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EVALUATION OF *PARTHENIUM* MANURES ON GROWTH OF MAIZE

D. R. Chamle
Department of Botany, Sharda Mahavidyalaya (Art's & Science), Parbhani - 431401 (M.S.), India.

ABSTRACT
A field experiment was conducted at Dr. Babasaheb Ambedkar Marathwada University in Aurangabad to assess the performance of Parthenium weed manures, including green manure (GM), compost (CM), vermicompost (VM) and dry leaf manure (DM) on the growth of maize. For comparison, mineral fertilizers were applied at rates of 120 kg N, 80 kg P and 40 kg K per hectare. Observations were recorded on morpho-physiological characters 87 days after sowing (DAS). The results clearly show that the application of green manure (GM) was more effective in improving the growth and yield of maize as compared to the other treatments.
KEYWORDS: *Parthenium, Green manure, Compost, Vermicompost, Dry leaf manure, Maize*

INTRODUCTION

Maize (Zea mays L.), a major cereal crop cultivated across diverse agro-climatic zones, occupies a prominent position in global agriculture. It serves as a critical source of food, feed, fodder and raw material for various industries (Murdia *et al.,* 2016). In India, maize has gained importance due to its high productivity potential, adaptability, and increasing demand from poultry and starch industries. However, sustaining maize productivity in the face of declining soil fertility and increasing costs of chemical fertilizers poses a significant challenge to farmers, particularly in resource-poor and rainfed farming systems.

Conventional agriculture has relied heavily on synthetic fertilizers to enhance crop yields, but their excessive and imbalanced use has led to multiple environmental issues such as soil degradation, nutrient imbalances and pollution of natural water bodies. In this context, the use of organic manures has gained attention as an eco-friendly alternative to improve soil health, maintain nutrient cycling and support sustainable crop production (Dubey, 2013). Among various organic sources, unconventional weed biomass has emerged as a potential input that can be utilized through appropriate composting techniques.

Parthenium hysterophorus, commonly known as Congress grass or Gajar gavat (Oudhia *et al.,* 2000), is an invasive, noxious weed that poses a serious threat to agriculture, biodiversity and human and animal health (Sivakumar *et al.,* 2009) due to its allelopathic properties and allergenic compounds. It spreads rapidly and colonizes fallow lands, roadsides and cultivated fields (Kaur *et al.,* 2014), where it competes with crops for nutrients, water and light. Despite its harmful effects, recent studies have indicated that *Parthenium* contains appreciable amounts of macro- and micronutrients (Channappagoudar *et al.,* 2007) and its biomass can be processed into nutrient-rich manure through composting or vermicomposting, which also reduces its toxicity.

Utilization of *Parthenium* as manure not only offers a sustainable method of weed management but also provides an opportunity to convert an environmental hazard into a valuable agricultural resource. However, scientific data on the effect of different forms of *Parthenium* manures such as fresh biomass, compost and vermicompost (Oli *et al.,* 2024) on the growth and yield of major crops like maize remains limited and inconclusive. The impact of such organic inputs on soil properties, plant growth parameters and overall crop performance needs systematic evaluation under field conditions.

Therefore, the present investigation is undertaken to evaluate the effect of *Parthenium* derived manures on the growth and development of maize. The study aims to compare different forms of *Parthenium* manure with conventional fertilizers and other organic inputs in terms of their influence on plant height, leaf area, biomass accumulation, and overall vigour of the crop.

MATERIAL AND METHODS

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

The fresh vegetation of *Parthenium hysterophorus* L. was collected from the university campus, brought to the laboratory and chopped into small pieces (2 - 3 cm) by using an iron cutter. The chopped weed material was incorporated into the plots at a rate of 13333 kg/ha, about 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).

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The 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. Identification of earthworm was done by Julka (1988). Within 17 days, high-quality compost was obtained. The manures were applied to the appropriate plots after 30 days, including plots that received fertilizers (100% NPK) and unfertilized control plots.

The fodder maize (*Zea mays* L.) var. 'African Tall' was sown at a rate of 100 kg/ ha. Each plot measured 9 m² and consisted of nine rows spaced 30 cm apart to maintain uniform population density.

