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IMPACT OF DIFFERENT RATES OF HALOPHYTIC COMPOST ALONG WITH FARM YARD MANURE AND *RHIZOBIUM* ON GROWTH OF *VIGNA RADIATA* L.

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ABSTRACT
A field investigation was conducted during kharif season 2020 at the Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai Nagar, Tamil Nadu, India. Sole and combined incorporation of different organic nutrient sources viz., *Suaeda maritima* compost, *Sesuvium portacultum* compost, farm yard manure and *Rhizobium* were evaluated in order to optimize organic nutrient management for green gram under rainfed conditions. Results showed that combined incorporation of (T_6) *Suaeda maritima* compost @ 3.13 t ha^{-1} + FYM @ 3.13 t h^{-1} + *Rhizobium* @ 2kg ha $^{-1}$ was found to be the most responsive nutrient management practice recording significantly higher crop growth when compared to other treatments and unmannered control.

***Keywords**: Green gram, Farmyard manure, Suaeda maritima compost, Sesuvium portacultum compost, Rhizobium*

INTRODUCTION
The major challenges for agricultural intensification to meet the growing food demand are to sustain biodiversity and to reduce the environmental consequences (Pittelkow *et al.*, 2015). With the advent of green revolution, crop productivity has been increased by the intensive use of chemical N fertilizer, but this leads to soil acidification and deterioration of soil health, ecosystem degradation and biodiversity loss (Ju *et al.*, 2009). Organic fertilizers, such as farmyard manure and crop residues, are alternatives to reduce the use of synthetic chemical fertilizers, as well as to prevent soil degradation (Saeid and Chojnacka 2019). One of the advantages of organic fertilizers is that, from composting, it recycles organic waste of urban and agricultural origin, the disposal of which would cause environmental impacts (Nicolodelli *et al.*, 2016). Utilization of agricultural semiproducts as organic amendments, such as, spent mushroom compost, green manure, cattle manure, straw residue reduce environmental risks and achieve sustainable agriculture production (Kang *et al.*, 2016). *Rhizobium* are biofertilizers which enhance biological processes of nitrogen fixation enhancing and promoting plant growth (Gohain and Kikon, 2017).
Pulses are an imperative component of a balanced vegetarian food diet, hence, known to be the 'poor man's meat'. Pulses play a vital role in soil fertility restoration through atmospheric nitrogen fixation in association with root nodule bacteria (Dhinagaran et al. 2021). Pulses occupy a leading place in various cropping system and grow as main crop, residue crop cover crop, catch crop, inter crop and green manure crop (Ram et al. 2021). Green gram can be grown in all season where sufficient irrigation dexterity is feasible. In summer season less extra rainfall, less cloudy condition, higher temperature and less humidity provide less infestation of pest and disease (Prashanth *et al.*, 2023).
Halophytes are plants that exhibit high salt tolerance, allowing them to survive and thrive under extremely saline conditions (Meng *et al.*, 2018). Halophytes constitute less than two per cent of the global flora (Hasanuzzaman *et al.*, 2014). In the world, 2000 to 3000 halophytic plant species are identified mainly belonging to angiosperms (Sabovljevic *et al.*, 2007). In India, there distribution is mainly confined to arid, semiarid inlands and highly saline wetlands along the tropical and sub-tropical coasts (Kumari *et al.*, 2015). The primary purpose of the present study is when halophytes are subjected to composting, it is possible that NaCl content present in the tissues will degrade during decomposition. Na^+ in NaCl may chelate with the

organic acids produced during decomposition and release the Cl^-, resulting in the reduction of NaCl. Decomposition nullifies the presence of NaCl content in the plant tissues (Ravindran *et al.,* 2007). Watson (2003) also stated that leaching the compost with water reduce the concentration of soluble salts.

MATERIAL AND METHODS

The field experiment was conducted at Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai Nagar, Tamil Nadu, India during June-October (Kharif) 2019. The experimental farm is geographically located at 11° 24' N Latitude and 79° 44' E Longitude at an altitude of +5.79 M above mean sea level. The maximum temperature was 29.0 °C to 39.5 °C with mean of 34.25 °C. The relative humidity ranged from 61 to 80 per cent with a mean of 70.5 per cent and crop received rainfall of 1400.9 mm.

Selection of Species

Two fast growing and dominant halophytes such as *Suaeda maritima* (L.) Dumort and *Sesuvium portulacastrum* L. were identified for making compost after detailed survey.

