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Effect of *Eichhornia crassipes* (Mart.) Solms. Compost on Morpho-Physiological Parameters of Blackgram (*Vigna mungo* (L) Hepper)

Sahana Sonter[1], Pramod V. Pattar[1], Ramalingappa[2]

[1]Department of Botany, Davangere University, Shivagangothri, Davangere.
[2]Department of Microbiology, Davangere University, Shivagangothri, Davangere. Karnataka, India. 577 002.

Corresponding Author: Pramod V. Pattar (drpramodvp@gmail.com)

ABSTRACT

Eichhornia crassipes (Mart.) Solms. is a noxious aquatic weed, that pollutes all fresh water bodies. To check its vigorous growth, control measures are crops (*Vigna mungo)* was treated by using compost dried from *Eichhornia crassipes*. The blackgram was allowed to grow in 30 days and the effect was studied by comparing with vermicompost. The physical parameters of crop were percentage of seed germination, length of root, shoot, leaf and stomatal index. The chemical parameter studied were chlorophyll content. The soil analysis was also done to study the change in the physical and chemical parameters of soil. The result signifies the use of *Eichhornia crassipes* (Mart.) Solms. as the organic manure.

Keywords: Water hyacinth compost, Blackgram, Organic manure, Physical parameters.

INTRODUCTION

The modern concept of environmental management is based on the recycling of waste and composting is a safe form of treatment of some waste and the reclamation of the nutrients contained in them (Iranzo *et., al.* 2004). During the last few years, composting has gained wide acceptance as a key component of integrated solid waste and aquatic weeds management. It has been promoted as an eco-friendly and sustainable solution to urban waste and aquatic weed management (Bayoumi,2005; Akanbi *et., al.* 2007). It encourages the production of beneficial micro organisms, which in turn break down organic matter to create humus, which increases the nutrients content in soils and improved soil structure and water holding capacity. Compost has also been shown to suppress plant diseases and pests and enhance higher yields of agricultural crops some of the agro wastes weeds and aquatic plants that could be used as composting materials in Nigeria are arm yard manure plant and crop residues wild sunflowers plants (*Tithonia diversifolia*). Water hyacinth (*Eichhornia crassips*), guinea grass (*Panicum* sp.), siam weed (*Choromoleana odorata*), cereals and legumes straws and stovers (Akanbi *et al* 2007). Recent census report on the population of the Motebennur pond shows the about 60 % of the population is engaged in agricultural production. These farmers continuously cultivate their land leading to a reduction in soil fertility and reduced crop productivity.

Eichhornia crassipes (Mart.) Solms know as water hyacinth is a free floating perennial hygrophyte belongs to the family *Pontedericeae*. The leaves are broad, thick, glossy, and ovate and float that grows in fresh water, but may be rooted in the mud from where it draws all its nutrients directly (Penfound and Earle 1948). *Eichhornia* has been recognized as the most harmful aquatic weed in the world due to its negative effects on people's livelihoods and waterways. It is one of the most productive plants on the earth and is considered the world's worst aquatic weed (Grodowitz, 1998). It tolerates annual temperatures ranging from 21.1^0 C to 27.2^0 C and its pH tolerance is estimated at 5.0 to 7.5. The 'beautiful blue devil' water hyacinth, grows rapidly as a dense green mat over a stagnant water bodies such as lakes, streams, ponds, waterways, ditches and blackwater (Center *et al.,* 1999). *Vigna mungo* is the important cereal. No research has been carried out and documented on the effects of application of water hyacinth compost on *Vigna mungo* especially with in the Motebennur pond.

MATERIALS AND METHODS

Material

Preparation of *Eichhornia* sp. compost:

Water hyacinth was harvested from natural wetlands and rinsed thoroughly with tap water in order to remove the mud and other undesirable materials. The water hyacinth materials were dried in air and chopped in to small pieces. The physical characteristics of the compost were observed and its chemical composition was assessed in terms of the total nitrogen, organic carbon, total phosphorous, total potassium and pH.

