



Effect of natural compost and synthetic fertilizers on the growth of bhendi (*Abelmoschus esculentus* (L.) Moench)

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Abstract

Research is currently being done on how the development of the Bhendi plant, *Abelmoschus esculentus*, is affected by organic compost and synthetic fertilizers. Observations for morphological characteristics, such as seed germination shoot length, root length, number of leaves, and whole plant fresh weight, whole plant dry weight, had been made at crucial growth phases in the life cycle of the Bhendi. Natural compost (NC) and Artificial fertilizers (AF), among other mixes of organic manures, were structured and used in the experiment. T1 - Control, T2 - (MWC 100%), T3 - (CMC 100%), T4 - (GMC 100%), T5 - (MWC + CMC+ GMC), T6 - (N)urea, T7 (P)super single phosphate, T8 - (K)potassium, T9 - (N+P+K), and T10 - (N+P+K)+ The data analysis revealed that applying natural compost increased the physical properties of plants when compared to the control and other treatments. While treatment compound synthetic fertilizer T9 (N+P+K) has shown a great potential for plant growth, results with treatment compound fertilizer T10-(N+P+K) + (MWC+CMC+GMC) were remarkably similar. As a result, the growth of the Bhendi plant and its fruit is fully dependent on the quantity of natural compost combined with synthetic fertilizers applied.

Keywords: Natural compost, beneficial, Bhendi, potential, growth, synthetic fertilizer, potential

Introduction

Tropical and subtropical areas of the world mainly rely on the vegetable bhendi, sometimes referred to as lady's fingers, gumbo, or bhendi. It belongs to the Malvaceae family, specifically the *Abelmoschus* variety. Okra is a hardy crop valued for its delectable and soft cases. In West Africa, okra blossoms, buds, and leaves are also consumed. In the jungles and hotter areas of mild Asia, okra is widely produced. Among the nations that industrially produce it are India, Turkey, Iran, West Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, West Bengal, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia, Cyprus, and the southern United States. To maintain soil productivity, more time must pass for plant nutrients to arrive from natural sources and be applied correctly. Natural farming enhances the wellbeing of plants and animals while providing several environmental advantages to the planet. Reusing and recovering lost resources, as well as ceasing the use of chemical compounds in manures or insecticides, all help to establish just and acceptable structures for environments that are environmentally friendly. Regular animal waste and garbage from the city can be taken out and repurposed by being converted into natural composts using a clean and safe technique called soil treatment. It is high-quality herbal manure that is simple to make, affordable, and effective in encouraging waste management. According to Narkhede et al., (2010) the compost created from municipal solid waste and sewage sludge had an outstanding amount of nutrients. The increase in fertilizer prices in emerging countries is having a significant negative impact on the poor farmers. Despite the fact that the use of chemical fertilizers, insecticides, and herbicides has enhanced agricultural production, there is growing concern regarding the

detrimental effects of chemical use on soil quality and productivity. The prolonged use of chemical fertilizers has reduced yields, affected soil health, increased the occurrence of pests and diseases, and polluted the environment (Ansari and Ismail 2001). The main elements of inorganic fertilizers are potassium, phosphorus, and nitrogen, all of which have an effect on vegetative and reproductive plant growth. Inorganic fertilizers are preferred because organic fertilizers frequently have lower nutrient concentrations, solubility's, and release rates. This is due to the fact that compared to inorganic fertilizers, organic fertilizers have lower nutrient concentrations, solubility's, and release rates. Additionally, using organic manures resulted in the best and most sustainable crop output while also improving the fertility and productivity of the soil (Sanwal et al., 2007). Combining organic and inorganic fertilizer sources may be helpful for a productive crop yield, a solid financial return, and healthy soil (Deshmukh et al., 2010).