The mineral fertilizers nitrogen (N), phosphorous (P_2O_5), and potassium (K_2O) were applied at rates of 120:80:40 kg/ha through urea, single super phosphate and muriate of potash. Growth analyses of the maize crop were recorded at 87 DAS, including measurements of plant height, diameter, number of leaves per plant, plant fresh weight, length, width and weight of the fourth upper leaf, as well as leaf area per plant determined by the gravimetric method (Shahane and Mungikar, 1984; Mungikar, 1986) and the leaf chlorophyll contents (a, b, and total) were estimated following the method of Yoshida *et al.* (1976).

All results were statistically analyzed using analysis of variance (ANOVA) and found to be significant compared to the control group (Mungikar, 1997).

RESULTS AND DISCUSSION

Table 1. Growth analysis of maize crop (Age of plant: 87 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	190.77	4.82	10.25	5.80	103.12	45.00	153.92	78.02	4.42	3.77	206.25
CM	166.17	4.27	9.50	3.42	97.80	38.40	139.62	72.50	4.05	2.65	176.25
VM	182.15	4.57	10.00	3.87	98.62	42.40	144.89	75.80	4.22	3.47	192.50
DM	156.45	4.27	9.50	3.35	75.82	33.65	112.82	70.15	3.75	2.65	161.25
FE	146.50	3.87^{ns}	9.25	3.02	56.85	28.50	88.37	66.15	3.70	2.35	148.75^{ns}
CO	119.50	3.78	8.00	1.75	31.60	11.37	44.72	52.65	3.25	1.87	128.75
S.E.	10.48	0.16					16.94				11.66
C.D.	26.93	0.41					43.53				29.96

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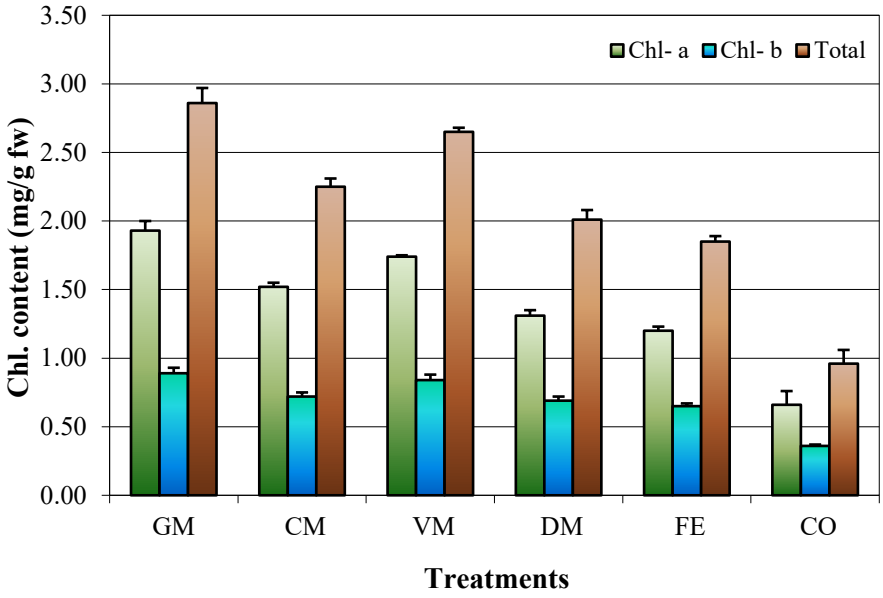


Fig. 1. Leaf chlorophyll contents of maize in response to weed manures (n = 4 ± SE).

A growth analysis of maize at 87 DAS revealed significant variations in morphological and physiological parameters under different organic treatments compared to the control (Table 1). The tallest plants were observed in the green manure (GM) treatment, measuring 190.77 cm, followed by vermicompost (VM) at 182.15 cm, compost (CM) at 166.17 cm, dry leaf manure (DM) at 156.45 and mineral fertilizer (FE) at 146.50 . The control treatment (CO) recorded the lowest plant height at 119.50 cm. This indicates that organic inputs, especially green manure and vermicompost, significantly enhanced vegetative growth.

