

## The Effect of Organic Fertilizer Dosage on the Yield of Shallots in Mulch

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### ARTICLE INFO

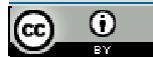
*Keywords:* Organic Fertilizer  
Dosage, Mulch, Shallot Plants

*Received :* 08, September

*Revised :* 10, October

*Accepted:* 12, November

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### ABSTRACT

The growth of the food processing industry has led to an increase in domestic demand for shallots, thus intensifying cultivation in areas suitable for shallot development. Magne Wish organic fertilizer creates a symbiotic relationship between plants, soil, and native soil microbes, combined with the use of mulch to maintain soil moisture, temperature fluctuations, and weed growth. The purpose of this study was to obtain the response of organic fertilizer dosage with the type of mulch so that the dosage of organic fertilizer and the type of mulch could be obtained to increase the yield of shallots. The study was conducted in the rice fields of Subak Aban, Tegal Darmasaba with a factorial randomized block design consisting of two factors, namely the dosage of organic fertilizer (D), 4 levels D1 = (100, 200, 300, 400 kg. ha<sup>-1</sup> and Mulch Type, 3 levels, namely (Black Silver Plastic; Rice Straw; Rice Husk).

## INTRODUCTION

Shallots (*Allium Ascalonicum* L.) are a vegetable commodity prioritized for development due to their high economic value (Mumtazah, 2021). This commodity is used as a primary ingredient in the spice mix for almost every regional specialty in Indonesia; it is also a raw material for the food industry and an ingredient in traditional medicine. Shallot extract contains many essential oils, volatile substances, and active chemical compounds (sulfur compounds) which are very beneficial for health (Aryanta., 2019). Shallot cultivation needs to be improved considering that consumer demand continues to increase in line with population growth and increasing purchasing power (Ekawati D, *et.al.*, 2023). To meet the demand for shallots, the Ministry of Agriculture is encouraging an increase in planted area, harvested area, and shallot productivity. Shallot cultivation in Bali province is uneven across all regencies, but is concentrated in Bangli and Klungkung. This has prompted the government to boost shallot production to meet national shallot demand (Deden and Umiyati, U. 2019). Efforts to increase shallot production include intensifying cultivation in areas suitable for shallot cultivation. One way to increase shallot yields through cultivation techniques is through fertilization. Fertilization involves adding nutrients to plants to increase the supply of nutrients needed to improve production and quality (Rudi Priyadi, *et al.*, 2021).

Organic farming has become increasingly attractive as a way to transform traditional chemical-based farming practices into a healthier, more environmentally friendly lifestyle. Applying organic fertilizer to the soil can influence and improve the physical, biological, and chemical properties of the soil. Organic matter, in addition to containing complete nutrients, also plays a crucial role in improving the physical, chemical, and biological properties of the soil, thereby maintaining and increasing soil fertility and reducing dependence on inorganic fertilizers (Indriyana *et al.*, 2020; Vindy Putri S., *et al.*, 2022).

The availability of nutrients can be obtained from organic fertilizers; together with BiOWiSH Technologies, PT Pupuk Karya Polowijo introduced MagneWish as a mineral that has natural and non-GMO (Genetically Modified Organism) content that is beneficial for the soil. MagneWish, which consists of magnesium, calcium, and endophytic microbes with HoloGene 3™ technology from BiOWiSH, which creates a symbiotic relationship between plants, soil, and native soil microbes, has undergone various trials on various types of land and also types of plants. This organic fertilizer has been proven to improve soil conditions for better root mass, increase plant vigor and continue to support environmental sustainability and stability at an affordable cost for farmers (Anonymous. 2024).

Shallots are a commodity that is highly susceptible to weather changes, particularly rainfall, which can significantly impact yields. This situation can be improved by cultivating them outside the conventional growing season, using microclimates such as using covers and various types of mulch, thereby stabilizing shallot production and market prices. Efforts to engineer the microclimate to achieve optimum plant growth are a hallmark of modern agriculture (Wisudawati Diakh *et al.*, 2016; Ayu Kristiyanti *et al.*, 2021). The use of mulch, both organic and inorganic, has long been practiced by farmers in Indonesia. The use of mulch aims to save water use by suppressing the rate of evaporation from the soil surface, maintaining soil moisture, reducing soil temperature fluctuations so that it benefits the growth of shallots and soil microorganisms, reducing the rate of soil erosion due to raindrops and can inhibit the rate of weed growth, as a source of soil organic matter. In addition, mulch also plays a role in stabilizing the soil, namely protecting the soil surface from direct raindrop impact. Mulch also plays a role in controlling soil temperature so that water loss and heat loss from the soil can be avoided (Kristiyanti, *et.al.*, 2021; Mahmudi, S. *et.al.*, 2017).

