacteria each at 5kg/ha). Further, it was noticed that, it was significantly superior over rest of the treatments.

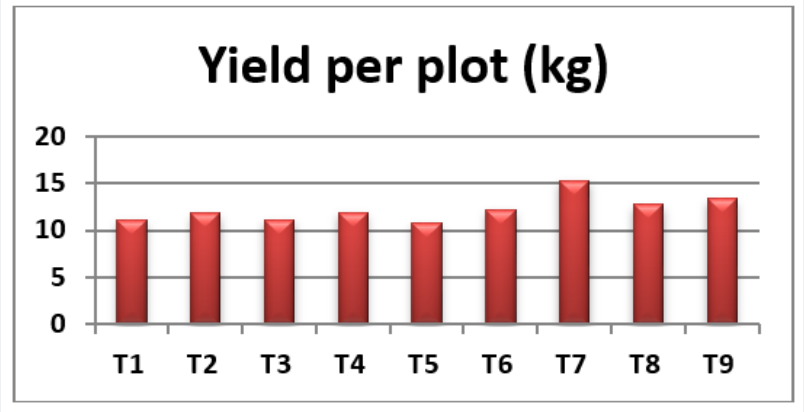

Figure 7: Effect of Integrated Nutrient Management on yield per plot (kg).

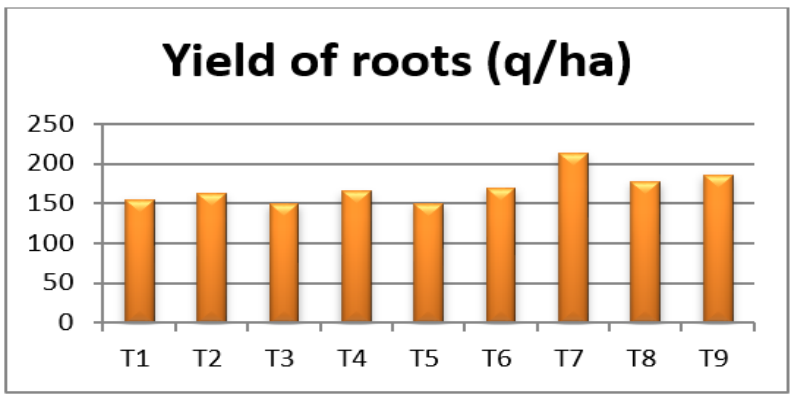

Figure 8: Effect of Integrated Nutrient Management on yield of roots (q/ha).

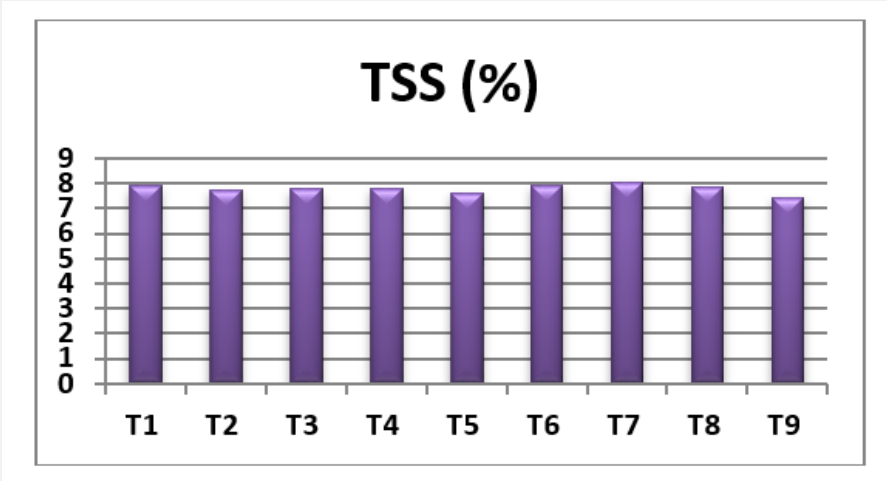

Figure 9: Effect of Integrated Nutrient Management on TSS (%).

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Quality attributes

TSS (%): Data gathered towards TSS (%) of root due to influence of various sources of integrated nutrient management have been presented in Table 1 and Figure 9. The improvement in TSS (%) of root was observed by the various treatments, while the differences between values were non-significant. The maximum TSS (%) recorded by the application of treatment T_7 (1/2 recommended NPK + ½ Green Leaf Manure + Biofertilizers i.e. *Azotobacter* and Phosphobacteria each at 5kg/ha) was used. Further, it was noticed that the data was non- significant.