Materials and methods

Using seeds and soils

To ascertain the soil's present NPK status, a pre-analysis was completed. According to the needs of the soil, inorganic fertilizers including urea (67 kg/ha), super phosphate (470 kg/ha), and murate of potash (63 kg/ha) were applied. The soil's physical and chemical properties, such as pH, conductivity, organic carbon, nitrogen, potassium, phosphorus, chlorides, total viable count, bulk density, etc., were measured using standard techniques (APHA 1995). Heavy metals from soil, including Cu, Fe, Mg, Mn, Ni, and Zn, were extracted using acid digestion techniques, as advised by Hessey (2002). Thermo 'S' series Atomic Absorption Spectrophotometer was then used to assess these

metals. Soil samples were gathered at a depth of 0.5 feet at each sampling position of the study site in Vadachennimalai, Attur, and Salem district. The soil and water laboratory at the Tamil Nadu Agriculture University (TNAU) in Coimbatore looked at this soil. *Abelmoschus esculentus* seeds were collected from the Tamil Nadu Agriculture University (TNAU), which is located in Coimbatore.

Fertilizers used

The Private company Ltd supplied the chemical fertilizers NPK (20:10:10) used in this study. It was a source of potassium, phosphorus, and nitrogen. Composts manufactured from various organic animal wastes, including market trash, goat manure, and cow manure, made up natural compost. Description of the composting process involved layering trash to create heaps of dry straws, manures, and inoculums (waste degrading microorganisms). Aerating or turning every two weeks on all heaps not less than 1.5 m in height allowed for the complete degradation of all substrates in the pile to produce mature compost (not more than 4 months). Table 1.1 lists the chemical elements of organic fertilizers.

Experimental design and treatments

Experimental approach

Trials were conducted using the following randomized complete block (RCB) design, which included ten treatments and three replicates:

1. T1-CONTROL
2. T2-MARET WASTE COMPOST (MWC)
3. T3-COW MANURE COMPOST (CMC)
4. T4-GOATS MANURE COMPOST (GMC)
5. T5-MWC+CMC+GMC
6. T6-N (NITROGEN)
7. T7-P (PHOSPHORUS)
8. T8-K (POTASSIUM)
9. T9-N+P+K
10. T10 -MWC+CMC+GMC)+(N+P+K)

An experimental design

Plots used as a representation of the experimental units. Natural compost was present in an agricultural field, ranging from 50 kg depending on the treatment taken into account. Before sowing and 25 days later, a variable amount of chemical fertilizer (NPK: 20:10:10) and natural compost (recommended dose) were mixed into the soil. Before planting, seeds were soaked in water for 24 hours to a maximum depth of 2 cm. Only one healthy plant per line remained after germination (7 and 10 days after sowing) in every line. Plots were watered once every five days. Assessed parameters

Plant survival and germination rates were assessed between the 7th and 10th day following seeding. This procedure involved totaling the seeds that germinated and expressing the result as a percentage using the formula below:

$$\text{Germination rate (\%)} = \frac{\text{Number of emerged plants}}{\text{Number of seeds sown}} \times 100$$

The experiment was set up in a complete block design with a plot size of 2.0 m 1.0 m, and the plant biomass was measured 55 days after seeding after the plants were dried in

an oven for 24 hours at 105°. 8.5 kg/ha of seeds were sown. Germination percentage, shoot length, root length, number of leaves, whole plant fresh weight, whole plant dry weight, etc. were measured on days 7, 15, and 30 following seeding (DAS). For the investigation of fresh and dry weight biomass, five plants at random from each plot were taken at 07, 15, and 30DAS. For each combination of treatments that was researched, comparative data was prepared.

Soil analysis

After being air dried, soil samples were crushed to fit through a 2-mm sieve. Samples were sieved to fine dirt through 0.5 mm pores for the measurement of carbon (C) and nitrogen (N). Using a pH meter, the pH of the soil was assessed in a 1:2.5 (w/v) soil/water suspension. Chromic acid digestion and spectrophotometric analyses were used to calculate organic C. (Heanes 1984). Colorimetric analysis was used to quantify total N using the wet acid method (Buondonno et al. 1995). following the Anderson and Ingram-recommended approach (1993). The bray extraction approach was used to extract the available phosphorus (P), and Murphy and Riley's blue molybdate method was used to analyze the resultant extracts (1962). Ammonium acetate was used to extract the exchangeable cations: calcium (Ca), magnesium (Mg), potassium (K), and sodium (Na), which were then, measured using an atomic absorption spectrophotometer (Garca and Báez, 2012). A colorimetric method was used to determine the CEC (cation exchange capacity). The hydrometer method was used to determine the particle size (three fractions) (Day 1953). While Ca, g, K, Na, and CEC were represented in cmol (+)/kg, or me/100 g, total C and total N were expressed in percentage (%).

