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ASSESSMENT OF SOIL FERTILITY BY APPLICATION OF FARMYARD MANURE IN SUNFLOWER (*HELIANTHUS ANNUS* L.) CROP IN TURBAT BALOCHISTAN

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A B S T R A C T

Sunflower is an important crop being grown worldwide. The experiment was carried out in the field in 2023 at the Research Farm Turbat Balochistan using a Randomized Complete Block Design (RCBD) with three replicates to assess the effects of various quantities of Farmyard manure (FYM) on sunflower. T1 = FYM = 0 kg/plot^{-1} (control), T2 = FYM = 20 kg/ plot^{-1}, T3 = FYM = 40 kg/ plot^{-1} and T4 = FYM = 60 kg/ plot^{-1} were the different treatments. It was observed that varied quantities of farmyard manure (FYM) significantly ($_P$ 0.05) affected sunflower growth and seed yield. Using T4 = FYM = 60 kg/ plot^{-1} to fertilize sunflowers produced plants measuring 18.54 m^2, 172.66 cm in height, 65.45 days to flowering, 56.33 centimeter in head diameter, 893.67 seeds per head, 54.55 g in seed weight, 85.05 g in seed index 1000 seed weight and 2212.3 kg in seed output per plot. The same is true for sunflower which was fertilized with T3 = FYM = 40 kg/ plot^{-1}, (16.87 m^2) plant population, 165.34 centimeter height of plant, 70.67 days to flower maturity, 53.66 centimeter head size, 840.38 seeds per head, 51.77 g seed weight per head, 81.45 g seed index per 1000 seeds and 200 kg seed yield per plot. T2 = FYM = 20 kg/ plot^{-1}, (15.67 m^2 plant population, 160.23 cm plant height, 75.87 days of flowering maturity, 49.34 centimeter head diameter, 780.66 seeds per head, 46.45 g seed weight per head, 72.27 g seed index per 1000 seeds and 1830.8 kg seed yield per plot are the parameters for the sunflower. T1 = FYM = 0 kg/ plot^{-1} resulted in (13.45 m^2) plants, (152.56 cm) plant height (80.67) days until flowering (45.15 cm) head diameter, (650.33) seeds per head, (40.66 g) seeds per head, (68.55 g) seeds per 1000 seeds, and (1650.5 kg) seed yield per plot. After reviewing the research data it was determined that rising amounts of farmyard manure (FYM) correlated with an increase in sunflower growth and production. The Sunflower fertilized with T_4 = FYM = 60 kg/ plot^{-1} resulted in highest. n conclusion, the assessment of soil fertility through the application of farmyard manure (FYM) in sunflower (Helianthus annuus L.) cultivation presents a holistic approach to sustainable agriculture.

Keywords: Farm Yard Manure (FYM); Organic Matter (OM); Sunflower (*Helianthus annuus* L.)

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INTRODUCTION

Sunflower (*Helianthus annuus* L.) plays an important part in Pakistan's oil seed crop and ranks third in terms of global edible oil output behind soybeans, peanuts, and other oilseed crops like canola and cotton (Thavaprakash et al., 2003). Sunflower oil is high in linoleic acid, which has many health benefits (Hashemi et al., 2015). It is a significant oilseed crop that does well in Pakistan's agricultural climate and farming practices (Kaleem et al., 2011). The sunflower represents an annual oilseed crop of a composite family. A type of oilseed with the quickest growth in Bharat is sunflower. Sunflowers cover the fourth-largest area in the planet (18.12 million acres) is in India. The nation's top producer of sunflowers is the state of Karnataka. It provides 43% of all production and more than 50% of all cropped land.

Sunflower is a vital oilseed crop with widespread global cultivation. It is not only a source of edible oil but also

provides raw material for various industrial applications. The success of sunflower cultivation heavily depends on the fertility status of the soil. FYM, a traditional and widely used organic amendment, contains a balanced mixture of organic matter, nutrients, and microorganisms that contribute to soil health (Devidayal and Agarwal, 1999; Sharma et al., 2008).

