https://doi.org/10.48047/AFJBS.6.16.2024.1711-1726

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Productivity and Seed Quality of Soybean (Glycine max L.) through Application of Maggot Compost and NPK

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Volume 6, Issue 16, Dec 2024

Received: 15 Oct 2024

Accepted: 25 Nov 2024

Published: 09 Dec 2024

doi: 10.48047/AFJBS.6.16.2024.1711-1726

ABSTRACT

Objective. The research aims to study the effect of maggot fertilizer and NPK fertilizer on the growth, productivity and seed quality of soybean plants. **Methods.** The research was conducted at the Exfarm of the Faculty of Agriculture, Hasanuddin University, Makassar from October 2023 - March 2024. The research was in the form of a 2-factor factorial experiment based on a Randomized Group Design (RGD). The first factor is the dose of maggot fertilizer which consists of 3 levels, namely 0 ton/ha maggot, 10 ton/ha maggot and 20 ton/ha maggot. The second factor is the dose of NPK fertilizer which consists of 3 levels, namely 0 kg/ha NPK fertilizer, 100 kg/ha NPK and 200 kg/ha NPK. **Results.** The results showed that there was a significant interaction between the treatment of 0 ton/ha maggot fertilizer and 100 kg/ha NPK fertilizer at harvest age (106.22 dap) and dry weight of 100 seeds (18.10 g). The treatment of 20 tons/ha of maggot gave the best effect on 50% flowering age (40.44 dap), percentage of filled pods (77.45%), number of pods per plant (128.80 pieces), number of seeds per plant (138.72 seeds), dry weight of seeds per plant (15.59 g), and production per hectare (3.34 tons). 0kg/ha NPK fertilizer gave the best effect on flowering age (40.56 dap). Filled pods (0.785), number of seeds (0.993) and seed dry weight (1.000) were significantly positively correlated to per plot production. **Conclusion.** Based on the results of the study, it is concluded that the use of maggot fertilizer and NPK fertilizer has a significant effect on the productivity of soybean plants but has not significantly affected the improvement of seed quality. Growth and production variables are positively correlated and have a very significant positive direct effect on the productivity of soybean plants.

Keywords: Maggot Compost NPK, productivity, soybean, seed quality.

Introduction

Soybeans (Glycine max (L.) Merill) are legumes that contain a very healthy source of vegetable protein. The nutritional value of soybean seeds consists of 40-45% protein, 18% fat, 24%-36% carbohydrates, 8% water content, amino acids and other nutrients that are beneficial to humans. Soybean is the third most important food after rice and corn. Soybeans can be processed into ingredients in the food industry, such as tofu, tempeh, soy sauce, soy milk, and others. According to Yulifianti (2018), about 83.7% of soybeans are used as food in Indonesia. Soybean production in 2022 reached 301.51 thousand tons but has not been able to meet domestic soybean needs. (Directorate General of Food Crops, 2022).

Efforts to meet the needs are carried out by intensification and extensification, extensification is difficult to do because of greater land competition, so intensification is a more appropriate solution, with improved cultivation techniques. This improvement can be in the form of balanced fertilizer use. Inorganic fertilizers used without being balanced with organic fertilizers are not effectively used, the use of both fertilizers will provide better results for plants and soil improvement (Setiko et al., 2021). Organic fertilizers produced from natural organic materials are considered a more efficient way to improve crop productivity and quality (Pramono, Natawijaya and Suhardjadinata, 2023). This research is expected to be one of the good solutions in increasing the growth and production of soybean plants.

Soybean cultivation in general is still carried out conventionally, one of which is the prolonged use of chemical fertilizers. Environmental pollution and soil damage can occur due to excessive use of chemical fertilizers, so it is necessary to balance the use of fertilizers in soybean cultivation. Efforts that can be made are to combine inorganic fertilizers and organic fertilizers, to reduce the excess of chemical fertilizers used. Irwan and Nurmala (2018) stated that the provision of organic materials and inorganic fertilizers, especially those containing N, P, K, and micro elements, is very good for improving the physical and chemical conditions of the soil and adding nutrients to the soil. This is because inorganic fertilizers only contain some nutrients even in large quantities, while organic fertilizers contain more complete macro and micro nutrients even in small amounts so that the use of organic and inorganic fertilizers together can provide nutrients in sufficient and balanced amounts.

