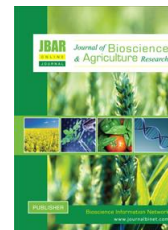


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Impact of organic leachate on growth and yield of ornamental sunflower

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ABSTRACT

A field experiment was accomplished at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, from October to December 2021 to evaluate the impact of organic leachate on the growth and yield of ornamental sunflower. The variety used was "Hybrid Ornamental Sunflower (F1)" (Vincent Choice). The single-factor experiment was laid out in a randomized complete block design (RCBD) with three replications. The experiment consisted of four treatments namely, T: Control (no leachate application), V: Vermicompost leachate, N: Neem oil cake leachate and M: Mustard oil cake leachate. Data on different growth, flower yield and quality attribute parameters were taken and all the treatments showed significant variations. Among the treatments, the tallest plant height (120.1 cm), the maximum number of leaves (35.1), leaf area (158.9 cm²), SPAD value (34.7), stalk diameter (7.1 mm), ray floret area (27.9 cm²), flower head size (15.0 cm), and flower head weight (30.4 g) showed superiority in N (Neem oil cake leachate). On the contrary, the shortest plant height (94.1 cm), the minimum number of leaves (28.1), leaf area (100.3 cm²), SPAD value (31.6), stalk diameter (5.3 mm), ray floret area (15.6 cm²), flower head size (10.8 cm), and flower head weight (16.9 g) observed minimum in T (Control) treatment. As a result, it can be concluded that N (Neem oil cake leachate) is an easy and effective organic substance that can potentially increase the entire growth and yield of ornamental sunflowers to advance the commercial cut-flower industry in Bangladesh.

Key Words: Organic matter, Cut flower and Safe production.

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I. Introduction

Sunflower (*Helianthus annuus* L.) is one of the world's most widely used cut flowers, belonging to the family Asteraceae (Kirtimala et al., 2018). The global floral industry is experiencing a surge in demand for sunflowers as cut flowers due to increasing cosmopolitan preferences (Devecchi, 2005). But in

Bangladesh, sunflowers are cultivated mainly for their oil seeds rather than cut flowers. No research has been conducted in our country on the production of ornamental sunflowers, so an experiment was carried out to introduce this innovative concept to flower producers and develop the flower industry. This plant responds very well to fertilizer application and effective fertilizer use is the key to its higher growth and yield (Verma et al., 2019). So, excessive application of inorganic fertilizers and synthetic chemicals a common agricultural practice that increases productivity. However, the vast chemicals used deteriorate soil quality also with crop productivity (Dwivedi and Dwivedi, 2019) and change the ecosystem negatively, which badly affects the environment and leads to serious health problems. Excessive fertilizer encourages the plant to develop vegetatively, promoting insect assaults that shorten the vase life of flowers and damage their color. Thus, the experiment utilized organic fertilizers as leachates i.e., Vermicompost leachate, Neem oil cake leachate and Mustard oil cake leachate, which worked incredibly quickly to extend flower vase life, enhanced excellent color, reduce insect infestations (Rakibuzzaman et al., 2021) and safeguard the environment while also being cost-effective compared to chemical fertilizers. Organic leachate contains essential plant nutrients such as macro and micronutrients as well as microorganisms that boost soil fertility through increased nutrient availability and enhance plant uptake efficiency, leading to plant growth and development (Pangaribuan et al., 2017). Enhancing crops, boosting agricultural output and stifling soil-borne illnesses, organic leachate is a superior supplier of nutrients (Stone et al., 2003 and Sharma et al., 1995). Furthermore, organic leachate can improve the physical, chemical and biological properties of the soil and help plants swiftly and readily absorb soil nutrients to produce high-quality cut flowers. Considering this, the major goal of this experiment is to identify the most effective organic leachate that performs best among all on the growth and quality yield of sunflowers.

