The Effect of Corn Compost and NPK Fertilizer on the Growth and Production of Shallot Plants (*Allium ascalonicum* L.)

Ardian*, Sri Yoseva, Nurbaiti, M. Amrul Khoiri, P. Angga, Anwary Mahsa

Department of Agrotechnology, Faculty of Agriculture, Riau University
Jl. Kampus Bina Widya KM. 12,5, Simpang Baru, Kota Pekanbaru, Riau, Indonesia
***Correspondence** : E-mail: ardian1960@yahoo.com, Phone +62 812-7677-3259

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ABSTRACT

Red onion (Allium ascalonicum L.) is a horticultural commodity essential for use as a cooking spice and in traditional medicine. To enhance shallot production, one effective method is adding organic matter to the soil, such as corn compost, which can improve the soil's cation exchange capacity (CEC) and provide more nutrients. Additionally, supplementing with essential nutrients during the vegetative and generative growth stages is important, which can be achieved through the application of NPK fertilizer. This study aims to investigate the interaction between corn compost and NPK fertilizer and to identify the optimal treatment combination. The research employs a completely randomized design (CRD) with two factors: the dosage of corn compost and the dosage of NPK fertilizer. The first factor includes four levels of corn compost: K0 = no corn compost, K1 = 15 t.ha^{-1}, K2 = 20 t.ha^{-1}, and K3 = 25 t.ha^{-1}. The second factor consists of three levels of NPK fertilizer: N1 = NPK 300 kg.ha^{-1}, N2 = NPK 400 kg.ha^{-1}, and N3 = NPK 500 kg.ha^{-1}. This results in 12 treatment combinations, with 3 replications, yielding a total of 36 experimental units. Data collected from the analysis of variance were further examined using Duncan's multiple range test at a 5% significance level. The results indicate that the combination of corn compost at 15 t.ha^{-1} and NPK fertilizer at 400 kg.ha^{-1} significantly increases plant height, leaf count, accelerates harvest time, and enhances fresh tuber weight per plant, fresh tuber weight per plot, and storable tuber weight per plot.

Keywords: *corn compost, NPK fertilizer, shallot*

INTRODUCTION

Shallots (*Allium ascalonicum* L.) are classified as a horticultural commodity that is essential for the community as a cooking ingredient and a raw material for medicines. Shallots have high economic value and nutritional content. According to (5) shallots contain various substances beneficial for health, such as carbohydrates (16.80 g), phosphorus (153 mg), calcium (181 mg), iron (1.7 mg), and vitamin C (31.2 mg).

Based on data from (1), the production of shallots in Riau Province in 2021 was 329 tons, with a harvested area of 67 hectares and a productivity of 4.91 tons per hectare. In 2022, the production of shallots decreased to 195 tons, with a harvested area of 63 hectares and a productivity of only 3.09 tons per hectare. The decline in shallot production has impacted the fulfillment of consumer needs in Riau, necessitating the import of shallots from other regions such as North Sumatra, West Sumatra, Central Java, and East Java. Increasing shallot production can be achieved, one of which is through the use of organic materials. Organic materials are one of the components that form soil aggregates, acting as a binding agent that helps soil particles unite into aggregates. Plant litter can be reused as compost, which is beneficial for soil improvement. One type of plant litter that is rarely utilized for composting is corn litter. Corn litter can be processed into corn compost, which plays a role in the plant production cycle as it is beneficial for enhancing soil fertility,

improving soil structure, and adjusting soil pH.

Corn compost can improve the cation exchange capacity (CEC) of the soil. Soils with high CEC can provide more nutrients compared to soils with low CEC (12). A drawback of compost is that it takes a long time to supply the nutrients required by plants. The nutrient needs of plants must be met optimally and efficiently; thus, using corn compost alone is insufficient to satisfy the plants' nutrient requirements.

Another approach to enhance the growth and production of shallots, aside from using corn compost, is through fertilization, one of which is the application of inorganic fertilizers. A commonly used inorganic fertilizer is NPK fertilizer, which contains nitrogen (N), phosphorus (P), and potassium (K) essential factors that must always be available for plants as they are utilized in plant metabolism and biochemical processes.

