Effect of Organic Manures prepared from *Trianthema* on Growth of *Zea mays* L.

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Abstract*—Trianthema portulacastrum* Linn. commonly known as Desert Horse purslane, it is a creeping, much branched, annual herb. This plant is an invasive weed in irrigated areas of nearly all states of India and other parts of world. The aim of present investigation was to study the influence of different manures prepared from *Trianthema* on growth of maize. A field experiment was carried out in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, India to prepare different manures from *Trianthema* and evaluate the performance of various manures viz. NADEP compost (AC), Bangalore pit compost (BC), *Trianthema* vermicompost (TV), dry leaf manure (DLM) and garden leaf vermicompost (GLV) on growth of fodder maize. It was compared with chemical fertilizer treatment and Control. Growth analysis was carried out periodically. The application of *Trianthema* vermicompost was more effective followed by dry leaf manure. Results are statistically significant when compared to chemical fertilizer treatment and control. Manures prepared from *Trianthema* are the best, active and cheapest source of plant nutrients. It will not only be useful for weed control, but will also promote use of manures to replace chemical fertilization to the deteriorating agricultural lands.

Keywords*—compost, dry leaf manure, vermicompost, weed.*

I. INTRODUCTION

A weed in a general sense is a plant that is considered by the user of the term to be a nuisance and normally applied to unwanted plants in human-made settings. *Trianthema portulacastrum* belongs to family aizoaceae and commonly called Wasu in local language Marathi has been reported in the many states of India and considered as a number one problematic terrestrial weed by virtue of its infestation in various agricultural and vegetable crops such as mustard, maize, potato, onion, cotton, soybean, pearl millet and sugarcane, especially during the rainy seasons [1]. It causes significant reduction in maize yields. Balyan and Bhan [2] reported 32% losses in maize grain yield due to unweeded *Trianthema*. It also affects the quality of maize grain as it reduces protein in maize crop [3]. Under irrigated low-land ecosystem, *Trianthema portulacastrum* was found to interfere in sweet potato cultivation seriously [4]. This weed is causing seviour losses in India and other parts of world also [5][6]. Systemic survey has not been conducted on control of this weed around the world [7]. It is currently controlled mechanically and treatment with pre and post emergence herbicides. Nevertheless best method of management of this weed is composting.

The continued use of chemical fertilizers causes health and environmental hazards such as ground and surface water pollution by nitrate leaching [8]. Composting has been recognized as a low cost and environmentally sound process for treatment of many organic wastes [9]. A process related to composting which can improve the beneficial utilization of organic wastes is vermicomposting. It is a non-thermophilic process by which organic materials are converted by earthworms and microorganisms into rich soil amendments with greatly increased microbial activity and nutrient availability. Vermicomposts are products derived from the accelerated biological degradation of organic wastes by earthworms and microorganisms. Earthworms consume and fragment the organic wastes into finer particles by passing them through a grinding gizzard and derive their nourishment from microorganisms that grow upon them [10].

Maheswarappa [11] reported increased amounts organic carbon, improvements in pH, decreased bulk density, improved soil porosities and water-holding capacities, increased microbial populations and dehydrogenase activity of soils in response to vermicompost treatments. Compost has a high nutritional value, with high concentrations of especially nitrogen, phosphorus and potassium, while the contamination by heavy metals and other toxic substances are very low [12]. Several examples in the literature show that compost and vermicompost are able to enhance the growth of a wide range of plant species further what can be expected because of the supply of nutrients [13][14].

Nutrient and weed management are leading production related challenges in organic farming systems [15]. The nutrient level and physical quality of soil is at alarming low level due to excess use of chemical fertilizers [16][17]. Weeds are causing great competition to crop plants and resulting in higher losses in yield. So nutrient and weed management can be done by use of weed for preparation of organic manure. Earlier references about use of *Trianthema* for preparation of organic manure are not found. In order to utilize the huge amount wasteland weed *Trianthema* as valuable resource for vermicompost, a study was conducted to investigate the influence on maize yield and nutrient uptake.

II. METHODOLOGY

A field experiment was carried out in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. The fresh vegetation of *Trianthema* was collected from University campus, brought to laboratory and chopped into small pieces (2 - 3 cm) by iron cutter. Equal amount (13333 kg/ha) of weed vegetation was used for the preparation of NADEP compost (AC), Bangalore pit compost (BC), *Trianthema* vermicompost (TV) and dry leaf manure (DLM). Equal amount of leaf litter was used for the preparation of Garden leaf vermicompost (GLV). The process of composting was done as described by Stoffella and Kahn [18]. The fresh vegetation of *Trianthema portulacastrurm* Linn. was collected from nearby area and chopped into small pieces (2-3 cm) by iron cutter. Equal amount of weed vegetation was used for the preparation of compost (TC), vermicompost (TV), dry powder TDP. The process for preparation of organic manures was followed as described by Naikwade [19].

