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Original Article

Organic Fertilizer Effect on Growth and Yield in Okra

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Abstract

An experiment was conducted to study the comparative effect of organic fertilizer, Bio-fertilizer, bio-promoters and mixed fertilizers on the growth and yield of okra (*Abelmoschusesculentus*). The experiment consisted of four treatments along with one control. The soil was treated one week before sowing. The treatments were laid in a completely randomized design with two replications. Plant growth was assessed for morphological trait such as seeds germination, plant height, fresh root weight, root branches and fruit yield. The application of different treatments had significant effects on all the parameters assessed. The application of T_1 gave better germination of seeds (62.34%). T_3 gave plants with the greatest plant height (167 cm); T_2 gave the better root branches (38) whereas T_2 and T_3 gave maximum root fresh weight (36.43 gm and 36.5 gm respectively). The application of T_2 gave maximum fruit yield (15.7Kg). The overall performance on highest yield was observed for T_2 followed by T_1. The data obtained from these treatments were significantly higher than the data obtained from the control. It was, therefore, concluded that the use of organic manure in the production of vegetables like okra should be encouraged.

Keywords

Okra; Organic Fertilizer; Bio-Fertilizer; Chemical Fertilizer; Environment; Growth and Yield.

Introduction

As India is an agriculture based country, farmers need adequate resources to replenish soil fertility and maintain the productivity of soil. Really, the green revolution has popularized the use of chemical fertilizers to achieve higher productivity (HazellB.R.P.2009). But due to continuous and indiscriminate use of fertilizers, the natural fertility of soil has been lost and this activity has contaminated our soil, water and food (Werner W. 2002; Rodriguez E., Sultan R., Hilliker A. 2004; Akanbi W.B., Togun A.O., Adediran J.A., Ilupeju E.A.O. 2010). Therefore, farmers are in need of searching alternative to replace the chemical fertilizers. In recent days, the use of organic inputs like organic fertilizer, vermin-compost, bio-fertilizers and bio-pesticides is becoming popular in the world wide. The demand for organic plants in the international market shows an upward trend and consumers are willing to pay a premium price for organic produces against conventional products (Donald. W. L.2003).

Lady finger is one of the most popular and intriguing vegetables in the India. It not only adds variety, taste and nutrition to Indian cuisine, but also it is one of the more reliable crops that farmers and gardeners can grow. The plant is cultivated in

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tropical, subtropical and warm temperate regions around the world. It can be eaten raw. Lady finger is very low in calories and dense with nutrients. It is high in fiber, vitamin A, C, and folate content (http://www.nutrition-and-you.com/okra.html). It is also a good source of the vitamins and minerals like Vitamin B&K, calcium, potassium, iron, zinc, and traces of magnesium and manganese (Gopalan C., Sastri S.B.V., Balasubramanian S.2007). Lady finger is one of those few vegetables which have the highest content of phytonutrients and antioxidants such as beta-carotene, xanthine and lutein (ArapitsasP. 2008). It is one of the best medicinal plants that helps red blood cells production and prevent anemia.The high antioxidants in lady finger helps protect the immune system against harmful free radicals and prevent mutation of cells. The high antioxidants and vitamin C content make okra useful for reducing asthmatic attacks. Folate in lady finger builds strong bones and density, preventing osteoporosis; reduce cholesterol thus also reducing atherosclerosis and the risk of heart diseases. The rich fiber and mucilaginous (slimy) content in lady finger pods help increase bulk, bind to toxins and ensure easy bowel movements with its natural laxative properties. Regularly eating okra also reduces the risk of colon cancer (Govind P., Madhuri S. 2011). It has insulin-like properties that help to reduce blood sugar level. The fiber helps improve the population of beneficial bacteria in the gut. The high antioxidants and vitamin C content make lady finger a good immune booster food. The mucilaginous content provides a temporary coating to the digestive tract and stomach lining while healing the ulcers. The rich folate content in lady finger can help decrease the incidence of neural tube defects in babies and helps in bowel movement. Helps reduce acne, psoriasis and other skin conditions. Also lady finger is helpful for vision health, preventing eye problems like cataract and glaucoma.

