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The Effect Of Combination Of Granular Organic Fertilizer (Gof) And An Organic Fertilizer On Maize Growth And Production

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ABSTRACT

Continous use of inorganic fertilizer causes a negative impact on soil production. Efforts to reduce the high dependence of farmers on the cheapest inorganic fertilizers are the addition of organic fertilizers. The purpose of this study was to determine the effect of the use of organic fertilizer in granular form (GOF) combined with inorganic fertilizer on the growth and yield of maize. The study was conducted in Garang Tiga Village, Simbang District, Maros Regency, South Sulawesi, in November 2018-February 2019 using a Randomized Block Design with 4 replications. The treatments consisted of without fertilization (as control), Urea 400 kg ha-$^{-1}$+SP-36 100 kg ha^{-1}+KCl 50 kg ha^{-1} (based on recommendations), GOF 100 kg ha^{-1}, Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl 37.5 kg ha^{-1} + GOF 50 kg ha^{-1}, Urea 300 kg ha-1 + SP-36 75 kg ha $^{-1}$ + KCl 37.5 kg ha^{-1} + GOF 100 kg ha^{-1}, Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl 37.5 kg ha^{-1} + GOF 150 kg ha $^{-1}$, and Urea 400 kg ha^{-1} + SP-36 100 kg ha^{-1} + KCl 50 kg ha^{-1} + GOF 100 kg ha^{-1}. The results showed that the combination of GOF with inorganic fertilizers could increase plant growth and maize yields. The optimum dose was achieved at Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl 37,5 kg ha^{-1} + GOF 100 kg ha^{-1} and yielded 8.05 tons of shelled corn ha^{-1} with an IBCR ratio of 2,30.

Keywords: Granular Organic Fertilizer (GOF), inorganic fertilizer, maize growth, and yield

INTRODUCTION

Corn is a cereal commodity that has high economic value. The role of corn other than as food and feed, is now widely used as energy and other industrial raw materials whose needs continue to increase every year. Therefore, the opportunity to increase domestic corn production is still wide open, both through increasing productivity and expanding the planting area (BPS, 2018).

Recently, the market demand for corn continues to increase, but this high demand is not matched by its availability, resulting in the demand being unfulfilled. Thus, efforts to improve the quality and quantity of results while maintaining environmental sustainability are very necessary. Agricultural businesses that rely on chemicals such as inorganic fertilizers and chemical pesticides that have been carried out in the past and continue to the present have caused many negative and detrimental impacts, not only on humans but also on the environment and all living things. Another negative impact that can be caused by chemical agriculture is the contamination of agricultural products by chemicals which in turn will have a negative impact on health (Novriani, 2010).

Realizing this, efforts are needed to eliminate or at least reduce chemical contamination into the human body and the environment. It is difficult to return to a natural farming system under conditions of abundant population and limited land holdings. Therefore, alternative farming systems

that are sustainable and environmentally friendly are needed. One of these alternatives is an organic farming system which refers to natural systems, but requires the help of biotechnology. Organic matter is a source of nutrients needed for plant growth. The addition of organic matter from several sources such as manure, green manure, plant residue compost, and industrial residue can improve the physical status of the soil (Tejada and Gonzales, 2007); Premsekhar and Rajashree, 2009; Efthimiadou et al, 2010; Farhad et al, 2011; Adamu and Leye, 2012; Akongwubel et al., 2012; Javed et al., 2013; Okon, 2013).

Organic fertilizers can improve soil physical properties through the formation of stable soil structures and aggregates and are closely related to the ability of the soil to bind water, water infiltration, reduce the risk of erosion, increase ion exchange capacity and as a soil temperature regulator, all of which have a good effect on plant growth. Minardi, et al., 2011). Sources of organic fertilizers are very diverse, the remains (waste) in the form of garbage is one alternative that is quite prospective to be used on agricultural land. The increase in population will result in the number of needs will also increase, which in turn will produce an abundance of waste. This waste needs attention and management because it can cause environmental pollution (Tambunan, et al., 2011).

