# EFFECTS OF POULTRY MANURE AND INORGANIC FERTILIZERS ON GROWTH AND YIELD OF RED AMARANTH (*Amaranthus cruentus* L.)

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## Abstract

A pot experiment was carried out in the Department of Soil and Environmental Sciences, University of Barishal to evaluate the effects of poultry manure (PM) and inorganic fertilizers on the growth and yield of red amaranth. Eight treatments with three replications were used and the treatment were $T_1$: Control (- RDF & - PM); $T_2$: 100% RDF; $T_3$: 75% RDF + PM 4 t/ha; $T_4$: 75% RDF + PM 8 t/ha; $T_5$: 50% RDF + PM 4 t/ha; $T_6$: 50% RDF + PM 8 t/ha; $T_7$: PM 4 t/ha; and $T_8$: PM 8 t/ha. The treatments were arranged in a completely randomized design. Results showed that poultry manure 8 t/ha along with 50% and 75% recommended doses of fertilizers exerted significant influence at 45 days on the plant height (13.50 cm at 75% RDF), leaf area (75.40 $cm^2$ at 50% RDF), number of leaves (8 at both 50% and 75% RDF), root fresh weight (1.3939 t/ha at 75% RDF), shoot fresh weight (6.4488 t/ha at 75% RDF), leaf fresh weight (5.9602 t/ha at 75% RDF) and yield (1.4853 t/ha on dry weight basis at 50% RDF) of red amaranth. The highest values for most of the parameters at 15, 30 and 45 days of germination were found in treatment $T_6$: (50% RDF + PM 8 t/ha).

***Key words*:** Red amaranth; Poultry manure; Inorganic fertilizers; Growth parameters; Yield.

## INTRODUCTION

Bangladesh is an agriculture based country and agriculture plays an important role in our economy (BBS 2017). The total cultivable area of Bangladesh is about 14.76 million hectares and net cultivable area is about 8.52 million hectares (Hasan 2017). Due to intensification of agriculture to grow more food and indiscriminate as well as imbalanced use of chemical fertilizers with a little or no addition of organic fertilizers, the soil fertility status of our country has been declining day by day and soils are losing their productive capacity. In this condition to increase soil fertility and productivity organic fertilizer addition into the soil is necessary. Organic fertilizer is a substitute to mineral fertilizer and presence of large quantities of plant nutrients as well as growth promoting agents make them important for enhancement of soil fertility and productivity (Huq and Shoaib 2013). There are a wide range of organic fertilizers in our environment and poultry manure is one of them. Poultry litter is a valuable source of organic fertilizer for plant nutrients as it contains high content of essential macro and micronutrients (Dikinya and Mufwanzala 2010). Poultry industry is located through the world and this sector has been growing at more than 5% per annum (FAO 2006). In Bangladesh, this rate is around 20% within the last two decades (Islam *et al.* 2014). A huge amount of poultry litter is generated every day. On dry weight basis, from 0.7 to 2.0 tons of litter per 1000 chickens per year have been reported (Bolan *et al.* 2010).

Bangladesh has sub-tropical climate. The rate of soil organic matter degradation and mineralization in Bangladesh soils is often relatively high (Karim and Iqbal 2001). Most of the soils of Bangladesh contain less than 1.5% soil organic matter and few soils contain even less than 1% soil organic matter (FRG 2012). Because of huge amount of poultry litter and its nutritional value it can be a great source of fertilizer. Moreover, for higher crop production the farmers of Bangladesh use chemical fertilizers without or little application of organic fertilizers. This management practice is deteriorating soil fertility and also hampering the economy of our farmers because of the higher price of chemical fertilizers (Karim and Aktar 2015). Separate use of organic and inorganic fertilizer is not efficient for yield and soil health. The combined use of organic and inorganic fertilizers gives significant increase in the crop growth and improves soil nutrient availability (Armin *et al*. 2016).

