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The Effect of Chicken Manure and Mycorrhizal Biofertilizer on Increasing Peanut (Arachis Hypogaea L.) Production Growth

Meriaty[1*], Irawaty Rosalyne[1]

[1] Program Studi Agroteknologi, Fakultas Pertanian, Universitas Simalungun, Indonesia.

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Corresponding Author:
Meriaty
meriatytarigan65@gmail.com

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Abstract: This study used a factorial Randomized Block Design (RAK), with 2 treatment factors, factor I is the provision of Chicken Manure consisting of 3 treatment levels, namely: K1 = 3 Kg / plot, K2 = 4 Kg / plot, K3 = 5 kg / plot. Factor II is the provision of Mycorrhizal Fertilizer consisting of 4 treatment levels, namely: M0 = Without the provision of Mycorrhizal Biofertilizer, M1 = 2 g / plot, M2 = 4 g / plot, M3 = 6 g / plot. The parameters observed in this study include: Plant Height (cm) 21, 35, and 49 DAP, Number of Primary Branches (branches) when the flowering period has finished, Number of Pods per Plant (pods), Percentage of Full Pods per Plant (%), Seed Production per plot (g). Based on the results of the study, it can be concluded that the treatment of chicken manure dose level significantly affected plant height at the age of 21, 35, and 49 DAP, but did not significantly affect the number of primary branches, number of pods per plant, percentage of full pods per plant, seed production per plot. The treatment of mycorrhizal fertilizer dose level significantly affected plant height at the age of 21, 35, and 49 DAP, number of primary branches, number of pods per plant, percentage of full pods per plant, seed production per plot. For the interaction of chicken manure and mycorrhizal fertilizer treatment significantly affected plant height at the age of 21 DAP, but did not significantly affect plant height at the age of 35 and 49 DAP, number of primary branches, number of pods per plant, percentage of full pods per plant and seed production per plot.

Keywords: Biofertilizer; Manure; Mycorrhiza; Peanuts.

Introduction

Peanuts (Arachis hypogaea L.) are a food crop with significant economic and health benefits. Peanuts are rich in fat (5 g), protein (17.3 g), iron (2 mg), nutrients A, B, C, D, E, and K, phosphorus (336 mg), and calcium (62 mg) (Dewi, 2019). Peanuts offer significant potential due to their extensive human uses. Besides being used directly, peanuts are often processed into roasted peanuts, boiled peanuts, peanut sauce, peanut eggs, and various types of cakes. Peanuts are also used to make cooking oil and animal feed (List, 2016; Zhao et al., 2023).

Based on data from the Central Bureau of Statistics (BPS) of the Indonesian Sustainable Agriculture System (HSU) (2018), there has been a long-term decline in peanut efficiency, reaching 500 tons with a collection area of 400 ha and an average production of 10.80 kWh. In 2015 (highest production), legume production reached 432 tons in 2016, with a harvested area of 355 ha and an average peanut production of 12.18 kW/ha. In 2017 (lowest production), peanut efficiency reached 149 tons in a harvested area of 122 ha and a normal production of 12.18 kW/ha.

Organic fertilizer is compost composed largely or entirely of natural materials derived from plants or animals that have undergone a chemical process, whether in solid or liquid form. Adding organic matter in the form of animal manure to the soil can improve soil quality and maturity. One option for improving soil nutrition, quality, and maturity is the use of chicken manure (El-Sherbeny et al., 2023; Van Chuong, 2023). Chicken manure contains 1% nitrogen, 0.80% phosphorus, 0.40% potassium, and 55% water content (Andriawan et al., 2022; Kamaluddin et al., 2022). Even

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though nutrients have been added using organic materials, these nutrients are still not directly absorbed by peanut plants. The use of biofertilizers can help fix phosphate and nitrogen so that they can be directly absorbed by peanut plants (Ahmed & El-Araby, 2012; Wang et al., 2021).

One use of biofertilizers is mycorrhizal biofertilizer. Mycorrhizae are a type of fungus that can penetrate plant roots to help ensure nutrient availability for plants (Bhantana et al., 2021; Wahab et al., 2023). Some of the roles of symbiotic mycorrhizal fungi include helping roots increase the absorption of phosphorus (P) and other nutrients such as N, K, Zn, Co, S, and Mo from the soil, increasing the plant's ability to with stand drought, and improving soil conditions. One alternative to compensate for nutrient deficiencies, particularly by facilitating phosphate availability, is the use of mycorrhizae (Nainggolan et al., 2020).

Based on the above description, the author is interested in conducting research to determine the increase in peanut (Arachis hypogaea L.) production due to the application of chicken manure and mycorrhizal biofertilizer.