Statistical analysis

All data, except those of germination and survival rates, soil mixtures and compost were subjected to analysis of variance (ANOVA) for comparison of mean values and Turkey test for multiple comparison range of mean values using the XLStat 2022 program.

Results and discussion

Before and after the experiment, the substrate combinations' physical and chemical properties

According to Table 2, which compares the physical and chemical properties of several composts, there is a difference between the soil's basic elements before and after the experiment. Different treatments have an uneven distribution of these components. Except for a few simple treatments like market trash compost, cow manure, and goat dung compost-based treatments, the soil pH was often acidic or neutral. When it comes to macro-elements, chemical fertilizer treatments had higher concentrations of calcium Ca, Mg, K, Na, C, and N, with respective values of 18.27 me/100 g, 9.88 me/100 g, 14.35 me/100 g, 1.55 me/100 g, 5.77 me/100 g, and 0.7%. Phosphorus, on the other hand, was barely found in the control. The T10 natural and synthetic compound fertilizers treatment was the wettest with 34.3% after the testing. At 55 days after sowing, the majority of the components in treatments were reduced in amount (DAS). The incorporation of some nutrients by the plant-based diet may be to blame for this decline. The pH levels after chemical fertilizer treatment were around 6.17. According to Zhang et al., the use of organic manure and NPK fertilizers improved the tomato plants' fruit quality,

growth, and output due to an improved nitrogen supply (1988). Similar to this, the use of NPK fertilizer (150, 50, and 50 kg/ha, respectively) considerably increased the concentration of magnesium in a number of green leafy vegetables, but had no effect on the concentration of copper (Reddy and Geeta 2001). Chemical fertilizers added to the soil had no effect on the potassium level of green leafy crops. Due to the higher decomposition of the organic forms of N, P, and K, the availability of N, P, and K was improved in the soil with different compost application rates. This improvement can be due to increased microbial activity. As a result, treatments with a specific dose of fertilizers were higher in mineral element concentration than the control. Following the application of organic fertilizer, previous studies have demonstrated increased soil N, P, K, Ca, Mg, and CEC status as well as decreased exchangeable acidity (EA) (Smith and Ayenigbara 2001). Following the application of animal manures, improvements in soil K, Ca, and Mg contents, a decrease in EA values, and an increase

in CEC have all been observed (Uwah et al. 2012). Goat dung compost and mineral fertilizers increased plant mortality rates (up to 67% dead plants after 55 days after sowing), which translated to a 37% plant survival rate. Conversely, 100 g of chicken compost and cow manure had no impact whatsoever on the survival rate of plants, indicating 100% of healthy plants. Uncontrolled fertilization, which caused the soil to turn from whitish to blackish and consequently decrease root development, may be to blame for the high mortality rate. These findings concur with those of Grzyb et al. (2013), who discovered noticeably high plant death after fertilizing apples with a lot of NPK minerals.