Red amaranth (*Amaranthus cruentus* L.) is a herbaceous plant in the family Amaranthaceae, originating from Central America. *Amaranthus cruentus* is a widespread traditional vegetable in all countries of tropical Africa. It is more popular in humid lowland like Bangladesh. Red amaranth is a superior source of carotene, iron, calcium, protein, vitamin C and trace elements (Grubben and Denton 2004). Keeping the above stated fact in view, the present study was carried out to examine the effects of poultry manure and inorganic fertilizers on growth parameters (plant height, leaf area and number of leaves) and yield of red amaranth (*Amaranthus cruentus* L.).

## MATERIAL AND METHODS

To carry out the pot experiment soil sample was collected from Charaicha village under Charkaua union of Barishal Sadar Upazila in Barishal District. Geographically, the experimental site is located at 22°39′44.08″ N and 90°21′44.36″ E at an elevation of 5 m above sea level and the site is under Ganges Tidal Floodplain Agro-ecological Zone AEZ-13 (Huq and Shoaib 2013). The sampling site (Fig. 1) was medium low land under Barishal series (Hussain *et al*. 2021).

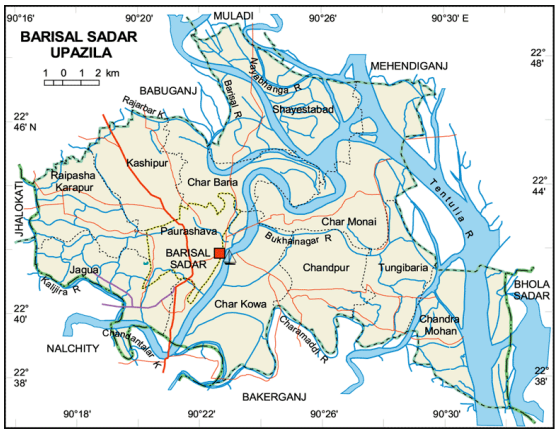


Fig. 1. Map showing the sampling site.

The soils were collected at 0-15 cm depth following composite sampling method. The collected soil samples were air-dried for 15 days and visible roots and debris were discarded. After air drying, the larger aggregates were broken by a wooden hammer. Ground samples were sieved through a 2 mm stainless steel sieve and mixed thoroughly to make a composite

sample. Approximately 500 g of soil samples were preserved in a plastic container for physico-chemical analysis. Poultry manure was used as organic fertilizer and it was collected from a local poultry industry named 'Gazi Poultry Farm' beside the 'BSCIC Industrial Area', Natunbazar, Barishal. After collection the poultry litter was sun dried for 14 days. It was passed through a 0.5 mm stainless steel sieve and preserved in an air-tight plastic container for different physical, chemical and physico-chemical analysis. Properties of collected soil samples and poultry manure were analyzed following standard methods (Table 1).

**Table 1. Properties of experimental soil and poultry manure.**

| Properties | Experimental soil | Poultry manure |
|---|---|---|
| Colour | - | Brown |
| Physical condition | - | Granular form |
| Odor | - | Absence of foul odour |
| Sand (%) | 87.09 | - |
| Silt (%) | 3.26 | - |
| Clay (%) | 9.65 | - |
| Texture | Loamy sand | - |
| Moisture (%) (Black 1965) | 29.87 | - |
| pH (Jackson 1962) | 6.48 | 7.72 |
| EC (dS/m) (USSLS 1954) | 3.65 | 4.26 |
| Organic carbon (%) (Jackson 1962) | 0.53 | 2.40 |
| Organic matter (%) | 0.903 | 4.13 |
| Total N (%) (Jackson 1958) | 0.84 | 2.10 |
| Available N (ppm) (Black 1965) | 1120 | - |
| Total P (%) (Jackson 1962) | - | 0.0250 |
| Total K (%) (Jackson 1962) | - | 0.0060 |
| Total S (%) (Page *et al*. 1982) | - | 0.0177 |
| Available P (ppm) (Jackson 1973) | 2.23 | - |
| Exchangeable K (meq/100 g) | 0.08 | - |
| Available K (ppm) (Page *et al*.1982) | 31.00 | - |
| Available S (ppm) (Hunt 1981) | 16.50 | - |
| CEC (meq/100 g) (Black 1965) | 270 | - |