The fresh vegetation of *Trianthema* was spread on the hygienic floor and subsequently sprayed with 5 % urea and single super phosphate and another lot of litter was also sprayed with 5 % dung slurry to enhance the composting process. These pretreated materials were arranged alternately along with well-composted inoculum and soil on each layer in pits. Each pit used for composting and vermicomposting was 105 x 75 x 90 cm (l x w x h). Water is essential for bacterial activity in the composting process (the nutrients for the microorganisms must be dissolved in water before they can be assimilated) [20]. So sufficient water was sprinkled in order to maintain the optimal moisture (50 - 70 %) over the material. The pits were enclosed with dung mud paste to prevent loss of moisture or heat and allowed to decompose. The trenches were watered whenever the dampness was less than 50 %. In composting, one of the main factors that can be most influenced by technology and around which system designs are developed is the provision of oxygen to the composting mass. So after one month intervals, turning the whole material upside down was employed for providing oxygen and achieving uniform homogenous decomposition of the organic wastes. The pits were again irrigated and closed by dung-mud mixture. Finally, amorphous, dark brown, well-fermented composts were obtained.

For preparation of vermicompost after partial decomposition of vegetation in compost pit, main species of earthworm *Eudrilus eugeniae* Kinberg (90 individuals per pit) were released. After 30 days a good quality vermicompost was obtained. For preparation of dry leaf powder fresh above ground biomass of Trianthema was dried in poly house, after drying converted into dry powder. The uniformly mixed samples (100gm) of each treatment were collected immediately from the pits for nutrients analyses. N120:P80:K40 kg/ha is the recommended dose for maize

Experiment was laid out in a randomized block design (RBD) with seven treatments as Trianthema NADEP compost (AC), Trianthema Bangalore compost (BC), Trianthema vermicompost (TV), Trianthema dry leaf manure (DLM), garden leaf vermicompost (GLV), Chemical fertilizer alone (FER) and absolute control (CO) with four replicates each. The fodder maize (*Zea mays* L.) var. 'African Tall' (Mahalaxmi) produced by Mahendra Hybrid Seeds Co. Ltd., Jalna was cultivated at a rate of 100 kg/ha. A plot with the size 9 m2 and nine rows spaced 30 cm apart was adopted to keep the uniform population density. The mineral fertilizers N, P2O5 and K2O (120:80:40 kg/ha) were applied through urea, single super phosphate and muriate of potash to chemical fertilizer treatment only.

A. *Growth analyses*

The growth analysis of fodder maize was noted at 68 as plant height, diameter, number of leaves per plant, plant fresh weight, 4th upper leaf length, its width and weight and leaf area per plant was determined by gravimetric method [21].

B. *Chemical analyses*

The chemical analysis of organic manures was carried out before application. The chemical analyses were done by adopting standard analytical methods. Ash values were obtained by burning the moisture-free samples in a muffle furnace at 600°C for 2 hours and calcium (Ca) content was analyzed by titrating the acid soluble ash solution against 0.01 N KMnO4 solution using methyl red as indicator [22]. Nitrogen (N) was estimated by micro-Kjeldahl method after digesting the sample with Conc. H2SO4 [23]. The amount of phosphorus was measured following Fiske and Subba Rau [24] as described by Oser [25]. Potassium (K) Content was determined on a flame photometer (model Mediflame- 127) as suggested by Jackson [26].

C. *Statistical analysis*

All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant difference (C.D., $p = 0.05$) which allowed determination of significance between different applications [27].

III. RESULTS AND DISCUSSION

A. *Chemical Analysis of organic Amendment*

All manures were prepared from fresh equal amount of Trianthema weed i.e. 13333 kg/ha. The dry matter and nitrogen Content was found more in the treatment of GLV (Table 1). The percent of calcium, phosphorus and potassium was found maximum in the treatment of BC, DLM and TV respectively. The total ash and carbon percentage was found more in the order as TV. The C/N ratio was highest in BC and lowest in DLM.

B. *Growth analyses*

First growth analysis of maize crop was done at 68 DAS (Table 2). The tallest plant was obtained in TV treated plots followed in order by DLM, GLV, AC, BC and FER over CON plots where soil available nutrients were not adequate to meet the crop demand. The diameter of stem, number of leaves, length and leaf area of 4th upper leaf of fodder maize was found highest in TV treatment. The fresh weight of root, stem,

Table 1. Analysis of *Trianthema* composts produced by different methods

Treatments	Fresh weight (kg ha^{-1})	DM		N		%					C:N
		%	kg ha^{-1}	%	kg ha^{-1}	Ca	P	K	C	N	
AC	6667	68.38	4559	0.71	32	2.79	0.09	0.13	24.52	0.71	34.63
BC	7222	67.40	4868	0.67	32	2.97	0.10	0.11	24.78	0.67	37.19
TV	5833	64.29	3750	0.92	34	2.63	0.13	0.14	27.68	0.92	30.21
DLM	13333	10.73	1431	2.0	29	1.00	0.24	0.11	8.05	2.0	4.03
GLV	7778	68.33	5315	0.83	44	2.87	0.09	0.08	26.98	1.00	32.39

Table 2. Growth analysis of maize plant (Age of plant: 68 DAS)