Compost preparation

Three months old healthy halophytes were harvested from nursery and used for the preparation of halophytic compost. The halophytes as well as rice straw were chopped well and the substrates were piled loosely in a compost pit to provide better aeration within the heap. The material was too compact and no heavy weights were put on top. Aeration was provided by placing perforated bamboo trunks horizontally and vertically at regular intervals, to carry air through the compost heap. The compost activator, consisting of a cellulolytic fungus (*Trichoderma harzianum)* was broadcast onto the substrates during pilling. The amount of activator used was usually 1.0 per cent of the total weight of the substrate (i.e., about 1 kg compost activator is mixed thoroughly with the substrates (Cuevas, 1997). The heap was covered over completely with white plastic sheets. Heat was maintained at 50 °C or higher and the heap was turned over every 5-7 days for the first two weeks and thereafter once every two weeks. Turning over the pile provided adequate aeration and evened up the rate of decomposition throughout pile. By the end of the third month, the compost was ready for use. It was dark brown, crumbly and hard with earthy aroma.

Preparation of Land

The field was ploughed with tractor drawn disc plough fallowed by a thorough harrowing to break the clods. The field was properly levelled and plot of 4m × 3m size were emarked with raised bunds all around to minimize the movement of nutrient. Channels were laid to facilitate irrigation to plots individually.

Table 1: Soil characteristics of the experimental field

Properties	**-**	**Value**
Mechanical Composition	-	
Coarse sand (%)	-	49.83
Silt (%)	-	18.20
Clay (%)	-	16.68
Textural class	-	Sandy loam
B. Physical properties	-	
Bulk density (g. cm-2)	-	1.42
C. Chemical Properties	-	
Electrical conductivity (dsm^{-1})	-	1.40
pH	-	8.1
Organic carbon (%)	-	0.40
Available Nitrogen (Kg ha^{-1})	-	173.0
Available Phosphorus (Kg ha^{-1})	-	21.9
Available Potassium (Kg ha^{-1})	-	363.75

Crop Variety

The green gram variety ADT-3 released by Tamil Nadu Agriculture University, Coimbatore was selected for the present study.

Experimental Soil

The Physico-chemical properties of the soil are presented in Table 1. The experimental soil was slightly alkaline with pH 8.1.

Table 2. Compost treatments and their concentrations

Treatments	Compost application
T_0	Control (Without compost)
T_1	*Sesuvium portulacastrum* compost @ 6.25 t ha^{-1}
T_2	*Suaeda maritima* compost @ 6.25 t ha^{-1}
T_3	*Sesuvium portulacastrum* compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1}
T_4	*Suaeda maritima* compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1}
T_5	*Sesuvium portulacastrum* compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1} + *Rhizobium* @ 2 kg ha^{-1}
T_6	*Suaeda maritima* compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1} + *Rhizobium* @ 2 kg ha^{-1}

Soil Analysis

The soil of the experimental site was tested before the experimentation in order to know the soil nature (Table 1). Furthermore, soil samples were collected periodically from the root zone of black gram. The soil samples were air dried and sieved through 2 mm sieve to analyse soil physico-chemical properties such as bulk density (Blake and Hartge, 1986), soil pH (Jackson, 1973), soil EC (Jackson, 1973), OC (Walkley and Black, 1934), available nitrogen (Page *et al.*, 1982), available phosphorus (Olsen *et al.,* 1954), available potassium (Knudsen *et al.*, 1982) and soil micronutrients by (Lindsay and Norvell, 1978).

RESULTS AND DISCUSSION

Properties of the halophytic compost

Eexperiment was carried to find out whether the process of decomposition of halophytes reduces the NaCl concentration in the compost. From the results (Table 3) it was observed that after 90 days NaCl concentration in the halophytic compost was drastically reduced to 40.47 per cent Na^+ and 48.0 per cent Cl^- in *Suaeda maritima* compost and 32.63 per cent Na^+ and 43.35 percent Cl^- in *Sesuvium portulacastrum* compost. It was also observed from the studies at the end of decomposition *Suaeda maritima* compost in combination with farmyard manure and *Rhizobium* showed higher nutrient content value when compared to other halophytic composts. Nutrients such as N, P, K, Ca, Mg and micronutrients were found higher in *Suaeda maritima* compost in combination with farmyard manure and *Rhizobium*. The reduction in soil pH was also noticed in *Suaeda maritima* compost along with Farmyard manure and *Rhizobium* over control and other treatments.

Impact of halophytic compost along with arm yard manure and Rhizobium on growth attributes of Vigna riadita L.