Table 1: chemical properties of natural manure

Types of Compost	K (%)	C (%)	N (%)	C/N	P (ug/g)
MWC	14.05	9.42	0.751	14.15	925.7
CMC	5.43	6.48	0.443	13.33	275.4
GMC	26.37	11.89	1.065	11.25	324.5

Table 2: Physico-chemical property variations of various soil mixture levels before and after treatments

Soil mixtures		pH (water)	Ca	Mg	K	Na	CEC	C (%)	(%)	MC (%)
Control	B	6.44	1.07	1.52	1.16	0.24	3.65	12.31	0.042	0.86
	A	6.34	1.44	1.64	1.04	0.12	3.85	11.31	0.045	3.24
MWC	B	6.63	4.68	1.52	2.17	0.34	5.03	10.23	0.149	2.35
	A	6.56	4.15	1.44	1.57	0.16	4.94	09.24	0.146	8.06
CMC	B	6.71	6.62	2.49	2.34	0.45	5.51	11.03	0.217	5.39
	A	6.98	6.11	2.88	2.24	0.25	4.31	11.01	0.236	9.06
GMC	B	7.52	5.25	3.05	2.85	0.40	4.23	12.03	0.136	9.50
	A	8.10	4.43	3.15	2.56	0.20	3.21	11.84	0.143	12.50
M+C+G	B	7.04	5.24	3.09	5.06	1.52	5.03	17.31	0.145	5.87
	A	7.21	5.25	2.94	5.00	1.43	4.05	16.42	0.143	11.01
N	B	7.28	7.41	1.76	1.73	0.37	3.05	11.05	0.481	12.51
	A	7.51	7.25	1.84	1.54	0.26	3.03	11.04	0.710	5.51
P	B	7.30	7.30	1.84	1.64	0.27	3.04	10.07	0.221	3.31
	A	6.17	7.39	2.36	1.53	0.24	3.02	10.06	0.212	6.52
K	B	7.31	8.12	3.23	1.34	0.23	2.94	10.05	0.131	4.01
	A	7.18	7.13	3.26	1.25	0.21	2.55	10.04	0.151	5.01
N+P+K	B	7.32	8.12	4.05	1.22	1.19	7.01	16.04	0.301	4.01
	A	7.25	7.91	4.04	1.10	1.16	8.52	15.05	0.366	3.02
N+P+K	B	6.79	8.71	0.50	5.73	1.78	0.58	0.84	0.421	16.14
M+C+G	A	6.78	9.21	0.65	5.74	1.29	0.89	0.79	0.045	34.03

Effect of natural compost and synthetic fertilizers on seed germination of Bhendi (*Abelmoschus esculentus*)

The rate of seed germination was higher when agrochemicals were used sparingly in treatments. It was increased by 100% for treatments T10 - MWC+CMC+GMC) + (N+P+K), T5 -MWC+CMC+GMC, and T9 - (N+P+K). The seed germination rate decreased in comparison to the T1control treatment when natural compost and synthetic fertilizers were applied separately (T2, T3, T4, T6, T7, and T8). We could tell that the compost was well-matured because of how fertilizer use affected the rate at which seeds germinated (Guedira et al. 2011). Under normal circumstances, the plant *Moringa oleifera* has a high rate of germination (Lamia et al. 2014). Compost for cow dung and poultry manure composts offer a modest advantage over other treatments, with a germination rate of up to 99%. The 24-hour pre-treatment of seeds before sowing may also be responsible for this high germination rate. Pre-treatment of *Moringa oleifera* seeds, such as soaking in water, dehiscence of seed, or removal of seed

shells, was found to significantly enhance germination rate. In soils without fertilizer input, a seed germination rate of 69.66% was found (Baye- Niwah and Mapongmetsem 2014), which is lower than the 99% found in the current study.



Fig 1: Effects of synthetic fertilizers and natural compost on the germination of Bhendi seed (*Abelmoschus esculentus*)

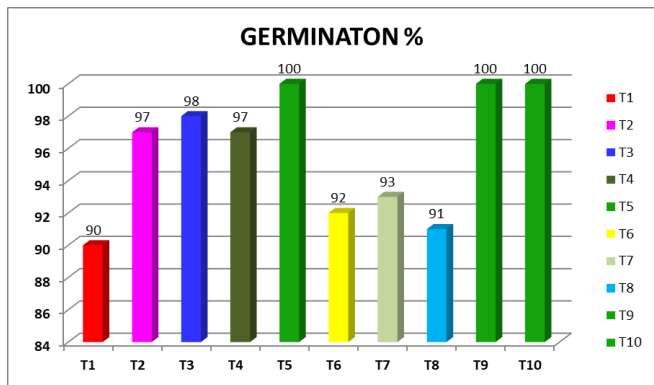


Fig 2: Effect of organic compost and artificial fertilizers on the germination of Bhenidi seed: Histogram (*Abelmoschus esculentus*)