Maggot fertilizer (former maggot) is an organic fertilizer that contains macro and micro nutrients so that it can provide and increase nutrients and minerals that are needed by plants. Organic fertilizer derived from former maggot or maggot has a pH of 7.78 and N content reaches 3.36% (Bahri, 2022). This former maggot can be used as an organic fertilizer which is

an alternative in increasing soil fertility. In addition to the use of maggot fertilizer, the addition of NPK inorganic fertilizers is also carried out to provide nutrients N, P, and K in the form of single or compound fertilizers. One of the compound fertilizers commonly used by farmers is NPK 16:16:16 compound fertilizer. The research was conducted to analyze the effect of the use of maggot organic fertilizer, which is not widely known and there is still a lack of information on the fertilizer with the addition of NPK inorganic fertilizer on the productivity and quality of soybean seeds.

Materials and Methods

This research was conducted in the laboratory and Exfarm land of Faculty of Agriculture, Hasanuddin University, Makassar. This research took place from October 2023 - March 2024. The tools used in this research are hoes, machetes, raffia, scissors, meters, rakes, hand sprayers, water pumps, hoses, springkles, shovels, sickles, analytical scales, digital scales, rulers, buckets, bamboo, plot boards. While the materials used were soybean seeds of Devon-1 variety, maggot organic fertilizer, NPK fertilizer, furadan, insecticide (prevathon), plastic mulch, rhizobium.

This research was conducted using a Factorial Randomized Group Design (RAK) with 2 treatment factors consisting of:

The first factor is the application of maggot compost fertilizer (K) with three levels:

k0: 0 tons/ha

k1: 10 tons/ha

k2: 20 tons/ha

The second factor is the application of NPK fertilizer (N) with three levels:

n0: 0 kg/ha

n1: 100 kg/ha

n2: 200 kg/ha

Based on the treatment, 9 combinations were obtained which were repeated 3 times so that there were 27 experimental units, each experimental unit or plot had 36 soybean planting holes and 6 plants that would be used as observation samples taken in the center. The total number of experimental units consisted of 972 plants. All data obtained were analyzed statistically using the analysis of variance (ANOVA) method. Treatments that have a significant effect, then the BNJ test is carried out with a confidence level of 95% with $\alpha = 0.05$.

Results and Discussion

Plant height

The results of the analysis of variance showed that the treatment of maggot fertilizer, NPK and the interaction of the two had no significant effect on the plant height of soybean plants.

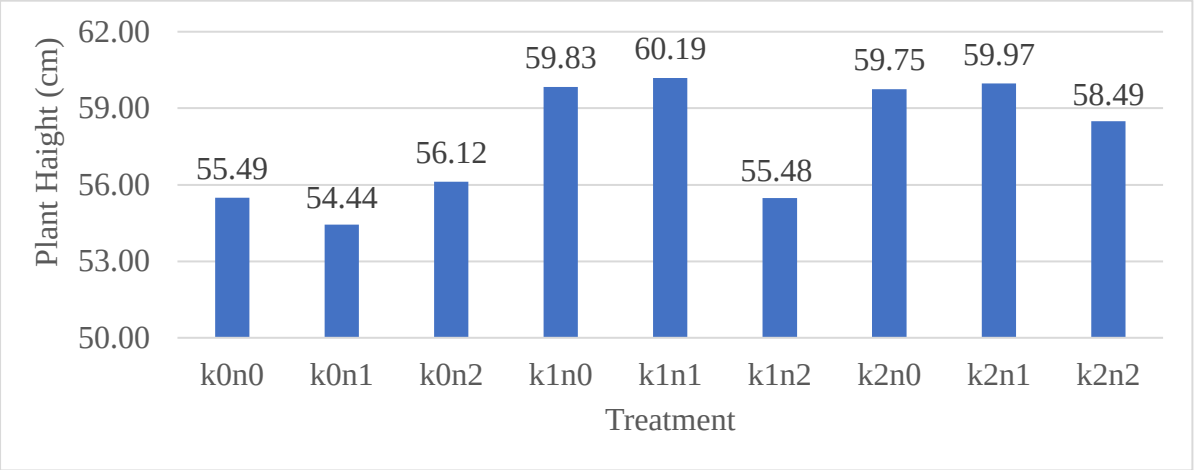

Figure 1: Bar diagram of plant height (cm)

Figure 1 shows that plant height tends to be higher (60.19 cm) in the treatment of 10 tons/ha maggot fertilizer and 100 kg/ha NPK fertilizer (k1n1) while plant height tends to be the lowest (54.44 cm) in the treatment without maggot fertilizer and 100 kg/ha NPK fertilizer (k0n1).