Plant height and Leaves plant^{-1}

The plant height increased progressively at successive observations with advancement of crop age and was significantly affected by different treatments (table 4). The plant height at 60 days was reached 64.7 cm in T6 (*Suaeda maritima* compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1} + *Rhizobium* @ 2 kg ha^{-1}) which was superior to rest of the treatments, while smallest plant height was observed in T_0 (control). These finding are in accordance with the results in soybean plant by Konthoujam *et al.*, (2013).

Table 3. Nutrient contents of *Sesuvium portulacastrum* (T_1) and *Suaeda maritima* compost (T_2) at maturity period (90 days)

Treatments	pH	C %	N %	C : N Ratio	P (%)	K (%)	Ca (ppm)	Mg (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)	mg/g fr.wt					
													Before Composting		After Composting		Percentage of reduction	
													Na	Cl	Na	Cl	Na	Cl
T_1	7.0	48.21	1.85	25.24	0.75	1.54	1824	1430	8.32	10,198	31.96	178	19.0	14.3	6.9	6.2	32.63	43.35
T_2	6.9	45.35	1.88	22.61	0.78	1.58	1832	1440	8.38	10,210	32.03	178	21.0	15.2	8.5	7.3	40.47	48.0
T_3	6.8	43.59	2.50	13.59	1.36	1.98	3325	2645	10.78	10,612	35.12	406						
T_4	6.7	41.62	2.56	13.41	1.42	2.04	3335	2658	10.84	10,632	35.22	446	....	....	....	....		
T_5	6.6	38.6	2.64	11.45	1.50	2.12	3350	2674	10.94	10,660	36.06	480	....	....	....	....		
T_6	6.4	36.61	2.74	11.13	1.60	2.22	3370	2698	11.14	10,680	36.26	504						

T_1 : *Sesuvium portulacastrum* compost**;** **T_2 :** *Suaeda maritima* compost**;** **T_3 :-** *Sesuvium portulacastrum* compost + Farmyard manure**;** **T_4 :** *Suaeda maritima* compost + Farmyard manure**;** **T_5 :** *Sesuvium portulacastrum* compost + Farmyard manure + *Rhizobium;* **T_6 :** *Suaeda maritima* compost + Farmyard manure + *Rhizobium.*

Number of branches plant^{-1}

The number of branches increased progressively at successive observations with advancement of crop age and was significantly affected by different treatments (Table 4). The maximum number of branches at 60 was recorded 16.94, 21.65 and 22.20 cm in treatment T_6, which were superior to rest of the treatments, while minimum number of branches was recorded in T_0 (control). The result is supported by Jain and Singh (2003), Gilani *et al.* (2004) and Singh *et al.* (2004).

Number of Leaves plant^{-1}

Number of leaves per plant was affected by different treatments. (Table 4). The maximum number of leaves per plant 50.2 was recorded in treatment T_6 (*Suaeda maritima* compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1} + *Rhizobium* @ 2 kg ha^{-1}), which were superior to rest of the treatments, while minimum number of leaves per plant was recorded in T_0 (control). Similar findings were also reported by (Shah and Ravindran,2020) who reported that halophytic compost in combination with farm yard manure and *Rhizobium* increased plant height and number of leaves in black gram.

Table 4: Impact of halophytic compost along with farm yard manure and *Rhizobium* on growth attributes of green gram, recorded at 60 days after sowing

Treatments	Plant height^{-1} (cm)	No. of Branches^{-1}	Number of Leaves^{-1}
Control (Without compost)	14.6	6.4	9.8
Sesuvium portulacastrum compost @ 6.25 t ha^{-1}	24.4	8.6	13.6
Suaeda maritima compost @ 6.25 t ha^{-1}	29.3	9.7	15.8
Sesuvium portulacastrum compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1}	37.2	11.4	19.6
Suaeda maritima compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1}	41.6	13.6	22.6
Sesuvium portulacastrum compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1} + *Rhizobium* @ 2 kg ha^{-1}	47.2	16.4	27.8
Suaeda maritima compost @ 3.13 t ha^{-1} + Farmyard manure @ 3.13 t ha^{-1} + *Rhizobium* @ 2 kg ha^{-1}	51.4	20.8	33.6

CONCLUSION

In this study results demonstrated that incorporation of halophytic compost along with farm yard manure and *Rhizobium* had abilities of promoting plant growth in field experiments. I recommend the use of halophytic compost along with farm yard manure and Rhizobium helping to reduced fertility of the soil from the use of chemical fertilizers.

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