The experiment was laid out in a Completely Randomized Design (CRD) with three replications. To set up the experiment all plastic pots were filled up with 3 kg of air-dried soil. Before 10 days of seed sowing, poultry manure was applied at 4 t/ha and 8 t/ha following treatment arrangements. After seeding, 100%, 75% and 50% recommended doses of fertilizers (RDF) were mixed following fertilizer recommendation guide according to the treatments. Seeds of red amaranth, variety-BARI-Lal sak-1 were collected from Barishal local market. About 65 seeds were sown in each pot in February, 2022. After 2-3 days seeds were germinated and after 10 days of germination, thinning and other cultural operations were done when necessary. During growth period, plants were also collected after 15 and 30 days and finally after 45 days, red amaranth plants were harvested from each pot. Growth parameters like plant height (Heady 1957), number of leaves (Hunt 1978), and leaf area (Hall *et al*. 1993) and fresh weight of root, shoot and leaf and yield (on dry weight basis) were measured.

## RESULTS AND DISCUSSION

Application of different rates of poultry manure and inorganic fertilizers showed significant positive effects on plant height, leaf area and number of leaves of red amaranth (Table 2).

**Table 2. Effects of poultry manure and inorganic fertilizers on plant height, leaf area and number of leaves of red amaranth after 15, 30 and 45 days of germination.**

| Treatments | 15 Days | | | 30 Days | | | 45 Days | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plant height (cm) | Leaf area ($cm^2$) | No. of leaves | Plant height (cm) | Leaf area ($cm^2$) | No. of leaves | Plant height (cm) | Leaf area ($cm^2$) | No. of leaves |
| Control (- RDF & - PM) | $2.10^{b}$ | $0.20^{c}$ | $2.00^{a}$ | $3.50^{b}$ | $2.52^{d}$ | $4.00^{d}$ | $3.50^{d}$ | $6.01^{f}$ | $4.00^{b}$ |
| 100% RDF | $3.00^{ab}$ | $0.24^{bc}$ | $2.00^{a}$ | $4.50^{a}$ | $11.52^{b}$ | $6.00^{b}$ | $12.00^{b}$ | $42.60c^{d}$ | $8.00^{a}$ |
| 75% RDF + PM 4 t/ha | $2.80^{ab}$ | $0.21^{c}$ | $2.00^{a}$ | $5.00^{a}$ | $10.80^{b}$ | $6.00^{b}$ | $13.00^{a}$ | $45.60^{c}$ | $8.00^{a}$ |
| 75% RDF + PM 8 t/ha | $3.00^{ab}$ | $0.28^{b}$ | $2.00^{a}$ | $5.00^{a}$ | $10.08^{b}$ | $7.00^{a}$ | $13.50^{a}$ | $42.40c^{d}$ | $8.00^{a}$ |
| 50% RDF + PM 4 t/ha | $3.00^{ab}$ | $0.28^{b}$ | $2.00^{a}$ | $5.00^{a}$ | $7.02^{c}$ | $6.00^{b}$ | $13.00^{a}$ | $50.50^{b}$ | $8.00^{a}$ |
| 50% RDF + PM 8 t/ha | $3.50^{a}$ | $0.24^{bc}$ | $2.00^{a}$ | $4.80^{a}$ | $16.66^{a}$ | $7.00^{a}$ | $11.50^{b}$ | $75.40^{a}$ | $8.00^{a}$ |
| PM 4 t/ha | $2.20^{b}$ | $0.24^{bc}$ | $2.00^{a}$ | $3.70^{b}$ | $5.00^{c}$ | $5.00^{c}$ | $8.50^{c}$ | $27.36^{e}$ | $8.00^{a}$ |
| PM 8 t/ha | $3.50^{a}$ | $0.36^{a}$ | $2.00^{a}$ | $3.60^{b}$ | $4.95^{c}$ | $5.00^{c}$ | $12.00^{b}$ | $39.60^{d}$ | $8.00^{a}$ |
| LSD at 5% | 0.891 | 0.055 | NS | 0.732 | 2.13 | 0.865 | 0.860 | 4.845 | 0.875 |

$^{abcdef}$ Data bearing different superscripts within the same column differ significantly ($P \leq .05$).