The second-largest state for sunflower production is Andhra Pradesh. Andhra Pradesh accounts for 34% of global sunflower production and about 25% of the overall sunflower area (Byrareddy et al., 2010). Due to its greater flexibility, potential for large yields, shorter duration, and profitability, the sunflower plant (*Helianthus annuus* L.) holds a lot of potential as an oil seed crop. Adaptability in the wild to many agroclimatic areas and soil types. Sunflower can be very helpful in addressing the country's deficit of edible oil because it plays a crucial part in contingency crop planning.

Soil fertility plays a pivotal role in agricultural productivity, influencing the growth and yield of crops. The sustainable management of soil fertility is essential for ensuring food security and promoting environmentally friendly farming practices. One effective method to enhance soil fertility is the application of organic amendments such as farmyard manure (FYM). This study focuses on the assessment of soil fertility in sunflower cultivation through the strategic application of FYM (Khan et al., 2010).

Due to the strain of a growing population, a high quality of life, and increasing demand from oil-using businesses, our nation is currently experiencing a severe scarcity of edible oil. Imports of edible oils help to partially meet this requirement. Farmyard manure is chosen for its ability to improve soil structure, water retention, and nutrient availability. The organic matter in FYM acts as a reservoir for essential nutrients, gradually releasing them to the plants. Additionally, the microbial community in FYM enhances soil health by promoting nutrient cycling and suppressing harmful pathogens (Adebayo et al., 2012).

To fulfill the rising demand from customers in such a situation, it is necessary to increase oil production self-sufficiency (Maheshbabu et al., 2010). To maintain the fertility of the soil, supply nutrients at the ideal level, and produce the highest crop yield possible with the lowest inputs, it is crucial to use nutrients from both chemical and natural forms of fertilizer in an integrated and balanced manner. Throughout the whole crop time, farmyard manure (FYM), which is a rich source of all the essential plant nutrients, maintains a constant flow of these nutrients, fostering higher growth rates and the achievement of yield qualities. The increased yields of seed and straw were a result of higher values of the growth and yield (Rasool et al., 2015).

The primary objective of this research is to evaluate the impact of farmyard manure application on soil fertility parameters in sunflower fields. This assessment will encompass various aspects, including changes in soil structure, nutrient content, microbial activity, and overall fertility. Understanding these dynamics is crucial for devising sustainable agricultural practices that optimize sunflower yield while minimizing environmental impact.

MATERIALS AND METHOD

Experimental design

A Randomized Complete Block Design (RCBD) with three replications was used to set up the experiment. The distribution of the various amounts of farmyard manure complied with the plan of the experiment. The experiment's four treatment combinations were randomly assigned into eight plots. The samples of soil and sunflower plants were taken at various phases from seeding through harvesting in year 2022. Samples of soil were collected from randomized plots. Samples were taken by using Auger in the different plots for laboratory analysis.

The experiment was conducted in 2022 in the CRD greenhouse at the Turbat Research Farm site in Balochistan. Three replications of the experiment were used in its Randomize Complete Block Design (RCBD) layout. The experiment's design was created to distribute the various levels of farmyard manure. The experiment's four treatment combinations were distributed randomly among 12 plots. Each unit plot is 1.5 m by 1.5 m (or 2.25 m^2) in size. Here is a presentation of the experiment field's layout. Treatment included T_1 = FYM = 0 kg $plot^{-1}$ (Control), T_2 = FYM = 20 kg $plot^{-1}$, T_3 = FYM = 40 kg $plot^{-1}$ and T_4= FYM = 60 kg $plot^{-1}$.

Data collection and analysis

After the collecting the aforementioned samples was completed at the laboratory for additional analysis to measure the soil's total organic carbon (TOC) (Walkley, 1947), organic matter , pH (McLean, 1983), electrical conductivity (Smith and Doran, 1997) and soil texture was analyzed by hydrometer method.

RESULTS

Physico-chemical properties of experiment soil

The soil texture was clay. The soil EC was recorded as 1.80 dS m^{-1}, pH was 7.4, organic matter 0.60%, total organic carbon 0.93, particulate organic carbon 0.90 and mineral

organic carbon 0.88, respectively (Table 1).

