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EFFECT OF *CROTALARIA* WEED MANURES ON MAIZE

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ABSTRACT--
A field experiment was conducted at Dr. Babasaheb Ambedkar Marathwada University in Aurangabad to evaluate the effects of various Crotalaria weed manures on the growth and yield of maize. The experimental design used was a randomized block design (RBD) and included six treatments with four replications. The treatments comprised green manure (GM), compost (CM), vermicompost (VM), dry leaf manure (DM), inorganic fertilizers (FE) and control (CO). Fodder maize (Zea mays L. cv. African Tall) was sown at a seed rate of 100 kg per hectare. Growth analyses of the crop were conducted 46 days after sowing (DAS). The results indicated that compost (CM) was the most effective in enhancing the growth and yield of maize.

KEYWORDS: *Crotalaria, Green manure, Compost, Vermicompost, Dry leaf manure, Maize*-------------------

INTRODUCTION

Maize (*Zea mays* L.) is a vital cereal crop with global significance, playing an essential role in food security, livestock feed and various agro-industrial processes (Murdia *et al.,* 2016). In tropical and subtropical regions, particularly in many parts of Africa and Asia, maize cultivation often faces challenges such as declining soil fertility (Vanlauwe *et al.,* 2015), high costs of synthetic fertilizers and unsustainable farming practices. There is an increasing need for cost-effective and environmentally friendly soil fertility management strategies to enhance maize productivity while maintaining long-term soil health.

Leguminous plants are commonly used as green manures due to their ability to fix nitrogen symbiotically. These plants also promote the mineralization of native soil nitrogen, which can significantly enhance soil productivity (Fox *et al.,* 1990; Azam *et al.,* 1993; Hood, 2001). Research has shown that leguminous plants are a good source of organic matter, primarily because of their higher nitrogen concentration compared to non-leguminous plants. Common green manure species include cowpea, soybean, *Dhiancha, Cassia, Crotalaria*, *Sesbania* etc.. Among these, *Crotalaria* species - fast-growing, nitrogen-fixing leguminous weeds, have demonstrated considerable potential for improving soil fertility. Species such as *Crotalaria juncea* (sunn hemp) and *Crotalaria spectabilis* are notable for their ability to fix atmospheric nitrogen in symbiosis with rhizobium bacteria and for their capacity to produce substantial biomass in a short time. When incorporated into the soil, *Crotalaria* biomass decomposes rapidly, releasing essential nutrients like nitrogen (N), phosphorus (P), and potassium (K) (Sinha *et al.,* 2009), thereby enriching the nutrient pool available for subsequent crops like maize.

In addition to nutrient enrichment, *Crotalaria* manures enhance soil structure, increase microbial activity and improve organic matter content. They may also provide allelopathic effects that suppress certain soil-borne pests, diseases and weeds, indirectly benefiting maize growth and yield. However, the effectiveness of *Crotalaria* green manure depends on several factors, including the species used, the quantity of biomass, the timing of incorporation and the prevailing soil and climatic conditions. Therefore, the present study aims to investigate the influence of *Crotalaria* weed manures on the growth and yield of maize.

MATERIAL AND METHODS

A field experiment was conducted at the research farm located within the Botanical Garden of Dr. Babasaheb Ambedkar Marathwada University in Aurangabad. The experiment was designed using a randomized block design (RBD) with six treatments and four replications.

Fresh vegetation of *Crotalaria notonii* Wt. and Arn. was collected from the vicinity of the university campus and then taken to the laboratory, where it was chopped into small pieces (2 - 3 cm) using an iron cutter. The chopped weed material was incorporated into the plots at a rate of 13333 kg/ha, approximately 15 - 20 cm deep in the soil, serving as green manure (GM). An equal amount of the vegetation was set aside for preparing compost (CM), vermicompost (VM), and for drying to produce dry leaf manure (DM).

Known weights of the plant material were evenly spread in trenches for composting and vermicomposting to a thickness of about 5 cm. Above each layer, a 5% dung slurry and soil were added alternately. Water was sprinkled on the layers to maintain optimal moisture levels (50 - 70%) throughout the process. This layering procedure was repeated until all composting materials were used. Finally, the pits were closed with cow dung slurry and fine clay to prevent heat loss and gas exchange, allowing anaerobic decomposition to commence.

After 18 days of partial decomposition, the main species of earthworm, *Eudrilus eugeniae* Kinberg - commonly known as the red variety was released into the vermicomposting pit, with 90 individuals per pit. Within 17 days, high-quality compost was obtained. The manures were applied to the appropriate plots after 35 days, including plots that received fertilization (100% NPK) and unfertilized control plots.

The fodder maize variety 'African Tall' (*Zea mays* L.) was cultivated at a rate of 100 kg/ha. The experimental plot measured 9 square meters and consisted of nine rows spaced 30 cm apart.

The mineral fertilizers, including nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O), were applied at rates of 120:80:40 kg/ha using urea, single super phosphate and muriate of potash.

