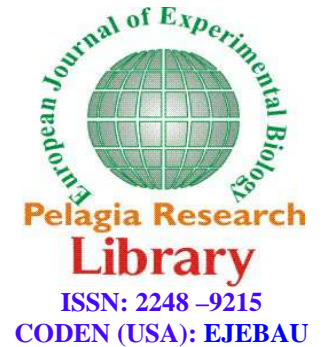




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Influence of Inorganic and Organic Fertilizers on Biomass Production of *Amaranthus* sp.

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ABSTRACT

A pot culture study was carried out to evaluate the effects of inorganic fertilizer (NPK) and organic fertilizer (farmyard manure) on root and shoot biomass. Both farmyard manure and NPK were show uniform increasing impact on biomass. Farmyard manure has superior response as compared to NPK.

Key words: *A.hybridus* subsp. *cruentus* var. *paniculatus* , Biomass, Fertilizers, NPK, Farmyard manure.

INTRODUCTION

Amaranth is a common name of the herbaceous genus *Amaranthus* of the family Amaranthaceae. Most of the species of this genus are annual weeds and few are valued as vegetable, grains and ornamental. Seeds of *A.hybridus* subsp. *cruentus* var. *paniculatus* are protein rich and consumed as pseudo cereal. *Amaranthus* is also known as pseudo cereal because the flavor, appearance and cooking of many species exhibit similarities to grains [1]. The seeds also ground into flour. They have high protein component and provide a good source of dietary fiber and dietary minerals like Iron, Magnesium, Phosphorus, Copper and especially Manganese [2]. Increased interest in amaranth appeared in the 1980s, when the United States National Academy of Science performed research on the grain and described its high nutritional value and agronomic potential [3].

The soil of Rajasthan is poor in fertility status, being low in nitrogen and low to medium in phosphorus while medium to high in potash. Organic matter content is very low [4]. Additional nutrients like NPK (Nitrogen, Phosphorus and Potassium) and farmyard manure (organic manure) if supplied to the soil may influence the growth and development of plants. The use of inorganic fertilizers to increase yield has been found to be effective only within few years, demanding consistent use on long-term basis. The hazardous environmental consequences and high cost of inorganic fertilizers make them undesirable, uneconomical and are out of reach of the poor farmers. Therefore, increased use of organic manure, a readily available alternative, which proves more environmental friendly. Keeping the above facts in view the investigation was carried out to study the influence of NPK and farmyard manure for biomass production.

MATERIALS AND METHODS

Seeds of *A.hybridus* subsp. *cruentus* var. *paniculatus* were collected from local shops of Jaipur by local name *ramdana* or *rajgeera*. Seeds were sown in earthen pots to confirm the plant species prior to set experiment. Specimen was identified at BSI Herbarium, Jodhpur. Pot culture study carried out with the seeds of *Amaranthus hybridus* subsp. *cruentus* var. *paniculatus*. The seeds were selected randomly for experiment. Seeds were sown under natural environmental conditions in earthen pots of 28×28×16 cm size. Each pot was filled with seven kg of garden soil. The soil was amended with different concentrations of NPK in ratio of 0.01 g/kg, 0.02 g/kg 0.03g/kg

and 0.05g/kg and farmyard manure in ratio of 1.0g/kg, 3.0g/kg 5.0g/kg and 10g/kg. For each treatment three replicates were taken. A set of pots without any additives considered as control. Pots were irrigated manually using watering cans regularly i.e., every day. After every 15 days the plants were harvested and data regarding biomass (fresh weight) were recorded up to three and half months (105 days) and statistically analyzed. Every 15 days of interval was considered as a single period. Vegetative growth, flowering and fruiting were recorded in treated as well as control plants in pot culture experiment.

RESULTS

The effect of nitrogen, phosphorus and potassium on biomass of root on biomass of root and shoot were studied in *A. hybridus* subsp. *cruentus* var. *paniculatus*. These nutrients were found to be affecting both biomass of root as well shoot. There was gradual increase in biomass of root and shoot with increase in concentration of NPK along with periods (Tables 1-2).