Plant population (m^{-2})

The results for the mean plant population of sunflowers (m^{-2}) as influenced by varied quantities of farmyard waste are shown in figure 1. The results proved the significant difference ($p<0.05$) in sunflower at various levels of Farmyard manure. The Farmyard manure 60 kg/ $plot^{-1}$ produced better with maximum plant population (m^{-2}) of (18.54), followed by Farmyard manure was applied 40 kg $plot^{-1}$ plant population (m^{-2}) of (16.87), While the lowest plant population (m^{-2}) of 13.45 was seen when farmyard manure of 0 kg $plot^{-1}$ (Control) was treated, a plant population (m^{-2}) of 15.67 was recorded where 20 kg $plot^{-1}$ of farmyard manure was applied (Figure 1).

Table 1. Evaluation of physico-chemical properties of experiment soil.

S. No	Soil properties		Values
1	Texture	Sand %	23.34
		Silt %	21.67
		Clay %	53.76
	Textural class		Clay
2	EC (dS m^{-1}) (1:2.5 Soil extract)		1.80
3	Ph		7.4
4	Organic matter (%)		0.60
5	Total organic carbon		0.93
6	Particulate organic carbon		0.90
7	Mineral organic carbon		0.88

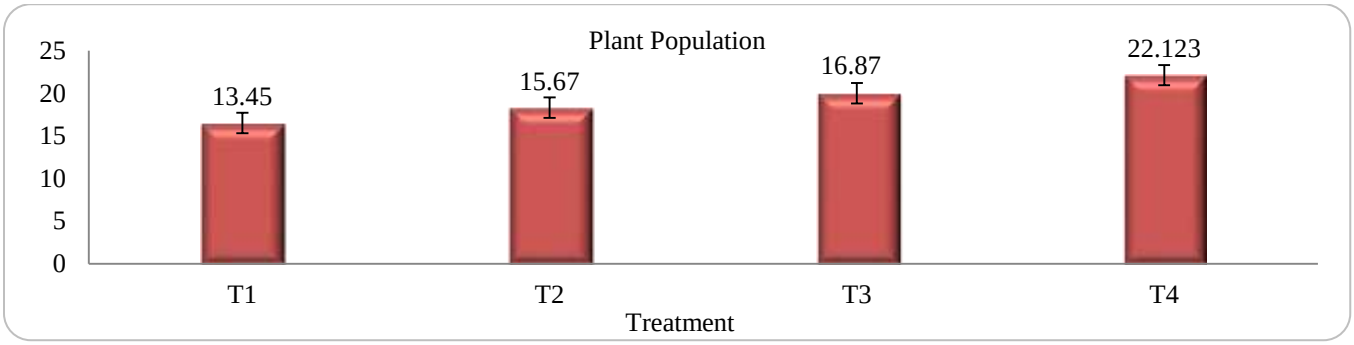

Figure 1. Plant population of sunflower crop under different application of farmyard manure.

Plant height (cm)

Figure 2 showed the various levels of FYM affected the observation of sunflower plant height (cm). The findings suggested that there were significant changes in the height of sunflower plants at different FYM doses (p 0.05). The maximum plant height (cm) was noted when FYM was applied 60 kg/ $plot^{-1}$ with (172.66 cm),followed by level of FYM 40 kg $plot^{-1}$ plant height (cm) with (165.34 cm), whereas the plant height (cm) (160.23 cm) was attained when Similar dosages of 20 kg $plot^{-1}$ FYM were used. However, after applying FYM at a rate of 0 kg $plot^{-1}$ (Control), the smallest plant height (152.56 cm) was observed (Figure 2).

Days to 1st flower

The results for the mean number of days until a sunflower blooms as influenced by different levels of farmyard manure are shown in Figure 3. The outcomes demonstrated a significant variation in sunflower at different quantities of farmyard manure (p 0.05). The Farmyard manure 0 kg $plot^{-1}$ produced better with maximum days taken to Days to 1st flower of (80.67), followed by Farmyard manure was applied 20 kg $plot^{-1}$ Days to 1st flower of (75.87), whereas Days to 1st flower of (70.67) was recorded where 40 kg $plot^{-1}$ of farmyard manure was applied, and the lowest Days to 1st flower of (65.45) was observed when Farmyard manure 60 kg $plot^{-1}$ was applied (Figure 3).