Effect of natural compost and synthetic fertilizers on shoot length of Bhenidi (*Abelmoschus esculentus*)

The shoot length rate was higher in treatments receiving only a little amount of agrochemicals. The following treatments caused it to increase: T5-MWC+CMC+GMC, T10 - (N+P+K), and T9 - (N+P+K). Several organic and inorganic chemical treatments (T2, T3, T4, T6, T7, and T8) each caused a decrease in the shoot length when compared to the T1 control.

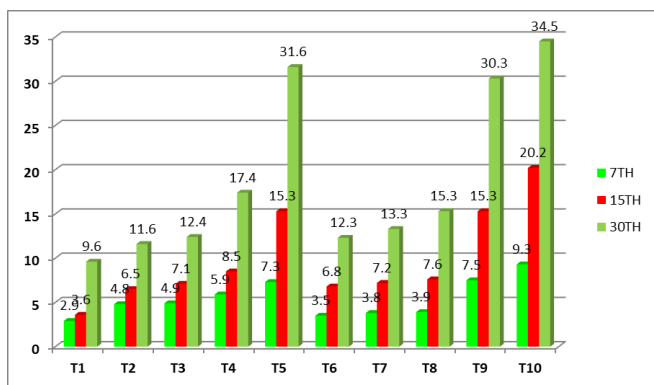


Fig 3: Histogram for Effect of natural compost and synthetic fertilizers on shoot length of Bhenidi (*Abelmoschus esculentus*)

Effect of natural compost and synthetic fertilizers on root length of Bhenidi (*Abelmoschus esculentus*)

Treatments using less synthetic fertilizer resulted in longer roots. The following treatments caused it to increase: T5-MWC+CMC+GMC, T10 - (N+P+K), and T9 - (N+P+K). Several organic and inorganic fertilizer treatments (T2, T3, T4, T6, T7, and T8) each resulted in a reduction in root length when compared to the T1 control.

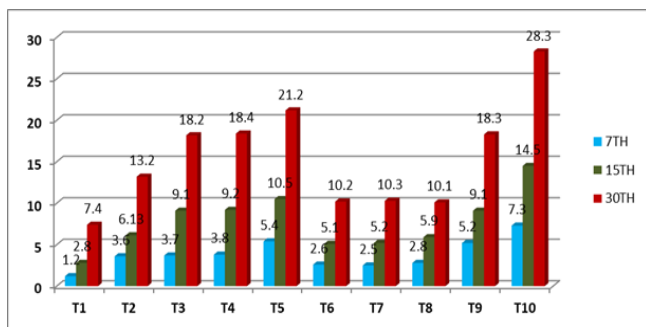


Fig 4: Histogram for Effect of natural compost and synthetic fertilizers on root length of Bhenidi (*Abelmoschus esculentus*)

Effect of natural compost and synthetic fertilizers on whole plant fresh weight of Bhenidi (*Abelmoschus esculentus*)

In those treatments getting only a tiny amount of synthetic fertilizers, the overall plant fresh weight rate was higher (Fig. 5). It was raised for the following treatments: T5-MWC+CMC+GMC, T10 - (N+P+K), and T9 - (N+P+K). Comparing different organic and inorganic fertilizer treatments, such as T2, T3, T4, T6, T7, and T8, to the T1 control on the other, each one helped to reduce the plant's overall fresh weight.