The Soil of the experimental pots or crates was 3 types;

Black Soil + Plant material (EC_1)

Black Soil + Sand +Plant material (EC_2)

Black Soil + Vermicompost (EC_3)

Greenhouse Experiments:

Clean plastic crates measuring 50 cm and 20 cm and having the 10×5=50 wells. The crates were filled with 3 different soil composition and moistened by applying water until the soil was thoroughly wet. The *Vigna mungo* seeds per wells were sown at a depth of 1 cm and within one week emergence, they were tinned to 4 seedling per well. Water hyacinth compost was applied at the ratio 1:1. Watering of the crates was carried out by adding 1000ml of water twice in a day to each crates. Sampling of plants was done 15 and 30 days after emergence. The roots and shoots of plant were measured and recorded. Greenhouse experimental set up was terminated after 30 days.

Percentage of Seed Germination:

The radical is the first organ to emerge from the germination seed. Germination percentage was on 5^{th} day and calculated using formula (ISTA, 1985).

Physiological Growth:

Five plants from each treatment were carefully uprooted on 15 and 30 days and their axial growth (roots and shoot length and leaf length) and fresh biomass were measured. They were then dried in shady for and weighed for dry mass measurements. Assessment of growth of test plant on 15 and 30 days were recorded and calculated using standard methods. Five plants were selected at random from each of the treatments.

Stomatal Index:

Stomata consists of a major route or way for the transpiration water loss to the surrounding atmosphere thus determination of stomatal frequency of leaf or total stomatal area of leaf is the basic information needed to access the rate of transpiration water loss through the stomata.

Estimation of Chlorophyll Pigment:

The chlorophylls are the essential compound for photosynthesis and occur in chloroplasts as green pigments in all photosynthetic plant tissues .They are bound loosely to proteins but are readily extracted in organic solvents such as acetone .It is extracted in 80% acetone and the absorption at 663 and 645 nm are read in spectrometer. Using the absorption co-efficient, the amount of chlorophyll is calculated. Calculate the amount of chlorophyll present in the extract Mg chlorophyll per gram tissue using he following equation,

RESULTS AND DISCUSSION

Seed Germination

The seeds are germinated in soil amended with *Eichhornia* compost (EC_1) of 84%, soil amended with vermicompost (EC_3) of 79% and soil amended with sand and *Eichhornia* compost (EC_2) of 95% which was the most seed germinated on the 5th day (Table 1). Application of compost EC_2 led to a higher seed germination compared to the EC_1 and EC_3 in the green house(Graph 1). Sharda and Lakshmi (2014), reported that application of water hyacinth manure had significant increase in the percentage of germination and fresh and dry weight of blackgram.

Plant Dry Weight

The treatments had a significanct effect on the whole plant dry weight of blackgram on 30th day.plant grown on soil amended with EC_2 had a mean plant dry weight of 9.90 g which was the highest mean weight on 30th day and significantly different from plants treated with EC_1 and EC_3 that produce a mean plant dry weight of 8.41 and 6.89 g respectively (Table 2). The study of water hyacinth as biofertilizer revealed that the incorporation of water hyacinth into soil crop system increased the performance of the blackgram (Graph- 2). Sharda and Lakshmi (2014), reported that application of water hyacinth manure had significant influence on the growth attributes had yield of the wheat plant.

Plant Height

Blackgram plants had significances in their stem height under various treatments in the greenhouse on 15th and 30th day after emergence (Plate-1, Fig.A). The least mean plant height on the 15th DAE, 8.6 cm was recorded for balckgram plants form the soil which was amended with vermicompost (EC_3) while the highest mean stem height of 9.2cm on the 15th DAE for plants obtained from soil amended with compost with sand(EC_2).The highest mean stem height of 19.8cm on the 30th DAE (Days after emergence) for plants obtained from soil amended with compost with sand(EC_2) while the vermicompost had a significantly lower plants compared to EC_2 on the 30th DAE (Table 3).

Results of analysis of variance showed a significance influence treatment water hyacinth with the stem height at the age 15 and 30 days, after planting (Graph-3) Abu Talkah (2015), reported that organic fertilizers water hyacinths very significant effect on the observation variable: Plant height, number of leaves, Leaf area age 30, 60, 90 days after planting. He suggested in his experiment is the use of organic fertilizers water hyacinth can be applied to types of bulbs because it is provide benefits on improving crop productivity and minimize environmental wastes.

Blackgram plants had significances in their root height under various treatments in the greenhouse on 15th and 30th day after emergence (Graph-4). The least mean plant height on the 15th DAE, 3.3 cm was recorded for blackgram plants form the soil which was amended with vermicompost (EC_3) while the highest mean root height of 4.6 cm on the 15th DAE for plants obtained from soil amended with compost(EC_1) (plate-1 fig B). The highest mean stem height of 9.6cm on the 30th DAE for plants obtained from soil amended with vermicompost (EC_3).while the soil amended with compost had a significantly lower root height compared to EC_3 on the 30th DAE (Table 4).