This study aims to investigate the interaction between corn compost and NPK fertilizer, specifically the effects of varying concentrations of coconut water and NPK fertilizer on the growth and yield of shallots (*Allium ascalonicum* L.).

MATERIAL AND METHODS

This research was carried out at the Technical Implementation Unit (TIU) of the Experimental Garden and Soil Laboratory, Faculty of Agriculture, Riau University, located at Bina Widya Campus, KM 12.5, Simpang Baru Village, Tampan District, Pekanbaru City. The study spanned four months. It utilized a factorial design structured as a completely randomized design (CRD) consisting of two factors. The first factor was corn compost, with four levels of treatment: no corn compost (0 $t.ha^{-1}$), corn compost at 15 $t.ha^{-1}$, corn compost at 20 $t.ha^{-1}$, and corn compost at 25 $t.ha^{-1}$. The second factor involved the dosage of NPK fertilizer 16-16-16, comprising three treatment levels: 300 $kg.ha^{-1}$, 250 $kg.ha^{-1}$, and 375 $kg.ha^{-1}$. These two factors were combined to create 12 treatment combinations, each repeated three times, resulting in a total of 36 experimental units.

The materials used in this study include shallot bulbs of the Bima Brebes variety, corn compost, NPK compound fertilizer 16-16-16, Dithane M-45, Decis 25 EC, plastic mulch, and water. The tools employed include hoes, machetes, measuring tapes, raffia strings, shading nets, watering cans, buckets, sprayers, labeling paper, cameras, digital scales, rulers, calipers, stationery, and other supporting equipment.

The parameters observed in this study include plant height, number of leaves, harvest age, number of bulbs per clump, bulb diameter, wet weight of bulbs per plant, wet weight of bulbs per plot, and dry weight of bulbs per plot. The data obtained were statistically analyzed using analysis of variance (ANOVA) with a linear model, followed by a Duncan's multiple range test at a 5% significance level.

RESULT

Plant Height

Table 1. Plant height (cm) of shallots given corn compost and NPK fertilizer

NPK Fertilizer (kg/ha)	Corn Compost (t/ha)				Average
	0	15	20	25	
300	34,26^{b}	34,36^{b}	35,50^{ab}	35,16^{ab}	34,80^{b}
400	34,56^{b}	34,56^{b}	36,16^{ab}	35,83^{ab}	35,28^{a}
500	34,33^{b}	34,50^{b}	35,16^{ab}	36,50^{a}	35,12 ^{ab}
Average	34,38^{b}	34,47^{b}	35,58^{a}	35,83^{a}	

Table 1 indicates that applying corn compost at a rate of 25 $t.ha^{-1}$ along with NPK fertilizer at 500 $kg.ha^{-1}$ led to a significant increase in the height of shallot

plants compared to the absence of corn compost (0 t.ha^{-1}) and the use of 15 t.ha^{-1} of corn compost combined with NPK doses of 300 kg.ha^{-1}, 400 kg.ha^{-1}, and 500 kg.ha^{-1}. However, this treatment did not show a significant difference when compared to other combinations. The increase in shallot plant height is largely determined by the nutrients that the plants take up. The synergistic effect of corn compost and NPK fertilizer enhances nutrient availability in the soil, which in turn promotes plant growth. High doses of organic materials like corn compost are beneficial for fulfilling the nutrient requirements of plants during their vegetative phase, particularly influencing plant height. The addition of corn compost also elevates the soil's cation exchange capacity (CEC), facilitating better nutrient availability. According to (10), adequate nutrient supply during the vegetative growth phase encourages active photosynthesis, which results in effective cell division, elongation, and differentiation. A balanced provision of macronutrients such as nitrogen (N), phosphorus (P), and potassium (K) is essential for young plants, as these nutrients play a vital role in stimulating growth in roots, stems, and leaves.