*Plant height*

At 15 days of germination, the highest plant height (3.50 cm) was found in the treatments $T_6$ (50% RDF + PM 8 t/ha) and $T_8$ (PM 8 t/ha) which was 66.67% higher over control. The second highest plant height (3.0 cm) was found in treatments $T_2$, $T_4$ and $T_5$ which was 33.33% higher over control (Table 2). At 30 days of germination, plant height of red amaranth varied significantly from 3.50 cm to 5.00 cm. The tallest plant (5.00 cm) was recorded from $T_3$ (75% RDF + PM 4 t/ha), $T_4$ (75% RDF + PM 8 t/ha) and $T_5$ (50% RDF + PM 4 t/ha) treatments which were statistically similar and the shortest plant (3.50 cm) was obtained from $T_1$ (control) that received no fertilizer. Plant height increased significantly from 2.86 to 42.86% over control across the treatments (Table 2). Similarly, at 45 days of germination, plant height of red amaranth varied significantly from 3.50 cm to 13.50 cm. The highest plant height (13.50 cm) was found in the treatment $T_4$ (75% RDF + PM 8 t/ha) which was 285.71% higher over control and the second highest plant height (13.00 cm) was noticed in treatments $T_3$ (75% RDF+ PM 4 t/ha) and $T_5$ (50% RDF + 4 PM t/ha) which was 271.43% higher over control. The lowest plant height (3.50 cm) was obtained from $T_1$ treatment (Table 2). It appeared that maximum plant height was attained with the combined application of poultry manure and inorganic fertilizers which was similar to the result reported by Alauddin *et al*. (2021).

*Leaf area*

The highest leaf area per plant (0.36 $cm^2$) was recorded from the application of $T_8$ (PM 8 t/ha) after 15 days of germination which was significantly different from other treatments. The second highest leaf area per plant (0.28 $cm^2$) was measured from the application of $T_4$ (75% RDF + PM 8 t/ha) and $T_5$ (50% RDF + PM 4 t/ha) which were statistically similar and the lowest leaf area per plant (0.20 $cm^2$) was noticed in the plant grown in $T_1$ treatment. Application of poultry manure at 8 t/ha showed an increase of 0.8 fold of leaf area per plant as compared to control, whereas the other treatments were in between the two (Table 2). After 30 days of germination, the highest leaf area per plant (16.66 $cm^2$) was measured from the application of $T_6$ (50% RDF + PM 8 t/ha) and the lowest leaf area per plant (2.52 $cm^2$) was noticed in $T_1$ (Control). Application of 8 t/ha poultry manure with 50% RDF showed an increase of 5.61 fold of leaf area per plant as compared to control (Table 2). For 45 days after

germination, the highest leaf area per plant (75.40 $cm^2$) was measured in $T_6$ (50% RDF + PM 8 t/ha) which was significantly different from other treatments and the lowest leaf area per plant (6.01 $cm^2$) was found in the control treatment. Application of poultry manure at 8 t/ha with 50% RDF showed an increase of 11.55 fold of leaf area per plant as compared to control, whereas the other treatments were in between the two (Table 2). Similar results were also obtained by Islam and Hossain (2014).

