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Himanshu Trivedi
School of Agricultural Sciences & Engineering IFTM University, Moradabad, Uttar Pradesh, India

Richa Khanna
School of Agricultural Sciences & Engineering IFTM University, Moradabad, Uttar Pradesh, India

Ram Kumar
School of Agricultural Sciences & Engineering IFTM University, Moradabad, Uttar Pradesh, India

Parul Punetha
Department of Floriculture and Landscaping, UUHF, Bharsar, Uttarakhand, India

Vicky Singh
School of Agricultural Sciences & Engineering IFTM University, Moradabad, Uttar Pradesh, India

Correspondence
Himanshu Trivedi
School of Agricultural Sciences & Engineering IFTM University, Moradabad, Uttar Pradesh, India

Response of vegetable amaranth to different doses of NPK and biofertilizers

Himanshu Trivedi, Richa Khanna, Ram Kumar, Parul Punetha and Vicky Singh

Abstract
To study the synergistic effect of NPK with biofertilizers a study was conducted at Agricultural Farm, IFTM University Moradabad in summer season of 2018. The experiment consisted of six treatments with four replications and it was laid out in Randomized Complete Block Design. The treatments were: T_1-Control, T_2- RDF (NPK @ 75:50:25 kg NPK/ha), T_3 – 50 % RDF + Azotobacter (5%) + PSB (5 %), T_4 - 75 % RDF + Azotobacter (5%) + PSB (5 %), T_5 - 100 % RDF + Azotobacter (5%) + PSB (5 %), T_6 – Azotobacter (5%) + PSB (5 %). T5 being the best treatment recorded maximum plant height (74.07 cm), leaf width (3.11 cm), plant dry weight (15.88 g), leaf length (6.17 cm) and yield (163.25 q/ha). However, in terms of yield T5 was found to be significant with T4 (130.5 q/ha). That shows the ability of biofertilizers in increasing the yield and nutrient use efficiency of amaranth.

Keywords: amaranth, biofertilizers, azotobacter, PSB, inorganic fertilizers, yield

Introduction

Vegetable amaranth is a widely grown tropical crop and it is one of the most important leafy vegetables in the lowlands of Asian continent and is particularly grown during summer and winter season. Amaranth is an annual, fast growing herb that can be cultivated easily in home gardens and at commercial scale. This feature makes it a potential crop for further exploration. The crop possesses excellent nutritional value, both in raw and cooked form. It is rich in protein, calcium, iron, vitamins A, C and K, riboflavin, niacin, vitamin B6, and folic acid. Apart from this, amaranth is low in saturated fats and sodium and interestingly the cholesterol is completely absent. It is a very good source of high quality protein with well-balanced amino acids (Ebert *et. al*, 2011) [2].

The modern agricultural practices are entirely based on extensive use of inputs like inorganic fertilizers. These chemical inputs are inevitable in lieu of increased demand of food products to feed the ever growing population. But everything that comes handy has certain limitations. It is known that chemical fertilizers are double edged sword. On one hand they are potent enough to increase the production and on other hand they are creating various problems *viz*. environmental pollution, nutrient imbalances in the soil, micronutrient deficiencies, reduced or stagnant yield as well as hazardous effects on human health. Therefore, it is becoming essential nowadays to combine the use of chemical fertilizers with some organic sources of nutrients. The use of organic along with inorganic not only reduces the soil and environment related risks, but also improve the efficiency of chemical fertilizers. One such potent organic source is the use of biofertilizers, which are nothing but the live and latent cells of microorganisms that are applied to our crops along with some carrier material. These soil microbes are potent enough to increase the plant growth by a plethora of mechanisms (Vessey, 2003). The potential biofertilizers plays an important role in maintaining the productivity and sustainability of soil systems and in turn helps in increasing the production potential of crops. It serves as a Farmer friendly, eco friendly and cost effective input that can be easily used in the farms in a wide range of crops (Khanna *et al*., 2019) [5]. By keeping in mind, the numerous benefits of biofertilizers, the present study was planned to study the combined effect of chemical fertilizers along with biofertilizers on growth and yield of vegetable amaranth.

Material and Methods

In order to observe the response of vegetable amaranth towards different doses of NPK and biofertilizers, a field experiment was conducted during summer, 2018 at Agricultural Research Farm, School of Agricultural Sciences & Engineering, Moradabad, U.P., India. Moradabad is situated between 28º 21' to 28º 16' North Latitude and 78º 4' East Longitude at an altitude of 250 m above the MSL. The soil of the experimental site was sandy loam soil with a pH ranging from 7-7.5 (Jackson, 1973) [4] and the organic carbon content of the experimental site was 0.6 % (Walkley and Black, 1934) [10].

The experiment consisted of six treatments with four replications and it was laid out in Randomized Complete Block Design. The treatments were: T_1- Control, T_2- RDF (NPK @ 75:50:25 kg NPK/ha), T_3 – 50 % RDF + Azotobacter (5%) + PSB (5 %), T_4 - 75 % RDF + Azotobacter (5%) + PSB (5 %), T_5 - 100 % RDF + Azotobacter (5%) + PSB (5 %), T_6 – Azotobacter (5%) + PSB (5 %).

