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Effect of vermicompost and fly ash on vegetative growth parameters of Lemongrass (*Cymbopogon flexuous*)

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ABSTRACT

An experiment entitled "Effect of vermicompost and fly ash on vegetative growth parameters of lemongrass (*Cymbopogon flexuosus*)" conducted during April to October 2024, at the Agriculture Research Farm (ARC-2) FOAG, Tantia University, Srigangangar, Rajasthan. The experiment was carried out in Randomized block design with three replication and 7 treatments as T_1 100% vermicompost, T_2 100% fly ash, T_3 50% vermicompost + 50% fly ash, T_4 25% vermicompost + 75% fly ash, T_5 75% vermicompost + 25%fly ash, T_6 RDF, T_7 control. The result of experiment indicated that vegetative growth of lemongrass like plant height at 60 DAT (81.00cm) found in T_5 highest and minimum (54.00cm) in T_7, highest plant height at 120 DAT (120.67cm) in T_5 and lowest (87.00) in T_7, maximum plant spread (51cm^2) in T_5 and lowest (29.67cm^2) in T_7, maximum no. of leaves/ plant at 60 DAT (45.67) in T_5 and lowest (14) in T_7, maximum no. of leaves/ plant at 120 DAT (128.67) and minimum (77.33) in T_7, maximum no. of tillers/ plant (33.67) in T_5 and minimum (12.00) in T_7, maximum leaf length at 60 DAT (75cm), minimum in T_7 (48.67cm), maximum leaf length at 120 DAT (134.00cm) in T_5 and minimum (92.00cm) in T_7. So according to all findings T_5 is best option for organic lemongrass production.

KEYWORDS

Lemongrass, Vermicompost, Fly Ash, Vegetative Growth

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Lemongrass (*Cymbopogon flexuous*) popularly known as citronella grass. It belongs to family Poaceae. It is known for its smoky, sweet, and lemony fragrance. Lemongrass is tall perennial grass. It grows in numerous parts of the tropical and subtropical south East Asia and Africa. In India it grows in Western Ghats, Karnataka, Uttar Pradesh, some part of Haryana and Tamil Nadu states other than foot slops of Sikkim and Arunachal Pradesh. The annual world production of lemongrass is around 1000 tons from an area of 16000 ha. In India it is cultivated in an area of 4000 ha (Gawali, 2019) and the annual production is around 250 tons other than foot slops of Sikkim and Arunachal Pradesh.

The herb originated in Asia. Lemon grass is a fast growing herbaceous grass; which has a feed able branched rhizome from which erect stem grow. The stem has many light green leaves, each consisting of a leathery, cylindrical sheath and a long narrow leaf blade. The leaves are the source of the essential oil, which contains over 70% citral. This citral is a key component for the synthesis of B-ionones. Additionally, the oil includes more than 17% oleoresin. Citral is widely used in perfumery for various products such as soaps, detergents, cosmetics, insect repellents, room fresheners, ayurvedic preparations, and flavoring agents for soft drinks and tea.

The oil, rich in citral, possesses germicidal, medicinal, and flavoring properties. Due to its ease of cultivation, low risk, minimal investment, and guaranteed market, cultivating lemon grass not only ensures a steady income for farm families year-round but also fills open spaces in plantations. In addition to the domestic market, lemongrass oil also has significant export potential. Currently, Sri Lanka and Indonesia are the top exporters of these oils (Sharma *et al*., 2022). Lemongrass is cultivated worldwide, with the main sources of essential oil being India and Guatemala. The East Indian variety from India contains a higher citral content compared to the West Indies variety from Guatemala. India, as the leading global producer of lemongrass, contributes nearly 80% of the total output, with a monthly market flow of 45 to 55 MT. Indian lemongrass is typically harvested three times a year, but some well-maintained crops can yield up to 5 harvests annually.

Eco-friendly agriculture has priority for safe products, so this work concern with improving the productivity of lemongrass by using organic as the alternative to the chemical fertilizers. The use of various organic fertilizers is growing because they are non-polluting, increase soil health and quality, and reduces weeds. Organic manures, such as farm yard manure (FYM) and vermicompost can be applied to boost crop yield in a variety of ways. Some liquid organic manure such as jivaamrit has the capability to boost growth and provide immunity in the plant system. Organic manures are rich in macro as well as micro nutrients, vitamins, amino acids growth promoting factors like IAA, GA and valuable microorganisms (Natarajan, 2007). Fly ash is a new trending and good option for fulfill plants nutrient requirement.