II. Materials and Methods

The experiment was accomplished at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, from October 2021 to December 2021. The study was comprised of organic leachates application viz., T; Control (No leachate application), V; Vermicompost leachate (Vermicompost: water= 1:3, W/V; Application: 1:20= Vermicompost leachate: water, V/V), N; Neem oil cake leachate (Neem oil cake: water= 1:3, W/V; Application: 1:20= Neem oil cake leachate: water, V/V) and M; Mustard oil cake leachate (Mustard oil cake: water= 1:3, W/V; Application: 1:20= Mustard oil cake leachate: water, V/V) was used in this experiment arranged in randomized complete block design (RCBD) with three replications. The genetically pure and healthy seeds of the “Hybrid ornamental sunflower (F1)” popularly known as (Vincent Choice) were used in this experiment and seeds were collected from A R Malik Seeds Pvt. Ltd., Dhaka, in October 2021.

The land in the field was well prepared and divided into 12 plots for planting them. The size of each unit plot was 3m × 1.8m with maintaining plant spacing (30 cm × 30 cm). Sunflower seeds were sowed at 2cm depth in soil. For preparing organic leachates; vermicompost (1kg), mustard oil cake (1kg) and neem oil cake (1kg) organic fertilizers were soaked in water (3L) into 3 individual pots (where, organic fertilizer: water=1:3, W/V) for proper fermentation. Leachates were prepared after 7 days of fermentation of these organic fertilizers and then turned into a slurry condition which was diluted with water 20 times (where, organic leachate: water=1:20, V/V) and after proper stirring, this prepared liquid was applied to the field to avoid plant damage and increase its efficiency. The first application was done with 15 DAS and the second application was done with 30 DAS. No pesticides and fungicides were used in this experiment. Earthen-up was done twice during cultivation which applied at 15 DAS and 35 days after sowing. Standard management practices were practiced during cultivation to produce sunflowers. For harvesting purposes of these cut flowers, the flower stem was cut sharply with holding the flower or flower bud.

Data have been collected based on four attributes - growth, physiological, quality and yield attributing parameters. Three plants were randomly selected from each unit of plot for the collection of data. The plants in the outer rows and the end of the middle rows were excluded from the random selection to avoid the border effect. Data on plant height, leaf number, SPAD value, stalk diameter, leaf area, ray floret area, flower head size, head weight and ray floret numbers per flower were measured. The leaf chlorophyll content was estimated using an automatic SPAD meter (SPAD-502 meter, Minolta, Japan). A young fully extended leaf was used for SPAD reading. The data recorded for different parameters

were statistically analyzed using Statistix-10 scientific analysis software to find out the significance of variation among the treatments and treatment means, which were compared by an LSD test at a 5% level of probability.



Plate 01. A pictorial depiction of organic leachate preparation.

III. Results and Discussion

Vegetative growth attributes

Plant height: Different treatments showed a significant impact on the plant height of ornamental sunflowers. The tallest sunflower plant (120.1 cm) was attained from N (Neem oil cake leachate) whereas the shortest plant (94.1 cm) was recorded from T (Control) treatment (Figure 01). The plant height in okra increased by applying neem seed cake (NSC) (Eifediyi et al., 2015). The foliar application of a combination of vermiwash with neem oil increased the brinjal plant growth (Tiwari and Singh, 2015). Neem products can be used as a bio-fertilizer, providing the macronutrients essential for plant growth (Ramachandran et al., 2007). The results could be due to the elongation of cells and the number of cells from cell division.