50% flowering age (days after planting)

The results of the analysis of variance showed that the treatment of maggot fertilizer and NPK fertilizer had a significant effect, while the interaction of the two had no significant effect on the flowering age of soybean plants.

Table 1. Age at 50% flowering in the treatment of maggot fertilizer and NPK fertilizer

Maggot Fertilizer (ton/ha)	NPK Fertilizer (kg/ha)			Average	NP BNJ
	0 (n0)	100 (n1)	200 (n2)		
0 (k0)	40,33	41,33	41,67	41,11 ab	
10 (k1)	41,00	40,67	42,00	41,22 b	0,67
20 (k2)	40,33	40,33	40,67	**40,44 a**	
Average	**40,56 p**	40,78 pq	41,44 q		
NP BNJ			0,67		

Notes: The numbers followed by the same letter in the column (a,b) and in the row (p,q) mean not significantly different in the BNJ test $\alpha = 0.05$.

The results of the BNJ test α 0.05 in Table 1 show that the treatment of maggot fertilizer (K) at the fastest 50% flowering age is 40.44 DAP in the treatment of 20 tons/ha maggot (k2), significantly different from the dose of 10 tons/ha (k1) but not significantly different from the dose of 0 tons/ha (k0). While the NPK fertilizer treatment (N) showed that the fastest 50% flowering age was 40.56 DAP in the NPK fertilizer treatment dose of 0 kg/ha (n0), significantly different from the dose of 200 kg/ha (n2), but not significantly different from the treatment of 100 kg/ha (n1).

Harvest age (days after planting)

The results of variance analysis showed that the treatment of maggot fertilizer and NPK fertilizer and their interaction significantly affected the harvest age of soybean plants.

Table 2. Harvest age in the treatment of maggot fertilizer with NPK fertilizer

Maggot fertilizer (ton/ha)	NPK fertilizer (kg/ha)			NP BNJ
	0 (n0)	100 (n1)	200 (n2)	
0 (k0)	110,44ab	**106,22 a**	109,22ab	
10 (k1)	110,83ab	108,67ab	109,39ab	5,36
20 (k2)	109,72ab	113,44 b	110,72ab	

Notes: Numbers followed by the same letter (a,b) mean not significantly different in the BNJ test α = 0.05.

The results of the BNJ α 0.05 test in Table 2 show that the fastest harvest age is 106.22 days after planting in the treatment of maggot fertilizer dose of 0 ton/ha and in the treatment of 100 kg/ha NPK fertilizer (k0n1) which is not significantly different from the treatment of k0n0, k0n2, k1n0, k1n1, k1n2, k2n0, k2n2 and significantly different from the treatment of k2n1. The treatment of maggot fertilizer at a dose of 20 tons/ha and 100 kg/ha NPK fertilizer (k2n1) gave a late harvest age of 113.44 days after planting.

Number of pods per plant, Percentage of filled pods and Number of seeds per plant

Table 3. Effect of maggot fertilizer on the number of pods per plant, percentage of filled pods and number of seeds per plant

Treatment	Variable Observation		
	Number of pods per plant	Percentage of filled pods	Number of seeds per plant
0 ton/ha (k0)	103,28 b	64,23 b	114,31 b
10 ton/ha (k1)	117,02 ab	75,73 ab	124,83 ab
20 ton/ha (k2)	**128,80 a**	**77,45 a**	**138,72 a**
NP BNJ	16,5	12,7	18,3

Notes: The numbers followed by the same letter in column (a,b) mean not significantly different in the BNJ follow-up test α = 0.05.

The results of the BNJ α 0.05 test in Table 3 show that the 20 ton/ha cassava fertilizer treatment showed the best results in the number of pods per plant (128.80 pieces), the percentage of filled pods (77.54%) and the number of seeds per plant (138.72 seeds) significantly different from the control treatment or 0 ton/ha cassava fertilizer.

Dry weight of 100 seeds

The results of the measurement of dry weight of 100 seeds (g) and its variance analysis showed that the treatment of maggot fertilizer and NPK fertilizer treatment had no significant

effect while the interaction of the two had a significant effect on the dry weight of 100 soybean seeds.