*Number of leaves*

Number of leaves per plant of red amaranth showed no significant variation by the application of poultry manure and inorganic fertilizers at 15 days of germination except 30 and 45 days. At 15 days, the same number of leaves (2.0) per plant was recorded for all treatments. After 30 days of germination, the maximum number of leaves (7.0) per plant was counted both in $T_4$ (75% RDF + PM 8 t/ha) and $T_6$ (50% RDF + PM 8 t/ha). The second maximum number of leaves (6.00) per plant was obtained from $T_2$ (100% RDF), $T_3$ (75% RDF + PM 4 t/ha) and $T_5$ (50% RDF + PM 8 t/ha) treatments respectively which were statistically similar, while the lowest number of leaves (4.0) per plant was recorded from the treatment that received neither poultry manure nor inorganic fertilizer ($T_1$ treatment). After 45 days of germination, the maximum number of leaves (8.0) per plant was recorded from all treatments except $T_1$ (Table 2). Fresh weight of roots, shoots and leaves showed significant positive response for the application of different rates of poultry manure and inorganic fertilizers at 15, 30 and 45 days after germination (Table 3).

**Table 3. Effects of poultry manure and inorganic fertilizers on the fresh weight of roots, shoots and leaves of red amaranth after 15, 30 and 45 days of germination.**

| Treatments | 15 Days | | | 30 Days | | | 45 Days | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fresh wt. of root (t/ha) | Fresh wt. of shoot (t/ha) | Fresh wt. of leaf (t/ha) | Fresh wt. of root (t/ha) | Fresh wt. of shoot (t/ha)) | Fresh wt. of leaf (t/ha) | Fresh wt. of root (t/ha) | Fresh wt. of shoot (t/ha) | Fresh wt. of leaf (t/ha) |
| Control (- RDF & - PM) | $0.0011^{d}$ | $0.0045^{e}$ | $0.0037^{d}$ | $0.0024^{e}$ | $0.0252^{d}$ | $0.0254^{e}$ | $0.3413^{d}$ | $0.7562^{c}$ | $0.5634^{e}$ |
| 100% RDF | $0.0014^{cd}$ | $0.0050^{de}$ | $0.0047^{b}$ | $0.0054^{d}$ | $0.0557^{b}$ | $0.0689^{b}$ | $1.0358^{b}$ | $4.8692^{b}$ | $3.5119^{c}$ |
| 75% RDF + PM 4 t/ha | $0.0022^{bc}$ | $0.0052^{d}$ | $0.0038^{d}$ | $0.0062^{c}$ | $0.0555^{b}$ | $0.0751^{a}$ | $1.3353^{ab}$ | $6.4488^{a}$ | $4.4005^{b}$ |
| 75% RDF + PM 8 t/ha | $0.0026^{b}$ | $0.0080^{b}$ | $0.0047^{b}$ | $0.0054^{d}$ | $0.0440^{bc}$ | $0.0630^{bc}$ | $1.3939^{a}$ | $4.8913^{b}$ | $5.9602^{a}$ |
| 50% RDF + PM 4 t/ha | $0.0032^{ab}$ | $0.0060^{cd}$ | $0.0042^{c}$ | $0.0072^{b}$ | $0.0409^{c}$ | $0.0576^{c}$ | $1.0171^{b}$ | $4.7855^{b}$ | $3.7272^{bc}$ |
| 50% RDF + PM 8 t/ha | $0.0035^{a}$ | $0.0118^{a}$ | $0.0054^{a}$ | $0.0082^{a}$ | $0.0802^{a}$ | $0.0662^{b}$ | $1.1752^{b}$ | $6.3051^{ab}$ | $4.7655^{b}$ |
| PM 4 t/ha | $0.0024^{bc}$ | $0.0049^{de}$ | $0.0042^{c}$ | $0.0058^{cd}$ | $0.0254^{d}$ | $0.0310^{de}$ | $0.4078^{d}$ | $1.5903^{c}$ | $1.8255^{d}$ |
| PM 8 t/ha | $0.0019^{c}$ | $0.0061^{c}$ | $0.0044^{bc}$ | $0.0053^{d}$ | $0.0328^{cd}$ | $0.0343^{d}$ | $0.6600^{c}$ | $3.4857^{bc}$ | $2.7663^{cd}$ |
| LSD at 5% | 0.0007 | 0.0009 | 0.0004 | 0.0009 | 0.0013 | 0.0064 | 0.1650 | 1.55 | 1.10 |

$^{abcde}$ Data bearing different superscripts within the same column differ significantly ($P \leq 0.05$).

