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Impact of fertilizer sources, both organic and inorganic, on *Aloe vera*

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ABSTRACT

This study examined the effects of various amounts of organic and inorganic fertilizers on the leaf and plant features as well as the yield of aloe vera at the Bangladesh Institute of Research and Training on Applied Nutrition (BIRTAN), Barishal. There were 14 different treatments viz., T_1=100% control, T_2=50% cowdung + 50% chemical fertilizer, T_3=100% vermicompost, T_4=100% cowdung, T_5=50% sawdust+ 50% chemical fertilizer, T_6=100% cocodust, T_7= 50% compost+ 50% chemical fertilizer, T_8= 100% poultry litre, T_9= 50% vermicompost + 50% chemical fertilizer, T_{10}= 100% sawdust, T_{11}= 50% poultry litre+ 50% chemical fertilizer, T_{12}= 50% cocodust+ 50% chemical fertilizer, T_{13}= 100% compost, T_{14}= 100% chemical fertilizer. With the application of the T_5 treatment (50 % sawdust+ 50 % chemical fertilizer), it was found that the plant generated the highest mature leaf length, leaf breadth, fresh leaf weight, leaf yield per plant and gel yield per plant. The number of suckers was also discovered to be highest with T_{13} treatment above 100% control, among other plant characteristics. Several fertilizer treatments considerably impacted the rate at which leaves grew, with the early phases of each treatment showing the most significant impact. It was discovered that T_9 had less impact than T_5 (50% sawdust+ 50% chemical fertilizer) on the Aloe vera plant's characteristics.

Key Words: *Aloe vera, fertilizer, Organic, Inorganic and leaf growth.*

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I. Introduction

*Aloe vera*_consists of at least 600 known species (Okamura et al., 1996) and is a valuable medicinal plant used for centuries to treat various ailments. The plant has numerous health benefits, attributed to biologically active compounds such as polysaccharides, phenolic compounds and vitamins (Barandozi et al., 2011). However, to achieve high yields and quality of *Aloe vera*, it is essential to provide optimal conditions for plant growth and development, which can be achieved through the application of fertilizers (Capasso et al., 1998).

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Organic and inorganic sources of fertilizers are commonly used in agriculture to enhance plant growth and development. Organic fertilizers such as compost, vermicompost and animal manure are considered a sustainable alternative to chemical fertilizers, as they are rich in essential nutrients and improve soil fertility and structure. On the other hand, Inorganic fertilizers provide a quick release of nutrients and are easy to apply (Van Dijk et al., 2022), but their excessive use can lead to soil degradation and environmental pollution.

Several studies have investigated the effect of organic and inorganic sources of fertilizers on the growth and yield of *Aloe vera* (Bellitürk and Aslam, 2021). However, there is a need for more research to determine the optimal fertilizer source and application rate for *Aloe vera* production. This study aimed to evaluate the effect of different organic and inorganic sources of fertilizers on the growth and yield of *Aloe vera*. The results of this study can provide useful information for farmers and growers who are interested in optimizing *Aloe vera* production using sustainable fertilization practices.

II. Materials and Methods

The study was conducted in BIRTAN Regional Station, Barishal from 2019 to 2021. The climate of this area is subtropical. The soil of the experimental site was clay loam, with a pH of 7.5.

pH	Salinity (E.C)	Organic matter (%)	N (%)	P (Olsen)	Sulphur	K
7.5	1.07	1.40	.069	7.9	8.3	0.12

The experiment was laid out by randomized complete block design with three replication comprising 14 treatments viz.

T_1= 100% control
T_2= 50% cowdung + 50% chemical fertilizer
T_3= 100% vermicompost
T_4= 100% cowdung
T_5= 50% sawdust+ 50% chemical fertilizer
T_6= 100% cocodust
T_7= 50% compost+ 50% chemical fertilizer
T_8= 100% poultry litre
T_9= 50% vermicompost + 50% chemical fertilizer
T_{10}= 100% sawdust
T_{11}= 50% poultry litre + 50% chemical fertilizer
T_{12}= 50% cocodust+50% chemical fertilizer
T_{13}= 100% compost
T_{14}= 100% chemical fertilizer

The plots used in the experiment were 3 m in length and 1m in breadth. Seedlings of around eight weeks were collected from different local nurseries. Organic fertilizer, as well as decomposed cowdung, vermicompost, compost, cocodust, saw dust, poultry litre, were used in this experiment as per treatment. Chemical fertilizer as urea- 500 gm (3 split top dressing 25 days interval), TSP-300gm, MOP - 200 gm (50% Basal+1% Top dressing), Zn-50 gm, Gypsum-250 gm and fertilizer combination (Cowdung + Chemical fertilizer, Vermicompost + Chemical fertilizer, Compost + Chemical fertilizer, Poultry litre + Chemical fertilizer, Cocodust + Chemical fertilizer, Saw dust + Chemical fertilizer were used as treatment. The plots were irrigated whenever necessary.