Method

This research was conducted in November 2022 – February 2023 in Bah Kisat, Tanah Jawa District, Simalungun Regency, North Sumatra at an altitude of ± 420 meters above sea level. The materials used in the research were Gajah variety peanut seeds, Chicken Coop fertilizer, Mycorrhizal fertilizer with the trademark Mycogrow, additional fertilizers in the form of Urea, TSP, and KCL, Dithane M-45 and Decis 25EC. The tools used in the research were hoes, machetes, buckets, hand sprayers, label boards, scales, meters, scissors, plastic ropes and stationery. The design used in this study was a factorial randomized block design (RBD), consisting of two treatment factors:

Factor I: Application of organic chicken coop fertilizer, consisting of three treatment levels: K1 = 3 kg/plot: 15 tons/ha; K2 = 4 kg/plot: 20 tons/ha; and K3 = 5 kg/plot: 25 tons/ha. Factor II: Application of mycorrhizal biofertilizer, consisting of four treatment levels: M0 = No application of mycorrhizal biofertilizer; M1 = 2 g/plot: 10 kg/ha; M2 = 4 g/plot: 20 kg/ha; M3 = 6 g/plot: 30 kg/ha.

Research Implementation

Land Preparation and Bed Construction

The peanut beds were constructed with a 2-meter length and 1-meter width (Ninama & Ausari, 2023). Bed construction began with clearing the land and loosening the soil with a hoe to a depth of approximately 30 cm. The purpose of bed construction was to prevent waterlogging of the peanut plants, thus minimizing the risk of peanut mortality.

Application of Organic Chicken Manure

The chicken manure used was mature manure, indicated by the unheated fertilizer. Application was carried out two weeks before planting. The manure was applied by mixing it evenly with the soil in each bed. Treatments K1, K2, and K3 were treated with chicken manure at doses of 3 kg/plot, 4 kg/plot, and 5 kg/plot, respectively.

Planting

Before planting, the seeds were soaked for 10 minutes. After soaking, any floating seeds were discarded as they would not be used. Then, the soaked seeds were placed into planting holes 3 cm deep. One seed was placed in each hole and gently covered with soil.

Mycorrhizal Biofertilizer Application

Mycorrhizal biofertilizer was applied when the plants were 14 days after planting (DAT). The mycorrhizal biofertilizer was applied by watering. Treatment M0 was not given mycorrhizal biofertilizer.

Treatment M1 was given 2 grams of mycorrhizal biofertilizer per plot, by dissolving 2 grams of mycorrhizal fertilizer in 1 liter of water. The mycorrhizal fertilizer solution was then applied by pouring it onto the soil at the base of the stem, evenly distributing it among 50 plants.

Treatment M2 was given 4 grams of mycorrhizal biofertilizer per plot, by dissolving 4 grams of mycorrhizal fertilizer in 1 liter of water. The mycorrhizal fertilizer solution was then applied by pouring it onto the soil at the base of the stem, evenly distributing it among 50 plants.

Treatment M3 was given 6 grams of mycorrhizal biofertilizer per plot, by dissolving 6 grams of mycorrhizal fertilizer in 1 liter of water. The mycorrhizal fertilizer solution was then applied to the soil at the base of the stems, evenly distributed among 50 plants.

Additional fertilizer was applied when the plants reached 2 weeks after planting (WAP) at a dosage of 10 g of urea per plot, 20 g of TSP per plot, and 10 g of KCl per plot.

Plant Maintenance

To ensure the peanut plants do not lack water, watering is necessary in the morning and evening using a watering can. Watering is done except when it rains, when watering is not required. Weeding is done periodically every week by manually pulling out the plants and removing weeds. The soil around the peanut

stems is loosened and raised to strengthen the plants, preventing them from falling over and also making it easier for the gynophores to penetrate the soil. Hilling was carried out when the plants were 4, 6, and 8 weeks old.

Pest and Disease Control

Pest control was carried out once the plants were 14 days after planting (DAP) at weekly intervals. Spraying of Decis 25EC insecticide at a dose of 2 ml/L of water was carried out to control leaf caterpillars, and Dithane M-45 fungicide at a dose of 3 g/L of water to control fungal pests. However, if the disease is still possible or not too severe, manual control can be carried out by killing visible insect pests and removing plant parts affected by fungi. Peanut plants were harvested 90 days after planting, when the peanut leaves had turned yellow.

Research Parameters

Plant Height (cm)

Peanut plant height was measured from the base of the stem to the tip of the tallest branch. Measurements were taken only on sample plants in each plot, at 21, 35, and 49 DAP.

Number of Branches

The number of branches is calculated by counting the total number of primary branches produced by the main stem. The branch count is performed once, at the end of flowering, assuming that the number of peanut branches will no longer increase after flowering. The number of branches is measured on sample plants per treatment plot.