Table-1 : Effect of NPK on root biomass (fresh weight) of *A. hybridus* subsp. *cruentus* var. *paniculatus* in pot culture experiment

Concs.	Biomass (Fresh weight) in gm per plant						
	I	II	III	IV	V	VI	VII
Control	0.09	0.19	0.92	1.23	1.90	2.25	2.35
0.01 g/kg	0.18	0.36	0.69	0.95	2.07	2.91	3.50
0.02 g/kg	0.21	0.49	0.93	1.65	2.24	3.31	3.81
0.03 g/kg	0.24	0.51	0.93	2.56	4.23	5.57	5.58
0.05 g/kg	0.31	0.60	0.75	3.00	5.27	6.30	6.96

Analysis of variance

Source of variation	DF	SS	MSS	F-ratio
Conc. within 0.00g/kg	6	12.1332	2.0222	8.52**
Conc. within 0.01 gm/kg	6	28.1458	4.6909	19.76**
Conc. within 0.02 gm/kg	6	30.9655	5.1609	21.75**
Conc. within 0.03 gm/kg	6	93.0486	15.5081	65.35**
Conc. within 0.05 gm/kg	6	135.1631	22.5271	94.93**
Between concentrations	4	63.6733	15.9183	67.08**
Error	70	16.6111	0.2373	-

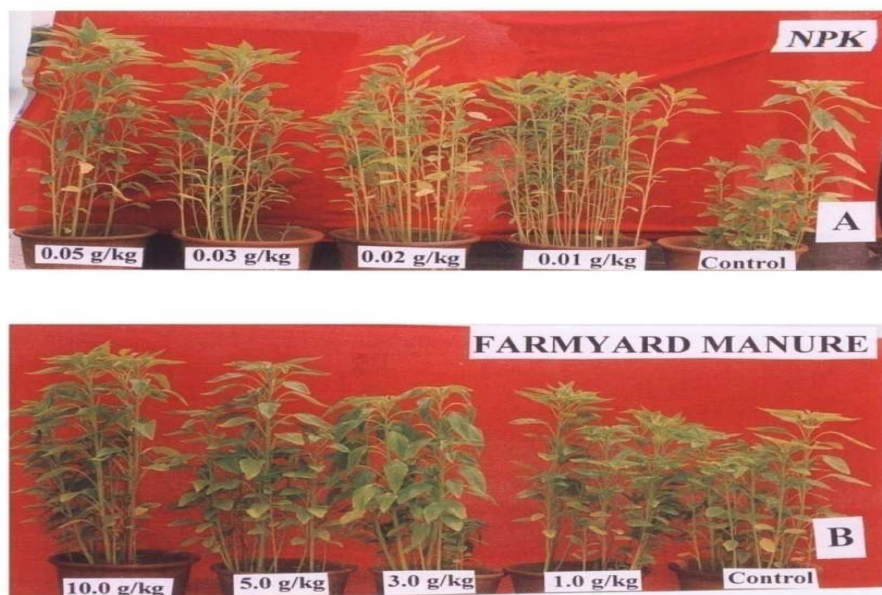
Table-2 : Effect of NPK on shoot biomass (fresh weight) of *A. hybridus* subsp. *cruentus* var. *paniculatus* in pot culture experiment

Concs.	Biomass (Fresh weight) in gm per plant						
	I	II	III	IV	V	VI	VII
Control	1.62	2.32	4.46	9.20	14.05	16.02	16.80
0.01 g/kg	0.71	1.56	3.35	12.21	20.15	22.55	23.69
0.02 g/kg	1.03	2.13	4.43	18.12	34.54	36.75	38.30
0.03 g/kg	1.21	2.41	4.29	26.77	50.48	53.19	54.31
0.05 g/kg	1.17	2.39	8.90	37.62	70.37	73.54	74.63