Seed yield (kg $plot^{-1}$)

The observation of sunflower seed yields as influenced by various levels of FYM. The findings revealed that there were significant differences in the sunflower seed output at different levels of FYM (p 0.05). The largest amount of sunflower seed production was recorded at 60 kg $plot^{-1}$ with a yield of (2212.3), followed by seed yields of (2000.5) kg

plot^{-1} and (1830.8) at 40 kg plot^{-1} and 20 kg plot^{-1} respectively. However when FYM was administered 0 kg plot^{-1} (control), the minimum seed yield (1650.5) was achieved (Figure 4).

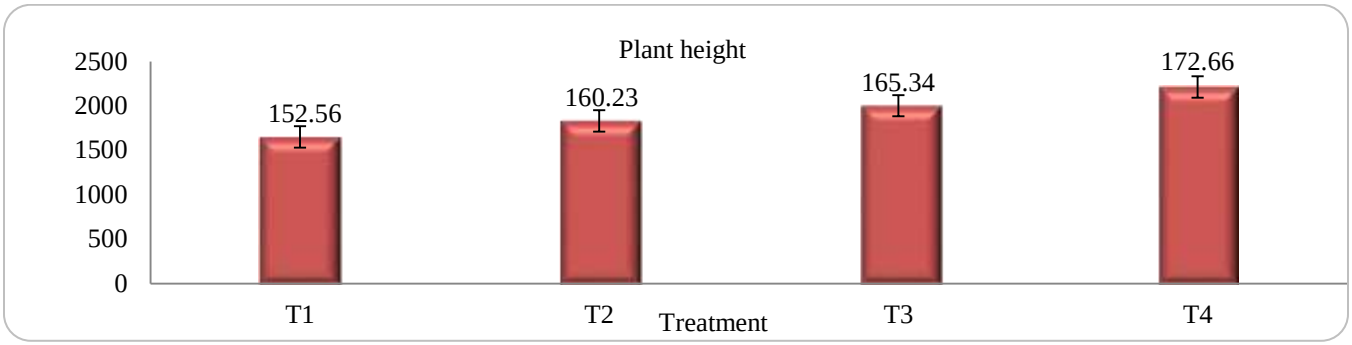

Figure 2. Plant height of sunflower crop under different application of farmyard manure.

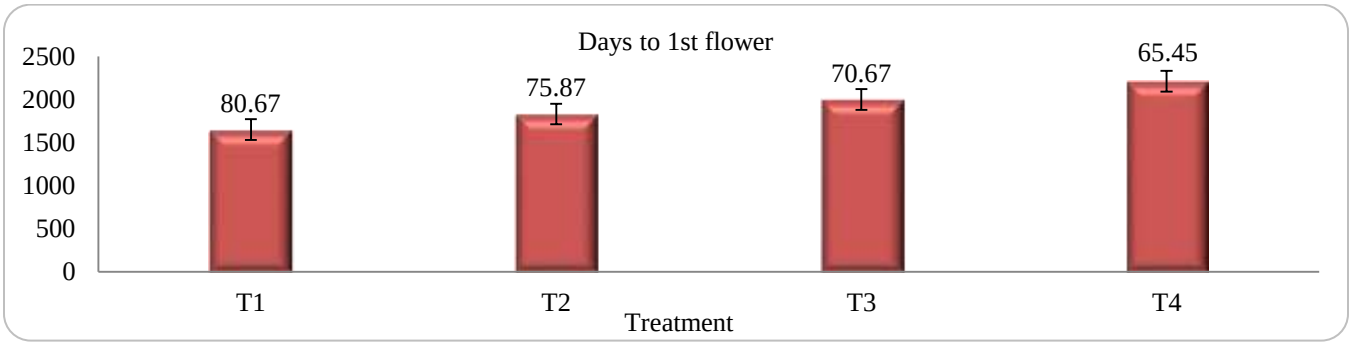

Figure 3. Days to 1st flower of sunflower crop under different application of farmyard manure.