Growth analyses of the maize crop were conducted 46 days after sowing (DAS). Measurements taken included plant height, diameter, number of leaves per plant, fresh weight of the plant and the length, width and weight of the fourth upper leaf. Leaf area per plant was determined using the gravimetric method (Shahane and Mungikar, 1984; Mungikar, 1986), and leaf chlorophyll contents (a, b, and total) were estimated according to Yoshida et al. (1976).

All results were statistically analyzed using analysis of variance (ANOVA). Treatment means were compared using the least significant differences (CD) method at a significance level of P = 0.05 (Mungikar, 1997).

RESULTS AND DISCUSSION

Growth analyses of the maize crop were conducted at 46 DAS (Table 1). The tallest plants were observed in the plots amended with compost (CM), followed by dry manure (DM), vermicompost (VM), green manure (GM) and finally, the unfertilized control (CO) during the growth analyses (Table 1). A similar trend was noted regarding the fresh weight of the stem, the total weight of the 4th upper leaf and leaf area. The diameter of the plants was greater in the CM treatment as compared to the DM and VM applications, while it was lesser in the CO plots compared to those treated with GM and FE. The fresh weight of roots was higher in the DM and FE amendments than in all other treatments and the fresh weight of leaves was greatest in the CM treatment, followed in order by DM, GM, VM and FE compared to the unfertilized CO. Additionally, the length of the 4th upper leaf was greater in the CM treatment than in the DM, VM and GM amendments, while its width was largest in the GM, CM and FE applications compared to the unfertilized plots (Table 1).

The chlorophyll contents, including Chlorophyll a, Chlorophyll b and total chlorophyll, ranged from 0.99 to 1.87 mg/g of fresh leaf weight, 0.24 to 0.79 mg/g and 1.22 to 2.60 mg/g respectively (Fig. 1). The chlorophyll levels were higher in all the manure-based treatments compared to those with only chemical fertilizers and the absolute control. Among all the treatments, the highest chlorophyll content was found in the plots amended with compost (CM) (Fig. 1).

All the results presented are calculated as the means of four replicates and the differences are statistically significant compared to the control. These findings indicate that the combined application of organic manure and chemical fertilizers provides the best source of nutrients for maize crops (Adhikari *et al.,* 2022), leading to increased growth and yield compared to solely using inorganic fertilizers and the absolute control.

Table 1. Growth analysis of maize crop (Age of plant: 46 DAS).

Treatments	Plant height (cm)	Diameter (cm)	No. of leaves (plant^{-1})	Fresh weight (g plant^{-1})				4th upper leaf			Leaf area (cm^2 plant^{-1})
				Root	Stem	Leaves	Total	Length (cm)	Width (cm)	Weight (gm)	
GM	76.12	3.02	6.50	0.95	7.87	8.05	16.88	58.07	3.25	2.09	97.25
CM	77.47	3.15	6.75	0.98	8.90	9.62	19.50	60.55	3.25	2.31	119.00
VM	75.90	3.07	6.50	0.98	7.97	8.02	16.98	58.62	3.07	2.12	107.50
DM	76.52	3.10	6.60	1.08	8.50	8.37	17.96	59.40	3.10	2.14	111.00
FE	73.17	3.02	6.30	1.05	7.60	7.52	16.17	51.95	3.25	2.01	92.50
CO	58.22	2.32	5.75	0.70	5.30	5.42	11.42	43.05	2.82	1.67	77.25
S.E.	3.26	0.12					1.12				6.09
C.D.	8.37	0.31					2.88				15.65

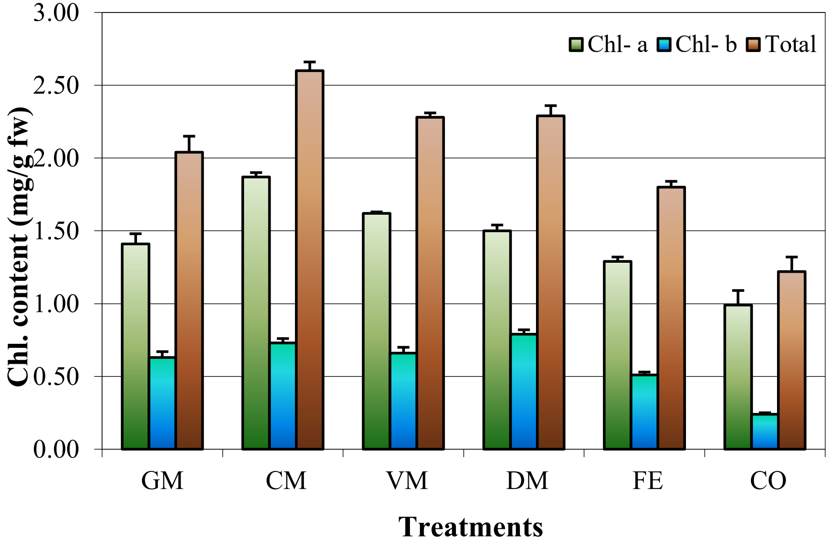

Fig. 1. Leaf chlorophyll contents of maize as affected by weed manures at 62 DAS (n = 4 $\pm$ SE).

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