Number of Leaves

Table 2. Number of leaves (pieces) of shallots given corn compost and NPK fertilizer

NPK Fertilizer (kg/ha)	Corn Compost (t/ha)				Average
	0	15	20	25	
300	26,53^{c}	26,53^{c}	26,73^{bc}	27,00^{abc}	26,78^{b}
400	26,53^{c}	26,73^{bc}	28,00^{ab}	27,33^{abc}	27,10^{ab}
500	27,00^{abc}	27,33^{abc}	27,86^{abc}	28,33^{a}	27,63^{a}
Average	26,62^{b}	26,86^{b}	27,53^{a}	27,66^{a}	

Table 2 illustrates that the use of corn compost at a rate of 25 t.ha^{-1} combined with NPK fertilizer at 500 kg.ha^{-1} led to a significant increase in the number of leaves on shallot plants compared to the absence of corn compost (0 t.ha^{-1}), as well as when using corn compost at doses of 15 t.ha^{-1} and 20 t.ha^{-1} with NPK at 300 kg.ha^{-1}, and with 15 t.ha^{-1} of corn compost paired with NPK at 400 kg.ha^{-1}. However, this treatment did not exhibit significant differences from other combinations. The observed increase in leaf count is likely attributed to the nutrient content specifically nitrogen (N), phosphorus (P), and potassium (K) that the plants receive from the application of corn compost and NPK fertilizer, fulfilling the nutrient needs of shallots. (3) noted that leaf development is closely linked to the nutrient absorption capability of the plants. Nutrients are vital for the creation of new plant cells, which are crucial for leaves to perform their essential role in photosynthesis.

Harvest Age

Table 3. Harvest age (days) of shallots given corn compost and NPK fertilizer

NPK Fertilizer (kg/ha)	Corn Compost (t/ha)				Average
	0	15	20	25	
300	60,00	59,00	60,00	59,00	59,50
400	60,00	59,33	58,33	58,33	59,00
500	59,33	58,33	58,66	59,33	58,91
Average	59,77	58,89	59,00	58,88	

Table 3 indicates that applying corn compost at doses of 25 and 20 t.ha^{-1} in combination with NPK fertilizer at 500 kg.ha^{-1} significantly hastened the harvest age of shallot plants compared to scenarios without corn compost (0 t.ha^{-1}), as well as with corn compost at 15 t.ha^{-1}, and at 20 t.ha^{-1} with NPK at 300 kg.ha^{-1}, and corn compost at 15 t.ha^{-1} with NPK at 400 kg.ha^{-1}. Nevertheless, this treatment did not reveal significant differences when compared to other combinations. The accelerated harvest age is likely due to the nutrient content specifically nitrogen (N), phosphorus (P), and potassium (K) that the

plants receive from the corn compost and NPK fertilizer, which fulfill the nutrient needs of shallots. Increased levels of corn compost and NPK fertilizer contribute to an earlier harvest for shallots. A sufficient supply of N, P, and K is essential in speeding up the harvest age. (7) noted that nutrient availability in the soil significantly influences both the vegetative and generative phases of plant metabolism.

Number of Bulbs

Table 4. Number of bulbs (pieces) of shallots given corn compost and NPK fertilizer

NPK Fertilizer (kg/ha)	Corn Compost (t/ha)				Average
	0	15	20	25	
300	4,90^{f}	5,00^{ef}	5,80^{def}	7,56^{ab}	5,81^{c}
400	5,20^{ef}	5,90^{de}	6,33^{cd}	8,23^{a}	6,41^{b}
500	6,56^{cd}	6,33^{cd}	7,23^{bc}	7,76^{ab}	6,97^{a}
Average	5,55^{c}	5,74^{c}	6,45^{b}	7,85^{a}	

Table 4 indicates that using corn compost at a rate of 25 t.ha^{-1} along with NPK fertilizer at 400 kg.ha^{-1} significantly boosted the number of bulbs produced by shallot plants compared to the absence of corn compost (0 t.ha^{-1}), as well as when using corn compost at doses of 15 t.ha^{-1} and 20 t.ha^{-1} combined with NPK at 300 kg.ha^{-1}, 400 kg.ha^{-1}, and 500 kg.ha^{-1}. However, this treatment did not yield significant differences when compared to other combinations. The number of bulbs formed is influenced by nutrient availability, especially potassium. (2) highlighted that potassium is vital for starch synthesis and the movement of photosynthesis products, which are essential for bulb development. Additionally, the number of bulbs can vary based on the variety and size of the seed bulbs, which affects the number of lateral shoots that develop on them (8). According to (9), each shallot bulb can produce between 3 to 20 lateral shoots. These shoots grow into new plants that subsequently form bulbs. The increase in bulb quantity is also linked to the rise in leaf number; a greater number of leaves leads to a higher bulb count.