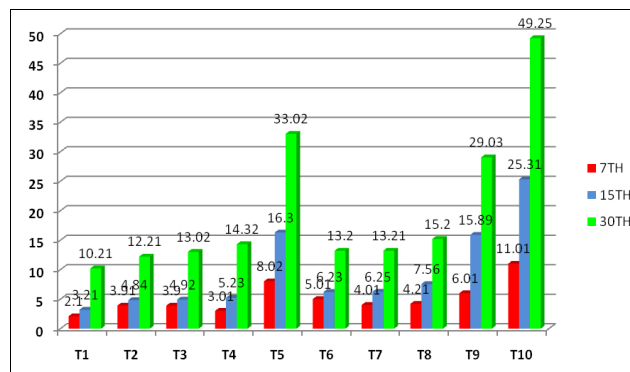


Fig 5: Histogram for Effect of natural compost and synthetic fertilizers on whole plant fresh weight of Bhenidi (*Abelmoschus esculentus*)

Effect of natural compost and synthetic fertilizers on whole plant dry weight of Bhenidi (*Abelmoschus esculentus*)

The overall plant dry weight rate was higher in groups that received less synthetic fertilizer (Fig. 6). The following treatments caused it to increase: T5-MWC+CMC+GMC, T10 - (N+P+K), and T9 - (N+P+K). Each organic and inorganic fertilizer treatment—T2, T3, T4, T6, T7, and T8—helped to lower the plant's overall dry weight when compared to the T1 control. The application of a small amount of compost, with or without inorganic fertilizer, has a considerable impact on plant biomass. Priyadarshani et al. (2013) found the similar results and found that compost and inorganic fertilizer should be administered in a 3:1 ratio for the best development of vetiver biomass. For field crops like lemongrass and sunflower, Rotkittikhun et al. (2007) showed that compost treatment combined with lower doses of inorganic fertilizer can result in higher biomass output. Increased soil aggregate stability may possibly have contributed to an increase in plant yields by favouring the growth of beneficial bacteria that enhanced biomass output (Basso and Ritchie 2005).

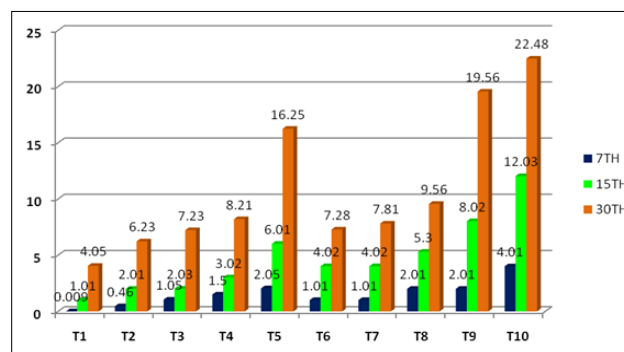


Fig 6: Histogram for Effect of natural compost and synthetic fertilizers on whole plant dry weight of Bhenidi (*Abelmoschus esculentus*)

Effect of natural compost and synthetic fertilizers on no. of leaves of Bhendi (*Abelmoschus esculentus*)

In treatments getting only a tiny amount of synthetic fertilizers, there were more leaves (Fig. 7). It was raised for the following treatments: T5-MWC+CMC+GMC, T10 - (N+P+K), and T9 - (N+P+K). Comparing several organic and inorganic fertilizer treatments (T2, T3, T4, T6, T7, and T8) to the T1 control on the other, each one helped to reduce the number of leaves at a given rate.

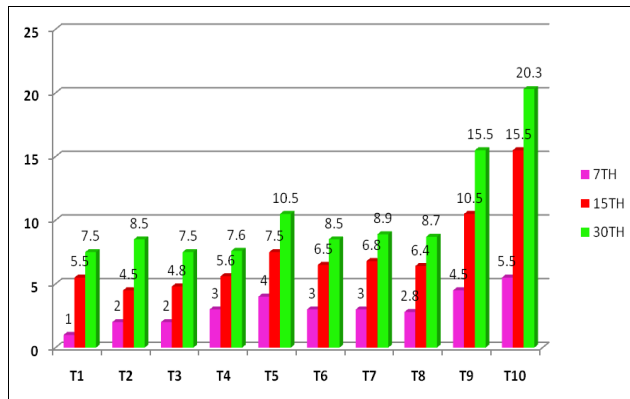


Fig 7: Histogram for Effect of natural compost and synthetic fertilizers on no. of leaves of Bhendi (*Abelmoschus esculentus*)