Analysis of variance

Source of variation	DF	SS	MSS	F-ratio
Conc. within 0.00g/kg	6	844.5467	140.7578	26.96**
Conc. within 0.01 gm/kg	6	1877.3062	312.8843	59.94**
Conc. within 0.02 gm/kg	6	5246.3062	874.3843	167.52**
Conc. within 0.03 gm/kg	6	11302.1595	1883.6932	360.92**
Conc. within 0.05 gm/kg	6	22498.2060	3749.7011	718.33**
Between concentrations	4	11503.1555	2875.7883	550.97**
Error	70	365.3638	5.1294	-

In case of root biomass significant enhancement in fresh weight was found in Vth as compared to control; although decline was observed only in 0.01g/kg concentration of NPK at III and IV periods of intervals. Maximum biomass was observed in 0.05 g/kg concentration of NPK at VII period. Biomass of shoot also increases with increase in concentration of NPK treatment at different periods. Significant enhancement in shoot biomass was found in IVth and Vth period as compared to biomass of root, almost in all the treatments. Although biomass decrease in all the concentrations at Ist period as compared to control (Plate 1A&B).



A. hybridus cruentus var. paniculatus

Plate: 1A: Showing the effect of different concentrations of NPK on biomass at IIIrd period
 1B: Showing the effect of different concentrations of farmyard manure on biomass at IIIrd Period
 Note: Flowering observed

Biomass of root and shoot gradually increase with increase in concentration of farmyard manure in different intervals of periods. Maximum root biomass was found in 10.00g/kg concentration at VIIth period and minimum root biomass found in 1.0g/kg concentration of farmyard manure. Biomass of root affected in IIIrd period with increase in concentrations from 1.0g/kg to 5.0g/kg, where reduction was observed as compared to control and other treatments (Table-3-4).

Table-3 : Effect of farm yard manure on root biomass (fresh weight) of *A. hybridus subsp. cruentus var. paniculatus* in pot culture experiment

Concs.	Biomass (Fresh weight) in gm per plant						
	I	II	III	IV	V	VI	VII
Control	0.09	0.19	0.92	1.23	1.90	2.25	2.35
1.00 g/kg	0.06	0.12	0.25	2.12	3.94	4.19	5.40
3.00 g/kg	0.08	0.36	0.67	2.30	4.56	5.71	6.11
5.00 g/kg	0.15	0.37	0.62	2.80	5.06	6.95	7.13
10.00 g/kg	0.59	1.08	2.12	3.37	6.57	7.46	7.95

Analysis of variance

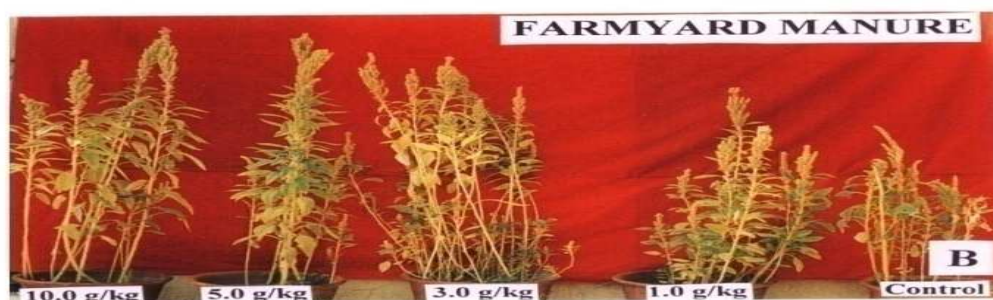
Source of variation	DF	SS	MSS	F-ratio
Conc. within 0.00 gm/kg	6	12.1332	2.0222	1.08 ^{NS}
Conc. within 1.0 gm/kg	6	36.3364	6.0560	3.25**
Conc. within 3.0 gm/kg	6	39.6807	6.6134	3.55**
Conc. within 5.0 gm/kg	6	66.3981	11.0663	5.95**
Conc. within 10.0 gm/kg	6	72.7294	12.1215	6.52**
Between concentrations	4	28.0729	7.0182	3.77**
Error	70	130.2048	1.8600	-

Table-4 : Effect of farmyard manure on shoot biomass (fresh weight) of *A. hybridus subsp. cruentus var. paniculatus* in pot culture experiment

