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The Potential Yield of Sunflowers on Coastal Land with Several Dosages of Mycorrhizae and Chicken Manure Fertilizer

Obel*
Universitas Andalas
Jl. Limau Manis, Pauh, Padang City, West Sumatra 25175, Indonesia
*Email: owbel@agr.unand.ac.id

ABSTRACT

Sunflower (*Helianthus annuus* L) is one of the best sources of vegetable oil because of the high quality of the oil. This plant is a leading commodity that has the potential to be developed because, from an economic point of view, it has various benefits as a food ingredient, raw material industry, raw materials, and medicines raw materials for beauty products. Today's sunflower development is more diverted to marginal lands. One of them is the use of coastal areas, which have various economic and technical problems. For this reason, it is necessary to implement innovations that can support sunflower cultivation in coastal areas. One of them is by applying mycorrhiza and adding chicken manure. This study aims to determine the effect of mycorrhiza and chicken manure doses on sunflower yields in coastal areas. This research was conducted using a randomized block design consisting of two factors: mycorrhiza and chicken manure, which were repeated three times. The results showed that mycorrhiza and chicken manure could increase the components of several characteristics and sunflower yields in coastal areas.

Keywords : *sunflower, yield, beach areas, mycorrhiza, chicken manure*

1. INTRODUCTION

Sunflower (*Helianthus annuus*) is one of the best vegetable oil sources because of its high quality. According to Lakshman et al. l 2021, the linoleic acid content in sunflowers ranges from 55-70% and around 35-42%, and there is an oil content in the seeds, which are unsaturated fatty acids with a high concentration. In addition, Katja (2012) explained that sunflower seed oil has a high nutritional quality among other vegetable oils. This plant is a leading commodity that has the potential to be developed because, from an economic point of view, it has various benefits as a food ingredient, raw material industry, raw materials, and medicines raw materials for beauty products.

Currently, the development of sunflowers is more diverted to marginal lands because there is still a large amount of available marginal land potential. Still, it needs to be managed properly in Indonesia. One of them is the utilization of coastal areas with various economic and technical problems. However, multiple studies have been conducted, such as research by Obel et al. (2022), which provides information that sunflowers can be developed on coastal lands even though their growth and yields could be more optimal. Yasin and Singh (2010) revealed that the product is the most economical for almost all plants and is highly influenced by environmental factors. For this reason, it is necessary to implement innovations that can support sunflower cultivation in coastal areas. One of them is by applying mycorrhiza and adding chicken manure.

Applying mycorrhiza to plants will form a collaboration between a type of fungus, soil, and plant roots which can provide nutrients for plants, improve soil structure, and potentially increase plant tolerance to unfavorable conditions. Kurnia et al. (2019), Symbiotic associations between mycorrhizae and plant roots are found in many natural environments and can generate various benefits for host plants. This happens because the hyphae owned by AMF can expand the surface for nutrient and water absorption (Wardhika et al., 2015).

In addition, to maximize mycorrhizal performance, adding another source of nutrients, namely chicken manure, is necessary so that soil fertility is maintained and micro and macro nutrients are sufficient for plants. Chicken manure contains three times more nitrogen (N) than other manures and a relatively high phosphorus (P) content. Namely 2.6% (N), 2.9% (P), and 3.4% (K), with a C/N ratio of 8.3 (Sutedjo, 2002). The results of Farida and Chozin's research (2015) showed that the higher the chicken manure dose, the more corn plant growth and production would increase. This result is also following the results of research by Zega and Telaumbanua (2022), which stated that using chicken manure can help increase the growth of tomato plants.

2. MATERIAL AND METHODS

2.1 Place and Time of Research

The research was conducted in August - November 2020 2 in Ampang Pulai, District of Koto XI Tarusan, Pesisir Selatan District West Sumatra Province

2.2 Materials and Tools

The materials used in this study were sunflower seeds, chicken manure, mycorrhiza, pearl NPK fertilizer, and chemical pesticides. In contrast, the tools used are digital scales, rulers, hoops,

hoes, knives, cords, sickles, scissors, raffia rope, cameras, stationery, plastic bags, paper bags (envelopes), wooden stakes, plastic sacks, label paper, meter, shovel, machete, paper, and permanent marker.