Materials and Methods

The experiment was conducted to test the efficacy of the Organic fertilizer,Bio-fertilizer, Bio-promoter and mixed fertilizers on growth & product yield in Okra against control. Also our aim was to find out the compatibility of organic fertilizer with Inorganic fertilizer. This experiment was carried out at the Patanjali Bioresearch Institute villagePadartha, Haridwar, India during 17th May to 4th September 2014. A factorial experiment on the basis of a modified completely randomized design (CRD) with two replications was implemented. The total plots size was 34.4 $m^2$and the numbers of plots were 10. The experiment design had one controls (only decomposed cow dung as a basal dose), four

Table 1: Composition of different treatments

Sl. No.	Treatment	Categories	Composition
1.	T_0	Control	Decomposed Cow Dung
2.	T_1	Organic Fertilizer	Carbon-24%, Nitrogen-2.25 %, Phosphorus-2.75 % , Potassium-1.775 %, Calcium-3%, Magnesium-0.45%, Sulphur-0.4%, Iron-0.6%, Zinc-0.35%, Manganese – 0.09%, Copper, Boron, Cobalt & molybdenum in trace amount
3.	T_2	Bio-fertilizer	T1 + Azotobactersp., Bacillus sp., Trichoderma sp., Pseudomonas sp., Azospirillumsp. and Frateuriasp.
4.	T_3	Bio-promoter	T1 + Auxin, Cytokinin, Gibberellin(all three are plant hormones) Allycine (antifungal), Embaline (Anti-bacterial), Azadrectine (Insecticidal), Mycorrhiza, Cathepsin D & Trypsin (Enzyme)
5.	T_4	Mixed fertilizer	T1 + DAP Ratio-70:30

The average rainfall during trial period was recorded 375 mm. During trial period means of high, low and average seasonal temperature were recorded 36^{0}C, 21^{0}C and 28.5^{0}C.The experimental soil was sandy loam. However, soil samples were taken from the field to identify chemical properties of soil before planting (Table 2).

Table 2: Chemical properties of the experimental field

pH	EC(µs)	Total N(%)	P(ppm)	K(ppm)	Organic C (%)
6.7	170	0.011	13.9	3.5	0.11

treatments (T_1, T_2, T_3 and T_4). Each treatments and control had two replications. The categories of treatments and composition for each treatment were taken as follows (Table 1)

All treatments were applied one week before sowing. Treatment T_1, T_2 and T_4 were appliedamounting at the rate of 800 gm/plot, T_3 was applied at the rate of 25 mg/plotand in Control (T_o)

decomposed cow dung was applied, amounting to 5 kg/plot. In mix fertilizer the ratio of DAP: T_1 was kept 30:70. The numbers of seeds sown per plot were 154 and sown after treated with Bio-fungicide (Trichoderma sp.) for T_1, T_2, T_3 and T_4 at the rate of 3 ml per liter for 10 minute, and waterwas used to treat the seeds for controlfor 1 hour. The space between rows was kept 45× 45 cm. In this experiment, morphological traits such as seed germination, plant height during harvesting, root number, root biomass, number of fruits, total fruit weight, total seed weight and 100 seed weight were measured.

In this experiment, we also analyzed different parameter for root like fresh weight, number of root branchesof tap root. For this randomly five plants were taken out from the each treatment by making a deep dig around the plants. To avoid root damage or loss during harvest, each pot was first submerged in a water bath for 5–30 min at ambient temperature and then plants were lightly shaken to release them from the substrate. The roots were then rinsed with tap water until all visible sand and soil particles were removed. Particles that adhered strongly to the roots were manually removed with tweezers.

Dry weight was measured by placing large root systems into small, tarred brown paper bags. Samples were dried in a forced-draft oven at 72 ± 2°C for 16 h. Only a few pouches (2–5) were removed for each batch measurement to avoid absorption of moisture from the air. Dried roots were weighed on a laboratory scale located in the same laboratory as the oven periods were used for sand and longer periods for soil.