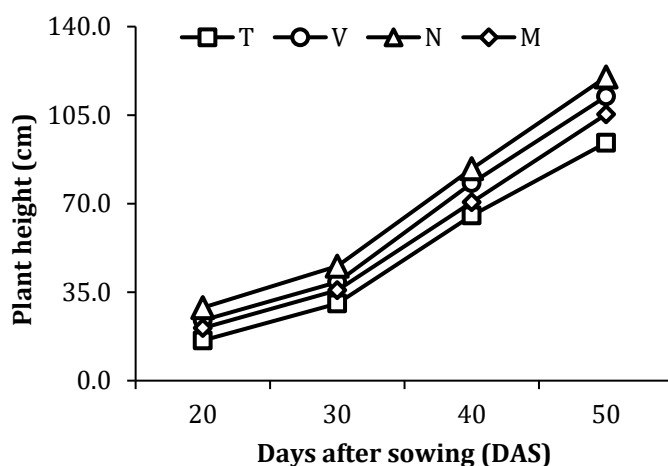


Figure 01. Effect of organic leachates on plant height (cm) at different days after sowing (Here, T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate)

Number of leaves per plant: The number of leaves expressed significant inequality in ornamental sunflowers grown under the application of different organic leachates. Plants with N (Neem oil cake leachate) treatment showed the maximum number of leaves (35.1), whereas the minimum (28.1) was

found in T (Control) treatment (Figure 02). The number of leaves studied showed significant variation in applied neem seed cake (NSC) in the okra plant Eifediyi et al. (2015).

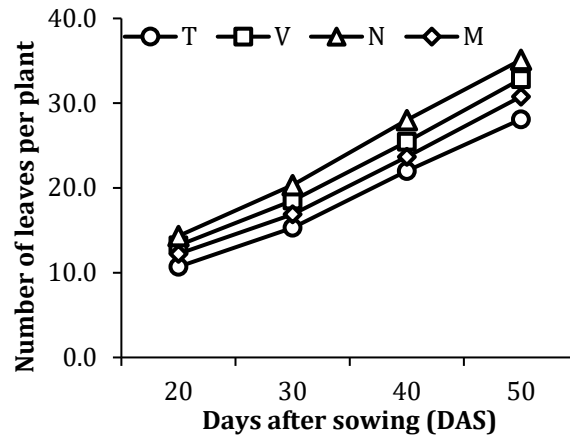


Figure 02. Effect of organic leachates on the number of leaves per plant on different days after sowing (Here, T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate)

Leaf area: Leaf area showed significant variation in different organic leachates on ornamental sunflowers. The N (Neem oil cake leachate) showed the maximum leaf area (158.9 cm²), while the minimum (100.3 cm²) was observed from the T (Control) treatment (Figure 03). The response of sesame to the higher leaf area in neem oil cake leachate may be an indication that the nutrient absorbed by the plants was utilized for cell multiplication, amino acid synthesis and energy formation that acted as structural compounds of chloroplast and an essential component in photosynthesis (Ng’etich et al., 2013).

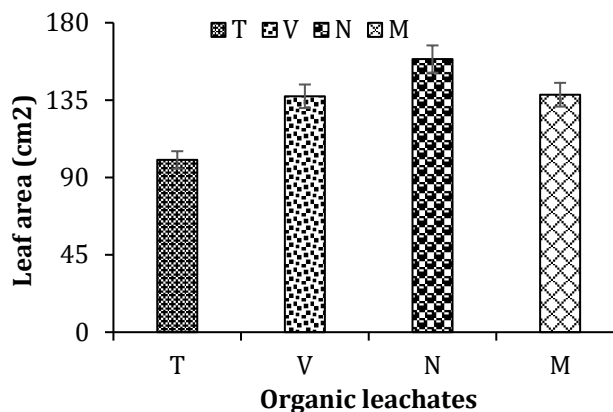


Figure 03. Effect of organic leachates on leaf area on different days after sowing (Here, T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate)

