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N Johnson
M.Sc., Department of Vegetable Science, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

Dr. N Seenivasan
Professor, Department of Horticulture and Controller of Examinations, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

K Nagaraju
Assistant Professor, Department of Vegetable Science, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

A Prashanth Kumar
Assistant Professor, Department of Plant Pathology, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

Dr. G Sathish
Assistant Professor, Department of Agriculture Statistics, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

Dr. P Gouthami
Assistant Professor, Department of Plant Physiology, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

Corresponding Author:
N Johnson
M.Sc., Department of Vegetable Science, College of horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

Effect of integrated nutrient management on yield and nutrient uptake of red Amaranthus (*Amaranthus cruentus* L.) var. Arun

N Johnson, Dr. N Seenivasan, K Nagaraju, A Prashanth Kumar, Dr. G Sathish and Dr. P Gouthami

Abstract
This study was conducted to assess the effect of integrated nutrient management on growth yield and quality of Red Amaranthus (*Amaranthus cruentus* L) var. Arun. was carried out during the *rabi* season of the year 2019-20 at SKLTSHU, college of horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana. The experiment was conducted with nine integrated nutrient management treatments T_1- RD NPK (75:40:25 kg/ha) (control), T_2- RD NPK (75:40:25 kg/ha) + FYM (25 t/ha), T_3- RD NPK (75:40:25 kg/ha) + *Azotobacter* (5 kg/ha), T_4- RD NPK (75:40:25 kg/ha) + *Bacillus* (5 kg/ha), T_5- RD NPK (75:40:25 kg/ha) + *Pseudomonas* (5 kg/ha), T_6- RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha), T_7-RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Bacillus* (5 kg/ha), T_8-RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Pseudomonas* (5 kg/ha) and T_9-RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha) in a Randomized Block Design and replicated thrice. Among all treatments the T_9 treatment RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha) recorded the maximum herbage yield (6714 kg/ha) and maximum harvest index (62%), maximum nitrogen uptake (38.20 kg/ha), highest phosphorus uptake (14.21 kg/ha) and highest uptake of potassium (27.90 kg/ha) over other treatments.

Keywords: Red amaranthus, nutrient uptake, *Azotobacter*, *Bacillus*, *Pseudomonas*

1. Introduction
Red Amaranthus (*Amaranthus cruentus*) is a flowering plant species produces the wholesome amaranth grain, a staple food. It has possibility as an auxiliary food and may likewise assumes a significant function in taking care of hunger world. This crop is grown in America, Guatemala, Peru, India, and Nepal as a minor crop. In the states of Himachal Pradesh, Gujarat, Maharashtra, and Karnataka, the crop is typically grown in both plains and hills.
Compared to other leafy vegetables, Red Amaranthus leaves are a unique source of antioxidant pigments like betalain, -xanthin, and -cyanin. They are also an excellent supplier of other antioxidant pigments like anthocyanins, carotenoids, and chlorophylls, as well as naturally existing antioxidant phytochemicals like vitamin C, phenolic acids, and flavonoids. (Sarker *et al.* 2018a and 2018b) [5]. These natural antioxidant compounds are not only significant for the food industry because of their health-promoting effects, but also as natural preservatives of food products (Venskutonis, *et al.* 2013) [7].
The lower production of Red Amaranthus is primarily due to the inefficient use of manures, fertilizers, and management techniques. The use of FYM per acre combined with 100% RDF resulted in significantly greater grain yield. Nitrogen integration with Azotobacter liquid culture resulted in increased yield and N and P uptake (Chaudhari *et al.* 2009) [2]. Like any other crop plant, amaranth an integrated combination of balanced nutrients (NPK) for optimum growth and yield.

2. Material and Methods
The Red Amaranthus var. Arun used as experimental material and the experiment was set up in a randomized block design with nine treatments and three replications. The soil of the experimental site was sandy loam with soil pH 7.98, organic carbon content of 0.35% and available N, P and K content of 241.54, 27.7and 240.8 kg ha^{-1} respectively. The total nine treatments consist of T_1- RD NPK (75:40:25 kg/ha) (control), T_2- RD NPK (75:40:25 kg/ha) +

FYM (25 t/ha), T_3- RD NPK (75:40:25 kg/ha) + *Azotobacter* (5 kg/ha), T_4- RD NPK (75:40:25 kg/ha) + *Bacillus* (5 kg/ha), T_5- RD NPK (75:40:25 kg/ha) + *Pseudomonas* (5 kg/ha), T_6- RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha), T_7-RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Bacillus* (5 kg/ha), T_8-RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Pseudomonas* (5 kg/ha) and T_9-RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha). N, P and K were provided through Urea, SSP and MOP respectively. Prior to seeding, manures such as FYM, vermicompost, and biofertilizers (Azotobacter, Bacillus, Pseudomonas) were applied to the various plots. Seeds were sown at 45 x 15cm spacing, and thinning was done 10 days afterwards in order to maintain spacing. Growth and yield parameters were recorded on five plants per treatment per plot in each replication. Growth parameters, yield, harvest index, and nutrient uptake were all recorded. The data was statistically evaluated by using analysis of variance (ANOVA) for RBD following the standard procedure as suggested by Panse and Sukhatme (1985) [4].

