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RESEARCH ARTICLE

Impact of Nitrogenous Sources, Both Organic and Inorganic on Sunflower Hybrids

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ABSTRACT

Sunflower (*Helianthus annuus L.)* is a globally significant oilseed crop, and nitrogen (N) is a crucial nutrient influencing its growth, yield, and oil quality. This study aimed to investigate the effects of different nitrogen sources on sunflower production. A field experiment was conducted using a randomized complete block design with various nitrogen treatments, including conventional fertilizers, organic sources, and Inorganic. Agronomic parameters such as plant height, leaf area index, and yield components were evaluated, along with oil content. Statistical analysis revealed significant differences among nitrogen treatments for various parameters. Organic nitrogen sources exhibited comparable performance to conventional Inorganic in promoting sunflower growth and yield, highlighting their potential as sustainable alternatives. Inorganic also showed promising results, particularly in enhancing nutrient uptake and soil health. These findings provide valuable insights into optimizing nitrogen management practices for sustainable sunflower production, contributing to enhanced productivity and environmental sustainability in oilseed cropping systems. Further research is warranted to elucidate the mechanisms underlying nitrogen source effects on sunflower physiology and to refine nitrogen management strategies for optimal crop performance and resource efficiency.

1. Introduction

Sunflower (*Helianthus annuus L*.) is a versatile oilseed crop renowned for its adaptability to diverse agro-climatic conditions and its high-quality oil content. Globally, sunflower production plays a crucial role in meeting the demand for edible oils, animal feed, and industrial applications [1]. The optimal growth and yield of sunflower are heavily influenced by various agronomic practices, with nitrogen (N) fertilization being among the most critical factors affecting crop performance [2].

Nitrogen is an essential nutrient required for various physiological processes in plants, including photosynthesis, protein synthesis, and overall growth and development [3]. Adequate nitrogen supply is essential for maximizing sunflower yield potential and oil content. However, inefficient nitrogen management practices can lead to environmental pollution, soil degradation, and economic losses [4]. Therefore, understanding the effects of different nitrogen sources on sunflower production is paramount for sustainable agricultural practices.

In recent years, there has been increasing interest in exploring alternative nitrogen sources, such as organic fertilizers, biofertilizers, and nitrogen-fixing crops, to mitigate the environmental impacts of conventional nitrogen fertilizers while maintaining or enhancing crop productivity [5]. Additionally, advancements in agronomic techniques and biotechnology have provided new avenues for optimizing nitrogen use efficiency and improving sunflower yield and quality [1].

Given the importance of nitrogen in sunflower production and the growing need for sustainable agricultural practices, this research aims to examine the properties of different nitrogen sources on sunflower growth, yield, and oil content [6]. By evaluating various nitrogen fertilization strategies, including conventional and alternative nitrogen sources, we seek to elucidate their impact on agronomic performance, nitrogen use efficiency, and environmental sustainability in sunflower cultivation [7]. Insights gained from this research will contribute to the development of evidence-based nitrogen management practices tailored to maximize sunflower productivity while minimizing environmental risks, thus fostering the long-term viability and resilience of sunflower production systems [8, 9]. Therefore, the study investigates the impact of nitrogenous sources, both organic and inorganic, on sunflower hybrid yield

2. Material and Methods

2.1Experimental Design

In 2022, a trial was carried out at the agronomy research farm at the University of Agriculture in Peshawar, Pakistan. The study used a randomized complete block design with three replications, where two factors were used in each replication: organic and inorganic nitrogenous sources (urea, chicken manure, and farmyard manure) and hybrids of sunflowers (Hysun-33, Agura-4, and Parsun-3). Five-row, three-by-three-meter plots were used. To encourage the impact of microorganisms on the breakdown of organic matter, farmyard and chicken manure were applied to the field 15 days before to planting, with plants spaced 25 cm apart and a uniform seeding rate of 8 kg ha-1. Both organic and inorganic nitrogenous sources were used to manage the required nitrogen (150 kg ha-1). The nitrogen content of farm manure is 1.08%. Farmyard manure has 1.08% N, 20% P_2O_5, and 0.45% K, but poultry dung comprises 2.80% N, 2.84% P_2O_5, and 2.30% MK [6]. Every agronomic and management approach was kept up to date for every experimental unit. The field was thoroughly tilled with a rotavator and cultivator, and the first watering was done following emergence. The following treatments are used in the experiment:

Factor A: Organic, and inorganic nitrogenous fertilizers

F_0 = CON
F1 = Farmyard manure
F2 = Poultry manure
F3 = Urea
F4 = Farmyard manure (50%)+urea (50%)
F5 = Poultry manure (50%)+urea (50%)

Factor B: Sunflower Hybrids

H_1 = Hysun-33
H_2 = Agura-4
H_3 = Parsun-3

2.2 Analyzed parameters

During the experiment, data were gathered on the following parameters (per standard procedure):

2.3 Emergence Days

The number of days from the date of sowing to 75% of emergence was recorded in each sub plot at 75% emergence, and the data was visually inspected.