Currently, organic fertilizers both in the form of solid (FOS) and liquid organic fertilizers (LOF) have been widely produced by fertilizer manufacturers and circulated in the community, including solid organic fertilizers in the form of granules. According to Syukur, et al., (2014), one of the functions of fertilizer is to add nutrients in the soil in the form that is available. This means that the added fertilizer must be absorbed by plants. According to Marsono and Sigit (2005) for soil physical properties, fertilizer plays a role in balancing soil conditions so that there is an increase in soil porosity and aeration. The purpose of this study was to determine the effect of the use of organic fertilizer in granular form combined with inorganic fertilizer on the growth and yield of maize.

MATERIALS AND METHODS

The research was conducted in Garang Tiga Village, Simbang District, Maros Regency, South Sulawesi, in November 2018-February 2019. The research location is located at coordinates 5 00' South Latitude and 119 30” East Longitude, with an altitude of 15-350 m above sea level. with an average rainfall of about 347 mm/month.

The study used a Randomized Block Design (RAK) with seven treatments and was repeated four times. The treatments studied were as follows:

P1 = withhout fertilizer (control)

P2 = Urea 400 kg ha^{-1} + SP-36 100 kg ha^{-1} + KCl 50 kg ha^{-1} (based on rekommendation)

P3 = GOF 100 kg ha^{-1}

P4 = Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl 37,5 kg ha^{-1} + GOF 50 kg ha^{-1}

P5 = Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl 37,5 kg ha^{-1} + GOF 100 kg ha^{-1}

P6 = Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl 37,5 kg ha^{-1} + GOF 150 kg ha^{-1}

P7 = Urea 400 kg ha^{-1} + SP-36 100 kg ha^{-1} + KCl 50 kg ha^{-1} + GOF 100 kg ha^{-1}

The study used a plot with a size of 5 m x 6 m. Channels between treatment plots were made with a width and depth of 30 cm so that there was no fertilizer contamination or surface water flow between one treatment plot and another and the distance between replicates was about 100 cm. Planting was carried out individually, with a spacing of 70x20 cm (1 seed/hole), the depth of the hole was 3 cm, then the hole was covered with loose soil. The application of granular organic fertilizer

(GOF) was given at 1 WAP, while 50% Urea was applied as basic fertilizer along with SP-36 and KCL (100%), while 50% urea was given again at 10 DAP. Control pests and diseases were carried out preventively by using the fungicide dithane M-45 with a concentration of 2 g liter-1 of water. Harvesting is done when the cob husks have dried or are brown, the seeds have hardened, and a black layer of at least 50% has formed on each row of seeds.

Parameters of plant growth and yield observed were plant height (30 DAP, 45 DAP, and 60 DAP), number of leaves (30 DAP, 45 DAP, and 60 DAP), length of the ear, diameter of the ear, weight of the ear without cob, number of rows, number of seeds, yield, weight of 100 grains, and maize yield. The data that has been collected is tabulated and analyzed by using Print Analysis to determine the effect of treatment. Meanwhile, to determine the effect between treatments, Duncan's test was used.

Furthermore, an economic analysis was carried out using the Incremental Benefit Cost Ratio (IBCR) analysis (Kadariah, 1988), namely farming analysis to determine the level of farming profits with the application of alternative fertilizer technology and an analysis of the impact of technology application which aims to see the production and income received by farmers before and after. after participating in the testing activities. Farming results are said to be profitable if the output is greater than the input or the IBCR value > 1 with the following formula:

$$IBCR = \frac{\text{Acceptance by treatment} - \text{Acceptance of control}}{\text{Treatment spending} - \text{Control spending}}$$

RESULTS AND DISCUSSION

Corn Plant Growth

Corn plant growth is the vegetative part of the plant, including plant height and number of leaves. Plant height is one of the benchmarks to determine the response of fertilization to vegetative growth. Based on the analysis of variance on the parameters of the vegetative part of corn plants, it was seen that the effect of fertilization treatment was significant on plant height variables at 30, 45, and 60 days after planting compared to plants that were not fertilized (control), as well as between treatments that were significantly different.

The highest plant height at 30 DAP was obtained in the treatment of Urea 400 kg ha-1 + SP-36 100 kg ha^{-1} + KCl 50 kg ha^{-1} + GOF 100 kg ha^{-1} (P7) which was 82.20 cm, while at when plants 45 and 60 days after planting, the highest plant height was obtained in the treatment of Urea 300 kg ha-1 + SP-36 75 kg ha-1 + 37.5 kg ha-1 + GOF 100 kg ha-1, which were 148.40 each. cm and 230.07 cm. Granule fertilizer application can donate P into the soil from the results of its decomposition, so as to increase the plant height.

