



RESPONSE OF PEANUT PLANT GROWTH AND YIELD TO DECREASED ORGANIC FERTILISER DOSAGE AND INCREASED ORGANIC FERTILISER DOSAGE

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Abstract

This study used a randomized complete block design (RCB) to evaluate the effect of various doses of organic fertilizer on the growth and yield of peanut plants. This research involved seven treatment units, each with a unique combination of inorganic and organic fertilizers. Each treatment was repeated four times, so there were 28 treatment units. Each unit comprises 16 plants carefully selected and managed to ensure consistent growing conditions. Four plants were taken from each unit as samples for analysis, and 112 sample plants were used to collect growth data and other relevant variables.

Peanut cultivation in Indonesia faces serious challenges, such as reduced productivity due to prolonged drought and inadequate agricultural practices. This research aims to determine the impact of lowering the dose of inorganic fertilizer and increasing the use of organic fertilizer on the growth and yield of peanuts. The results showed a significant effect of various fertilizer combinations on growth parameters. Treatment P5 (a combination of inorganic and organic fertilizer) gave the best results in vegetative observations. In contrast, treatment P4 (a combination of inorganic and organic fertilizer) was superior in yield and pod weight. These findings emphasize the importance of implementing integrated fertilizers in peanut cultivation to improve agricultural sustainability. This research provides valuable insights for farmers and researchers in developing more efficient and environmentally friendly farming practices and supporting increased productivity of peanut plants in various environmental conditions.

Keywords: Groundnut cultivation, integrated fertilization, organic fertilizer, inorganic fertilizer, sustainable agriculture.

INTRODUCTION

Groundnuts (*Arachis hypogaea* L.) are an essential food crop in Indonesia, with their demand continuing to increase due to population growth and food industry needs. This crop ranks second after soybeans in meeting the community's food needs as a direct food material and a processed product (Balitkabi, 2008). Farmers often plant groundnuts as an intercrop or utilize vacant land after harvesting the main crop. However, groundnut production has decreased recently due to prolonged drought and inadequate cultivation practices. Data from the Ministry of Agriculture (2018) shows a decline in productivity from 638,896 tons in 2014 to 512,198 tons in 2018, causing an inability to meet market demand and a 50.55% increase in imports in 2017, reaching 292,173 tons.

Crop productivity is influenced by fertilizer use, both organic and inorganic. NPK fertilizer is a standard inorganic fertilizer that contains Nitrogen (N), Phosphorus (P), and Potassium (K). Organic fertilizer comes from decomposed plant or animal matter. Organic fertilizer improves soil structure,

increases water absorption, and provides nutrients to the plants, while inorganic fertilizer provides quick results but can harm the environment in the long run. Therefore, it is necessary to increase the use of organic fertilizer to balance soil conditions and reduce environmental damage. Integrated fertilization is recommended to minimize the adverse effects of inorganic fertilizers. In addition to proper fertilization, superior varieties such as Hypoma 1, released by the government in 2012, can increase agricultural production (Swastika, 2013).

This research aims to observe the differences in growth response and groundnut yields with an organic fertilizer in the form of cow manure and inorganic fertilizer in the form of NPK multi-fertilizer 16:16:16, as well as measure the effect of fertilizer dose on plant growth and yield. Overall, groundnut cultivation in Indonesia requires a better strategy to address challenges such as climate change and improper fertilizer use. Organic fertilizer, integrated fertilization, and superior varieties can sustain groundnut productivity, meet domestic market demand, and reduce import dependence. This research will provide valuable information for farmers to optimize groundnut cultivation.

LITERATURE REVIEW

Groundnuts (*Arachis hypogaea* L.) are not native to Indonesia but originated from South America, specifically Brazil, particularly in the Paraguay and Paraná river valleys. The plant was first brought to Europe and then spread to Asia in the early 18th century (Sumarno, 2015). Its classification is: Kingdom: Plantae, Division: Spermatophyta, Subdivision: Angiospermae, Class: Dicotyledonae, Order: Rosales, Family: Papilionaceae, Subfamily: Leguminosae, Genus: *Arachis*, Species: *Arachis hypogaea* L. (Tjitrosoepomo, 2013).