Final data were recorded at harvest (60 DAP) to measure plant characters. Flexible taps and a scale were used to measure the leaf. The weighing was done by digital balance (Kaifeng Group Co., Ltd., China). The data were analyzed following the Analysis of Variance (ANOVA) technique and mean separations were adjusted by the Multiple Comparison tests (Gomez and Gomez, 1984) using the statistical computer programme MSTAT-C v.1.2 (MSTAT-C, 1990). Means were compared by using an LSD test at 5% level of significance.

III. Results and Discussion

Table 01 displays the results of the leaf and plant characteristics of *Aloe vera* plants at harvest (60 days after transplanting) under different treatments. The treatments include various types of organic and inorganic fertilizers such as cow dung, vermicompost, sawdust, compost, chemical fertilizers, poultry litter and cocodust. The results indicate that the plant height varied significantly among treatments, with the highest value of 39.67 cm observed in T_5 (50% sawdust + 50% chemical fertilizer) and the lowest value of 25 cm in T_6 (100% cocodust). The number of leaves per plant ranged from 4.67 to 6.67, with T_5 again having the highest value and T_9 (50% vermicompost + 50% chemical fertilizer) having the lowest value. In this experiment application of 50% vermicompost + 50% chemical fertilizer as

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recommended doses did not show superior results to fertilizer application which was supported by Barandozi et al. (2011), Hasanuzzaman et al. (2008) and Saha et al. (2005). This trend of increased production due to increased fertilizer application was also observed in leaf length, leaf breadth, total weight/plant, leaf yield/plant and leaf area.

Fresh leaf weight per plant varied significantly among treatments, with the highest value of 413.89 g observed in T_5 and the lowest value of 287.54 g in T_1 (100% control). Similarly, leaf length, breadth and area also varied significantly among treatments, with the highest values observed in T_5 and the lowest values observed in T_1. The highest length of leaves was observed in the treatment where 50% sawdust+ 50% chemical fertilizer was applied. The growth rate in length decreased with the decrease in sawdust. The lowest growth rate was observed in the control treatment, where no fertilizer was applied. This dose of fertilizer improved the *A. vera* plant growth by providing the essential nutrient, resulting in the maximum cell growth and turgidity that influenced the leaf growth. Pichgram (1987) also observed similar results in *A. vera*.

Table 01. Different morphological characteristics of *Aloe vera* at final harvest stage (60 DAP) with different treatment conditions

Treatment	Plant height	No. of leaf/plant	Fresh leaf weight/plant(g)	Leaf length(cm)	Leaf breadth(cm)	Leaf area(cm²)
T_1	28.33ab	5 cd	287.54 c	29.33 ab	2.33 c	68.34 c
T_2	35.67 a	5 cd	322.7 bc	32 ab	3 bc	96 b
T_3	33 ab	6.33 ab	350.8 ab	28.33 b	3.33 bc	90 b
T_4	34.67ab	6 abc	345.24 b	28.67 b	3 bc	94.67 b
T_5	39.67 a	6.67 a	413.89 a	37 a	4 a	150.67 a
T_6	25 b	6.33 ab	376.77 a	30.67 ab	3 bc	101.33 b
T_7	34.33ab	5 cd	310.45 bc	29.33 ab	3 bc	95.67 b
T_8	36.33 a	5.67abcd	360.56 ab	32 ab	3.33abc	106.67 b
T_9	31.33ab	4.67 d	304 c	27.33 ab	3 bc	82 b
T_{10}	27.67ab	5.33bcd	324.98 b	25.67 b	2.67 c	70 b
T_{11}	33.67ab	5.67abcd	356.43ab	29 b	3 bc	92.67 b
T_{12}	35.33ab	6 abc	340.78 b	30.33 ab	3.67 ab	105 b
T_{13}	35.67 a	5 cd	305.33 c	31.33 ab	3 bc	92 b
T_{14}	37.67 a	5.33bcd	362.54 a	32.67 ab	3.33 abc	108.79ab
CV(%)	8.53	6.89	7.01	5.54	4.05	5.08

T_1= 100% control, T_2= 50% cowdung + 50% chemical fertilizer,T_3= 100% vermicompost, T_4= 100% cowdung, T_5= 50% sawdust+ 50% chemical fertilizer, T_6=100% cocodust, T_7= 50% compost+ 50% chemical fertilizer, T_8= 100% poultry litre, T_9=50% vermicompost + 50% chemical fertilizer, T_{10}= 100% sawdust, T_{11}= 50% poultry litre+50% chemical fertilizer, T_{12}= 50% cocodust+50% chemical fertilizer, T_{13}=100% compost, T_{14}=100% chemical fertilizer.

Table 02 presents data on yield and yield contributing characters of *Aloe vera* at the final harvest stage (60 DAS) as well as soil moisture and plant mortality percentage of an experimental field under different treatment conditions. The leaf yield per plant ranges from 346.33 g (in T_1) to 564.67 g (in T_5), with significant differences among the treatments. Similarly, the gel yield per plant varies from 170.16 g (in T_1) to 298.67 g (in T_5), with significant differences among the treatments. The study of Moorthy and Malliga (2012) observed significant improvement in growth, yield and gel quality of *Aloe spp* by applying biofertilizers. The application of nutrient matter increased the cell division and elongation without hampering the nutrient uptake process, which provided better results due to better nutrition. Barandozi et al. (2011) and Guerrero et al. (2001) found that nutrient matter addition is a suitable technique for accelerating the natural recovery process of burned soils.