Likewise, the number of leaves formed was significantly different between fertilized and unfertilized plants (control). Based on plant vegetative growth data, it was seen that plants responded positively to the use of GOF combined with inorganic fertilizers. This illustrates that the combination of fertilizers is able to provide nutrient requirements (mainly N, P, and K nutrients) for plants.

Nitrogen, phosphorus, and potassium are essential nutrients for plant growth and are needed in large quantities (macro) because they play a role in plant metabolism, vegetative growth, especially

in cell division, chlorophyll formation and stimulate the growth of meristem tissue (Hardjowigeno, 2007). The addition of GOF to the soil planted with corn causes corn to grow and thrive.

GOF is easily decomposed so that it can stimulate plant growth. This statement is in accordance with the results of research by Indah Megahwati, 2009, that GOF is an organic material of high quality and decomposes quickly or is quickly available to plants. Organic fertilizers play a role in improving soil fertility. The content of nutrients in organic fertilizers is not too high, but has other features that can improve soil physical properties such as soil permeability, soil porosity, soil structure, water holding capacity, and soil cations (Hardjowigeno, 2007). Data from observations of the effect of discombination of GOF and inorganic fertilizers on plant height and number of leaves can be seen in Tables 1 and 2.

Table 1. Effect of GOF and An Organic Fertilizers on Average Plant Height in Corn Plants

Treatment	Average plant height (cm)		
	30 DAP	**45 DAP**	**60 DAP**
P1	71,67 [a]	127,47 [a]	205,53 [a]
P2	81,13 [c]	144,13 [bc]	227,20 [b]
P3	75,60 [bc]	138,40 [b]	216,80 [b]
P4	77,80 [bc]	139,60 [b]	219,00 [b]
P5	79,20 [bc]	148,40 [bc]	230,07 [bc]
P6	77,93 [bc]	141,07 [bc]	225,07 [b]
P7	82,20 [c]	144,47 [bc]	227,20 [b]

Note: In the same column, the numbers followed by the same letter are not significantly different in the 5% DMRT test

The highest number of leaves at the age of 30 and 60 days after planting was obtained in the treatment of fertilizer application of Urea 300 kg Urea ha-1+ 75 kg SP-36 ha-1 + 37.5 kg KCl ha-1 + 100 kg GOF (P5), i.e. 5.33 and 12.27, and significantly different from the control treatment and between treatments. Meanwhile, at the age of 45 days after planting, the highest number of leaves was obtained in the treatment of 400 kg Urea ha-1 + 100 kg SP-36 ha-1 + 50 kg KCl ha-1 + 100 kg GOF (P7) which was 8.93.

Table 2. The effect of applying pog and inorganic fertilizers on the average number of leaves on corn plants

Treatment	Average number of leaves		
	30 DAP	**45 DAP**	**60 DAP**
P1	3,73 [a]	5,27 [a]	8,07 [a]
P2	5,07 [c]	7,93 [b]	11,13 [bc]
P3	4,80 [b]	7,40 [b]	10,47 [b]
P4	5,07 [c]	7,47 [b]	11,07 [bc]
P5	5,33 [c]	7,73 [b]	12,27[c]
P6	4,89 [b]	7,60 [b]	11,07 [bc]
P7	4,90 [b]	8,93 [bc]	10,60 [b]

Note: In the same column, the numbers followed by the same letter are not significantly different in the 5% DMRT test

Yield of Corn

The yield component of maize is the generative part of the plant, including the length of the cob, the diameter of the cob, the number of rows per cob, the number of seeds per row, the weight of the peeled cob, the weight of 100 grains, and the yield of maize. From the results of statistical data analysis, it is known that the treatment of GOF combined with inorganic fertilizers has a significant effect on all parameters of plant yield components.