3. Results and Discussion

3.1 Yield Parameters

The experimental results indicated that the yield parameters were significantly influenced by different treatments presented in table 1. Among the integrated nutrient management treatments, T_9 treatment RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha) recorded the maximum Herbage yield (6714 kg/ha) and maximum Harvest index (62%). The data also shows that using different biofertilizers alone or in combination has a distinct effect on the herbage yield of Red Amaranthus. However, the maximum yield could be due to increase in plant height, number of leaves, and yield attributes *viz.*, fresh weight of whole plant, fresh and dry weight of leaves. This could be due to the nutrients were easily available in readily available form, and the C:N was higher than the control.

3.2 Nutrient Uptake

The data on the Nutrient uptake by plant is shown in Table.2

3.2.1 Nitrogen uptake (kg/ha)

Nitrogen uptake by plant was highest in the treatment T_9 (RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha) is 38.20 kg/ha. The nitrogen uptake is increased due to availability of nitrogen might be by the addition of nitrogenous fertilizers, application of biofertilizers and due to ability of nitrifying bacteria to fix the atmospheric nitrogen in soil in usable form by the Red Amaranthus crop.

3.2.2 Phosphorus uptake (kg/ha)

The highest phosphorus uptake by plant in the treatment T_9 (RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha) is 14.21 kg/ha. The maximum uptake of potassium may be linked to the release of potassium from the soil's lattice layer of potash-bearing minerals. And the addition of FYM along with bio-fertilizers caused an increase in higher magnitude of potassium uptake by the plant.

3.2.3 Potassium uptake (kg/ha)

Potassium uptake by plant was highest in the treatment T_9 (RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha) is 27.90 kg/ha. The reason for increased potassium uptake is due to the addition of FYM along with bio-fertilizers caused an increase in higher magnitude of available potassium (K). The highest uptake of potassium may be to the release of potassium from the soil's lattice layer of potash-bearing minerals.

Table 1: Effect of integrated nutrient management on Herbage yield (kg/ha) and Harvest index (%) of Red Amaranthus var. Arun

Treatment No.	Treatment details	Herbage yield (kg/ha)	Harvest index (%)
T_1	RD NPK (75:40:25 kg/ha) (control)	4613^{b}	52
T_2	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha)	5195^{b}	57
T_3	RD NPK (75:40:25 kg/ha) + *Azotobacter* (5 kg/ha)	4963^{b}	56
T_4	RD NPK (75:40:25 kg/ha) + *Bacillus* (5 kg/ha)	4869^{b}	55
T_5	RD NPK (75:40:25 kg/ha) + *Pseudomonas* (5 kg/ha)	4876^{b}	55
T_6	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha)	5827^{ab}	60
T_7	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Bacillus* (5 kg/ha)	5728^{ab}	59
T_8	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Pseudomonas* (5 kg/ha)	5702^{ab}	58
T_9	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha)	6714^{a}	62
	LSD at 5%	1399.37	NS
	SEm±	393.36	4.50

Table 2: Effect of Integrated Nutrient Management on nutrient uptake (Kg/ha) by the plant after harvesting of the crop

Treatment No.	Treatment details	Nitrogen uptake (Kg/ha)	Phosphorus uptake (Kg/ha)	Potassium uptake (Kg/ha)
T_1	RD NPK (75:40:25 kg/ha) (control)	27.40^{d}	8.62^{c}	20.93^{b}
T_2	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha)	31.98^{abcd}	11.02^{bc}	23.36^{ab}
T_3	RD NPK (75:40:25 kg/ha) + *Azotobacter* (5 kg/ha)	30.71^{bcd}	10.21^{bc}	21.26^{b}
T_4	RD NPK (75:40:25 kg/ha) + *Bacillus* (5 kg/ha)	29.50^{cd}	10.62^{bc}	22.02^{b}
T_5	RD NPK (75:40:25 kg/ha) + *Pseudomonas* (5 kg/ha)	30.45^{bcd}	10.55^{bc}	21.95^{b}
T_6	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha)	36.80^{ab}	11.74^{ab}	25.97^{ab}
T_7	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Bacillus* (5 kg/ha)	35.65^{abc}	12.52^{ab}	24.61^{ab}

T_8	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Pseudomonas* (5 kg/ha)	34.63^{abc}	12.96^{ab}	24.12^{ab}
T_9	RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha)	38.20^{a}	14.21^{a}	27.90^{a}
	LSD at 5%	6.41	3.031	5.43
	SEm ±	1.80	0.85	1.53

4. Conclusion

The current study suggests that integrated nutrient management has a substantial impact on the growth, yield, and quality of Red Amaranthus var. Arun. Among the different integrated nutrient management source of treatments, T_9 treatment (RD NPK (75:40:25 kg/ha) + FYM (25 t/ha) + *Azotobacter* (5 kg/ha) + *Bacillus* (5 kg/ha) + *Pseudomonas* (5 kg/ha) proved to be the best treatment to improve growth, yield and quality of Red Amaranthus var. Arun. The results indicated that recommended dose of NPK applied were efficiently utilized with the combination of bio-fertilizers.

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