2.4 Emergence (M^{-2})

Three randomly chosen rows of one meter each were used to count the total number of plants in each subplot that emerged. The findings were then converted to m^{-2}.

2.5 Days to flowering

The estimated number of days until blossoming is the number of days from the date of planting to the point at which over 80% of the plants in an experimental plot yield flowers.

2.6 Days till star formation

The bloom may at first resemble a star during the vegetative stage. The days to star formation were calculated as the total number of days from seeding to the day when 80% of the stars in each subplot had formed.

2.2 Height (PH) of plant (cm)

Five randomly chosen plants from each line had their mature plant height measured, and the measurement means were computed.

2.3 Statistical Analysis:

Data obtained from the field experiment were subjected to analysis of variance (ANOVA) to assess the significance of treatment effects on sunflower growth, yield, and quality parameters.

Mean separation tests (e.g., Tukey's HSD) were performed to compare treatment means and identify significant differences among nitrogen sources.

3. Results

Table 1 displays the impact of organic and nitrogenous fertilizers on the number of days until sunflower hybrids appear. The average table showed that although both organic and inorganic nitrogenous fertilizers had no discernible impact on days to emergence, sunflower hybrids had a considerable impact. Agura-4 hybrid took longer to emerge (12.6) than Hysun-33 (11.3) and Parsun-3 (9.7), among other sunflower hybrids. There was no significant interaction seen between the sunflower hybrid and either organic or inorganic nitrogenous source.

Both organic and inorganic nitrogenous fertilizer were shown to have a significant impact on the emergence m-2 of sunflower hybrids (Table 1), however there was no appreciable difference in emergence m-2 between the two types of fertilizer when combined with sunflower hybrids. Hysun-33 (16.6) and Parsun-3 (15.7) had the lowest emergence m-2, whereas plots harboring hybrid Agura-4 had the greatest (17.8). Applying urea and poultry dung together yielded the highest emergence m-2 (22.0) value of all the nitrogenous fertilizers.

Both organic and inorganic nitrogenous fertilizers had a substantial impact on the number of days it took for sunflower hybrids to produce stars; however, there was no significant interaction between nitrogenous fertilizers and sunflower hybrids (Table 2). Agura-4 had the longest number of days to star formation (53.2) among the hybrid sunflowers, followed by Hysun-33 (51.7) and Parsun-3 (50.7). In contrast to the CON, which took the fewest days (41.1) to induce star formation, the combined application of urea and poultry manure required the longest (57.6). Table 2 displays the impact of nitrogenous fertilizers, both organic and inorganic, on the number of days until sunflower hybrid flowers. Days to flowering were significantly impacted by every treatment, according to an analysis of variance. Similarly, in terms of days to flowering, the interaction was not significant. The plants that took the longest to flower were Agura-4 (71.9 days), Hysun-33 (70.2 days), and Parsun-3 (69.2). Nitrogenous fertilizers applied in combination, such as poultry manure+urea and farmyard manure+urea, took the longest to blossom (76.1 and 75.3), followed by urea applied alone (71.3). In contrast, the control group began flowering quicker (63.4).

Sunflower hybrids and nitrogen sources did not significantly interact, according to Table 3's matching mean data for plant height. However, both inorganic and organic nitrogenous fertilizers had a significant effect on these hybrids' plant heights. Agura-4 and Hysun-33 produced longer plants (171.2 and 172.1 cm, respectively) in comparison to Parsun-3 (153.2 cm). While the control generated shorter plants (159.0 cm), the treatment of urea and chicken manure alone resulted in taller plants (166.9 and 165.3 cm, respectively). Plants treated with a combination of farmyard waste plus urea and chicken manure plus urea grew to be higher (170.2 and 169.0 cm, respectively).

Table 1. Impact of nitrogenous sources, both organic and inorganic, on sunflower hybrids' days to emergence and emergence m^{-2}.