This is presumably because the GOF contains phosphorus, which is a carbohydrate-forming agent, which increases in the soil. GOF causes soil organic matter that is not available to rot and decompose which then becomes available nutrients for plants. This organic material is decomposed by the help of microorganisms caused by GOF such as bacteria and fungi (Sitorus, 2008). Patil and Udmale (2016) stated that the application of organic fertilizers helps in better absorption of plant nutrients which in turn can increase plant cell division thereby increasing plant growth parameters. The highest cob length and diameter were obtained in the treatment of Urea 300 kg Urea ha-1+ 75 kg SP-36 ha-1 + 37.5 kg KCl ha-1 + 100 kg GOF (P5) ie 16.40 cm and 47.94 mm. The average length of the cob and the diameter of the cob can be seen in Table 3.

Table 3. Effect of GOF and inorganic fertilizers on the average length and diameter of the cob on corn

Treatment	Length of cob (cm)	Diameter of cob (mm)
P1	13,10 [a]	38,04 [a]
P2	16,31 [c]	45,49 [b]
P3	15,30 [b]	45,07 [b]
P4	15,97 [b]	45,79 [b]
P5	16,40 [c]	47,94 [b]
P6	16,27 [c]	46,99 [b]
P7	16,00 [c]	44,10 [b]

Note: In the same column, the numbers followed by the same letter are not significantly different in the 5% DMRT test

The combination of GOF with inorganic fertilizers showed a significant effect on the parameters of the number of rows per ear and the number of seeds per row. Marsono and Sigit (2001), said that phosphorus serves to stimulate root growth and development, as a basic material for protein, helps respiration and assimilation, helps the process of ripening seeds and fruit. Lack of phosphorus will cause the size of the cobs to be small and their shape is not normal, so that the number of rows for each cob and the number of seeds produced is less (Syahputra et al., 2019).

According to Kartikawati LD (2011), carbohydrates formed due to the presence of potassium are not entirely used for the development of stems, leaves and roots, some are left for fruit and seed development, so in the reproductive phase of plant development, carbohydrates are stored (hoarded) and the plant stores most of the carbohydrates it makes. Micronutrients can increase the absorption of phosphorus, if the soil lacks micronutrients it can inhibit the response of plants to phosphorus fertilization (Setiawati, 2014).

Chemically, giving GOF can increase soil fertility. According to Hasibuan (2006), granular organic fertilizer has an important role such as increasing humus levels in the soil and can prevent Al and Fe poisoning in acid-reacting soils. This can be maintained if the application of fertilizer is carried out continuously.

GOF is thought to be able to add nutrients in the soil and is sufficient for the development of corn plants. Sapareng, et al (2017) also state the same thing, namely that if one factor is more real than another factor, then the other factor will be covered and will not affect the plant. The average number of rows per cob was obtained in the treatment of Urea 400 kg ha-1 + SP-36 100 kg ha-1 + 50 kg ha-1 + GOF 100 kg ha-1 (P7) 1 which was 15.53 rows and the number of seeds per row and the highest yield was obtained in the treatment of Urea 300 kg ha-1 + SP-36 75 kg ha-1 + 37.5 kg ha-1 + GOF 100 kg ha- (P5) ie 98.20 seeds and 78%. The average number of rows per cob, number of seeds per row, and yield for each treatment can be seen in Table 4.

Table 4. Effect of GOF and inorganic fertilizer application on the average number of rows, number of seeds, and rendemen of corn

Treatment	Number of rows	Number of seed	Rendemen
P1	13,67 a	82,47 a	70a
P2	15,27 b	94,67 ab	75 ab
P3	14,80 b	94,20 ab	73 ab
P4	14,80 b	93,40 ab	74 ab
P5	15,27 b	98,20 b	78 b
P6	15,27 b	94,80 ab	76 b
P7	15,53 b	94,80 ab	76 b

Note: In the same column, the numbers followed by the same letter are not significantly different in the 5% DMRT test

The average weight of 100 seeds, weight of cobs, and the highest yield of shelled corn was obtained in the treatment of Urea 300 kg ha-1 + SP-36 75 kg ha-1 + 37.5 kg ha-1 + GOF 100 kg ha- (P5) namely 38.70 g, 60 kg, and 8.5 t ha-1, respectively. This shows that the nutrient content in GOF is able to provide plant nutrient needs. Inorganic fertilizers combined with GOF can increase yields by 50% compared to inorganic fertilizers or GOF only. The combination of inorganic fertilizers and organic fertilizers supports each other so that during the growing period, plants are not deficient in nutrients (Abbey and Canton, 2004; Gambo et al, 2008).