*Fresh weight of root*

Results revealed that the fresh weight of root increased significantly at 15, 30 and 45 days of germination as compared to control. At 15 days of germination, the highest fresh weight of root (0.0035 t/ha) was found in $T_6$ (50% RDF + PM 8 t/ha) which was 218.18% higher over control. At 30 days after germination, fresh weight of root of red amaranth varied significantly from 0.0024 t/ha to 0.0082 t/ha. The highest root fresh weight (0.0082 t/ha) was recorded in $T_6$ (50% RDF + PM 8 t/ha). The lowest fresh weight of root (0.0024 t/ha) was found in $T_1$ (control) that received no fertilizer (Table 3). After 45 days of germination, the

highest fresh weight of root (1.3939 t/ha) was observed in $T_4$ (75% RDF + PM 8 t/ha) which was 308.41% higher over control and the second highest value (1.3939 t/ha) was noticed from $T_4$ (75% RDF + PM 8 t/ha) which was 291.24% higher over control. The lowest fresh weight of root (0.3413 t/ha) was obtained from $T_1$ (control) (Table 3).

*Fresh weight of shoot*

Data on shoot fresh weight revealed that the application of poultry manure and inorganic fertilizers had significant effects. At 15 days after germination, the highest shoot fresh weight (0.0118 t/ha) was found in the treatment $T_6$ (50% RDF + PM 8 t/ha) which was 162.22% higher over control. The second highest shoot fresh weight (0.0080 t/ha) was found in $T_4$ (75% RDF + PM 8 t/ha) which was 77.78% higher over control and the lowest shoot fresh weight (0.0045 t/ha) was obtained from $T_1$ (control) (Table 3). At 30 days of germination, fresh weight of shoot of red amaranth varied significantly ($P \leq 0.05$) from 0.0252 t/ha to 0.0802 t/ha. The highest shoot fresh weight (0.0802 t/ha) was recorded from $T_6$ (50% RDF + PM 8 t/ha) which was 218.25% higher over control and the second highest value (0.0557 t/ha) was obtained from $T_2$ (100% RDF) which was 121.03% higher over control and which was statistically similar to $T_3$ (75% RDF+ PM 4 t/ha) and $T_4$ (75% RDF + PM 8 t/ha). The lowest shoot fresh weight (0.0252 t/ha) was obtained from $T_1$ (control) that received no fertilizer (Table 3). After 45 days of germination, the highest shoot fresh weight (6.4488 t/ha) was found from $T_3$ (75% RDF + PM 4 t/ha) which was 752.79% higher over control and the second highest value (6.3051 t/ha) was noticed from $T_6$ (50% RDF + PM 8 t/ha) which was 733.79% higher over control. The lowest shoot fresh weight (0.7562 t/ha) was obtained from $T_1$ (control) (Table 3).

*Fresh weight of leaves*

At 15 days after germination, the maximum leaf fresh weight (0.0054 t/ha) was found in the treatment $T_6$ (50% RDF + PM 8 t/ha) and the second highest fresh weight of leaf (0.0047 t/ha) was obtained in $T_2$ (100% RDF) and $T_4$ (75% RDF + PM 8 t/ha). The minimum leaf fresh weight (0.0037 t/ha) was noticed from $T_1$ (control) (Table 3). At 30 days after germination, fresh weight of leaves of red amaranth varied significantly ($P \leq 0.05$) from 0.0254 t/ha to 0.0751 t/ha. The highest fresh weight of leaves (0.0751 t/ha) was recorded from $T_3$ (75% RDF + PM 4 t/ha) which was 195.67% higher over control and the second highest value (0.0689 t/ha) was obtained from $T_2$ (100% RDF) which was 171.26% higher over control and which was statistically similar to $T_6$ (50% RDF + PM 8 t/ha). The lowest fresh weight of leaves (0.0254 t/ha) was obtained from $T_1$ (control) that received no fertilizer (Table 3). After 45 days of germination, the highest fresh weight of leaves (5.9602 t/ha) was found from $T_4$ (75% RDF + PM 8 t/ha) and the second highest value (4.7655 t/ha) was noticed from $T_6$ (50% RDF + PM 8 t/ha). The increase in leaf fresh weight of red amaranth after 45 days ranged from 224.01 to 957.90%.