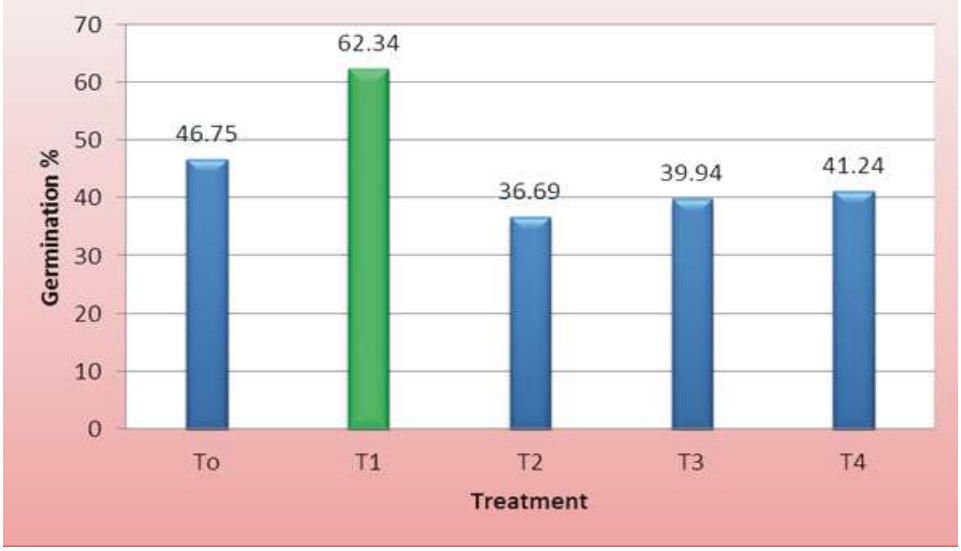
After blotting excess moisture from the roots with absorbent paper, root fresh weight was measured under the following conditions. (i) Laboratory environment: ambient temperature, 25 or 32 8C, air current created by the air conditioning system, 0 and 4.3 m s-1, 30 or 74% relative humidity, and light intensities of 60 or 200 µmol m-2 s-1. Roots were subjected to these conditions for 1 h. (ii) Time factors: time elapsed between extraction of plants from the substrate and weight measurement, and extraction time determined by the size of the experiment. (iii) Technical factors: type of absorbent paper used, Whatman No. 1 filter paper (Whatman, GE Healthcare UK limited), fine adsorbing tissue (Kleenex 100, Mexico), and common white paper (78 g m-2, Leeds bond, Kimberly-Clark, Mexico), and two technicians doing extraction and measurement procedures in the same experiment. Standard conditions, when a single variable was changed, were air temperature 25°C, RH 30%, light intensity 200 µmol m-2 s-1, 5 plant samples, and water absorption from the extracted roots with fine absorbing tissue. Fresh weight measurements were made on the same material which was reported by dry weight.

Results

1. Germination

Germination wasobservedafter 15 days of showing and at the interval of 2 days after first germination count. The mean germination percentage, after 18 days of sowing were 36.69 for T_2,