O, and I N fertilizers (150 kg N ha^{-1})	**Hybrids (H)**			
	Parsun-3	**Agura-4**	**Hysun-33**	**Mean**
CON	8.0	11.3	10.3	9.9
FYM	9.0	12.3	10.7	10.7
PM	9.7	13.3	10.7	11.2
U	10.0	12.7	11.0	11.2
FYM 50%+U 50%	10.3	12.7	12.7	11.9
PM 50%+U 50%	11.3	13.3	12.7	12.4
Mean	9.7^{c}	12.6^{a}	11.3^{b}	
O, and I N fertilizers (150 kg N ha^{-1})	**Hybrids** Parsun-3	Agura-4	Hysun-33	Mean
CON	8.3	12.0	10.0	10.1^{f}
FYM	13.0	15.3	14.0	14.1^{e}
PM	15.0	17.0	16.0	16.0^{d}
U	17.3	18.3	17.3	17.7^{c}
FYM 50%+U 50%	19.3	21.0	20.0	20.1^{b}
PM 50%+U 50%	21.0	23.0	22.0	22.0^{a}
Mean	15.7^{c}	17.8^{a}	16.6^{b}	

LSD ($P \leq 0.05$) value for fertilizers (F) = ns
LSD ($P \leq 0.05$) value for Hybrids (H) = 1.2

H X F = ns
LSD ($P \leq 0.05$) value for fertilizers (F) = 0.9
LSD ($P \leq 0.05$) value for Hybrids (H) = 0.6
H X F = ns
There is a considerable difference between means in the same category indicated by different letters.

Table 2. Impact of nitrogenous sources, both organic and inorganic, on the duration taken for sunflower hybrids to produce stars and bloom.

O, and I N fertilizers (150 kg N ha^{-1})	**Hybrids (H)**			**Mean**
	Parsun-3	**Agura-4**	**Hysun-33**	
CON	43.0	45.7	43.7	44.1^{e}
FYM	45.7	50.0	48.0	47.9^{d}
PM	50.0	51.7	52.0	51.2^{c}
U	53.3	55.0	53.3	53.9^{b}
FYM 50%+U 50%	55.7	58.3	56.0	56.7^{a}
PM 50%+U 50%	56.7	58.7	57.3	57.6^{a}
Mean	50.7^{b}	53.2^{a}	51.7^{b}	
O, and I N fertilizers (150 kg N ha^{-1})	Hybrids			Mean
	Parsun-3	Agura-4	Hysun-33	
CON	62.0	65.0	63.3	63.4^{e}
FYM	65.0	68.0	67.0	66.7^{d}
PM	69.0	71.0	69.0	69.7^{c}
U	70.0	73.0	71.0	71.3^{b}
FYM 50%+U 50%	74.0	77.0	75.0	75.3^{a}
PM 50%+U 50%	75.0	77.7	75.7	76.1^{a}
Mean	69.2^{c}	71.9^{a}	70.2^{b}	

LSD ($P \leq 0.05$) value for fertilizers (F) = 1.49
LSD ($P \leq 0.05$) value for Hybrids (H) = 1.06
H X F = ns
LSD ($P \leq 0.05$) value for fertilizers (F) = 1.0
LSD ($P \leq 0.05$) value for Hybrids (H) = 0.7
H X F = ns
There is a considerable difference between means in the same category indicated by different letters.

4. Discussion

A statistical study of the data revealed that while organic and inorganic nitrogenous fertilizers had no discernible impact, sunflower hybrids had a considerable impact on days to emergence. Agura-4 sunflower hybrid developed faster from seed than Parsun-3 and Hysun-33. The genetic makeup, environmental conditions, and viability of the seeds could all contribute to these variations in germination. Our findings corroborate those of [10], who found that the number of days till emergence was considerably influenced by a number of sunflower hybrids. The amount of time till emergence was not significantly affected by nutrient fertilizers, either organic or inorganic. The seed may not be greatly affected by the external supply of nutrients since it uses its own stored food in the endosperm for growth and development until the plant becomes autotrophic. Sajjad et al. [11] reported that nitrogen availability had no effect on days till emergence.

Nitrogenous fertilizers significantly affected sunflower hybrid emergence m^{-2}, but there was no appreciable influence of the interaction between nitrogenous fertilizers and sunflower hybrids on emergence m-2, according to a study of the data on emergence m^{-2}. In comparison to other sunflower hybrids, hybrid Agura-4 had a higher emergence m-2 in the planted plots, whereas hybrid Parsun-3 displayed a lower emergence m-2. Poultry dung and urea applied together produced the highest emergence m-2 of all the nitrogenous fertilizer treatments when compared to other treatments. The plants and heads at the m-2 level were greatly impacted by the nitrogenous fertilizer treatment [12], signifying that appearance at the m-2 level was also compressed.