Inorganic fertilizers release quickly and provide the needed nutrients at the right time, while GOF which contains high organic matter is able to improve the physical, chemical, and biological properties of the soil. Giving granulated fertilizer into the soil will undergo a decomposition process that produces organic acids. The increase in available P is due to the presence of P mineralization in the GOF by microorganisms in soil (Minardi et al al., 2011). According to Wahyudin et al (2017), element P is very influential in the process of growth and fruit formation. The average weight of 100 seeds, weight of cobs, and maize yield for each treatment can be seen in Table 5.

Table 5. Effect of GOF and inorganic fertilizers on the average weight of 100 seeds, weight of cobs, and yield of corn

Treatment	Weight 100 seed (gr)	Weight of cob (kg)	Yield of corn (t/ha)
P1	32,33 b	43,3 a	3,98 b
P2	38,00 a	53,3 ab	7,28 ab
P3	36,00 a	50,0 ab	7,00 ab
P4	37,67 a	50,8 ab	7,13 ab

P5	38,70 a	60,0 a	8,05 a
P6	36,00 a	56,7 ab	7,68 ab
P7	37,00 a	58,3 a	7,90 a

Note: In the same column, the numbers followed by the same letter are not significantly different in the 5% DMRT test

Economic Analysis

The economic analysis of corn crop per hectare is presented in Table 6, which shows that the overall IBCR ratio is >1 meaning that all treatments are quite profitable. According to Islam (2017) that the economic calculation of fertilizer use depends on three factors, namely: 1) increase in yield per unit of fertilizer input, 2) price per unit of fertilizer, and 3) price obtained per unit of yield.

Economically, among the fertilizer treatments tested, the most favorable was Urea 300 kg ha-1 + SP-36 75 kg ha-1 + 37.5 kg ha-1 + GOF 100 kg ha-1 with an IBCR ratio of 2.31, more higher than fertilizer treatment based on recommendations with an IBCR ratio of 2.08.

Table 6. Economic analysis on the combination treatment of GOF with inorganic fertilizers on corn

No.	Treatment	Output (Rp)	Input(Rp)	IBCR
1	Without fertilizer (control)	3.575.000	10.345.000	-
2.	Urea 400 kg ha^{-1} + SP-36 100 kg ha^{-1} + KCl 50 kg ha^{-1} (based on recommendation)	8.830.000	21.290.000	2,08
3.	GOF 100 kg ha^{-1}	8.200.000	20.755.000	2,25
4.	Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl 37,5 kg ha^{-1} + GOF 50 kg ha^{-1}	8.275.000	20.245.000	2,11
5.	Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl 37,5 kg ha^{-1} + GOF 100 kg ha^{-1}	9.100.000	23.100.000	2,31
6.	Urea 300 kg ha^{-1} + SP-36 75 kg ha^{-1} + KCl37,5 kg ha^{-1} + GOF 150 kg ha^{-1}	9.250.000	21.470.000	1,96
7.	Urea 400 kg ha^{-1} + SP-36 100 kg ha^{-1} + KCl 50 kg ha^{-1} + GOF 100 kg ha^{-1}	9.500.000	22.100.000	1,98

Description: GOF price Rp. 4,000/kg, Urea Rp. 2.500/kg, SP-36 Rp. 3.500, KCl Rp. 6000/kg, the price of shelled corn is Rp. 4,000/kg

CONCLUSION

The combination of GOF with inorganic fertilizers is effective in increasing plant growth and maize yields. The optimum dose was achieved by administering Urea 300 kg ha-1 + SP-36 75 kg ha-1 + KCl 37.5 kg ha-1 + GOF 100 kg ha-1 and producing shelled corn 8.05 tons ha-1. Economically, giving Urea 300 kg ha-1 + SP-36 75 kg ha-1 + KCl 37.5 kg ha-1 + GOF 100 kg ha-1 was more profitable with an IBCR ratio of 2.30 compared to other treatments.

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