Materials and Methods

A field experiment entitled "Effect of vermicompost and fly ash on vegetative growth parameters of lemongrass (*Cymbopogon flexuous*)" was carried out during the Kharif season (April to Oct.) 2024 at the Agriculture Research Farm (ARC2), Faculty of Agriculture, Tantia University, Srigangangar. The location site was situated in the North – Western part of India between 28.4^{o} to 30.3^{o} N latitude and 72.3^{o} to 75.3^{o}E longitude and at 175.6 meters height above mean sea level.

As per the agro climatic zones of Rajasthan it has been designated as Irrigated North Western Plain Zone 1b. The zone has extreme climatic conditions with scorching summer, cold winter and mild rainy season. The experiment was conducted using 7 treatments, laid out in a randomized Block Design (RBD) with three replications to minimize experimental error. The total number of plots was twenty one (7 treatments × 3 replication). Each plot has a gross size of 4×3m. The lemongrass variety used for study was Krishna, sown at a spacing of 60x60cm. The seven treatments included: T_1 100% vermicompost, T_2 100% fly ash, T_3 50% vermicompost + 50% fly ash, T_4 25% vermicompost + 75% fly ash, T_5 75% vermicompost + 25% fly ash, T_6 RDF, T_7 control. Treatments were imposed firstly at field preparation time and remain is applied at standing crop. The experimental area was kept weed free. Weeding was done at 15 days interval. The first irrigation was given immediately after planting. The subsequent irrigation was given as required. Twenty five irrigations were given to the crop in 6 months duration. The first harvest of the crop is taken 90 days and second harvest was taken at 180days. Obtain vegetative parameters are plant height at 60 and 120 DAT, plant spread at 120 DAT, no. of leaves/plant at 60 and 120 DAT, no. of tillers/plant at 120 DAT, leaf length at 60 and 120 DAT.

Results and Discussion

The data on vegetative growth characters e.g. plant height at 60 and 120 DAT, no. of leaves/ plant at 60 and 120 DAT, length of leaves at 60 and 120 DAT, plant spread at 120 DAT, no. of tillers/plant at 120 DAT were recorded and presented here.

Plant Height (cm)

The data presented in table 1 revealed that significant effect was exhibited on the plant height of lemongrass with regard to vermicompost and fly ash application. At 60 DAT maximum plant height (81.00cm) recorded in T_5 (75% VC + 25% FA), which was statistically at par with treatment T_3 (50% VC + 50% FA), T_4 (25% VC + 75% FA), T_1 (100% VC), T_2 (100% FA), T_6 (RDF), T_7 (control) which recorded plant height 75.33cm, 73.67cm, 69.67cm, 59.67cm, 58.00cm and 54.00cm respectively.

Table 1. Effect of vermicompost and fly ash on plant height, number of leaves/ plant, leaf length at 60 and 120 DAT

Treatments	Plant Height (cm)		Number of Leaves		Leaf Length (cm)	
	60 DAT	120 DAT	60 DAT	120 DAT	60 DAT	120 DAT
T_1 –100% vermicompost	69.67	98.67	30.00	99.67	64.33	124.00
T_2 – 100% fly ash	59.67	97.33	26.33	90.33	59.00	109.17
T_3 – 50% vermicompost + 50% fly ash	75.33	114.33	43.33	119.00	73.33	131.00
T_4 – 25% vermicompost + 75% fly ash	73.67	109.00	35.00	113.00	70.67	125.67
T_5 – 75% vermicompost + 25% fly ash	81.00	120.67	45.67	128.67	75.00	134.00
T_6 - RDF	58.00	94.67	22.33	90.67	52.00	100.67
T_7 - Control	54.00	87.00	14.00	77.33	48.67	92.00
SEm ±	0.78	0.82	0.63	0.99	0.95	0.94
C.D.(P=0.05)	2.40	2.55	1.94	3.07	2.93	2.91

Table 2. Effect of vermicompost and fly ash on plant spread and number of tillers/ plant at 120 DAT

Treatments	Plant Spread ($cm^{2)}$	Number of Tillars/ Plant
T_1 – 100% vermicompost	42.00	23.67
T_2 – 100% fly ash	39.33	21.33
T_3 – 50% vermicompost + 50% fly ash	49.00	32.67
T_4 – 25% vermicompost + 75% fly ash	42.67	31.00
T_5 – 75% vermicompost + 25% fly ash	51.00	33.67
T_6 - RDF	36.00	23.00
T_7 - Control	29.67	12.00
SEm ±	1.33	0.84
C.D.(P=0.05)	4.12	2.60

After 120 days of transplanting highest plant height (120.67cm) was recorded in T_5 (75% VC + 25% FA), followed by T_3 (50% VC + 50% FA), T_4 (25% VC + 75% FA), T_1 (100% VC), T_2 (100% FA), T_6 (RDF), T_7 (Control) which recorded plant height 114.33cm, 109.00cm, 98.67cm, 97.33cm, 94.67, 87.00cm respectively.