Table 4. Dry weight of 100 seeds (g) in the treatment of maggot fertilizer

Maggot Fertilizer (ton/ha)	NPK Fertilizer (kg/ha)			NP BNJ
	0 (n0)	100 (n1)	200 (n2)	
0 (k0)	17,67b	17,60b	18,07a	
10 (k1)	**18,10a**	**18,10a**	17,87ab	0,34
20 (k2)	18,07a	17,83ab	17,87ab	

Notes: The numbers followed by the same letter in column (a,b) mean not significantly different in the BNJ follow-up test α = 0.05.

The results of the BNJ further test α 0.05 in Table 4 show that the highest dry weight of 100 seeds is 18.10 g, obtained from the treatment of 10 tons/ha maggot fertilizer and 0 kg/ha NPK fertilizer treatment (k1n0) and in the treatment of 10 tons/ha maggot fertilizer and 100 kg/ha NPK fertilizer treatment (k1n1) which is not significantly different from the treatment of k1n2, k2n1, k2n2, but significantly different from the treatment of k0n0, k0n1.

Seed dry weight, Production per plot and Production per hectare

Table 5. Effect of maggot fertilizer on seed dry weight, production per plot and productivity

Treatment	Variable Observation		
	Seed dry weight (g)	Production per plot (g)	Production per hectare (ton/ha)
Kontrol (k0)	13,09 b	471,27 b	2,73 b
10 ton/ha (k1)	14,30 ab	514,93 ab	3,07 ab
20 ton/ha (k2)	**15,59 a**	**561,33 a**	**3,34 a**
NP BNJ	2,02	72,60	0,43

Notes: The numbers followed by the same letter in column (a,b) mean not significantly different in the BNJ follow-up test α = 0.05.

The results of the BNJ α 0.05 test in Table 5 show that the 20 ton/ha maggot fertilizer treatment showed the best results in the weight of seeds per plant (15.59 g), production per plot (561.33%) and productivity (3.34 ton/ha of seeds) significantly different from the control treatment or 0 ton/ha maggot fertilizer.

Seed Water Content, Germination, and Vigor Index

The results of the analysis of variance showed that the treatment of maggot fertilizer, NPK and the interaction of the two had no significant effect on the moisture content, germination and vigor index of soybean seeds.

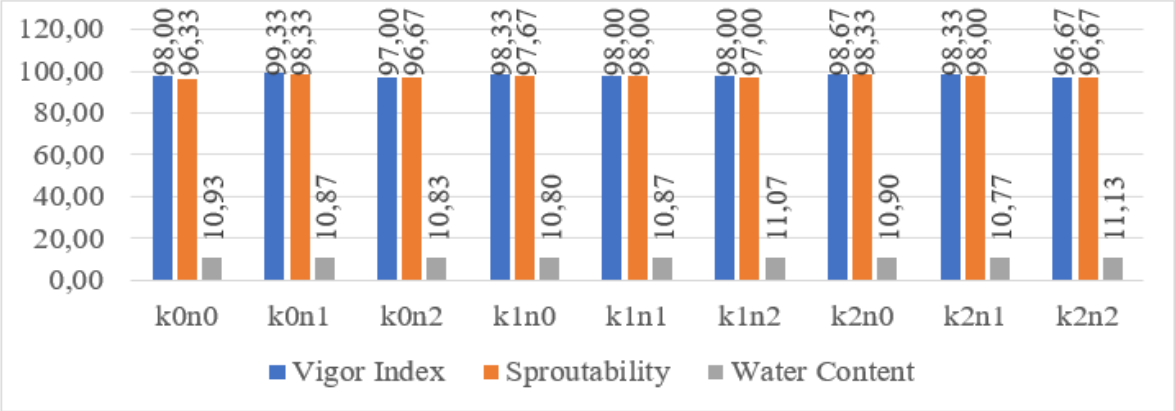

Figure 5. Bar chart of seed moisture content, germination, and vigor index

Growth appearance and growth speed

The results of the analysis of variance showed that the treatment of maggot fertilizer and NPK and the interaction of the two had no significant effect on the appearance of growth and speed of soybean seeds.