Blackgram plants had significances in their leaf length under various treatments in the greenhouse on 15th and 30th day after emergence(figure 5).The least mean leaf length on the 15th DAE, 2.4 cm was recorded for balckgram plants form the soil which was amended with compost (EC_1) while the highest mean leaf length of 2.8 cm on the 15th DAE for plants obtained from soil amended with vermicompost (EC_3)(Graph 5). The highest mean leaf length of 8.5cm on the 30th DAE for plants obtained from soil amended with compost and sand (EC_2) (Plate1 Fig. C).While the soil amended with vermicompost had a significantly lower leaf length compared to EC_2 (Table 5).

Osoro *et al*.,(2014) reported that water hyacinth increased the growth of parameters of maize. Abu Talkah (2015), reported that organic fertilizers water hyacinths very significant effect on the observation variable: Plant height, number of leaves, Leaf area age 30, 60, 90 days after planting. He suggested that in his experiment is the use of organic fertilizers water hyacinth can be applied to types of bulbs because it is an provide benefits on improving crop productivity and minimize environmental wastes.

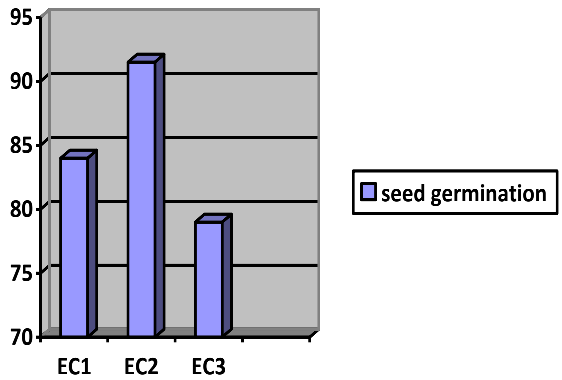
Stomatal Index

The various treatments had a significant effect on the number of stomata of blackgram plants. EC_3 and EC_2 treatment had plants with the highest mean stomatal index of 16.8 while compare to the EC_1 (Table 6).

The present study revealed that the application of water hyacinth manure had significant influence on the aperture calibration of blackgram. There was a significant increase stomatal aperture of 140 in the soil amended with compost (EC_1), while the soil amended with vermicompost (EC_3) and soil amended with compost and sand (EC_2) have the less stomatal aperture compare to EC_1 in 10X. Similarly the EC_1 had a highest aperture calibration while the EC_2 and EC_3 had a same calibration in 40X (Table 7). The study of water hyacinth as biofertilizer revealed that the incorporation of water hyacinth into soil crop system increased the performance of the blackgram. Gunnarsson and Petersen(2006) highlighted that using composed water hyacinth material could serve as quality manure for improving soil fertility conditions and thus crop yields on the whole.Chukwuka and Omotayo (2008 and 2009), indicated the soil fertility poential of water hyacinh compost and revealed its enhanced affect on productivity of *Zea mays* crop.

Table 1: Percentage of Seed Germination

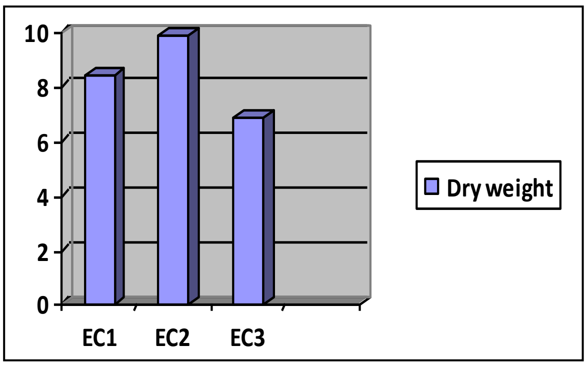
Treatment	Germination Percentage
EC_1	84 %
EC_2	91.5 %
EC_3	79 %



Graph 1: Percentage of seed germination at different soil composition

Table 2: Mean whole plant dry weight (g) of blackgram in the green house under different soil amendment.