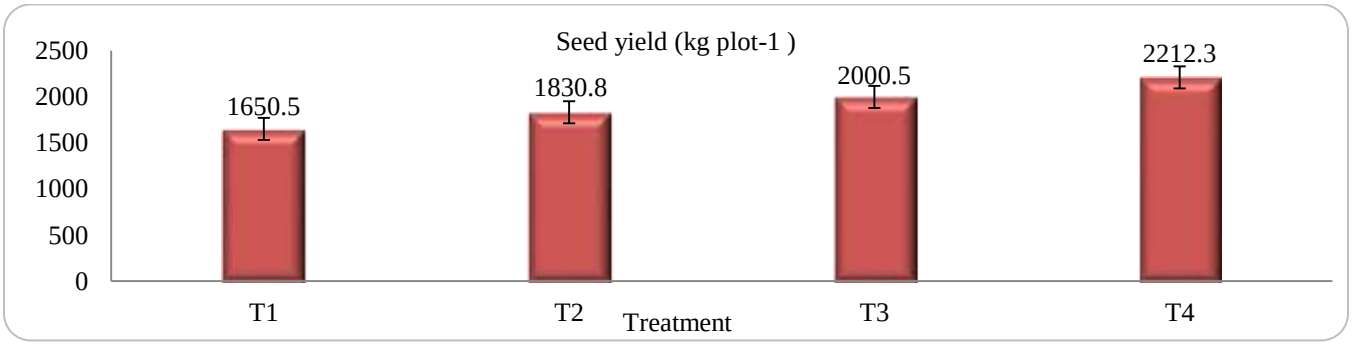

Figure 4. Sunflower seed yield (kg plot^{-1}) for various applications of farmyard manure.

Different quantities of farmyard manure (FYM) were observed to significantly (P 0.05) affect the growth and production of sunflower. Sunflower fertilized with T_4 = FYM = 60 kg plot^{-1} resulted with 18.54 m^2 plant population, 172.66 cm plant height, 65.45 days to flower maturity, 56.33 cm in diameter, 893.67 seeds per head, 54.55 g per head, 85.05 g per 1,000 seeds, and 2212.3 kg per head of seed. Similarly, Sunflower fertilized with T_3 = FYM = 40 kg plot^{-1} , 16.87 m^2 plant population, 165.34 cm plant height, 70.67 days to flower maturity, 840.38 seeds per head, 51.77 g of seed weight per head, 81.45 g of seed index per 1,000 seeds, and a head diameter of 53.66 cm resulted and seed yield of 2000.5 kg.

DISCUSSION

In comparison to the control, Farmyard manure (FYM) application considerably improved sunflower growth and production characteristics. When FYM was added the leaf area index likewise exhibited an upward trend. In addition to supplying both macro and micronutrients. FYM also

increases the accessibility of additional organic nutrients favorably affecting the number of leaves a plant produces and increasing the photosynthetic surface enhancing the leaf area index. Byrareddy et al. (2010) discovered that FYM treatment at 8 tonnes ha^{-1} resulted in higher plants with more leaves per plant compared to no FYM addition. Dry material formation a crucial growth characteristic appears to significantly rise with FYM treatments above control despite the use of FYM at 10 or 20 t ha^{-1} being equivalent. Goober gas slurry outperformed all the other sources in terms of producing a much greater seed yield (Iqbal et al., 2023; Sadiq et al., 2023).

The application of FYM in sunflower cultivation not only holds agronomic benefits but also has positive environmental implications. By reducing dependence on synthetic fertilizers, FYM contributes to sustainable farming practices. The organic nature of FYM also promotes soil carbon sequestration, aligning with broader environmental goals. Balancing agronomic gains with environmental sustainability underscores the importance of adopting practices that integrate FYM into sunflower cultivation strategies (Laghari et al., 2023).