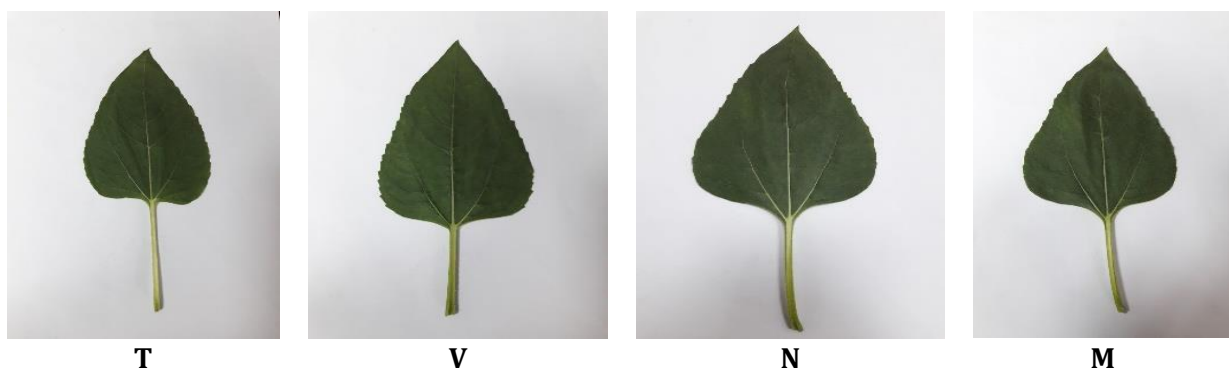


Plate 02. A visual representation of the leaf area of ornamental sunflower under different treatments; T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate

Stalk diameter: Stalk diameter was significantly varied with different treatments. The maximum stalk diameter (7.1 mm) was observed from N (Neem oil cake leachate) whereas the minimum (5.3 mm) was observed from T (Control) treatment (Figure 04).

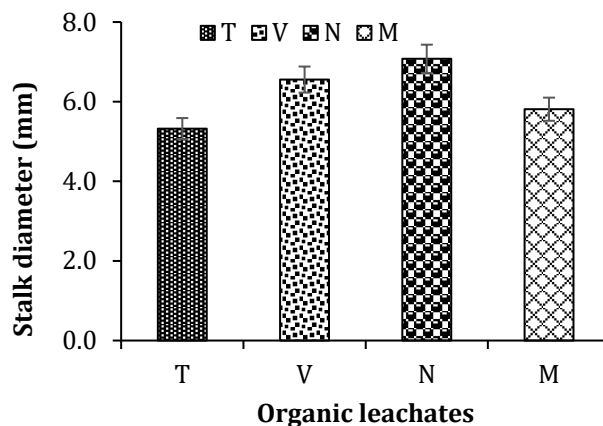


Figure 04. Effect of organic leachates on stalk diameter on different days after sowing (Here, T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate)

Stem diameter: The performance of stem diameter varied significantly when various organic leachates were applied. The maximum stem diameter (12.8 mm) was observed from N (Neem oil cake leachate), while T (Control) treatment showed the minimum (8.0 mm) (Table 01).

SPAD value: Chlorophyll enhances the growth of a plant, which is correlated with plant growth. In different treatments, the SPAD value of leaves showed significant variation. The highest SPAD value (34.7) was observed from N (Neem oil cake leachate) whereas the lowest value (31.6) was from T (Control) treatment (Table 01). The application of liquid organic fertilizer increased the amount of chlorophyll (Banijamali et al., 2018) and encouraged guard-cell energy and stomata aperture leading to proper photosynthesis (Mansfield et al., 1990). The chlorophyll content of leaves is frequently correlated with photosynthetic capacity, leaf N status and RuBP carboxylase activity (Evans, 1998; Seemann et al., 1987). Variation in chlorophyll content was also observed in Rose (Ahmad et al., 2011).

Internode length: The internode length increased probably due to higher nutrient content, which resulted in better vegetative and reproductive growth of the plant. In different treatments, the internode length of ornamental sunflowers showed significant variation. The highest internode length (8.3 cm) was observed from N (Neem oil cake leachate) and the lowest (6.4 cm) was found from T (Control) treatment (Table 01). Mishra et al. (2020) observed the maximum internode length in okra by applying neem oil cake as an organic fertilizer.

Ray floret area: Significant variation in ray floret area was recorded among the treatments (Table 01). The maximum ray floret area (6.3 cm²) was observed from N (Neem oil cake leachate) whereas the minimum (3.5 cm²) was recorded from T (Control) treatment.