Research by Faisal, M., and Gusni Yelni (2021) found that using black and silver plastic mulch can produce optimal results for shallots. Furthermore, sufficient nutrient availability is essential to increase yields in this cultivation system; however, the drawback is that it provides shelter for pests under the mulch and can lead to plant root rot due to the stable and humid temperature beneath the plastic surface (Harsono, P. 2021). Efforts to reduce root rot disease can be achieved by using transparent plastic mulch. Transparent plastic mulch allows incoming light to pass through, trapping it beneath the plastic, activating microorganisms in the soil. The resulting heat can kill pests sheltering under the plastic and reduce root rot attacks. Straw mulch lowers soil temperature, conserves soil, suppresses erosion, and inhibits the growth of weeds (Septiarini Zuliati, *et al.* 2020; Yuliartini, *et al.* 2023).

The problem formulation is: 1). What dose of organic fertilizer produces higher yields of shallots? 2) Do different types of mulch have different effects on shallot yields? 3). Is there an interaction between the dose of organic fertilizer and the mulch used on shallot yields?

The specific objective of this study was to determine the response of organic fertilizer doses combined with mulch types to shallot yields. Cultivation methods employed appropriate technology and other integrated cultivation components within a sustainable production system.

## LITERATURE REVIEW

Shallots have extensive benefits both as a cooking ingredient and as a traditional medicine because they contain active compounds such as flavonoids, quercetin, saponins, tannins, glycosides, and polyphenols which have positive effects on health. Quercetin compounds function as antioxidants that can neutralize free radicals and reduce the risk of degenerative diseases such as cancer and diabetes; in addition, flavonoids in shallots also have the ability to improve the immune system by strengthening the immune response and protecting the body from bacterial infections; with the content of nutrients and active chemical compounds, shallots are not only useful for improving the taste of food but also contribute to the prevention and treatment of various diseases (Aryanta, 2019).

Shallots are a seasonal vegetable crop that adapts easily to lowland and highland areas. The optimal altitude for shallot growth and development is 0-1000 meters above sea level, with an optimum altitude of 0-450 meters above sea level. Shallots require a dry climate. The average temperature for shallots is 25-32°C, with an optimum temperature of 22°C. Optimal humidity. Shallots have pseudo-stem fibrous roots formed from leaf sheaths that wrap around each other. Shallot leaves have relatively short stems, with round, hollow, tapered leaves at the ends, and are 15-40 cm long. The leaves are dark green or light green. The shape of the shallot bulb varies, namely round, round, like an inverted top, and flat. The number of bulbs per cluster varies between 4-8 and the shape of the bulbs can vary from slightly round to more flattened. Bulbs are formed in the soil in a dense position (Rahmat and Herdi, 2017).

Organic fertilizers can improve the ion binding and release systems in the soil, thus supporting plant growth. The ability of organic fertilizers to bind water can increase soil porosity, thereby improving respiration and plant root growth. Organic fertilizers can also stimulate beneficial soil microorganisms, such as rhizobium, mycorrhizae, and bacteria (Sentana, 2010). Currently, many types of fertilizers derived from organic materials have been discovered, including manure, green manure, compost, biofertilizer, humus, litter fertilizer, liquid organic fertilizer, and guano fertilizer (Anonimus, 2020).