2.3 Research Design

factorial randomized block design. Factor I mycorrhizal doses were A1 = 0 g/plant, A2 = 5 g/plant, A3 = 10 g/plant and A4 = 15 g/plant. While Factor II is the dose of chicken manure, namely K1 = 0 g/plant, K2 = 10 g/plant, K3 = 20 g/plant, and K4 = 30 g/plant. Each treatment was repeated three times. The research data obtained were analyzed using the F-test method at a 5% level, followed by DNMRT at a 5% level.

2.4 Research Implementation

Sunflower seeds are sown first in a nursery tub which already contains planting media in the form of a mixture of manure, soil, and husk charcoal with a ratio of 1:1:1. The seeds are then stored in a shaded place, waiting to be moved for about three weeks after sowing. Next, the soil is tilled by hoeing and leveling. After that, chicken manure was applied, and mycorrhiza according to treatment. After one week, planting is carried out by inserting one sunflower seed in each planting hole that was previously made. The maintenance is replanting until seven weeks dap, weeding at 15 daps, watering, fertilizing, and pest control.

5. Observation Parameters

Parameter The observed growth included the percentage of time of complete blooming, tube flower diameter, ribbon flower diameter, total seed planting, and weight of 100 seeds.

3. RESULTS AND DISCUSSION

3.1 Time of Perfect Bloom (HST)

Based on statistical data, it was found that the application of mycorrhiza and chicken manure showed no interaction with the time of full bloom. Observational data can be seen in Table 1.

Table 1. The average time of perfect blooming days after planting (HST)

		Chicken Manure (g/plant)				Average
		0	10	20	30	
		---------- HST ----------				
mycorrhiza (g/plant)	0	73.67	73.33	73.33	73.00	73.33 $_{a}$
	5	73.33	73.00	72.67	72.67	72.92 $_{ab}$
	10	72.00	72.67	71.33	72.67	72.17b
	15	70.33	72.33	69.67	70.67	70.75c
Average		72.33 $_{a}$	72.83 $_{a}$	71.75 $_{b}$	72.25a	

The numbers followed by the same lowercase letter according to the column and row were not significantly different according to the DNMRT follow-up test at the level of 5%

The application of mycorrhiza has a real influence on the time of full bloom. The higher the dose of mycorrhiza applied, the less time it takes for the sunflower to bloom, as shown in Table 1. This result is because mycorrhizae can provide conditions that suit the needs of sunflowers. These conditions can be in the form of adequate water availability and sufficient nutrients so that flower development occurs more quickly. Mycorrhizal fungi can increase nitrogen (N) and potassium (K) uptake (Musfal, 2010). Astiko et al. (2012) added that applying mycorrhiza and manure can increase the concentration of N, P, and K

and thus increase nutrient uptake, growth, and plant yields.

Furthermore, Idhan and Nurjamsi (2016) also explained that mycorrhizae can increase the uptake of nutrients N, P, and K when in symbiosis with plant roots. The results of research on legumes showed that the administration of mycorrhiza could increase the absorption of microelements Cu and Zn as well as sufficient absorption of water and nutrients by plants causing better plant growth (Sastrahidayat, 2011). In addition, in tomato plants, mycorrhizal administration can increase the number of tomato flowers/plants by an average of 16.5 buds compared to those without mycorrhizae, which only amounts to 14 buds (Gunadi & Subhan, 2007).

3.2 Diameter of Flower Tube (mm)

Based on statistical data, it was found that the application of mycorrhiza and chicken manure showed no interaction with sunflower diameter. The diameter of sunflowers ranges from 176.83 mm to 179.50 mm. Observational data can be seen in Table 2.

Table 2. The average diameter of sunflower tube flowers at the age of 7 WAP

		Chicken Manure (g/tan)				Average
		0	10	20	30	
		---------- mm ----------				
mycorrhiza (g/tan)	0	176.83	177.07	178.40	178.73	177.76b
	5	176.90	177.50	179.07	178.87	178.08b
	10	178.23	179.17	179.50	179.23	179.03 a
	15	177.57	179.17	179.50	178.90	178.78 ab
Average		177.38b	178.23 ab	179.12a	178.93 a	

The numbers followed by the same lowercase letter according to the column and row were not significantly different according to the DNMRT follow-up test at the level of 5%

Table 2 shows that the application of mycorrhiza and chicken manure did not show a significant interaction between the two. This result is due to the ability of the plant itself to grow in the environment. A favorable environment will provide a container for mycorrhiza and plants to associate well, but on the other hand, it will be unfavorable so that the response to plants is not visible. Hajoeningtijas (2009) has stated that mycorrhiza can be associated with almost 90% of plant species. Each type of plant can also be associated with one or more. However, not all plants can give a positive growth response to mycorrhizal inoculation; this depends on the plant's " *mycorrhizal dependency* " of the plant. The more roots that are infected, the greater the absorption rate of nutrients, especially in nutrient-poor soils (Farida & Chozin, 2015). Furthermore, Fitriatin et al. (2014) added that the application of mycorrhiza provides great benefits for soil fertility in the long term.