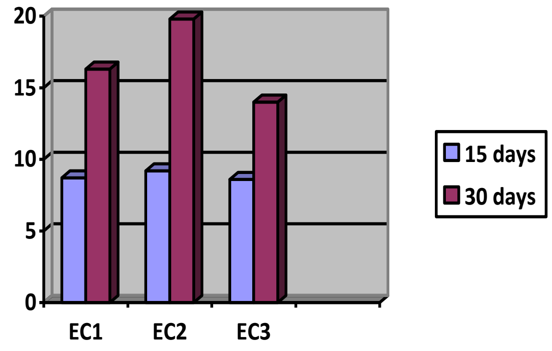
Treatments	Dry weight (g)
EC_1	8.41
EC_2	9.90
EC_3	6.89



Graph 2: Plant dry weight of blackgram

Table 3: Mean Stem height (cm) of Black Gram plants grow in the Green house under different soil composition

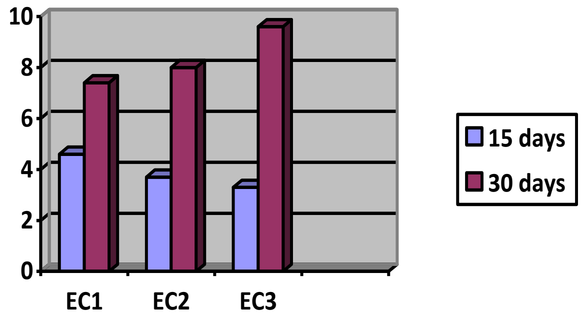
Treatments	15 days	30 days
EC1	8.7	16.3
EC2	9.2	19.8
EC3	8.6	14



Graph 3: Mean stem height at different soil composition

Table 4: Mean Root height (cm) of Blackgram plants grow in the green house under different soil compositions

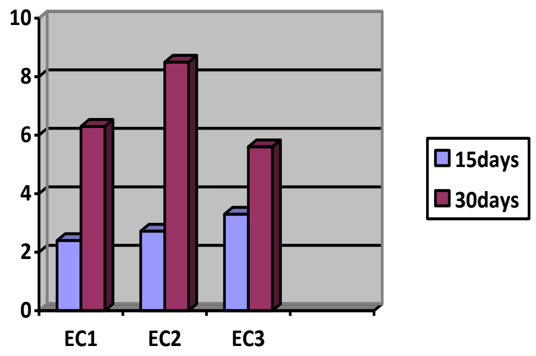
Treatment	15 days	30 days
EC$_1$	**4.6**	**7.4**
EC$_2$	**3.7**	**8.0**
EC$_3$	**3.3**	**9.6**



Graph 4: Mean root height at different soil composition.

Table 5: Mean Leaf length (cm) of Black gram plants grow in the green house under different soil composition.

Treatment	15 Days	30 days
EC$_1$	**2.4**	**6.3**
EC$_2$	**2.7**	**8.5**
EC$_3$	**2.8**	**5.6**



Graph 5: Mean leaf length of blackgram at different soil composition

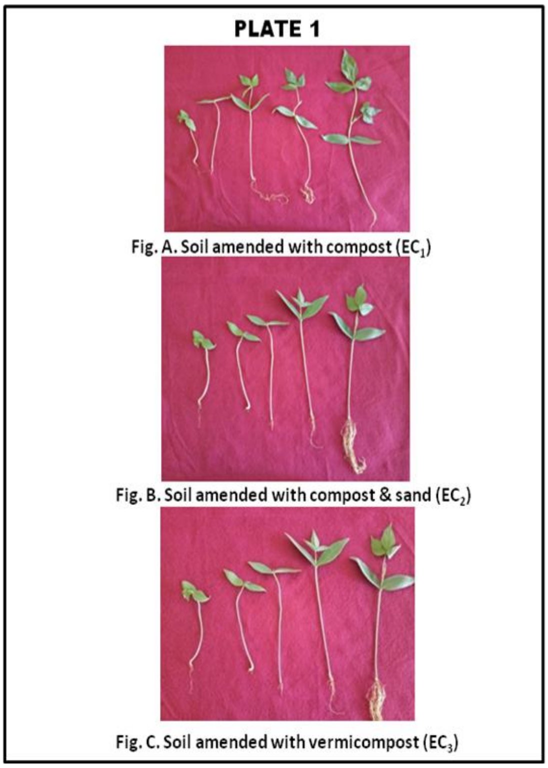


Figure: Showing effect of *Eichhornia crassipes* compost on *Vigna mungo* growth

Table 6: Mean of stomatal index of blackgram plant grown in green house under different soil composition.