Diameter of Shallot Bulbs

Table 5. Diameter of shallot bulbs (cm) given corn compost and NPK fertilizer

NPK Fertilizer (kg/ha)	Corn Compost (t/ha)				Average
	0	15	20	25	
300	2,20^{b}	2,21^{b}	2,24^{b}	2,26^{b}	2,22^{a}
400	2,20^{b}	2,27^{b}	2,23^{b}	2,40^{a}	2,27^{a}
500	2,26^{b}	2,23^{b}	2,25^{b}	2,26^{b}	2,25^{a}
Average	2,22^{a}	2,24^{a}	2,24^{a}	2,31a	

Table 5 demonstrates that the application of corn compost at a rate of 25 t.ha^{-1} combined with NPK fertilizer at 400 kg.ha^{-1} significantly enhanced the diameter of shallot bulbs compared to other treatment combinations. The increase in bulb size is attributed to the sufficient availability of nutrients for the plants. Specifically, macronutrients like potassium, supplied by both corn compost and NPK fertilizer, play a crucial role in improving the quality of shallot bulbs, leading to larger bulb sizes. (11) noted that potassium in the soil is essential for carbohydrate and protein synthesis, which contributes to the enlargement and enhancement of bulb quality in shallots.

Fresh Bulb Weight per Plant

Table 6. Fresh bulb weight per plant (g) of shallots given corn compost and NPK fertilizer

NPK Fertilizer (kg/ha)	Corn Compost (t/ha)				Average
	0	15	20	25	
300	61,23^{c}	60,93^{c}	62,46^{bc}	63,56 ^{b}	62,16 ^{b}
400	61,66^{c}	63,16 ^{b}	64,03^{ab}	64,60^{ab}	63,25^{ab}
500	62,82^{bc}	63,76^{b}	64,50^{ab}	64,83 ^{a}	63,98 ^{a}
Average	61,91^{b}	62,62^{ab}	63,85^{ab}	64,14^{a}	

Table 6 indicates that the use of corn compost at a rate of 25 t.ha^{-1} along with

NPK fertilizer at 500 kg.ha^{-1} significantly enhanced the fresh bulb weight per plant of shallots. This increase in bulb weight is attributed to the nutrient availability provided by corn compost and NPK fertilizer during the vegetative phase, which promotes root development and enables the roots to effectively absorb nutrients from the soil. According to (6), root growth is influenced by both internal factors (such as the supply of photosynthates from leaves, primarily in the form of sucrose) and environmental conditions (including soil temperature and moisture levels). When essential nutrients are available in balanced and adequate amounts, it leads to improved plant metabolism, facilitating efficient accumulation of assimilates in the bulbs and resulting in increased bulb weight.

Fresh Bulb Weight per Plot

Table 7. Fresh bulb weight per plot (g) of shallots given corn compost and NPK fertilizer

NPK Fertilizer (kg/ha)	Corn Compost (t/ha)				Average
	0	15	20	25	
300	1362,6^{b}	1413,67^{ab}	1473,33^{ab}	1500,33^{ab}	1437,50^{b}
400	1377,00^{ab}	1540,33^{ab}	1607,33^{a}	1496,67^{ab}	1505,33^{ab}
500	1539,67^{ab}	1560,33^{ab}	1564,33^{ab}	1545,17^{ab}	1552,38^{a}
Average	1426,44^{b}	1504,78^{ab}	1548,33^{ab}	1514,06^{a}	