These outcomes are consistent with prior research findings showing young *M. oleifera* plants accumulate N, P, and K as a result of different organic amendments (Adebayo et al. 2011). Adebayo et al. (2011) found that adding organic amendments to the soil tends to enhance the chemical characteristics of the soil and plant organs. Since they provided more mineral components including N, P, K, Ca, N, Mg, and C for plant growth and development, compost kinds and mineral fertilizer were more effective. When compared to the other treatments and the control, Dania et al. (2014) found that the nitrogen of *M. oleifera* leaves was greatly improved by natural compound compost and compound synthetic fertilizers. As a result, in the current study, plants with healthy growth also had greater macro element enrichment than plants with stunted growth. This might be because nutrients are effectively transferred to the sink and are more readily available through manures. Hanchimani (1994) asserted that *M. oleifera* responded well to fertilizer application, which improved nutrient availability in the pods and thus boosted yield. K and Ca were discovered to be present at higher levels among the elements determined by atomic absorption in various plants, with Ca aiding in the transfer of long-chain fatty acids that lower blood pressure and prevent heart disease (Rajurkar and Damame 1998).

Table 1: Effect of organic compost and artificial fertilizers on seed germination, shoot length, root length, total plant weight (fresh and dried), and number of Bhendi leaves (*Abelmoschus esculentus*)

TREAT	GER %	SL(cm) DAS			RL(cm) DAS			WPFW(g) DAS			WPDW(g) DAS			NOL/P DAS		
	7th	7	15	30	7	15	30	7	15	30	7	15	30	7	15	30
T1-CONT	93	2.9	3.6	9.6	1.2	2.8	7.4	2.10	3.21	10.21	0.09	1.01	4.05	1	5.5	7.5
T2-MWC	97	4.8	6.5	11.6	3.6	6.13	13.2	3.91	4.84	12.21	0.46	2.01	6.23	2	4.5	8.5
T3-CMC	98	4.9	7.1	12.4	3.7	9.1	18.2	3.90	4.92	13.02	1.05	2.03	7.23	2	4.8	7.5
T4-GMC	97	5.9	8.5	17.4	3.8	9.2	18.3	3.01	5.23	14.32	1.50	3.02	8.21	3	5.6	7.6
T5-M+C+G	100	7.3	15.3	31.6	5.4	10.5	21.2	8.02	16.30	33.20	2.51	6.01	16.25	4	7.5	10.5
T6-N	92	3.5	6.8	12.3	2.6	5.1	10.2	5.01	6.23	13.20	1.01	4.02	7.28	3	6.5	8.5
T7-P	93	3.8	7.2	13.3	2.5	5.2	10.3	4.01	6.25	13.21	1.01	4.02	7.81	3	6.8	8.9
T8-K	91	3.9	7.6	15.3	2.8	5.9	10.1	4.21	7.56	15.20	1.01	5.30	9.56	2.8	6.4	8.7
T9-N+P+K	100	7.5	15.3	30.3	5.2	9.6	18.3	6.01	15.89	29.23	2.01	8.02	19.56	4.5	10.5	15.5
T10- N+P+K M+C+G	100	9.3	20.2	34.5	7.3	14.5	28.3	11.01	25.31	49.25	4.01	12.03	22.48	5.5	15.3	20.5





Fig 8: Overall agricultural field preparation, seed sowing, and water irrigation evidence

Conclusion

Natural composts and synthetic fertilizers compound treatments, which have a 100% germination rate, have been beneficial to the growth of plants. Composts are useful because of their often high mineral content, as excessive nutrient concentrations have a negative impact on plant survival rates. It is suggested to use very small volumes of organic compost mixed with synthetic fertilizer to increase the agricultural productivity of *Abelmoschus esculentus*.

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