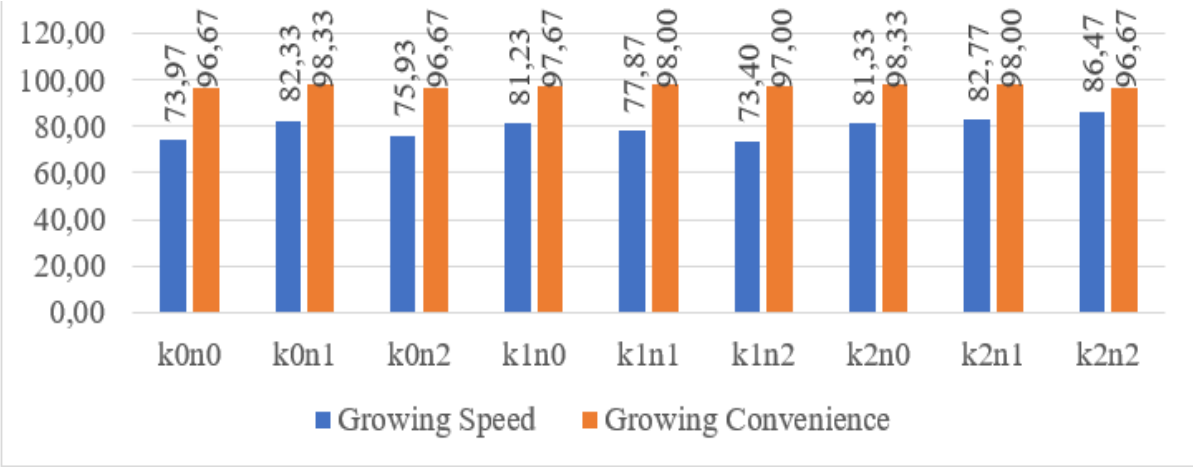

Figure 8. Bar diagram of growth appearance and growth speed

Correlation Analysis

Table 6. Correlation of soybean plant growth and production variables

	PH	FE	HE	NoP	FP	NoS	DW	SW100	PP
PH	1,000								
FE	-0,590^{tn}	1,000							
HE	0,558^{tn}	-0,488^{tn}	1,000						
NoP	0,552^{tn}	-0,155^{tn}	0,621^{tn}	1,000					
FP	0,510^{tn}	-0,062^{tn}	0,019^{tn}	0,551^{tn}	1,000				

NoS	0,438^{tn}	-0,305^{tn}	0,469^{tn}	0,674*	0,783*	1,000			
DW	0,432^{tn}	-0,289^{tn}	0,436^{tn}	0,608^{tn}	0,785*	0,993**	1,000		
SW100	0,676*	0,017^{tn}	0,180^{tn}	0,339^{tn}	0,267^{tn}	-0,007^{tn}	0,014^{tn}	1,000	
PP	0,432^{tn}	-0,289^{tn}	0,436^{tn}	0,608^{tn}	0,785*	0,993**	1,000**	0,014^{tn}	1,000

Notes: (*) significant at 0.05 level, r = 0.666, (**) very significant at 0.01 level, r = 0.798, (tn) not significant at 0.05 and 0.01 levels.

The results of the correlation analysis in Table 6 show that the plant height parameter is significantly positively correlated with 100 seed weight (0.676), not significantly correlated with harvest age (0.558), number of pods (0.552), filled pods (0.510), number of seeds (0.438), dry weight of seeds (0.432), production per plot (0.432), negatively correlated not significantly with flowering age (-590). Flowering age parameter was positively and significantly correlated to 100 seed weight (0.017), negatively and significantly correlated to harvesting age (-0.488), number of pods (-0.155), filled pods (-0.062), number of seeds (-0.305), seed dry weight (-0.289), production per plot (-0.289). Harvesting age was significantly positively correlated with number of pods (0.621), pods filled (0.019), number of seeds (0.469), seed dry weight (0.436), 100 seed weight (0.180), production per hectare (0.436). Number of pods was significantly positively correlated to number of seeds (0.674), not significantly positively correlated to pods filled (0.551), seed dry weight (0.608), 100 seed weight (0.339) and production per plot (0.608). The parameter of filled pods was significantly positively correlated to the treatment of number of seeds (0.783), dry weight of seeds and production per plot (0.785), positively correlated not significantly to the weight of 100 seeds (0.267). The parameter number of seeds was significantly positively correlated to the parameters of seed dry weight and production per plot (0.993), negatively correlated not significantly to the weight of 100 seeds (-0.007). The parameter of seed dry weight was significantly positively correlated to the parameter of production per plot (1.000) and not significantly positively correlated to the weight of 100 seeds (0.014).