The application of FYM in sunflower cultivation goes beyond nutrient provision; it plays a pivotal role in enhancing overall soil fertility. FYM improves soil structure, leading to better water infiltration and root development. Additionally, the organic matter in FYM serves as a substrate for beneficial microorganisms, fostering soil health. The positive impact of FYM on soil fertility parameters, such as increased cation exchange capacity and nutrient availability, has been well-documented in scientific literature (Mallick and Majumder, 2023). The Sunflower receiving T2 = FYM = 20 kg plot-1, 15.67 m2 plant population, 160.23 cm plant height, 75.87 days to flower maturity, 49.34 cm in head diameter, 780.66 seeds per head, 46.45 g per head of seed, 72.27 g per 1000-seed weight, and 1830.8 kg per plot of seed. T1 = FYM = 0 kg plot-1 (control) resulted with 13.45 m2 plant population, 152.56 cm plant height, 80.67 days to flower maturity, 650.33 seeds per head, 40.66 g of seed weight per head, 68.55 g of seed index per 1,000 seeds, and a head diameter of 45.15 cm result in a plot seed yield of 1650.5 kg. The results are similar with the previous studies by Mallick and Majumder (2023).

It is possible to attribute the increase in growth and yield-attributing characteristics for the favorable response of seed yield to organic manures. In addition, goober gas slurry appears to be superior to cell rich and farmyard manure for improving yield on an equal nitrate base because it consists of higher levels of nutrients and has improved physical conditions after drying which makes it simple to be separated finely and mixed with soil particles. Less carbon molecules are present in the employed digested slurry due to an increase in mineralization which improves nitrogen availability and hastens the nutrient release process. The results of Laura and Idnani (1972) and Udayasoorian et al. (1993). Interpreted results having similarities with this manuscript result.

The assessment of soil fertility through the application of farmyard manure in sunflower cultivation is a multifaceted endeavor. As evidenced by scientific studies, the judicious use of FYM positively influences soil properties, nutrient availability, and overall crop performance. Integrating soil fertility assessment methods with the application of FYM emerges as a sustainable approach for sunflower cultivation. Current study highlights the importance of understanding nutrient dynamics, emphasizing the role of FYM in sustainable agriculture, and providing practical recommendations for farmers to enhance soil fertility and sunflower yield (Mokhtari et al., 2022; Oueriemmi et al., 2021).

CONCLUSION

The integration of soil fertility assessment and FYM application in sunflower cultivation represents a synergistic approach towards achieving agricultural sustainability. Acknowledging the dynamic relationship between soil health, organic amendments, and crop productivity it will be crucial for fostering resilient and environmentally conscious farming practices in the cultivation of sunflower and other crops.

CONFLICT OF INTEREST

All authors have declared that there is no conflict of interest regarding publication of this article.

AUTHOR'S CONTRIBUTION

The writing of this article was assisted and helped by all authors.

REFERENCES

Adebayo, A., Akintoye, H., Aina, O., Olatunji, M., Shokalu, A., 2012. Assessment of organic amendments on growth and flower yield of sunflower (*Helianthus annus*). Libyan Agricultural Research Centre Journal International 3, 24-29.

Byrareddy, B., Uppar, D., Vyakarnahal, B., Hiremath, S., Hunje, R., Nadaf, H., 2010. Effect of integrated nutrient management on sunflower hybrid (KBSH-I) seed production. Karnataka Journal of Agricultural

Sciences 21, 171-175.

Devidayal, D., Agarwal, S., 1999. Response of sunflower genotypes (*Helianthus annuus*) to nutrient management. The Indian Journal of Agricultural Sciences 69, 23-39.

Hashemi, S.M.B., Khaneghah, A.M., Tavakolpour, Y., Asnaashari, M., Mehr, H.M., 2015. Effects of ultrasound treatment, UV irradiation and Avishan-e-Denaei essential oil on oxidative stability of sunflower oil. Journal of Essential Oil Bearing Plants 18, 1083-1092.

Iqbal, A., Iqbal, M.A., Akram, I., Saleem, M.A., Abbas, R.N., Alqahtani, M.D., Ahmed, R., Rahim, J., 2023. Phytohormones promote the growth, pigment biosynthesis and productivity of green gram [*Vigna radiata* (L.) R. Wilczek]. Sustainability 15, 9548.

Kaleem, S., Hassan, F., Mahmood, I., Ahmad, M., Ullah, R., Ahmad, M., 2011. Response of sunflower to environmental disparity. Nature and Science 9, 73-81.