Treatment	Plant height (cm)	Diameter (cm)	No of leaves /plant	Plant fresh weight(g)				4th upper leaf			Leaf area (cm2)/ plant
				Root	Stem	Leaves	Total	Length (cm)	Width (cm)	Weight (g)	
AC	164.68	1.24	7.75	4.37	93.57	33.06	131.00	67.95	7.03	5.71	399.15
BC	162.45	1.23	9.25	4.29	90.00	32.83	127.13	75.45	6.38	5.68	401.86
TV	173.68	1.38	9.75	5.35	107.47	42.47	155.29	76.75	6.48	6.70	480.86
DLM	168.05	1.27	9.50	4.94	100.29	36.34	141.57	75.15	5.00	6.20	446.65
GLV	167.35	1.34	9.75	4.64	97.07	35.58	137.28	73.13	6.25	6.02	429.98
FER	149.23	1.18	7.00	3.99	84.48	27.61	116.08	73.95	5.65	5.55	377.28
CON	92.83	1.02	6.75	2.73	53.43	16.29	72.45	60.58	4.73	3.01	213.12
SE	**10.59**	**0.04**	**0.50**	**0.32**	**6.62**	**3.12**	**10.02**	**2.16**	**0.32**	**0.45**	**32.59**
CD	**25.94**	**0.11**	**1.23**	**0.77**	**16.21**	**7.65**	**24.56**	**5.29**	**0.77**	**1.10**	**79.84**

leaves, weight of 4th upper leaf and ultimately for total fresh weight of plant was maximum in TV treatment followed in order by DLM, GLV, AC, BC and FER while it was minimum in CON treatment.

All types of organic manures prepared from *Trianthema* resulted in increased growth, chlorophyll content and nutrients of fodder maize. The contents of organic manures prepared in this experiment are comparable to earlier studies [28]. These nutrients are released slowly as per requirement of crops resulting in higher yield [29]. Patra *et al.* [30] proved that organic manure contains high content of nitrogen and phosphorus and a slow and sustainable availability of the nutrients can occur in various crops. Same results were obtained in mint [31]. Earlier there are results of increased maize yield by application of organic manure [32].

Arancon et al [33] reported significantly increased growth and yields of field tomatoes (*Lycopersicon esculentum*) and peppers (*Capsicum anuum grossum*) when vermicomposts, produced commercially from cattle manure, food waste or recycled paper, were applied to field plots at rates of 20 t/ha and 10 t/ha in 1999 and at rates of 10 t/ha and 5 t/ha in 2000 compared with those receiving equivalent amounts of inorganic fertilizer. Fallah, [34] carried out an experiment and concluded that organic composts such as sewage and city waste compost and cow waste increase the yield and yield components of corn, so that there was a significant increase in leaf area index, plant height and 1000-seed weight and seed yield. The marketable tomato yields in the vermicompost (plus fertilizers) plots were consistently and significantly greater than those from inorganic-fertilizer only treated plots. There were significant increases in shoot weights, leaf areas and marketable fruit yields of pepper plants grown in plots that were treated with vermicomposts compared to those of plants grown in inorganic fertilizers. Leaf areas, numbers of strawberry suckers, numbers of flowers, shoot weights, and

marketable fruit yields of strawberries all increased significantly in response to supplemented vermicompost applications compared to those from strawberries that received inorganic fertilizers only [35].

Vermicompost contains most nutrients in plant-available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium [36]. Vermicompost has been shown to have high levels of total and available nitrogen, phosphorous, potassium (NPK) and micro nutrients, microbial and enzyme activities and growth regulators [37] [38] and continuous and adequate use with proper management can increase soil organic carbon, soil water retention and transmission and improvement in other physical properties of soil like bulk density, penetration resistance and aggregation as well as beneficial effect on the growth of a variety of plants [39].

The improved performance of fodder maize as a result of added *Trianthema* manure is due to the supply of nutrient elements to the plants. Organic manures are not only sources of major nutrients, but they also provide other micronutrients and plant growth-promoting molecules, which together lead to better crop yields [40] [41]. The involvement of other macro and micro nutrients in the metabolic processes of plants including maize had been reported in previous research [42]. It means that *Trianthema* manures provide macro and micro nutrients resulting in improved crop growth as compared to chemical fertilizer, reducing the total input cost for the production.

IV. CONCLUSION

It is concluded on the basis of results that biomass of the weed *Trianthema portulacastrum* can be efficiently used to prepare manures for organic farming. This use of Trianthema will not only be useful for weed control, but will also promote use of manures to replace chemical fertilization to the deteriorating agricultural lands. Trianthema vermicompost showed best results. Drying of *Trianthema* leaves and use of it as dry leaf manure proved effective for increasing crop production. Preparation and use of manures is the unique solution providing control of noxious weeds outcome in the best valuable nutrient resource for the crops. The author recommends vermicompost, compost and dry leaf manure prepared from Trianthema as the best, active and cheapest source of plant nutrients working with high efficiency as compared to fertilizer treatment. Training and awareness programmes must be arranged by government, NGOs, institutes to farmers for preparation and use of organic manures from *Trianthema* as it's long term use can help in agricultural sustainability.

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