Table 7. Correlation of germination variables and productivity of soybean plants

	WC	Germ	VI	UoG	GS	PH
KA	1,000					
DK	-0,509^{tn}	1,000				
IV	-0,472^{tn}	0,763*	1,000			
KesT	-0,534^{tn}	0,992**	0,816**	1,000		
KecT	0,003^{tn}	0,421^{tn}	0,033^{tn}	0,380^{tn}	1,000	
PH	0,585^{tn}	-0,028^{tn}	-0,382^{tn}	-0,076^{tn}	0,551^{tn}	1,000

Notes: (*) significant at 0.05 level, r = 0.666, (**) very significant at 0.01 level, r = 0.798, (tn) not significant at 0.05 and 0.01 levels.

The results of the correlation analysis showed that the water content parameter was positively and insignificantly correlated with growth speed (0.003) and production per hectare (0.585), negatively and insignificantly correlated with germination (-0.509), vigor index (-0.472), and uniformity of growth (-0.534). The germination parameter was highly significantly positively correlated to sprouting rate (0.992), significantly correlated to vigor index (0.763), not significantly to sprouting rate (0.421), not significantly negatively correlated to production per hectare (-0.028). The vigor index parameter was positively and significantly correlated to growth synchrony (0.816), not significantly to growth speed (0.033) and negatively and not significantly correlated to production per hectare (-0.382). The parameter of growth synchrony was positively and significantly correlated with growth speed (0.380), negatively and significantly correlated with production per hectare (-0.076). Growth speed parameter was positively and significantly correlated to production per hectare (0.551).

Path Coefficient Analysis

Table 8. Path coefficient analysis of germination and yield parameters on soybean crop productivity

Variabel	Direct effect	Indirect effect					Total effect
		WC	Germ	VI	PH	NoS	
WC	0,095^{tn}		-0,014	0,031	-0,014	0,488	0,585
Germ	0,027^{tn}	-0,048		-0,049	0,021	0,022	-0,028
VI	-0,065^{tn}	-0,045	0,021		-0,003	-0,290	-0,382
PH	0,050^{tn}	-0,027	0,011	0,004		0,393	0,432
NoS	0,898**	0,052	0,001	0,021	0,022		0,993
Residual	0,330						
R square	0,670						

Notes: (*) significant at 0.05 level, r = 0.666, (**) very significant at 0.01 level, r = 0.798, (tn) not significant at 0.05 and 0.01 levels.

Path coefficient analysis in table 8 shows that the variable that has a very real direct effect on plant productivity is the number of seeds with a path coefficient value of 0.898, while the variables of water content, germination, vigor index, plant height have no real direct effect.

Discussion

The BNJ test results in table 1 show that the fastest 50% flowering age in the treatment of 20 tons/ha maggot fertilizer is 40.44 (dap) while the fastest flowering age in the treatment of 0 kg/ha NPK fertilizer is 40.56 (dap). According to Astuti et al. (2018), stated that Phosphorus (P) content in plants helps in the growth of flowers, fruits, and seeds. Soybean flowers generally appear in the axil of the petiole with the number of flowers varying between 2-25 flowers. The content of the P element in fertilizer can be used in the formation of soybean plant flowers. This is in accordance with the opinion of Sipayung et al. (2023), which states that during the formation of flower buds, plants absorb a lot of phosphorus nutrients that can accelerate flowering. The flowering age of soybean plants is influenced by genetic and environmental factors.

Table 2 shows that the fastest harvest age is 106.22 DAP in the treatment of 0 ton/ha maggot fertilizer and 100 kg/ha NPK fertilizer treatment and is significantly different from the treatment of 20 ton/ha maggot with 100 kg/ha NPK. According to Sjamsijah et al., (2017) which states that flowering age is related to physiological maturity because the age of harvesting plants is influenced by the speed of flowering. Providing fertilizer to soybean plants can meet the nutrients needed so that it can accelerate the harvest age. According to Simorangkir, (2023) states that the element P plays a role in the process of respiration, photosynthesis and plant metabolism so as to encourage the rate of plant growth including accelerating the harvest age.