Table 3. Impact of nitrogenous sources, both organic and inorganic, on sunflower hybrids' leaf plant-1 and plan height (cm).

O, and I N fertilizers (150 kg N ha^{-1})	Hybrids (H)			Mean
	Parsun-3	Agura-4	Hysun-33	
CON	17.0	20.3	19.3	18.9
FYM	18.0	21.3	19.7	19.7
PM	18.7	22.3	19.7	20.2
U	19.0	21.7	20.7	20.4
FYM 50%+U 50%	19.3	21.7	21.7	20.9
PM 50%+U 50%	20.3	22.3	21.7	21.4
Mean	18.7^{b}	21.6^{a}	20.4^{a}	
O, and I N fertilizers (150 kg N ha^{-1})			Hybrids	Mean
	Parsun-3	Agura-4	Hysun-33	
CON	147.3	163.7	166.0	159.0^{d}
FYM	151.3	167.0	169.3	162.6^{c}
PM	153.0	172.0	171.0	165.3^{b}
U	155.0	172.7	173.0	166.9^{b}
FYM 50%+U 50%	155.7	175.0	176.3	169.0^{a}
PM 50%+U 50%	157.0	176.7	177.0	170.2^{a}
Mean	153.2^{b}	171.2^{a}	172.1^{a}	

LSD ($P \leq 0.05$) value for fertilizers (F) = ns
LSD ($P \leq 0.05$) value for Hybrids (H) = 1.9
H X F = ns
LSD ($P \leq 0.05$) value for fertilizers (F) = 2.0
LSD ($P \leq 0.05$) value for Hybrids (H) = 1.4
H X F = ns
There is a considerable difference between means in the same category indicated by different letters.

The number of days preceding star formation in sunflower hybrids was significantly impacted by both organic and inorganic nitrogenous fertilizers, although there was no significant interaction. The three stars having the longest time to star formation are Agura-4, Hysun-33, and Parsun-3. Wajid et al. [13] reported that there were significant differences in certain phenological events among the sunflower hybrids. The control plots had the shortest time to star formation, while the application of urea and poultry manure together required the longest amount of time. The physiological and metabolic functions of agricultural plants, as well as their growth during the vegetative and reproductive stages, are significantly influenced by nutrient management [14].

The results of the data's analysis of variance showed that there was no interaction between sunflower hybrids and nitrogenous sources; however, the plant height of the hybrids was considerably impacted by both organic and inorganic nitrogenous fertilizers. Agura-4 and Hysun-33, two hybrids of sunflowers, produced taller plants than Parsun-3, which produced shorter plants. Vast differences in plant height were noted among hybrid sunflowers [15]. Taller plants were observed in the poultry manure+urea and farmyard manure+urea combination treatments compared to the control plots. Plant height fluctuations could be caused by the single and combined application of organic and inorganic fertilizers. Sunflower plants grew taller when fertilized with both organic and inorganic fertilizers [16].

The number of days before flowering was considerably impacted by each treatment, according to the analysis of variance. Days until flowering did not appear to have any effect on the relationship either. Agura-4, a hybrid sunflower, took longer to bloom than Parsun-3 and Hysun-33. The plant's genetic potential could be the cause of the variation in the number of days till flowering. According to Wahid et al. [13], the hybrid sunflowers showed significant differences in a number of phenological events. The average number of days required for blooming was highest for the combinations of poultry manure plus urea and farmyard manure plus urea when compared to the other nitrogenous fertilizer treatments. Massignam et al. [17], claim that nutrition management had a major impact on the plant's physiological processes and phenological stages.

5. Conclusion

It is concluded that hybrid Agura-4 considerably increased yield and yield components among the various hybrids of sunflowers. Comparatively speaking, the performance of applying a combination of poultry manure and urea was superior than that of other nitrogenous fertilizers.

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Ethical Approval
All experimental techniques, including the handling and application of plants, were authorized by the Institutional Review Committee of the Biomedical Research, University of Agriculture Peshawar, Pakistan, and adhered to all applicable laws and regulations in the country.

Conflict of Interest
The current study's authors all certify that they have no competing interests, either financial or otherwise.

Availability of Data and Material
No other information is at this time available.

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Authorship contribution statement: The study's conceptualization, design, preparation of the materials, data collection, analysis, and paper writing were all done by the authors.

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