Khan, N.I., Malik, A.U., Umer, F., Bodla, M.I., 2010. Effect of tillage and farm yard manure on physical properties of soil. International Research Journal of Plant Science 1, 75-82.

Laghari, R., Laghari, G.M., Kaleri, A.A., Manzoor, D., Lund, M.M., Awan, M.H., Sheikh, Z.A., Soomro, M.K., Soomro, M.M., Solangi, S., 2023. Growth and yield of sunflower under the integrated farmyard manure and potassium fertilization: Growth and yield of sunflower. Futuristic Biotechnology 14, 20-25.

Laura, R., Idnani, M., 1972. Effect on wheat yield and nitrogen uptake from manures made from spent-slurry. Plant and Soil 37, 283-295.

Maheshbabu, H., Hunje, R., Biradarpatil, N., Bablad, H., 2010. Effect of organic manures on plant growth, seed yield and quality of soybean. Karnataka Journal of Agricultural Sciences 21, 219-221.

Mallick, R., Majumder, K., 2023. Integrated nutrient management in sunflower (*Helianthus annuus* L.). Indian Journal of Agricultural Research 57, 47-51.

McLean, E., 1983. Soil pH and lime requirement. Methods of Soil Analysis: Chemical and Microbiological Properties 9, 199-224.

Mokhtari, N.E.P., Kızılgeçi, F., Ahmed, R., Iqbal, M.A., 2022. Exploring zinc and boron chemo-priming effects on low-vigour seed germination and seedling establishment of sunflower (*Helianthus annuus* L.). Turkish Journal of Agriculture-Food Science and Technology 10, 1966-1971.

Nelson, D., Somers, L., 1982. Methods of Soil Analysis, Part 2: Chemical and Microbial Properties. American Society Agronomy, Inc. and SSSA, Inc., Madison Wis, USA.

Oueriemmi, H., Kidd, P.S., Trasar-Cepeda, C., Rodríguez-Garrido, B., Zoghlami, R.I., Ardhaoui, K., Prieto-Fernández, Á., Moussa, M., 2021. Evaluation of composted organic wastes and farmyard manure for improving fertility of poor sandy soils in arid regions. Agriculture 11, 415.

Rasool, S., Mian Inayatullah, M.A., Ali, M., Ali, S., Rizvi, S.A.H., Hyder, S., Begum, F., Raza, G., Ali, K., 2015. Taxonomic study of mosquitoes (*Culicidae*: Diptera) of district Narowal, Punjab-Pakistan. Journal of Biodiversity and Environmental Science 6, 368-373.

Sadiq, M., Rahim, N., Iqbal, M.A., Alqahtani, M.D., Tahir, M.M., Majeed, A., Ahmed, R., 2023. Rhizobia inoculation supplemented with nitrogen fertilization enhances root nodulation, productivity, and nitrogen dynamics in soil and black gram (*Vigna mungo* (L.) Hepper). Land 12, 1434.

Sharma, K., Neelaveni, K., Katyal, J., Srinivasa Raju, A., Srinivas, K., Kusuma Grace, J., Madhavi, M., 2008. Effect of combined use of organic and inorganic sources of nutrients on sunflower yield, soil fertility, and overall soil quality in rainfed Alfisol. Communications in Soil Science and Plant Analysis 39, 1791-1831.

Smith, J.L., Doran, J.W., 1997. Measurement and use of pH and electrical conductivity for soil quality analysis. Methods for Assessing Soil Quality 49, 169-185.

Thavaprakash, N., Senthilkumar, G., Sivakumar, S., Raju, M., 2003. Photosynthetic attributes and seed yield of sunflower (*Helianthus annuus* L.) as influenced by different levels and ratios of nitrogen and phosphorus fertilizers. Acta Agronomica Hungarica 51, 149-155.

Udayasoorian, C., Balamurugan, P., Muthuvel, P., 1993. Direct and residual effect of FYM and NPK levels on sunflower. Agricultural Journal Science 5, 207-209.

Walkley, A., 1947. A critical examination of a rapid method for determining organic carbon in soils-effect of variations in digestion conditions and of inorganic soil constituents. Soil Science 63, 251-264.