Graph 1: Effect of different treatment on germination

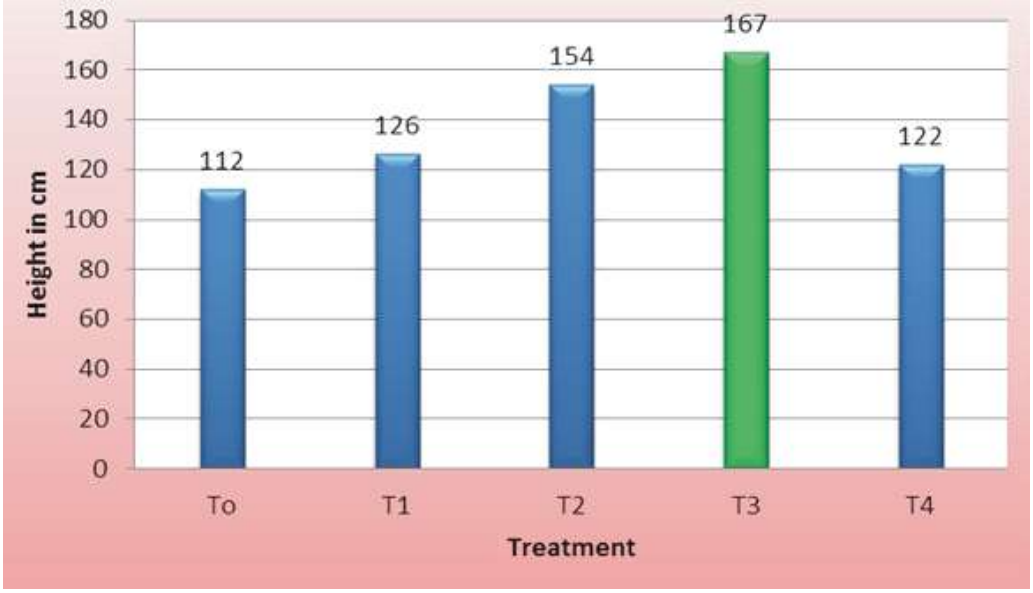


39.94% for T_3, 62.34% for T_1, 41.23% for T_4 and 46.75% for control. The best germination 60.34 was observed in plot treated with T_1 (Graph 1).

2. *Plant height*

In this study, application of, organic fertilizer, bio-fertilizer, bio-promoter and mixed organic fertilizer

Graph 2: Effect of different treatment on plant height

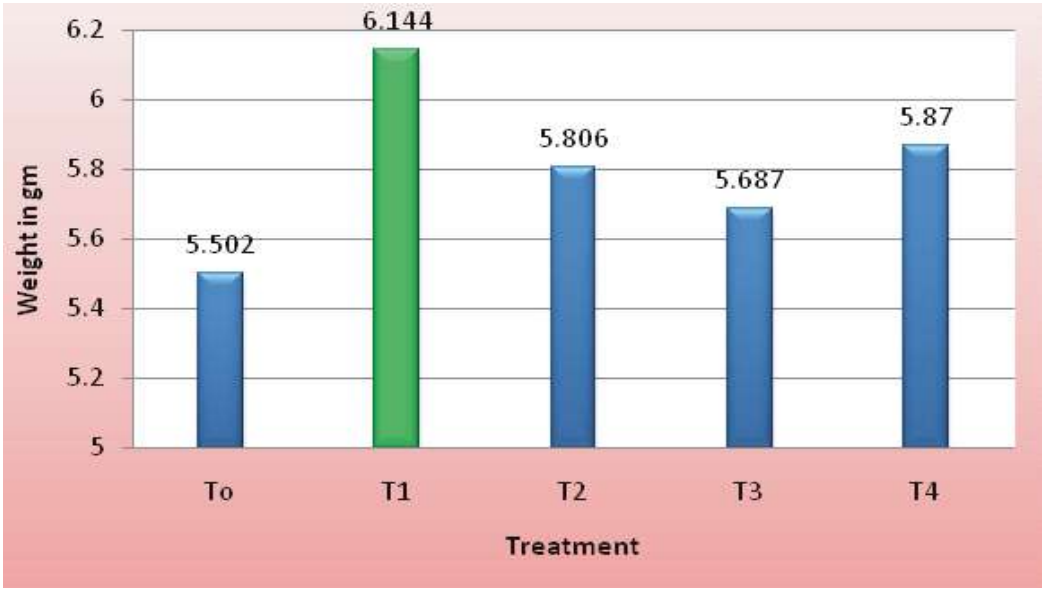


caused significant effect on plant height of Okra. The mean data were observed at the time of flowering and found thatT_3 caused the highestplants of 167 cmheight followed by T_2 154 cm (Graph 2). Means of plant highest presented the lowest 112 cm for control (T_0), whereas it was 126 cm for T_1 and 122 cm for T_4.