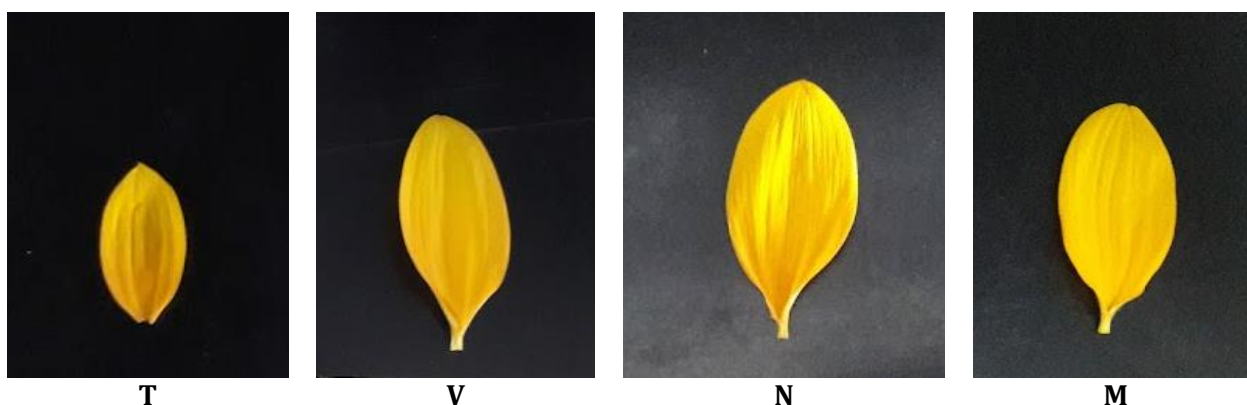


Plate 03. Pictorial presentation of the ray-floret area of ornamental sunflower under different treatments; T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate

Table 01. The effect of organic leachates on vegetative performance (Stem diameter, SPAD value, internode length, ray floret area) of ornamental sunflower**

Treatment*	Stem diameter (mm)	SPAD value	Internode length (cm)	Ray floret area (cm ²)
T	5.5 c	10.8 c	16.9 c	15.6 c
V	7.0 ab	13.5 b	28.9 b	26.0 b
N	7.5 a	15.0 a	30.4 a	27.9 a
M	6.6 b	12.7 b	27.9 b	26.6 b
LSD _{0.05}	0.6	0.9	1.2	1.1
CV (%)	8.5	7.0	4.8	4.7

* Here, T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate

**In a column means having a similar letter (s) are statistically identical and those having a dissimilar letter (s) differ significantly as per a 0.05 level of probability

Yield attributes

Flower head size: The yield attributes varied significantly among the treatments and were enhanced by the effect of different organic leachate applications on ornamental sunflowers (Figure 05). Among other organic leachates, N (Neem oil cake leachate) showed better performance in enhancing the flower head size (15.0 cm), while the minimum (10.8 cm) was found from T (Control). The increase in the diameter of the flower might be due to the application of nutrients from organic sources, which promote growth and accumulate photosynthates in flowers, resulting in larger flower diameters in gerbera (Giri et al. 2021).

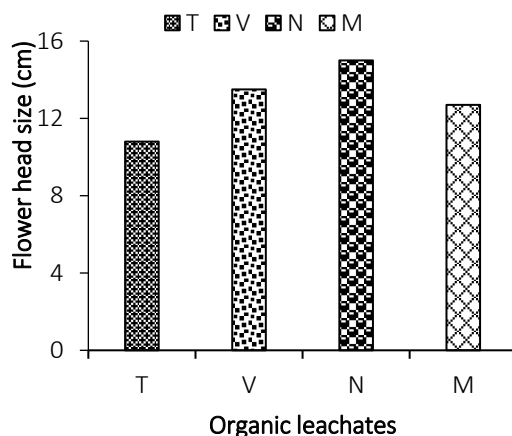


Figure 05. Effect of organic leachates on flower head size on different days after sowing (Here, T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate)