In addition, Setiadi (2007) revealed that plant dependence on mycorrhizae is the relative level where plants depend on the presence of mycorrhizal fungi to achieve maximum growth at a certain level of soil fertility. Arbuscular mycorrhizal fungi form favorable associations with more than 80 % of the recorded land plant species (Abobaker et al., 2018). Hajoeningtijas (2009) further added that the plant response is determined by the characteristics of the plants and fungi and the soil conditions where the experiment was carried out.

3.3 Ribbon Flower Diameter (mm)

Based on statistical data, it was found that the application of mycorrhiza and

chicken manure showed no interaction with the diameter of the ribbon flower. The diameter of the sunflower ribbon varies from 15.03 mm to 15.97 mm. Observational data can be seen in Table 3.

Table 3. The average diameter of sunflower tube flowers at the age of 7 WAP

		Chicken Manure (g/tan)				Average
		0	10	20	30	
		---------- mm ----------				----------
mycorrhiza (g/tan)	0	15.03	15.27	15.47	15.33	15.28 b
	5	15.37	15.60	15.93	15.40	15.58 ab
	10	15.80	16.00	15.93	15.97	15.93 a
	15	15.80	15.90	15.93	15.97	15.90 a
Average		15.50b	15.69 ab	15.82a	15.67 ab	

The numbers followed by the same lowercase letter according to the column and row were not significantly different according to the DNMRT follow-up test at the level of 5%

Table 3 shows that mycorrhiza and chicken manure applied at several doses did not have a significant interaction with the diameter of the sunflower tube flower. The diameter of the ribbon flower visually did not differ from one another according to the measurement data. This result is due to the characteristics of the ribbon flowers that are owned by these sunflower varieties. Each variety displays different phenology depending on its suitability for its growing environment so that the treatment does not have too much effect on these changes. Trustinah (2015) explained that genetic and environmental factors and the interaction between the two influence plant performance. The environment can be defined as the combination of all non-genetic variables that influence genotypic expression, including location, season, and crop management. Plant performance or results that are inconsistent with environmental changes are an indication of genotype interaction with the environment. Lakshman et al. (2021) added that environmental and genotypic factors influenced several expressions of sunflower characters, although genotypic factors predominated.

3.4 Total Seeds Planted (seeds)

Based on statistical data, it was found that the application of mycorrhiza and chicken manure showed no interaction with total sunflower seed planting. The greater the dose of mycorrhiza applied, the more total seeds produced, and vice versa; the higher the dose of chicken manure will increase the total number of seeds produced. Observational data can be seen in Table 4.

Table 4. Total sunflower seeds planted

		Chicken Manure (g/plant)				Average
		0	10	20	30	
		----------seed ----------				----------
mycorrhiza (g/plant)	0	1088.00	1090.67	1043.00	1124.67	1086.58b
	5	1110.00	1118.67	1096.33	1128.00	1113.25b
	10	1096.67	1115.33	1105.00	1144.67	1115.42b
	15	1130.00	1173.33	1183.67	1194.67	1170.42a
Average		1106.17b	1124.50ab	1107.00b	1148.00a	

The numbers followed by the same lowercase letter according to the column and row were not significantly different according to the DNMRT follow-up test at the level of 5%

Applying mycorrhizae at different doses gave different results to the total sunflower seed planting. Without mycorrhizal administration, the total number of seeds was only about 1086.58, and it increased with the addition of mycorrhizal doses. This result is because mycorrhizae play a role in providing the nutrients plants need in their development. In addition, mycorrhizae can help the availability of sufficient water in the soil for plants so that the nutrient absorption process will run smoothly. This result follows the statement of Rungkat (2009), which states that mycorrhizal plants usually grow better than non-mycorrhizal plants.