Number of Leaves

The data presented in table 1 indicate that different doses of vermicompost and fly ash exhibited significant effect on number of leaves of lemongrass at 60 and 120 DAT. Maximum number of leaves per plant (45.67) at 60 DAT was recorded in treatment T_5 (45.67) followed by T_3 (50% VC + 50% FA), T_4 (25% VC + 75% FA), T_1 (100% VC), T_2 (100% FA), T_6 (RDF), T_7 (control) which recorded leaves per plant 43.33, 35, 30, 26.33, 22.33, respectively and minimum number of leaves per plant observed in T_7 (14). At 120 DAT maximum number of leaves per plant found in T5 (128.67) followed by T_3 (119.00), T_4 (113.00), T_1 (99.67), T_2 (90.33), T_6 (90.67), and minimum number of leaves per plant found in T_7 (77.33).

Leaf Length (cm)

Data presented in table 1 revealed that vermicompost fly ash show a significant effect on leaf length of lemongrass at 60 DAT and 120 DAT. Maximum leaf length at 60 DAT found in T_5 (75cm) followed by T_3 (73.33cm), T_4 (70.67cm), T_1 (64.33cm), T_2 (59cm), T_6 (52cm) and minimum leaf length found in T_7 (48.67cm). At 120 DAT maximum leaf length found in T_5 (134cm) followed by T_3 (131.00cm), T_4 (125.67cm), T_1 (124.00cm), T_2 (109.17cm), T_6 (100.67cm), and the minimum leaf length was observed in T_7 (92.00cm). The result of experiment indicate that highest plant height at 60 DAT (81.00cm) found in T_5 and highest plant height at 120 DAT (120.67cm) in T_5 and maximum plant spread ($51cm^2$) in T_5, maximum no. of leaves/plant at 60 DAT (45.67) in T_5, maximum no. of leaves/plant at 120 DAT (128.67), maximum no. of tillers (33.67) in T_5, maximum leaf length at 60 DAT (75cm), maximum leaf length at 120 DAT (134.00cm) in T_5 and minimum (92.00cm) in T_7.

Plant Spread (cm^2)

The data presented in table 2 revealed that vermicompost and fly ash show significant effect on plant spread of lemongrass. Among all the treatments maximum plant spread observed in T_5 (51.00cm^2) followed by T_3 (49.00cm^2), T_4 (42.67), T_1 (42.oo), T_2 (39.33), T_6 (36.00), and minimum plant spread recorded in T_7 (29.67cm^2). After plant height maximum plant spread is also obtained in T_5 (75% vermicompost + 25% fly ash) followed by T_3 (50% vermicompost + 50% fly ash).

Number of Tillers/ Plant

According to data presented in table 2 revealed that vermicompost, fly ash and their combination show a significant effect on number of tillers per plant at 120 DAT. Maximum number of tillers per plant (33.67) found in T_5 (75% VC + 25% FA) followed by T_3 (50% VC + 50% FA), T_4 (25% VC + 75% FA), T_1 (100% VC), T_2 (100% FA), T_6 (RDF) as 32.67, 31.00, 23.67, 21.33, 23.00, respectively, T_7 (control), as 32.67, 31.00, 23.67, 21.33, 23.00, respectively, where minimum number of tillers per plant found in T_7 (12.00).

These findings are obtained because vermicompost improve soil quality , fulfil nitrogen requirement, improve soil texture, increase porosity and fly ash also increase micro nutrient availability in soil and plant and improve soil quality but in a maintained ratio. Higher dose of fly ash can cause toxic effect on crop and soil. Similar findings are observed by (Kumar *et al*., 2024) study on response of aromatic rosa grass to different proportion to fly ash and vermicompost and they obtain that in all treatments T_3 (20% fly ash + 80% vermicompost) produce significantly more biomass than the other treatments, (Panda *et al.,* 2018) observed that Low levels of fly ash (25%) amended soil improve the seedling growth parameters in lemongrass, (Dwibedi *et al.,* 2021), conduct an experiment on seedling growth physiochemical transformation of rice nursery soil under varying level of coal fly ash and vermicompost amendment, final result consider that the porosity, water holding capacity and nutrient availability increased with the addition of vermicompost.

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