Mulch is a covering material for cultivated plants intended to maintain soil moisture and suppress weed and disease growth, thus promoting plant growth. Mulch materials can include plant residues or plant parts, classified as organic mulch, or synthetic materials such as plastic, classified as inorganic mulch (Suhardjo et al., 1993). The use of organic mulch as a ground cover is actually a traditional technique used for intensive crop production. Applying organic mulch to the soil creates a favorable microclimate between the soil, water, and plants. The use of organic mulch in chili farming is expected to create a suitable microclimate for plants, improve the physical and chemical environment of the soil, facilitate nutrient cycling in the soil-water-plant system, and improve nutrient availability for plants. The addition of nutrients to organic mulched soil as a product of soil biological organisms can reduce the use of chemical fertilizers, reduce farmer costs, reduce dependence on imported fertilizers, and also benefit the environment so that it can support a sustainable agricultural system.

Organic mulches include straw mulch and rice husk mulch, which function to suppress weed growth, maintain soil aggregates from rainwater impacts, reduce soil surface erosion, prevent water evaporation and protect the soil from exposure to sunlight. They can also help improve the physical properties of the soil, especially soil structure, thereby improving the stability of soil aggregates and controlling pests and diseases in plants (Thomas et al., 1993). Straw and rice husk mulch have distinct advantages over plastic mulch. This is due to the ability of straw and rice husk mulch to decompose due to its organic nature. The decomposing material turns into humus, which helps fertilize the soil. Rice husk mulch, on the other hand, is made from materials such as plant debris or reeds. This type of mulch is organic, with the straw cut into small pieces to ensure even application and ensure no areas are left untouched (Litbang, 2013). Plastic mulch is an inorganic type of mulch. It's a sheet of plastic used to cover the soil in beds or fields for plant cultivation. Mulch is very useful for inhibiting weed growth, protecting the soil from erosion, maintaining good soil structure, and retaining soil moisture. Although classified as inorganic, its use is environmentally friendly because it is made from low-density polyethylene.

MagneWish is a natural mineral containing magnesium, calcium, and endophytic microbes that improve soil conditions, increase plant vigor, and support environmental sustainability at an affordable cost. This product creates a symbiotic relationship between plants, soil, and native microbes. The endophytic *Bacillus* from BiOWiSH helps release root exudates containing sugars and enzymes to stimulate beneficial microbial activity in the rhizosphere and mobilize bound nutrients for easier root absorption. Furthermore, *Bacillus* plays a role in optimizing crop yields through the rhizophagy cycle, where microbes enter root cells to release nutrients and then return them to the soil to continue the cycle. The magnesium and calcium in MagneWish improve soil characteristics by increasing pH, reducing acidity, improving water penetration, and supporting plant growth. Magnesium is essential for metabolism, protein synthesis, and chlorophyll formation, while calcium plays a role in regulating metabolic processes, plant responses to the environment, seed germination, and photosynthesis. Overall, MagneWish is beneficial in improving soil and microbiome, developing root mass, increasing growth, and encouraging more optimal crop yields with a recommended dose of 150–300 kg/ha (Biowishtechnologies.com, 2024).

## METHODOLOGY

The research was conducted in rice fields in Subak Aban, Tegal Darmasaba Traditional Village, Abiansemal District, Badung Regency, from March to October 2025. The research method used a Factorial Randomized Block Design, consisting of two factors, namely the dose of MagneWish organic fertilizer (D) consisting of 4 levels: D1 = 100 kg.ha-1; D2 = 200 kg.ha-1; D3 = 300 kg.ha-1; D4 = 400 kg.ha-1 and the type of mulch consisting of 3 levels, namely M1 = black silver plastic; M2 = rice straw; M3 = rice husk. So that 12 combination treatments were repeated 3 times. The implementation of the research included land preparation, making 36 plots measuring 1.0 x 1.0 m with a ridge height of 20 cm, a distance between replications of 50 cm; planting was carried out in the afternoon, for shallot seeds, before planting, cut the tips by 1/3, then plant them to a depth of 3 cm, planted with a spacing of 15 x 15 cm; then covered with straw mulch and burnt rice husks; for black and silver plastic mulch, it is installed before planting. Organic fertilizer treatment is given twice according to the treatment dose. Maintenance includes watering, replanting, weeding, and pest and disease control. Harvesting is carried out after the shallot plants are 60 days after planting. Variables observed in shallot plants include plant height, number of leaves, number of onion bulbs, fresh and oven-dry weight of bulbs and fresh and oven-dry weight of stover, and harvest index. Data were analyzed statistically using analysis of variance.