A similar trend was noted for stem diameter, with GM showing the largest diameter at 4.82 cm, followed by CM and VM. The control treatment had the smallest stem diameter at 3.78 cm, which differed significantly from the GM treatment (Table 1).

These findings support previous studies indicating that organic amendments improve soil structure and nutrient availability, thus promoting plant elongation and stem thickening (Irin & Hasanuzzaman, 2024).

The plants treated with green manure (GM) exhibited the highest number of leaves, averaging 10.25. This suggests superior foliage development compared to other treatments. The treatments with vermicompost (VM) and compost (CM) also encouraged leaf formation, producing averages of 10.00 and 9.50 leaves, respectively. In contrast, the control treatment had the lowest leaf count at 8.00, underscoring the significance of organic nutrition in leaf initiation and growth (Table 1).

The total fresh weight per plant followed this trend: GM (153.92 g) > VM (144.89 g) > CM (139.62 g) > DM (112.82 g) > FE (88.37 g) > CO (44.72 g). Among the components, the stem contributed the most to the total fresh weight, followed by leaves and roots. GM plants displayed the highest weights for both stems (103.12 g) and leaves (45.00 g), indicating better biomass accumulation due to the application of green manure. Both VM and CM also demonstrated effective biomass distribution. Conversely, the control treatment had the least fresh weight across all parts, reflecting poor growth attributed to a lack of nutrient supplementation. These results confirm that organic manures enhance biomass production, likely due to improved nutrient uptake, root development and moisture retention.

Significant differences were observed in the characteristics of the fourth upper leaf. The longest fourth leaf was recorded in the GM treatment, measuring 78.02 cm, followed by the VM and CM treatments. The leaf width was also highest in GM at 4.42 cm, gradually decreasing down to the control group, which measured 3.25 cm. Leaf weight ranged from 3.77 g in GM to 1.87 g in the control treatment, indicating better leaf growth in the organically treated plots. The fourth upper leaf plays a crucial role in photosynthesis, so improvements in its dimensions are likely to enhance physiological functions and lead to better plant productivity.

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In terms of leaf area, the highest average per plant was observed in GM at 206.25 cm², followed by VM at 192.50 cm² and CM at 176.25 cm². The control group recorded the smallest area at 128.75 cm². Leaf area serves as a direct indicator of a plant's photosynthetic capacity; therefore, the larger leaf areas found in GM and VM-treated plants suggest improved CO_2 assimilation and energy capture. This confirms the synergistic effect of organic matter on leaf development, likely due to sustained nutrient release and enhanced soil microbial activity (Table 1).

The chlorophyll contents, which include Chlorophyll a, Chlorophyll b and total chlorophyll, ranged from 0.66 to 1.93 mg/g of fresh leaf weight for Chlorophyll a, 0.36 to 0.89 mg/g for Chlorophyll b and 0.96 to 2.86 mg/g for total chlorophyll (Fig.1). Overall, all weed manure treatments performed better than the control. Among these treatments, GM showed the greatest positive impact on chlorophyll synthesis in maize leaves, indicating its potential to enhance plant health and vigor under organic soil amendment practices. The FE and DM treatments also contributed to chlorophyll development, but they were less effective than GM, VM and CM (Fig.1).

CONCLUSION

The results clearly indicate that the green manure (GM) application produced the most vigrous growth across all parameters studied, including plant height, stem thickness, leaf development, fresh biomass, and leaf area. Both vermicompost (VM) and compost (CM) also significantly improved plant growth as compared to the control. The fertilized (FE) and unfertilized (CO) treatments performed poorly, highlighting the importance of nutrient-rich organic inputs for optimal maize growth at early stages.

These findings are in accordance with previous research suggesting that organic manures, particularly green manure and vermicompost, not only supply essential nutrients but also improve soil physical and biological properties, thereby enhancing crop growth and development (Grantina-Ievina, L. *et al.,* 2015).

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