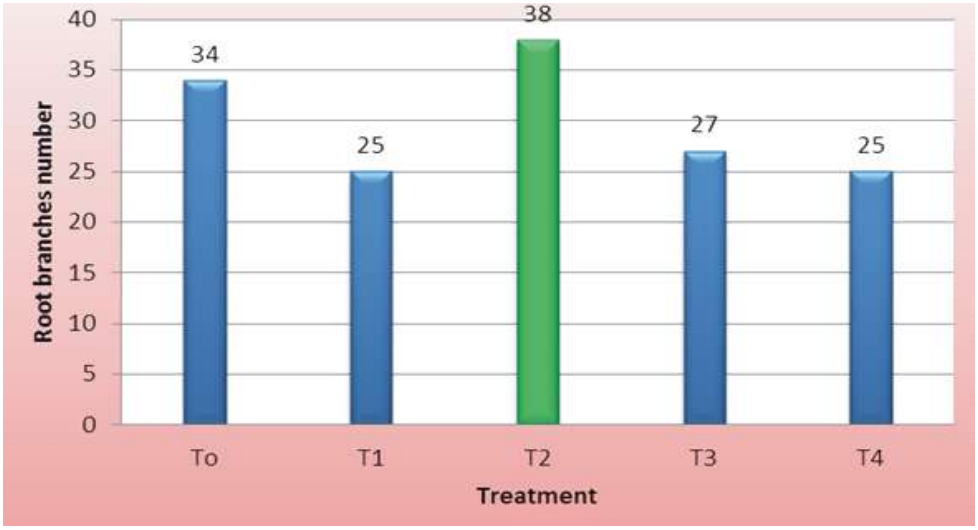
3. *Root analysis*

The maximum fresh root weight was observed 36.5 gm/plantfor the T_3 treatment, whereas the lowest 16.3 gm/plantwere for control (T_0). The fresh root weight per plant for T_2, T_1 and T_4 was 36.43gm, 28.17gm and 21gm respectively (Graph3). The average numbers

Graph 3: Effect of different treatment on root weight



Graph 4: Effect of different treatment on number of root branches



of root branches per plant were measured highest 38 for T_2. The average root number per plant for T_1, T_3, T_4 and Control (T_0) count were 25, 27, 25 and 34 respectively (Graph 4).

4. Fruit Yield

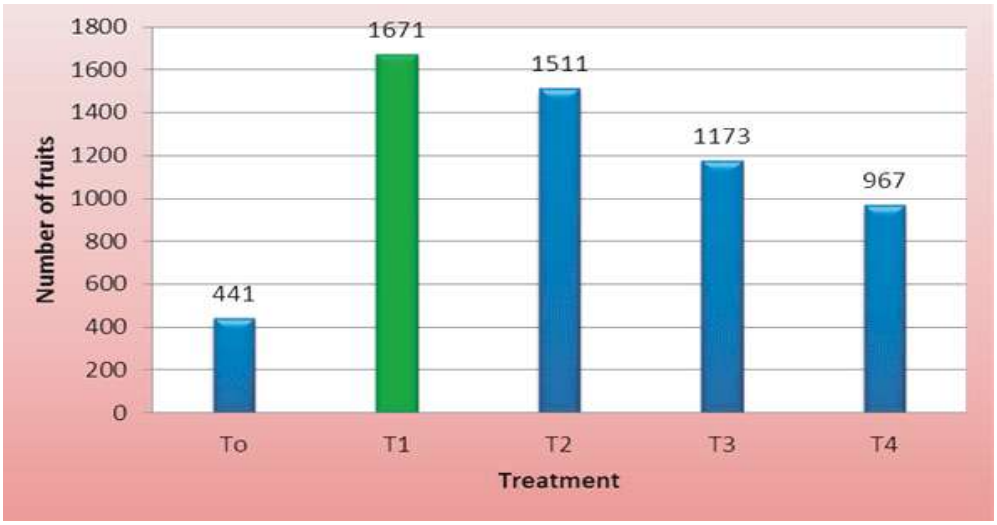
The fruit were harvested at different interval of time for five times. The harvested data were recorded for each time for every replication for each treatment. The total fruit harvested for each treatment/plot were recorded. The maximum number of fruit yield 1671, wereharvested fromT_1 treated plots and least 441 for Control (T_0). The total number of fruits from each two plots for T_2, T_3, and T_4 was 1511, 1173 and 967 respectively (Graph 5).

The weight for total harvested fruits from each replications of each treatment were measured in gram and found maximum for T_2 treated plots (15.7 Kg) whereas it was lowest for T_0 (3.9 Kg). The total fruit yield in terms of weight for T_1, T_3 and T4was 14.4 Kg, 11.4 Kg and 4.3 Kg respectively (Graph 6).