The growth of groundnuts can be divided into two types: upright and sprawling. Farmers prefer the upright type because it has a shorter maturation period (100-120 days), grows straight up or slightly inclined, and its pods are located on the main stem and branches. The sprawling type grows sideways with extended maturation (150-200 days), producing pods near the ground with two seeds. The morphology of groundnuts includes a single stem root that reaches a depth of 50-55 cm with a radius of 12-14 cm, as well as lateral roots that are 15-20 cm long. The roots of groundnuts have nodules caused by the infection of nitrogen-fixing bacteria such as *Rhizobium japonicum* and *Bradyrhizobium* spp. The nodules are formed through hair roots or crevices, with groundnuts precisely forming nodules on lateral roots (Tajima et al., 2006).

The groundnut plant is an upright shrub with a non-woody stem. The main stem can reach a length of 12-65 cm with fine hairs. Lateral branches can reach 80-100 cm. The branching pattern is four-fold: alternating, sequential, irregular with flowers on the main stem, and irregular without flowers on the main stem. The leaves of groundnuts are compound leaves with three to four leaflets. The Spanish type has oval-shaped leaves, while the Valencia type has more pointed leaves. The flowers are butterfly-shaped with a yellow corolla and can self-pollinate. The flowering stage occurs 3-6 weeks after planting, with flowers lasting 24 hours before wilting and falling off, leaving only 70-

75% of them to form pod shells or ginophores. The fruit of groundnuts is a pod that varies in size, length, shape, and curvature. The Spanish type can produce up to 50 pods per plant, while the Virginia type can produce up to 250 pods. Each pod contains 1-4 seeds, usually 2-3 seeds. The seeds of groundnuts are protected by a seed coat that depends on the variety. The climate affecting groundnuts' growth includes rainfall of 800-1300 mm per year, an optimum temperature of 28-32°C, and relative humidity of 65-75%. Groundnuts are suitable for cultivation in low-lying areas with a maximum elevation of 1000 meters above sea level. Fertilization is essential for the growth of groundnuts. The elements N, P, and K each have a significant role.

Phosphorus is essential for seed development and root growth, while potassium helps maintain the water status of the plant. Proper fertilization, such as organic fertilizer at 2-5 tons/ha, single urea fertilizer (N) at 100 kg/ha, SP-36 (P) and KCl (K) at 200 kg/ha each, and NPK fertilizer at 50 kg/ha, can increase crop productivity. Integrated fertilization using organic and inorganic fertilizers can maintain soil organic matter and improve soil quality. Organic fertilizer, such as chicken manure, helps improve soil physical properties and increase soil biota. Giving organic fertilizer and inorganic fertilizer can increase soil productivity and fertilizer efficiency. Research results show that giving organic fertilizer together with inorganic fertilizer has a positive effect on the growth and yield of groundnut plants. Problem Statement: 1) Does reducing inorganic fertilizer dosage and adding organic fertilizer elicit a distinct response in plant growth and production? 2) What is the optimal dosage of organic fertilizer that yields the most favorable outcomes for peanut plant growth?

METHOD

The research study employed a randomized complete block (RCB) design to investigate the effect of different doses of organic fertilizer on plant growth. The study involved 7 treatment units, each with a unique combination of inorganic and organic fertilizers. The treatments were designed to test the impact of varying levels of organic fertilizer on plant growth, with each treatment unit representing a different dose of organic fertilizer. Each treatment unit was repeated four times, resulting in 28 treatment units. Each treatment unit contained 16 plants, carefully selected and managed to ensure consistent growing conditions. From each treatment unit, four plants were taken as samples for analysis. One hundred twelve sample plants were used to gather data on plant growth and other relevant variables. The study's design allowed for a comprehensive examination of the effects of different doses of organic fertilizer on plant growth, providing valuable insights for farmers and researchers interested in sustainable agriculture practices.

RESULTS AND DISCUSSION

The reduction of inorganic fertilizer dosage and addition of organic fertilizer in combination significantly affects various growth parameters, such as plant height, leaf number, productive nodes

number, number of gynophores, number of pods per plant, number of pods per plot, number of filled pods, number of empty pods, number of root nodules, fresh weight of pods, dry weight of pods, and weight of 100 seeds. The highest average peanut plant height was achieved in treatment P5 when the plants were 10 DAS, with an average height of 67.02 cm. Treatments P3 and P7 yielded similar results with heights of 65.90 cm and 65.72 cm, respectively. Treatment P1 showed the lowest result, with an average height of 61.75 cm. Adding organic matter to the soil increases the content of crucial organic carbon for the soil's physical and chemical properties.