Table 3 shows that the 20 ton/ha cassava fertilizer treatment showed higher results on the number of pods per plant (128.80 pieces), the percentage of filled pods (77.45%) and the number of seeds per plant (138.72 seeds). This is influenced by maggot fertilizer which is rich in nutrient content so that these elements are absorbed by plants and play a role in helping metabolic processes in plants both in the vegetative and generative phases. This is supported by the opinion of Triwijayani et al. (2023), that maggot is very good for plants because it contains amino acids, enzymes, microorganisms and hormones that are not found in other organic fertilizers, besides that maggot has nutrients needed by plants such as nitrogen (N), phosphorus (P), potassium (K), and organic carbon (C). According to Meilani et al. (2022), that maggot can release several bacterial compounds that can play a role in protecting against harmful microbes that interfere with plants.

Maggot fertilizer provides nutrients needed by soybean plants and is available in a balanced state and can trigger plant growth and also in the process of good photosynthesis. Based on the statement of Nadia et al. (2023), that more organic fertilizers increase soil microorganisms and plant nutrients greatly determine the increase in photosynthesis rate. This

is also supported by the opinion of Nazaruddin and Irmayanti (2020), photosynthesis during the seed filling period is usually the most important source for the weight of the seed yield. This is because before seed filling, most assimilation results are used for vegetative production and flower production, while during seed filling most assimilation results are used for these processes.

To increase land productivity, organic fertilizer can be applied. The presence of nutrients P, K contained in kosgot fertilizer can stimulate and improve the process of soybean plant seed formation. According to Risnawati and Yusuf, (2019) stated that the element P also takes part in protein synthesis, especially those found in green tissues, carbohydrate synthesis, spurs the formation of fruits and seeds and determines the ability to germinate seeds that are used as seeds. Furthermore, according to Amir and Fauzy, (2018), that the need for K in soybean plants is quite high. Potassium plays an important role during the seed filling period, K can also extend the seed filling period, so that plants can better supply photosynthate to seeds.

Table 4 shows that there is an interaction in the treatment of 10 tons/ha maggot and 0 kg/ha NPK and in the treatment of 10 tons/ha maggot and 100 kg/ha NPK on the dry weight of 100 seeds with the highest average of 18.10 g. This is thought to be due to the application of maggot fertilizer. It is suspected that the application of maggot fertilizer and NPK fertilizer can affect soybean plant yields such as dry weight of 100 seeds because it can increase the availability of nitrogen, phosphate and potassium in the soil. According to Astuti et al. (2018) that fertilization will increase the yield of dry weight (BK) of plants. Afzal et al. (2012) added that the addition of nitrogen content in the growing medium will increase the weight of the yield, increasing both fresh and dry biomass. Astuti et al. (2018) explained that in fertilization, it is necessary to balance the amount of nutrients in the soil in accordance with the plant's need for these nutrients, therefore in carrying out fertilization, several things must be considered, namely the type of soil to be fertilized, the type of fertilizer used, the dose (amount) of fertilizer given, the time of fertilization and the method of fertilization.

Table 5 shows that maggot fertilizer gives higher results in the dry weight of seeds per plant with the highest average (15.59 g) obtained in the 20 ton/ha maggot fertilizer treatment. This is due to the provision of organic fertilizers at the right dose which can improve the physical, chemical and biological properties of the soil, improve the soil structure to be looser so that plants easily absorb nutrients and obtain high production. According to Marlina et al. (2015), the N element contained in fertilizer is a constituent of organic matter in seeds such as amino acids, proteins, coenzymes, chlorophyll and a number of other materials in seeds, so that

the provision of fertilizers containing N in plants will increase the dry weight of seeds. During the generative phase, plants need N, P and K. Sajar (2023) states that the provision of fertilizers containing the element N can increase the weight of soybean seeds because the element nitrogen is a constituent of organic matter in seeds, namely proteins, amino acids, coenzymes and chlorophyll and a number of other materials in seeds. This is also supported by the opinion of Lestari et al. (2021), stating that plant needs still utilize the nutrients available in the soil, so it is directly proportional to the increasing dose of fertilizer, the higher the seed weight per plant.