The number of suckers per plant ranges from 1.67 (in T_1) to 3.67 (in T_{13}), with T_5, T_8, T_{11} and T_{12} having the highest number of suckers per plant. A more or less similar trend was observed in case of total plant weight along with sucker. Number of suckers per plant was highest with the treatment T_{13} (100% Compost), which were followed by T_9 and T_5. These results were supported by Hernández-Cruz et al. (2002). Overall, T_5 has the highest yield and yield-contributing characters, followed by T_4, T_{11} and T_{12}. T_1 has the lowest yield and yield-contributing characters among all treatments.

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Table 02. Yield and yield contributing characters of *Aloe vera* at final harvest stage (60 DAS) and Soil moisture and plant mortality percentage with different treatment conditions

Treatment	Leaf Yield/plant (g)	Gel yield/plant (g)	No. of sucker/plant	Soil moisture (%)	Mortality rate
T_1	346.33 c	170.16 c	1.67 c	39.67 b	5 a
T_2	422.7 b	210.33 b	2.33 bc	45 ab	3.33 a
T_3	435.67 ab	215.9ab	2.67 abc	46.67 b	1.67 a
T_4	489.33 a	234.33 a	2.33 bc	50.67 ab	2.67 a
T_5	564.67 a	298.67 a	3 ab	42 ab	3.67 a
T_6	420.45 b	208.5 b	2.33 bc	51.67 ab	4.33 a
T_7	389.33 bc	190.00 c	2.33 bc	41.67 ab	2.67 a
T_8	450.23 ab	220.10ab	3 ab	46.67 ab	3.33 a
T_9	386.00 bc	192.33 c	2.33 bc	46.67 ab	3 a
T_{10}	397.67 bc	196.80 c	1.67 c	42.33 ab	3.33 a
T_{11}	449.33 ab	218.33ab	2.67 abc	54 a	1.67 a
T_{12}	445.00 ab	227.20ab	2.67 abc	50 ab	3.33 a
T_{13}	391.33 c	193.45 c	3.67 a	54 a	1.33 a
T_{14}	420.46 b	230.73 a	2.67 abc	48.33 ab	1.98 a
CV(%)	7.07	6.34	4.61	6.42	8.90

T_1= 100% control, T_2= 50% cowdung + 50% chemical fertilizer,T_3= 100% vermicompost, T_4= 100% cowdung, T_5= 50% sawdust+ 50% chemical fertilizer, T_6=100% cocodust, T_7= 50% compost+ 50% chemical fertilizer, T_8= 100% poultry litre, T_9=50% vermicompost + 50% chemical fertilizer, T_{10}= 100% sawdust, T_{11}= 50% poultry litre+50% chemical fertilizer, T_{12}= 50% cocodust+50% chemical fertilizer, T_{13}=100% compost, T_{14}=100% chemical fertilizer.

The soil moisture percentage ranges from 39.67% (in T_1) to 54% (in T_{11} and T_{13}), with significant differences among the treatments. The highest soil moisture percentage was observed in T_{11} and T_{13}, while the lowest was in T_1. The plant mortality rate ranges from 1.33% (in T_{13}) to 5% (in T_1), with significant differences among the treatments. The lowest plant mortality rate was observed in T_{13}, while the highest was in T_1. The soil moisture level is crucial for plant growth and development, and excessive soil moisture or waterlogging can negatively affect plant growth and survival. The results of this table indicate that there are significant differences in soil moisture percentage among the different treatment conditions, which may have influenced the plant mortality rate.

Overall, the results suggest that organic fertilizers such as vermicompost, cow dung, poultry litter, sawdust and compost can improve the growth and yield of *Aloe vera* plants compared to chemical fertilizers alone (T_{14}). Organic manures also contain plant growth regulators like humic acid, auxins, gibberlins and cytokinins which are responsible for plant growth and yield in many crops (Kumari, Shweta & Upadhyay, 2016). However, the type and combination of organic fertilizers used can have varying effects on plant growth and yield.

V. Conclusion

Based on the results of the study, it can be concluded that the use of organic fertilizers such as vermicompost, cowdung, cocodust, poultry litter, sawdust and compost had a significant effect on the growth and yield of *Aloe vera* plants compared to inorganic sources of fertilizers. *Aloe vera* plants grown with organic fertilizers had higher plant height, number of leaves per plant, fresh leaf weight per plant, leaf length, leaf breadth, leaf area, leaf yield per plant, and gel yield per plant compared to those grown with inorganic fertilizers. Additionally, the use of organic fertilizers also increased the number of suckers per plant, indicating more vigorous and healthy plant growth. Therefore, it can be concluded that the use of organic fertilizers is a more sustainable and practical approach to improving the growth and yield of *Aloe vera* plants.

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