## RESEARCH RESULTH AND DISCUSSION

The statistical analysis of all observed variables revealed significant effects of Magne Wish Organic Fertilizer Dose (D) and Mulch Type (M), as well as their interaction (DxM) on the observed variables. These effects are presented in.

**Table 1. Significance of MagneWish Organic Fertilizer Dose (D) and Mulch Type (M) and their Interaction (DxM) on all Observed Variables**

No	Variable	Treatment		
		Organic Fertilizer Dose (D)	Mulch Type (M)	Interac tion (DxM)
1	Maximum plant height (cm)	ns	ns	ns
2	Maximum number of leaves per clump (piece)	ns	ns	ns
3	Number of tubers per clump (tubers)	ns	ns	ns
4	Fresh weight of tubers per clump (g)	ns	ns	ns
5	Fresh Weight of of stover per clump (g)	ns	ns	ns
6	Oven Dry Weight of Tubers per clump (g)	ns	ns	ns
7	Oven-dry weight of stover per clump (g)	ns	ns	ns
8	Harvest Index	ns	ns	ns

Note: ns = No significant effect ( $P \geq 0.05$ )

• = Significant effect ( $P < 0.05$ )

\*\* = Very significant effect ( $P < 0.01$ )

Interaction of MagneWish Organic Fertilizer Dose with Mulch Type (DxM), MagneWish Organic Fertilizer Dose (D) and Mulch Type (M) had no significant effect ( $P \geq 0.05$ ) on all observed variables (Table 1).

The average maximum plant height; maximum number of leaves; number of tubers per clump and fresh and oven-dry weight of tubers per clump, fresh and oven-dry weight of tubers per clump, and harvest index for the MagneWish Organic Fertilizer Dose (D) and Mulch Type (M) treatments are presented in Tables 2 and 3.

**Tabel 2. Average Maximum Plant Height (cm), Maximum Number of Leaves (Pieces), Number Tubers Per Hill and Fresh Weight of Tubers Per Hill in the Fertilizer Dose Treatment Magne Wish Organic (D) and Mulch Type (M)**

Treatment	Maximum plant height (cm)	Maximum number of leaves (pieces)	Number of tubers per clump (tubers)	Fresh weight of tubers per clump (g)
Organic Fertilizer Dosage MagneWish				
D <sub>1</sub> ( 100 kg..ha <sup>-1</sup> )	36.49 a	30.56 a	5,89 a	60.46 a
D <sub>2</sub> ( 200 kg..ha <sup>-1</sup> )	37.86 a	35.72 a	6,61 a	65.91 a
D <sub>3</sub> ( 300 kg..ha <sup>-1</sup> )	38.92 a	36.78 a	6,39 a	68.37 a
D <sub>4</sub> ( 400 kg. ha <sup>-1</sup> )	39.31 a	38.56 a	6,50 a	72.08 a
BNT 5 %	-	-	-	-
Jenis Mulsa				
M <sub>1</sub> (Black Silver Plastic)	37,83 a	35.58 a	6.92 a	66,55 a
M <sub>2</sub> (Straw)	38,53 a	38,63 a	6,04 a	68,10 a
M <sub>3</sub> (Husk)	38,08 a	32,00 a	6.58 a	57,96 a
BNT 5 %	-	-	-	-

**Table 3. Average Fresh Weight of Stover Per Clump (G), Oven Dry Weight of Tubers Per Clump (G), Oven Dry Weight of Stover Per Clump (G) and Harvest Index (%) in the Treatment of MagneWish Organic Fertilizer Dosage (D) and Mulch Type (M)**

Treatment	Fresh weight of stover per clump (g)	Oven Dry Weight of Tubers per clump (g)	Oven-dry weight of stover per clump (g)	Harvest index (%)
Organic Fertilizer Dosage MagneWish				
D <sub>1</sub> ( 100 kg..ha <sup>-1</sup> )	15.20 a	4.92 a	0.66 a	87.67 a
D <sub>2</sub> ( 200 kg..ha <sup>-1</sup> )	15.28 a	5.01 a	0.78 a	86.43 a
D <sub>3</sub> (300 kg..ha <sup>-1</sup> )	15.74 a	5.84 a	0.73 a	87.14 a
D <sub>4</sub> ( 400 kg..ha <sup>-1</sup> )	15.78 a	5.79 a	0.72 a	88.33 a
BNT 5 %	-	-	-	-
Type of mulch				
M <sub>1</sub> (Black Silver Plastic)	15,62 a	5,31 a	0,71 a	84,65 a
M <sub>2</sub> (Straw)	15,97 a	6,08 a	0,75 a	88.29 a
M <sub>3</sub> (Husk)	14,97 a	5,03 a	0,70 a	81,24 a
BNT 5 %	-	-	-	-