Table 5 shows that the maggot treatment gave higher results in production per plot (561.33 g) and production per hectare (3.34 tons) in the 20 ton/ha maggot fertilizer treatment. This is thought to be because maggot is able to fulfill the nutrients needed by soybean plants. According to Ralle and Subaedah (2020), the increase in organic matter and nutrients will affect the activity of organisms in the soil so that the growth and yield of soybeans increase. This is also supported by the opinion of Sari et al. (2022) that maggot contains organic nutrients which if utilized on agricultural land can reduce the decline in soil nutrients. One of the factors causing low crop production is improper fertilization (Husain and Rahim, 2024). Not only that, the availability of nutrients in the soil can also affect the amount of production of a plant.

The results showed that there were parameters that had no significant effect on NPK fertilizer treatments such as plant height, number of leaves, number of branches, number of pods per plant, percentage of empty pods, number of seeds per plant, dry weight of seeds per plant, dry weight of 100 seeds, production per plot, and production per hectare. This is thought to be because the maggot fertilizer used has met the needs of nutrients needed by soybean plants, causing the dose of NPK fertilizer to show no significant effect on the yield of soybean plants. As according to Pramono et al. (2023), which states that organic fertilizers contain various organic nutrients that provide additional micro and macro nutrients that are more complete for plants. Meanwhile, the dose of NPK fertilizer does not provide sufficient nutrients for the specific needs of soybean plants, especially in terms of micro nutrients. Jali et al. (2020), added that good plant growth can be achieved if the nutrients needed for plant growth and yield are available, balanced and in optimal doses. Plants that are in the sufficient zone with nutrient addition treatment will only increase the content of these elements in plant tissues but have little or no effect on increasing growth and yield.

Based on table 6, it can be seen that harvest age (UP), number of pods (JP), number of seeds (JB), dry weight of seeds (BKB), production per plot (PP) are positively correlated with plant height. Weight of 100 seeds (B100B) had a strong positive correlation with plant height,

indicating that taller plants tend to produce more pods, seeds, and have greater seed weight. This means that the taller the plant, the more the number of pods, the number of seeds and the weight of the seeds, the plant production also tends to increase.

Based on Table 7, it can be seen that there is a highly significant positive correlation between germination and vigor index. This indicates that seeds with high germination tend to have good vigor as well. The variable of uniformity of growth has a highly significant positive correlation with germination and vigor index. This indicates that seeds with good uniformity of growth tend to have high germination and vigor. Plant productivity showed no significant correlation with other variables. This indicates that in this study the variables of germination and early growth of soybean plants did not have a significant effect on plant productivity. According to Irmayanti et al. (2024), a negative correlation means that when one variable increases, the value of the other variable tends to decrease and if it is positively correlated, it means that an increase in one variable, the other variable also tends to increase, and vice versa.

In table 8, it can be seen that the number of seeds has a very real positive direct effect on the productivity of soybean plants (0.898). This means that the higher the value of the number of seeds, the productivity tends to increase. Germination, vigor index and number of seeds also have indirect effects on plant productivity and other parameters. Most of these indirect effects are positive, which means that germination power, vigor index and seed weight indirectly increase the productivity of soybean plants through synergy with other variables. The R square value of 0.670 indicates that 67% of the variance in productivity can be seen from the independent variables. R Square shows the proportion of variance in the dependent variable (crop productivity) that can be explained by all independent variables.

Conclusion

Based on the results of the study, it can be concluded that the interaction of 0 ton/ha cassava fertilizer and 100 kg/ha NPK gave the best results in the harvest age parameter (106.22 dap) and the interaction of 10 ton/ha cassava fertilizer and 100 kg/ha NPK gave the best 100 seed dry weight (18.10 g). Application of 20 tons/ha maggot fertilizer showed optimal results at 50% flowering age (40.44 dap), number of pods per plant (128.80 pieces), percentage of filled pods (77.45%), number of seeds per plant (138.72 seeds), dry weight of seeds per plant (15.59 g), and production per hectare (3.34 tons). The treatment without NPK fertilizer application (0 kg/ha) produced the fastest flowering age (40.56 HST). There were no significant differences in seed quality parameters. Correlation analysis and path coefficient showed that seeds with high germination, vigor index and growth uniformity will produce better early plant growth and variables of harvest age, number of pods, weight of seeds per plant are important

factors affecting plant productivity, with the number of seeds showing the most significant influence on plant productivity (path coefficient 0.898).

Acknowledgments

The authors are grateful to the Agrotechnology Study Program, Faculty of Agriculture, Hasanuddin University for providing the facilities needed in conducting the research. The authors would also like to thank colleagues who have helped and provided advice in the completion of the research.

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