Decomposed organic matter forms humus, which has a negative charge and is thus capable of adsorbing soil cations. Mangas et al. (2021) stated that soil with high cation exchange capacity (CEC) could bind and store more essential plant nutrients. Treatment P5 (inorganic fertilizer 25 grams/plot + organic fertilizer 3.5 kg/plot) resulted in the highest plant height because nitrogen (N) content is more available. Nitrogen is essential for chlorophyll and plant protein synthesis during growth, aiding in cell division and enlargement in apical meristems (Munawar, 2011; Purbajanti et al., 2019). The number of peanut leaves also significantly differed in the variance analysis. Treatment P5 produced the highest average leaf count (120 leaves) at 10 DAS, which did not significantly differ from P6 (119.13 leaves) and P4 (118.38 leaves). The lowest leaf count was obtained in P1 (114.63 leaves), which did not significantly differ from P2 (115.88 leaves).

Nutrient availability promotes plant growth, with more leaves indicating better photosynthesis and greater assimilate uptake (Kustiani & Santorini, 2019; Suwarno, 2013; Safei, 2014). Treatment P5 yielded the highest result in observing the number of root nodules (138.00 pieces), significantly different from P1 (110.75 pieces) but not significantly different from P6 and P7 (132.00 pieces). Root nodules are formed from the symbiosis between Rhizobium bacteria and leguminous plants, which bind nitrogen from the air and convert it into amino acids used by plants (Setyawan et al., 2015; Damanik et al., 2010; Sadmaka et al., 2017; Hidayat, 2008). The highest productive node count was obtained in treatment P4 (67.50 pieces), significantly different from P5, P7, and P6. Productive nodes play a role in flower and gynophore formation, which turns into pods. Nutrient availability, especially nitrogen, influences branch formation in peanut plants (Karim et al., 2019; Harjanti et al., 2014). Treatment P4 produced the highest gynophore count per plant (63.75 pieces), significantly different from P5, P7, and P6. Gynophore formation is related to productive node growth and plant height (Sufianto, 2011). Treatment P4 also provided the highest number of pods per plant and plot, with 23.4 and 373.8 pods, respectively. It is supported by optimal macro-nutrient availability (Hulopi, 2008). The highest number of filled pods was obtained in P7 (20.80 pods), similar to P4 (20.30 pods).

The highest number of empty pods was found in P5 (4.00 pieces), similar to P4 and P6. Imbalances in nutrients and environment affect the number of filled and empty pods (Siregar, 2021; Hazmi & Hartoyo, 2013; Hakim in Tommy D. Sondah et al., 2012). The highest fresh pod weight was produced in P4 (40.40 grams), significantly different from P1 (25.45 grams). Fresh pod weight is related to photosynthesis and nutrient content, especially nitrogen, phosphate, and potassium

(Laminulla et al., 2018). Dry pod weight in P4 (33.04 grams) also significantly differed from P1 (18.81 grams), indicating a positive relationship between fresh and dry weight (Jumin, 2014; Suharja & Sutarno, 2009; Surya et al., 2019). The highest weight of 100 seeds was obtained in treatment P4 (50.00 grams), significantly different from P7 (36.00 grams). This difference is influenced by seed size, environmental conditions, and genetic factors (Surya et al., 2019; Sufianto, 2011; Sandra, 2012).

CONCLUSION

Based on the findings of the study on the Response of Peanut Plant Growth and Yield to Decreased Organic Fertiliser Dosage and Increased Organic Fertiliser Dosage, it can be concluded that There is a significant effect on peanut plant growth and yield responses to decreased organic fertilizer dosage from the recommended dosage, combined with increased organic fertilizer dosage, on parameters such as plant height, leaf count, productive branch count, ginophore count, root hair count, pod yield per plant, pod yield per plot, filled pod count, empty pod count, fresh pod weight, dry pod weight, and 100-seed weight.

Treatment P5, which received a combination of inorganic fertilizer (25 grams/plot) and organic fertilizer (3.5 kg/plot), produced the best results for vegetative observation parameters such as plant height and leaf count, root hair count, and empty pod count. Treatment P4, which received a combination of inorganic fertilizer (25 grams/plot) and organic fertilizer (3.0 kg/plot), produced the best results for parameters such as productive branch count, gynophore count, pod yield per plant, pod yield per plot, filled pod count, fresh pod weight, dry pod weight, and 100-seed weight.

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