Table 7 indicates that the use of corn compost at a rate of 20 t.ha^{-1} combined with NPK fertilizer at 400 kg.ha^{-1} significantly enhanced the fresh bulb weight per plot of shallots compared to conditions without corn compost (0 t.ha^{-1}) and with NPK at 300 kg.ha^{-1}. However, this treatment did not display significant differences from other combinations. The increase in fresh bulb weight can be attributed to the nutrient availability resulting from the application of corn compost and NPK fertilizer during the vegetative phase, which promotes root development and enhances the roots' ability to absorb nutrients from the soil. (6) noted that root elongation rates are affected by internal factors (such as the supply of photosynthates from leaves, typically in the form of sucrose) as well as environmental factors (including soil temperature and moisture levels). Adequate and balanced availability of essential nutrients improves plant metabolism, leading to more efficient accumulation of assimilates in the bulbs, which in turn boosts bulb weight.

Weight of Marketable Shallot Bulbs per Plot

Table 8. Weight of marketable shallot bulbs per plot (g) given corn compost and NPK fertilizer

NPK Fertilizer (kg/ha)	Corn Compost (t/ha)				Average
	0	15	20	25	
300	1112,67^{b}	1163,67^{ab}	1223,33^{ab}	1250,33^{ab}	1187,59^{b}
400	1127,00^{ab}	1290,33^{ab}	1246,67^{ab}	1357,33^{a}	1255,33^{ab}
500	1289,67^{ab}	1310,33^{ab}	1314,33^{ab}	1295,17^{ab}	1302,38^{a}
Average	1176,44^{b}	1254,78^{ab}	1264,06^{ab}	1298,33^{a}	

Table 8 shows that the application of corn compost at a dose of 25 t.ha^{-1} and NPK fertilizer at a dose of 400 kg.ha^{-1} significantly increased the weight of marketable bulbs of shallots compared to no corn compost (0 t.ha^{-1}) and NPK at 300 kg.ha^{-1}. However, this treatment did not show significant differences compared to other combinations. The high weight of marketable shallot bulbs is attributed to the ability of corn compost and NPK fertilizer to meet the nutrient requirements of the shallots. Increasing the doses of corn compost and NPK fertilizer enhances the weight of marketable bulbs, indicating that the necessary nutrients are adequately supplied and available for the shallots. The marketable weight of the plants is the accumulation of organic carbohydrate compounds produced through photosynthesis, which is influenced by the availability and absorption of soil nutrients by the roots. According to (4), the vegetative growth of plants is closely

related to the availability of nutrients in the soil, as these nutrients determine the production of plant dry weight, which results from the processes of accumulation, respiration, and photosynthate accumulation.

DISCUSSION

Authors should analyze the results and interpret them in light of previous research and the proposed hypotheses. The findings and their implications should be discussed in the broadest possible context. The discussion should delve into the significance of the results without reiterating them. Support the findings with relevant theories, concise citations, and an examination of published literature. The following elements should be addressed in the discussion: How do your results relate to the initial questions or objectives presented in the Introduction (what/how)? Do you provide a scientific interpretation for each of your findings (why)? Are your results consistent with those reported by other researchers (what else), or are there notable differences? Additionally, potential directions for future research may be highlighted.

CONCLUSION

The study titled "The Effect of Corn Compost and NPK Fertilizer on the Growth and Production of Shallot Plants" investigates the synergistic effects of corn compost and NPK fertilizer on shallot growth. The research indicates that the combination of corn compost at a dosage of 15 $t.ha^{-1}$ and NPK fertilizer at 400 $kg.ha^{-1}$ significantly enhances various growth parameters, including plant height, leaf count, and overall yield metrics, such as fresh and storable tuber weights. The findings suggest that the optimal treatment combination can effectively improve shallot production, thereby making a valuable contribution to local agricultural practices aimed at sustainable development goals. (Refer to pages 1 and 2 for detailed results and methodology.)

ACKNOWLEDGEMENT

I would like to thank all parties who have helped in this research. Thank you to the students who have contributed with their ideas and enthusiasm. Also, thank you to fellow lecturers and institutions who have provided support and resources.

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