*Yield*

Statistically significant positive effects of all the treatments on the yield of red amaranth were found in the experiment as compared with control. At 15 days after germination, the maximum yield of red amaranth (0.0035 t/ha) was obtained in $T_6$ (50% RDF + PM 8 t/ha)

which was 400% higher over control and the minimum yield (0.0007 t/ha) was obtained in the control treatment (Table 4). At 30 days after germination, yield of red amaranth varied significantly from 0.0106 t/ha to 0.0382 t/ha. The highest yield (0.0382 t/ha) was recorded in $T_6$ (50% RDF + PM 8 t/ha) which was 260.38% higher over control and the second highest value (0.0184 t/ha) was obtained from $T_3$ (75% RDF + PM 4 t/ha) which was 73.58% higher over control and which was statistically similar to $T_2$ (100% RDF). The lowest yield (0.0106 t/ha) was obtained from $T_1$ (control) that received no fertilizer (Table 4). After 45 days of germination, the highest yield (1.4853 t/ha) was found in $T_6$ (50% RDF + PM 8 t/ha) which was 1,087.29% higher over control and statistically similar to$T_4$ (75% RDF + 8 t/ha PM).

**Table 4. Effects of different treatments on the yield (on dry weight basis) of red amaranth after 15, 30 and 45 days of germination.**

| Treatments | 15 Days | 30 Days | 45 Days |
|---|---|---|---|
| | Yield (on dry weight basis) (t/ha) | Yield (on dry weight Basis) (t/ha) | Yield (on dry weight basis) (t/ha) |
| Control (-RDF & -PM) | $0.0007^{e}$ | $0.0106^{e}$ | $0.1251^{d}$ |
| 100% RDF | $0.0012^{d}$ | $0.0174^{b}$ | $1.1837^{b}$ |
| 75% RDF + PM 4 t/ha | $0.0020^{c}$ | $0.0184^{b}$ | $1.4636^{ab}$ |
| 75% RDF + PM 8 t/ha | $0.0028^{b}$ | $0.0151^{cd}$ | $1.4850^{a}$ |
| 50% RDF + PM 4 t/ha | $0.0030^{b}$ | $0.0138^{d}$ | $1.2018^{b}$ |
| 50% RDF + PM 8 t/ha | $0.0035^{a}$ | $0.0382^{a}$ | $1.4853^{a}$ |
| PM 4 t/ha | $0.0016^{cd}$ | $0.0141^{cd}$ | $0.3610^{cd}$ |
| PM 8 t/ha | $0.0028^{b}$ | $0.0155^{c}$ | $0.6119^{c}$ |
| LSD at 5% | 0.00045 | 0.0016 | 0.2670 |

$^{abcde}$ Data bearing different superscripts within the same column differ significantly ($P \leq 0.05$).

From the study, it is revealed that all the treatments had significant positive effects over control in respect of growth parameters and yield of red amaranth. In the case of growth parameters (plant height, leaf area and number of leaves), fresh weight of shoots, roots and leaves, and yield (on a dry weight basis), positive results were observed when inorganic fertilizers and poultry manure were applied together. Use of poultry manure (8 t/ha) with 50% and 75% recommended doses of fertilizers revealed better results for growth and yield of red amaranth than the single use of chemical fertilizers and poultry manure. Among all the treatments, $T_6$ (50% RDF + PM 8 t/ha) was the best.

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