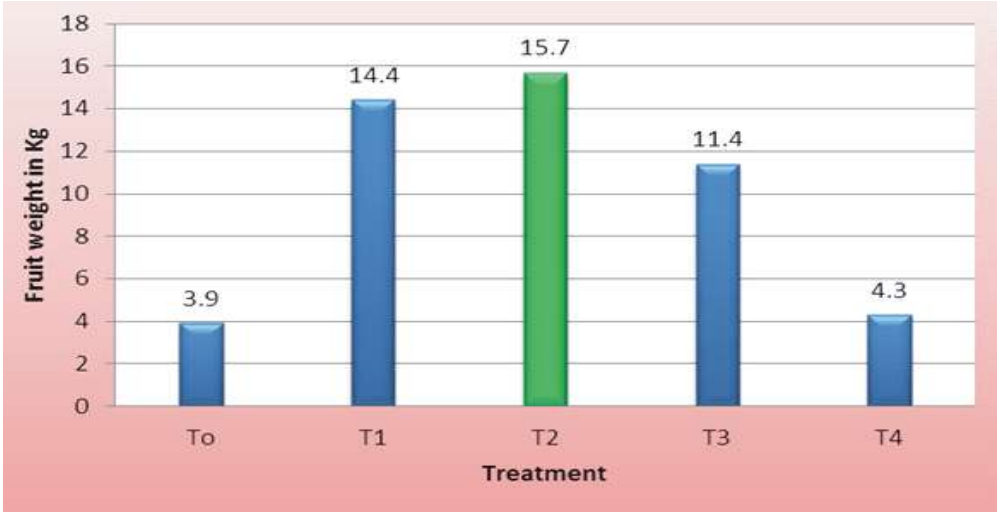
5. 100 seed weight

In this study, we were also conduct the seed index by weighing the 100 seed weight for each treatment. The maximum seed index was observed for T_1 (6.144 gm) and the least for control (5.502 gm). Seed index for T_2, T_3 and T_4 were 5.806 gm, 5.687gm and 5.870gm respectively (Graph 7).

Graph 5: Effect of different treatment on fruit number



Graph 6: Effect of different treatment on total fruit yield



Discussion and Conclusion

From the above result we observed better germination for T_1, highest plant on T_3, maximum root fresh weight for T_3, more number of root branches for T_2, best seed index for T_1, the maximum number of fruit for T_1 and height