Description: The average values followed by the same letter in the same treatment and column are not significantly different at the 5% BNT test level.

The application of MagneWish Organic Fertilizer Dosage statistically had no significant effect on the growth and yield of shallots on various types of mulch, this is because MagneWish fertilizer acts as a soil conditioner where the mineral content in MagneWish fertilizer such as magnesium (Mg) and calcium (Ca) which are secondary essential macronutrients can only improve soil fertility by neutralizing pH and increasing water penetration (Biowishtechnologies.com, 2024).

MagneWish organic fertilizer creates a symbiotic relationship between plants, soil, and native soil microbes, where endophytic *Bacillus* helps release root exudates that can increase the activity of beneficial microbes in the rhizosphere and is able to stimulate native microbes that mobilize bound nutrients to be absorbed into plant roots, in order to improve soil conditions to increase plant strength and nutrient absorption which will optimize crop yields. Increasing the dose of MagneWish fertilizer resulted in a tendency for the growth and yield of shallots to increase, but the differences were not significant. It is known that shallots require more complex nutrients such as N, P, K, and S. These nutrients are essential nutrients that plants need in large amounts ( $\geq 0.1\%$ ) and function as metabolic processes in shallots (Suntari *et al.*, 2023). In this study,

shallots received a supply of nutrients available in the soil in the form of C (moderate), N (low), P (very high), and K (moderate) based on the results of soil analysis at the research site.

The use of various types of mulch, namely black and silver plastic mulch, rice straw, and rice husk charcoal, did not significantly affect the growth or yield of shallots. This finding aligns with the results of research conducted by Kristianti *et al.* (2021), which found that the type of mulch showed no statistically significant effect on growth or yield variables, although rice husk mulch numerically provided the highest fresh weight of bulbs per clump, which was not significantly different from rice straw and black and silver plastic. In this study, straw mulch tended to provide better yields and growth than black and silver plastic mulch and burnt rice husks. This is because straw helps maintain soil moisture by reducing the rate of evaporation, controlling soil temperature fluctuations, and suppressing weed growth. Furthermore, straw mulch also helps reduce soil erosion due to rainwater splashes. With more stable soil microenvironment conditions, shallot plant growth and microorganism activity in the soil are more optimal (Yuliantini *et.al.* 2023). Straw mulch has a distinct advantage over plastic mulch where straw mulch shows the lowest soil temperature compared to no mulch or with black silver plastic mulch, this is because the heat received by straw mulch does not directly enter the soil and can immediately occur with free air. Straw mulch is a mulch of rice plant residues classified as a type of organic mulch. Straw is cut into small pieces with the aim of installing mulch on the soil evenly and rotting because it is organic, the rotting material will turn into humus which helps fertilize the soil (Damaiyanti *et. al.*, 2013 in Yuliantini *et. al.*, 2023).

## CONCLUSIONS AND RECOMMENDATIONS

1. The interaction between organic fertilizer dosage and mulch type had no significant effect ( $P \geq 0.05$ ) on all observed variables.
2. Increasing the organic fertilizer dosage tends to increase the fresh weight of shallot bulbs per clump.
3. Straw mulch tends to provide better yields and growth than black and silver plastic mulch and burnt rice husks.

## ADVANCED RESEARCH

Further research is needed in different locations and with different technological inputs, as differences in growing environments and altitude significantly affect the yield of cultivated shallots.

## ACKNOWLEDGMENT

The research team would like to thank the Rector of Warmadewa University and the Director of the Directorate of Research and Community Service for their financial and other support to conduct this research, as well as the Pekaseh Subak Aban and students who assisted in ensuring the smooth running of the research activities.

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