Furthermore, Nurmala (2014) explained that mycorrhizal plants can increase water absorption and nutrients by extending root reach to stimulate better plant growth. Based on the research results of Khairuna et al. (2015) in increasing soil fertility, AMF, which is symbiotic with plant roots, will produce secretions in the form of acid phosphatase and organic acids, which function to chelate Al metal to form insoluble Al organic compounds, thereby reducing the solubility of Al ions, reducing the concentration of Al-dd in acid soils and raises soil pH. Furthermore, from the activity of the phosphatase enzymes produced by AMF, it functions to release P bonds from organic complexes to increase the P available to plants (Sutariati et al., 2014).

In addition, the application of chicken manure also affects the total planting of seeds produced. Higher doses give higher results even though there is stagnation at the increase. This result is because the presence of chicken manure in excessive amounts or not according to the dosage will not be absorbed or used optimally by the plant itself. Besides adding nutrients to the soil, chicken manure can also increase humus, improve soil structure and encourage the life of soil microorganisms. As we know, chicken manure contains a high level of N, which inhibits other elements from being used by plants. According to Yulianingsih (2018), excess nitrogen will decrease boron absorption in plants, and a lack of boron will cause inhibition of fruit formation and the development of porous plant roots and stems.

3.5 Weight of 100 Seeds (g)

Applying mycorrhiza and chicken manure showed no interaction with the weight of 100 sunflower seeds. The greater the dose of mycorrhiza applied, the heavier the 100 seeds produced, and vice versa, the higher the dose of chicken manure applied will increase the weight of the 100 seeds produced. Observational data can be seen in Table 5.

Table 5. Weight of 100 sunflower seeds

		Chicken Manure (g/plant)				Average
		0	10	20	30	
		---------- gr ----------				
mycorrhiza (g/plant)	0	3.56	3.97	3.86	3.98	3.84 b
	5	3.64	3.95	3.96	3.99	3.88 b
	10	3.71	3.85	3.96	3.98	3.88 b
	15	3.94	3.96	3.96	3.98	3.96a
Average		3.71 b	3.93 a	3.94 a	3.98a	

The numbers followed by the same lowercase letter according to the column and row were not significantly different according to the DNMRT follow-up test at the level of 5%.

Table 5 shows that mycorrhiza can increase the weight of 100 sunflower seeds and vice versa for the application of chicken manure. However, the two treatments did not provide a real interaction. This result is because the applied mycorrhiza can cause competition, so the results are also not visible. This result is explained by Suherman et al. (2015) that giving too little FMA (low FMA work) or too much FMA can cause competition between FMAs, so the results obtained are not optimal. Masfufah et al. (2016) revealed that FMA root infection reaches its maximum limit if FMA is inoculated at certain doses. The infection rate of FMA roots will decrease if the dose of FMA given to the treatment is too high because the mycorrhizal aggregation that is too high will compete interspecifically to obtain energy from the host plant. In addition, Nurhayati (2012) stated that different types of plants will show different reactions to mycorrhizal infections, thereby affecting the development of infection and colonization of mycorrhizal fungi.

The application of chicken manure also increases the weight of the seeds produced, although the weight of 100 seeds is low. This result is because it depends on the ability of each variety to interact with the existing environment. Yasin and Singh (2010) revealed that yield is the most economical for almost all plants and is highly influenced by environmental factors. The nutrients provided are sometimes sufficient and unavailable due to several influencing factors, so plants cannot use them optimally. Venkateswarlu and Visperas (1987) said that differences in seed filling caused the difference in yield between varieties due to the supply of assimilated to the seeds by different *sink* and *source strength conditions.*

This condition may also be influenced by the slower response of plants to organic fertilizers because organic fertilizers are slow release or the process of decomposing nutrients is slow. In addition, immature organic matter (high C/N) is also considered detrimental because if it is applied directly to the soil, it is attacked by microbial bacteria and fungi to obtain energy. So that a high microbial population also requires plant nutrients to grow and reproduce. Nutrients that plants should use change to be used by microbes so that there is competition for existing nutrients which often causes symptoms of deficiency; the more organic matter is given to the soil,

the higher the population that attacks it, the more nutrients are immobilized. However, when the microbes die, they will experience decomposition of the immobilized nutrients and become available again**.**

4. CONCLUSION

Based on the results obtained, applying mycorrhiza and chicken manure can increase the components of several characteristics and sunflower yields in coastal areas. There was an increase in yield with increasing doses applied.

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