Plate 04. Pictorial view of the flower head size of ornamental sunflower under different treatments; T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate

Flower head weight: Significant variations were found in flower head weight due to the different treatments (Figure 06). The maximum flower head weight (30.4 g) was observed in N (Neem oil cake) while the minimum weight (16.9 g) was found in T (control). Mishra et al. (2020) observed the number of large-sized fruits with maximum fruit weight by the combined application of organic and inorganic fertilizers in the okra plant.

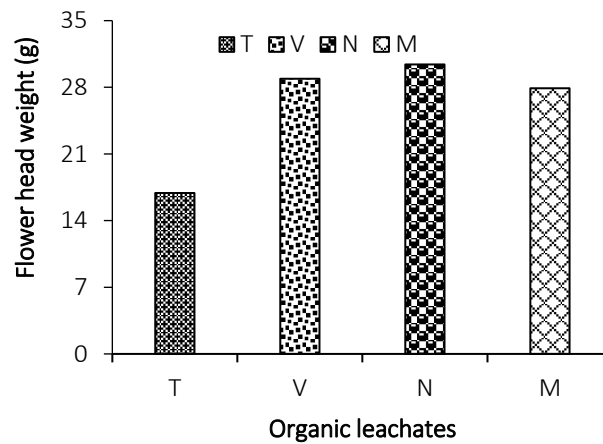


Figure 06. Effect of organic leachates on flower head weight on different days after sowing (Here, T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate)

Flower disc size: Considering different treatments, flower disc size of ornamental sunflower showed significant variation (Table 02). The maximum flower disc size (7.5 cm) was observed from N (Neem oil cake leachate) while the minimum (5.5 cm) was found from T (Control) treatment. This might be a facilitative response of neem oil cake to extend the plant growth stages due to its involvement in the structural support of cell membrane as well as in non-structural components of enzymes, nucleic acids, amino acids and chlorophyll pigments (Seilsepour and Rashidi, 2011).

Flower disc weight: The significant variation is noted by applying different organic leachates (Table 02). The maximum flower disc weight (27.9 g) was observed in N (Neem oil cake leachate) while the minimum (15.6 g) was found in T (control).

Ray floret numbers per flower: In different organic leachate treatments, ray floret numbers per flower showed significant variation. The maximum ray floret number (32.1) was observed in N (Neem oil cake leachate) while the minimum (28.9) was found in the T (control) treatment (Table 02). Data revealed that different organic leachate applications influenced the maximum ray floret number. The plant growth-influencing substances produced by microorganisms increased flowering and enhanced flower quality (Arancon et al., 2008).

Table 02. The effect of organic leachates on yield attributes (flower disc size, flower disc weight and ray floret numbers per flower) of ornamental sunflower**

Treatment*	Yield attributes		
	Flower disc size (cm)	Flower disc weight (g)	Ray floret numbers per flower
T	5.5 c	15.6 c	28.9 b
V	7.0 ab	26.0 b	31.0 ab
N	7.5 a	27.9 a	32.1 a
M	6.6 b	26.6 b	30.3 ab
LSD _{0.05}	0.6	1.1	2.6
CV (%)	8.5	4.7	8.8

*Here, T: Control; V: Vermicompost leachate; N: Neem oil cake leachate; M: Mustard oil cake leachate

**In a column, means having a similar letter (s) are statistically identical and those having a dissimilar letter (s) differ significantly as per a 0.05 level of probability

IV. Conclusion

According to the findings, the growth and flowering of ornamental sunflowers varied significantly amongst different organic leachates. Based on the findings, neem oil cake leachate showed effective performance among all the treatments due to its promising significance of growth attributes and reproductive characteristics of high-quality sunflower production. So, it can be said that neem oil cake leachate would be the prominent way to increase sunflower yield.

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