The field was prepared by ploughing and then leveling was done to bring it to a fine tilth. After field preparation, plots of 2.0 m^2 were prepared and treatments were allotted as per randomized plan. The sowing of vegetable amaranth crop was done on 17th March 2018. The seeds of "Bolpur Local" variety of vegetable amaranth (*Amaranthus tricolor* L.) were used in the experiment and it was sown at a spacing of 30 × 5 cm. In all the treatments the chemical fertilizers and biofertilizers were applied as basal dose and RDF was applied as per the treatment. Recommended dose of fertilizer was 75:50:25 kg N, P_2O_5 and K_2O, ha^{-1}. The fertilizers used were: Urea, DAP, MOP, Azotobacter and PSB.

One irrigation channel of 1 m was prepared and after sowing one general irrigation of 4-5 cm was applied to all the treatments and after that irrigation was provided on the basis of visual observations and critical stage approach. The experiment was conducted in a total area of 74.2 m^2 and area per plot was 2.0 m^2. The net cultivated area was 48 m^2. In order to keep the crop weed free and to obtain maximum yield, one hand weeding was done at 15 days after sowing. The crop was harvested 40 days after sowing, i.e. 27th April 2018. For data collection five plants were selected from every plot and every replication and they were tagged and all the observations were recorded using the same plants. The data were analyzed using analysis of variance (ANOVA) technique as applicable for Randomized Complete Block Design (Rangaswamy, 2006) [7]. The results were interpreted on the basis of F- test and critical difference at 5% was used for calculating the significant difference between the means of two treatments (Gomez and Gomez, 1984) [3].

Results and discussion

During the growth period of crop a number of observations are recorded and the data was statistically analyzed and the same is discussed below here and numerical values are depicted in Table 1.

Effect on Growth Attributes: The data on plant height revealed that, though non significant difference were there among different nutrient management treatment, but the highest value of plant height was recorded in T5 i.e. 100 % RDF + Azotobacter (5%) + PSB (5 %) and the lowest was recorded in the control plot where no fertilizers were applied. The order of various treatments in terms of plant height was T5>T2>T4>T3>T6>T1. The data collected on leaf width indicates that at harvesting i.e. at 40 DAS there was a significant difference among the treatments. The significantly highest value of leaf width was obtained with T5, however it was found to be at par with T4. This indicates the efficiency of NPK along with biofertilizers in enhancing the growth attributes of amaranth as well as the ability of biofertilizers in nutrient saving (Khanna *et al.*, 2019) [5].

Plant dry weight recorded at 35 DAS, recorded significant difference among different treatments. The treatment T5 recorded significantly superior dry weight of plants as compared to rest of the treatments, except for T4. The control treatment recorded the significantly lower dry matter as compared to all other treatments, but was at par with T6. These results are in confirmation with the findings of Rahi (2013) who concluded that Nitroxin biofertilizer was effective in increasing the fresh and dry weight of amaranth. This could be attributed to the reason that the biofertilizers are beneficial in increasing the growth of plants by improving the availability of nutrients (Khanna *et al.*, 2019) [5].

Effect on Yield of Amaranth: There was a significant difference in terms of yield of different treatments. T5 being at par with T2 and T4 recorded significantly highest yield. Similar results were also obtained by Chhaudhari *et al.* (2009), who reported that N application along with inoculation of biofertilizers in Amaranthus has resulted in better yield attributes, nutrient uptake and net returns.

Table 1: Growth and yield parameters of vegetable Amaranth as affected by various nutrient treatments.

Treatments	Plant Height at harvesting (cm)	Leaf Width at harvesting (cm)	Plant Dry Weight at 35 DAS (g)	Leaf Length at harvesting (cm)	Yield (q/ha)
T_1- Control	54.81	2.15	9.05	4.38	94.16
T_2- RDF (NPK @ 75:50:25 kg NPK/ha)	70.67	2.47	12.61	5.33	126.75
T_3 – 50 % RDF + Azotobacter (5%) + PSB (5 %)	65.02	2.42	12.53	4.89	117.00
T_4 - 75 % RDF + Azotobacter (5%) + PSB (5 %)	68.00	2.73	12.81	5.62	130.50
T_5 - 100 % RDF + Azotobacter (5%) + PSB (5 %)	74.07	3.11	15.88	6.17	163.25
T_6 – Azotobacter (5%) + PSB (5 %)	60.22	2.33	10.72	4.45	101.08
SEm ±	7.9	0.202	1.038	0.364	12.56
CD (5%)	NS	0.614	3.157	NS	38.21

Conclusion

The present study serves as a confirmation towards the important role of biofertilizers in increasing the yield of various crops. The present investigation suggests that 75 % RDF+ Azotobacter (5%) + PSB (5%) was most effective in terms of yield of Amaranth. Also the effect of biofertilizer was not that prominent in Amaranth because it is a very short duration crop (40 days) and only leaves were harvested as economic product.

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