Graph 7: Effect of different treatment on Seed index

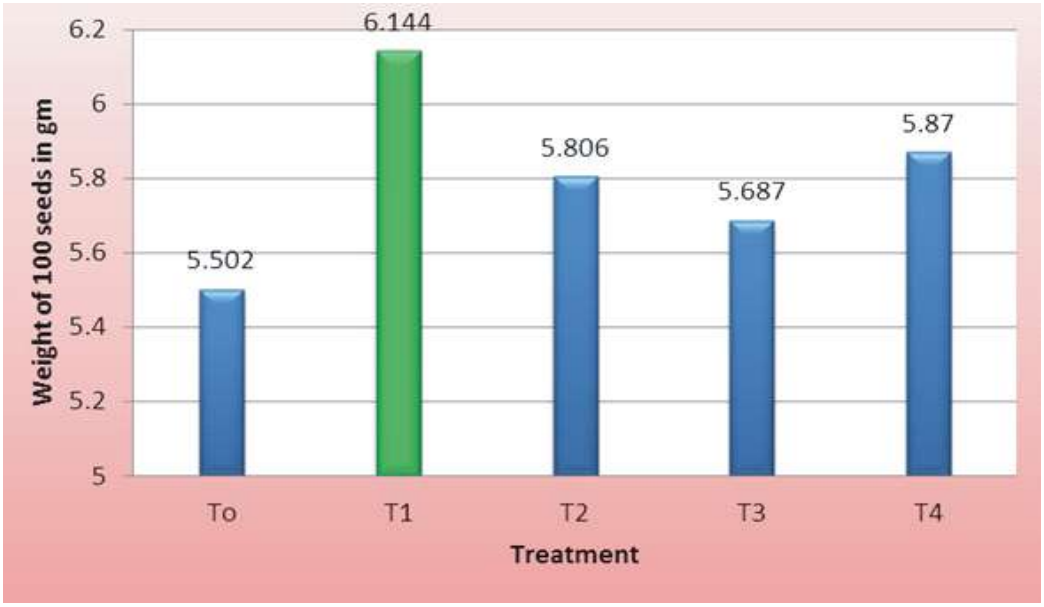


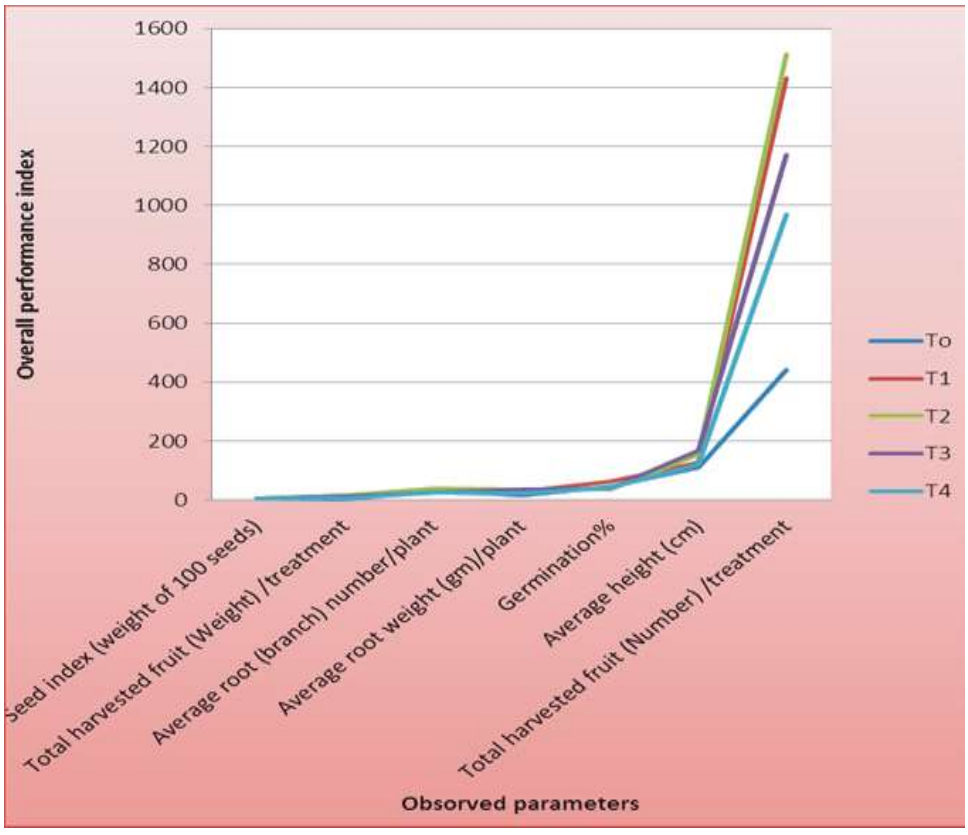
Table 2: Average result observed for different parameters for different treatments

Treatment	Germination%	Average height (cm)	Average root weight (gm)/plant	Average root (branch) number/plant	Total harvested fruit (Number) /treatment	Total harvested fruit (Weight) /treatment	Seed index (weight of 100 seeds)
T_0	46.75	112	16.3	34	441	3.9	5.502
T_1	62.34	126	28.17	25	1671	14.4	6.144
T_2	36.69	154	36.43	38	1511	15.7	5.806
T_3	39.94	167	36.5	27	1173	11.4	5.687
T_4	41.24	122	21	25	967	4.3	5.870

Fig. 1: Dry podsobtained comparison for different treatment.
A- T_2, B- T_3, C- T_4, D- T_1 and E- T_0.

yield (in terms of biomass) for T_2. The conclusion which we made on the basis of above results, the best treatment was T_2 followed by T_1, T_3, T_4 and T_0. So the best performer for maximum yield was T_2 (Graph 8).

Graph 8 : The overall performance of different organic manures tested



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