Concs.	Biomass (Fresh weight) in gm per plant						
	I	II	III	IV	V	VI	VII
Control	1.62	2.32	4.46	3.20	14.02	16.02	16.80
1.00 g/kg	0.79	1.54	3.70	18.41	35.52	37.53	38.51
3.00 g/kg	1.71	3.68	7.03	20.62	36.37	42.21	42.19
5.00 g/kg	2.14	4.89	8.67	22.12	43.52	44.31	45.99
10.00 g/kg	3.43	7.39	16.25	40.29	69.03	71.38	73.06

Analysis of variance				
Source of variation	DF	SS	MSS	F-ratio
Conc. within control	6	844.5467	140.7578	90.63**
Conc. within 1.0 gm/kg	6	5567.2451	927.8791	597.49**
Conc. within 3.0 gm/kg	6	5830.2523	971.7087	625.72**
Conc. within 5.0 gm/kg	6	7070.0494	1178.3415	758.77**
Conc. within 10.0 gm/kg	6	1785.2439	293.08739	1887.30**
Between concentrations	4	10795.4226	2698.8556	1737.90**
Error	70	108.7056	1.5529	

Effect on shoot biomass found that in lower concentration (1.00g/kg) at Ist to IIIrd period biomass reduced. At higher concentration gradual increase in biomass was observed in all the periods studied. Maximum value of shoot biomass was found in 10.0g/kg in VIIth period (Plate2A&B).



A. hybridus subsp. cruentus var. paniculatus

Plate: 2A: Showing the effect of different concentrations of NPK on biomass at VIth period

2B: Showing the effect of different concentrations of farmyard manure on biomass at VIth period

Analysis of NPK and farmyard manure treatment concluded that farmyard manure showed better response against the NPK treatment in both root and shoot biomass

DISCUSSION

Nitrogen, Potassium and Phosphorus (NPK) are essential elements for the growth and reproduction of plants. Nitrogen is an essential constituent of all proteins. Phosphorus is necessary for certain enzymatic processes too but it doesn't appear to be involved directly in catalysis. For the metabolites, phosphorus plays a direct role as a carrier of energy. The use of compost or manure in agriculture as an organic source of nutrients is common in many tropical, developing countries. One of the drawbacks of such materials is their low nitrogen content. Farmers commonly use chemical N fertilizers such as urea, calcium ammonium nitrate and NPK formulations to obtain better crop growth and yield. These chemical supplements may have a negative impact on the environment through nitrate leaching into water, leading to eutrophication of surface waters that can affect public health.

Gliricidia sepium, a fast growing, tropical perennial hedge plant was tested as a source of N in organo-mineral fertilizer formulations. Average nutrient content of *Gliricidia* is 3.8% N, 0.32% P, 1.8% K, 0.8% Ca and 0.2% Mg using a sand culture and *Amaranthus caudatus* as a test crop. It was shown that amending commercial compost with 30% *Gliricidia* pruning would benefit many small-scale farmers and control environmental pollution [5]. Increased biomass production were observed under the treatment of NPK in the cultivation of *A. cruentus* [6]. NPK and poultry manure favoured growth and yield of the *Amaranthus* species but influenced proximate composition

differently [7]. Enhanced effect were reported with NPK and farmyard manure treatment on *Amaranthus palmeri* Wats, and found that both the treatments show enhancing effect [8]. Present findings are similar and showing that the farmyard manure is superior on NPK.

In general, relative effectiveness of used organic and inorganic manure may sequenced as farmyard manure > NPK were observed in studied plants for root as well as shoot fresh weight. Flowering and fruiting in *A. hybridus* subsp. *cruentus* var. *paniculatus* take place almost throughout the year. In present investigation, period of flowering was observed to be July and August whereas seed setting (fruiting) takes place in the month of September.

CONCLUSION

Farmyard manure and NPK were used to study the biomass of root and shoot on *A. hybridus* subsp. *cruentus* var. *paniculatus*. Both the inorganic and organic manure showed the enhancing effect on biomass production. Farmyard manure is found superior than the NPK for root as well as shoot fresh weight..

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