Discussion

Effect of integrated nutrient management on growth parameters

The integrated use of NPK along with organic manure and biofertilizers significantly improved the growth characters of the carrot crop in comparison to chemical fertilizers alone. Application of half recommended NPK + Green leaf manure @ 2.5ton/ha. + biofertilizers, i.e. Azotobacter, Phosphobacteria each half 5kg/ha. were showed the maximum height of plant and number of leaves per plant significantly. The integrated use of nutrients actually resulted in rapid cell division, multiplication and cell elongation in meristematic region of plant which promoted vegetative growth of the plant in the form height of plant and more number of leaves per plant. This also might be due to the production of plant growth substances by *Azotobacter*, which stimulated the metabolic proces of plants through the way of activation of desirable enzyme. The above results of plant were in close agreement with the finding of Yadav et al. [2] investigated the influence of organic and inorganic fertilizers on growth and yield of carrot. Similar kind results were also observed by Naidu et al. [3], Mehdi et al. [4] and singh and singh [5]. The length of leaf was significantly increased with the application of biofertilizer and chemical fertilizer during years. the maximum length of leaves was observed in T_7 (recommended NPK + Green leaf manure @2.5ton/ha + Biofertilizers i.e. *Azotobacter* Phosphobacteria each at 5kg/ha). The increases in this parameter is due the availability of nitrogen through biological nitrogen fixation because of nitrogen nutrition play a vital role in development of plants and influenced physiological activities and it is a component of protoplasm and chlorophyll and produced growth regulating substances. Similar result was reported by Velmurugan et al. [6] revealed that the application of recommended doses of fertilizer (15ton/ha FYM + 50:100:50NPK/ha as basal dressing and 50kg N at 45 days after transplanting) recorded the maximum length of leaves in carrot. The response of integrated nutrient management showed pronounced on the fresh weight of leaves per plant. The application of T_7 (1/2 doses of NPK + 1/2 does of green leaf manure @ 2.5t/ha + Biofertilizers i.e. *Azotobacter* and Phosphobacteria each at 5kg/ha) gave the maximum fresh weight of leaves per plant. The increase in above parameter was due to maximum fresh weight of leaves per plant and length of leaf was also more in this treatment. This could be attributed to more leaf size of the highest-level owing to synthesis more chlorophyll and amino acid resulting in accelerated vegetative growth. A similar result was reported by Kachari and Korla [7] recorded the maximum weight of leaves per plant (g) of cauliflower by the application of 50 percent of recommended doses of NPK @ 125:75:65kg/ha + *Azospirillum* + FYM @ 25 t/ha. Similar kind results were also observed by Dwivedi and Singh [8] and Chaurasia et al. [9].

Effect of integrated nutrient management option on yield parameters

The integrated nutrient management showed marked effect on length and diameter of root. The maximum length and diameter of root was recorded with the application of treatment T_7 (1/2 doses of NPK + ½ does of green leaf manure @ 2.5ton/ha + Biofertilizers i.e. *Azotobacter* and Phosphobacteria each at 5kg/ha) followed by T_9 treatment (Recommended doses of NPK @ 80:60:60kg/ha) consonance with the finding of Singh and Singh [5] and Yadav et al. [2].

Effect of integrated nutrient management on quality parameters

The nutritional quality of carrot was judged by determined the total soluble solids (0B) content. It is observed that with the application of various components of integrated nutrient management all the quality parameters motioned above improved but non-significantly of investigation. Improvement in TSS (0B) content of carrot was observed by the application of various sources of nutrients, although the differences were found non-significant. The maximum TSS (0B) content of carrot was recorded with the application of treatment of T_7 (1/2 doses of NPK + 1/2 does of green leaf manure @ 2.5t/ha + Biofertilizers i.e. *Azotobacter* and Phosphobacteria each at 5kg/ha) followed by the treatment of T_8 (1/2 NPK + 1/2 Vermicompost + Biofertilizers).The increase in nutritional quality of roots might be due to the increases the efficiency of microbial inoculants to fix atmospheric nitrogen and secreting growth promoting substances, besides during the decomposition of green leaf manure various organic acids and CO2 was released, which was improve the physical properties of soil and make the favorable environment for the activity of microorganism and both of these accelerates the physiological process of plants. This result corroborates with the findings Alimazor and Kholuyako [10].

Conclusion

Therefore, on the basis of experimental findings following specific conclusions are narrated earlier the being drawn, which may in general pated for the profitable cultivation of carrot. On the basis of investigation, it could be possible to conclude that the application of T_7 (1/2 recommended dose of NPK 40:30:30kg/ha + ½ Green leaf manure 2.5ton/ha + Biofertilizer i.e. *Azotobacter* and Phosphobacteria each at 5kg/ha), Proved to be best for the growth and yield of carrot under eastern U.P. Condition.

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