Treatment	Number of stomata	Number of epidermal cells	Stomatal index
EC1	**21**	**123.6**	**14**
EC2	**28**	**139**	**16.8**
EC3	**27.6**	**136**	**16.7**

Table 7: Stomatal Aperture calibration of blackgram in different soil composition.

Objective	Treatment	No. of division on Stage Micrometer (SM)	No. of division on Occular Micrometer (OM)	Calibration	Stomatal aperture
	EC1	**7**	**5**	**14**	**140**
10X	**EC2**	**5**	**4**	**12.5**	**125**
	EC3	**6**	**5**	**12**	**120**
	EC1	**9**	**4**	**22.5**	**225**
40X	**EC2**	**6**	**3**	**20**	**200**
	EC3	**8**	**4**	**20**	**200**

Estimation of Chlorophyll Pigment

The chlorophyll a, b and total content of fresh leaves were deteced by UV-vis spectrophotometer after 30 DAS. The trated plant (EC_3)showed the highest amount of chlorophyll a, b and total was 0.08, 0.17 and 0.11 mg/wt respectively(Table 8). The increased chlorophyll content in the study might be associated with the supply of essential nutriens to the plants (Graph 8). Since chlorophyll synthesis in the plants is directly related o the availability of the physiological activity Fe, N, P and S micronutrients in plants available form. Hence the availability of these nutrients of plants helps in the formation of chlorophyll in the leaves. Increased chlorophyll a, b and carotenoids content in green leaves with foliar application of organic solution has also been observed by Tejada and Gonzalez(2003) in rice.

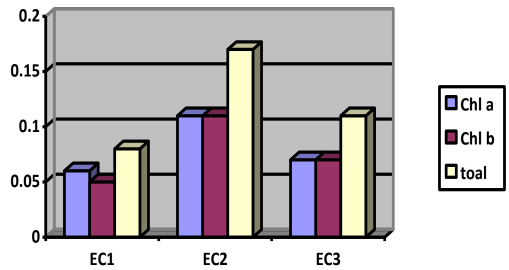
Soil Analysis At Different Soil Composition

The differences noted on blackgram days to growth is attributed to different amounts of NPK supplied at different soil composition(Table 9). Water hyacinth compost is reported to improve soil aggregation due to increased organic matter, increased water retention capacity and cation exchange capacity of soil (Khan and Sarwar.,2002; Rashid and Iftekhar,1992).

Stomata present in blackgram plant

Table 8: Chlorophyll pigment present in Blackgram plant at different soil composition.

Treatment	Mg chlorophyll a/g tissue	Mg chlorophyll b/g tissue	Mg total chlorophyll % g tissue
EC_1	0.06	0.11	0.07
EC_2	0.05	0.11	0.07
EC_3	0.08	0.17	0.11



Graph 8: Chlorophyll pigment in blackgram plant under different soil composition

Table 9: Macro and Micronutriens present in different soil compositions.

Parameters			Macronutrients			Micronutrients			
Treatment	pH	EC (dS/m)	NPK OC %	P_2O_5	K_2O	CU	Zn	Mn	Fe
EC_1	7.0	0.21	2.29	9.8	18.4	2.18	0.78	41.5	25.3
EC_2	6.7	0.08	2.53	20.0	20.0	3.4	1.03	40.2	28.4
EC_3	7.2	0.08	2.05	11.6	20.0	2.64	0.91	39.3	27.1

CONCLUSION

Water hyacinth compost increased the morphological and physiological parameters of blackgram. This is therefore an indicator of better yields if proper farm management is practiced under favorable environmental conditions. Vermicompost also performs well in crop production but its adverse effects on the soil and the environmental makes its use undesirable. Although the field results indicates that blackgram production without fertilizer application in the some farms is possible, there is fear that without replenishment, the macronutrients could be depleted leading it low yields. Therefore, compost from water hyacinth which is locally available, plentiful and cost free can be effectively used as an organic soil amendment or soil restoration and crop production. Suggestion in the experiment is the use of organic fertilizers water hyacinth can be applied to their types of bulbs because it can provide benefits on improving crop productivity and minimize environmental waste in addition it is necessary to research on the use of fertilizers water hyacinth with other inorganic fertilizer on the growth and yield of Blackgram.

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