Number of Pods per Plant (pods)

The number of pods per plant is determined at harvest time. Peanuts are considered ready for harvest when the plants have entered the senescence stage, indicated by the leaves turning yellowish or brownish. Each clump is carefully removed with a hoe, and each pod produced is counted, including both full and empty pods. The number of pods is calculated only for the sample plants in each plot.

Percentage of Fully Pods per Plant (%)

The pods containing seeds, or full-fledged peanut pods, produced by each sample plant were separated from the empty pods (without seeds). The percentage of full (full) pods was then calculated. The rice pod percentage was calculated only for the sample plants from each plot.

Seed Production per Plot (grams)

Each peanut population in each treatment plot was harvested, and the full-fledged pods containing seeds were separated from the empty pods. The full-fledged pods containing seeds were then husked to remove the seeds, and the seeds were then air-dried. The air-dried seed production per plot was then weighed and converted to area per hectare.

Result and Discussion

Peanut Plant Height (cm)

The results of the analysis of variance showed that the application of chicken manure and mycorrhizal fertilizer significantly affected plant height at 21, 35, and 49 days after planting. Likewise, the interaction resulting from the combination of chicken manure and mycorrhizal fertilizer significantly affected plant height at 21 days after planting, but had no significant effect at 35 and 49 days after planting.

Table 1. Results of the Difference Test on Average Plant Height (cm) Due to the Application of Chicken Manure and Mycorrhizal Fertilizer at 21, 35, and 49 DAP

Treatments	Plant Height (cm)		
	21 DAP	35 DAP	49 DAP
K_1	5.22 b	15.31 b	34.27 b
K_2	6.04 a	15.87 a	35.01 a
K_3	6.44 a	16.08 a	35.53 a
BNT 5% K	0.49	0.29	0.75
M_0	4.76 c	14.76 d	32.73 d
M_1	5.64 b	15.52 c	34.42 c
M_2	5.95 b	15.95 b	35.35 b
M_3	7.24 a	16.80 a	37.25 a
BNT 5% M	0.57	0.34	0.86
K_1M_0	4.59 f	14.52	32.33
K_1M_1	5.05 ef	15.04	33.98
K_1M_2	5.53 def	15.59	34.54
K_1M_3	5.71 de	16.10	36.24
K_2M_0	5.11 def	15.03	32.97
K_2M_1	5.83 cd	15.76	34.79
K_2M_2	5.55 def	15.83	34.80
K_2M_3	7.67 ab	16.87	37.49
K_3M_0	4.59 cd	14.72	32.88
K_3M_1	6.05 cd	15.76	34.49
K_3M_2	6.78 bc	16.43	36.72
K_3M_3	8.34 a	17.42	38.03
BNT 5% KM	0.99		

Description: Numbers followed by different notations in the same column are significantly different at the 5% LSD level

Table 1 shows that the tallest plants resulting from the application of chicken manure at 21, 35, and 49 days after planting were K3 plants at 21, 35, and 49 days after planting (6.44 cm), 16.08 cm, and 35.53 cm, respectively.

This was significantly different from the K1 treatment and not significantly different from the K2 treatment.

Chicken manure is a good source of both high- and low-nutrient and can improve soil fertility, act as a substrate for soil microorganisms, and increase microbial activity, resulting in faster decomposition (Zhang & Zhang, 2025). The nutrients contained in chicken manure, especially those applied on a large scale, namely N, P, and K, are beneficial for plant growth. N is needed for vegetative development, K for stronger stems, and P for flowers and fruit (Ma et al., 2024; Silalahi et al., 2018).

Table 1 shows the effects of mycorrhizal fertilizer application. Plant heights at 21, 35, and 49 days after planting were highest in M3, with heights of 7.24 cm, 16.80 cm, and 37.25 cm, respectively, significantly different from the other treatments. This was followed by M2 treatment at 21, 35, and 49 days after planting (5.95 cm), 15.95 cm, and 35.35 cm, respectively. These heights were not significantly different from the M1 treatment, but significantly different from the other treatments. The results of this study indicate a significant effect of mycorrhizal fertilizer application at 21, 35, and 49 days after planting. This is due to the microbial activity contained in mycorrhizal fertilizer, which can improve the physical, chemical, and biological properties of the soil, making it more fertile and enabling plants to grow better. This is because the presence of mycorrhizae increases root infection, which produces hyphal clusters that increase nutrient absorption. Furthermore, it is known that the more infected roots, the greater the nutrient absorption rate, especially in infertile soils (Basiru et al., 2025; Farida & Chozin, 2015).

Table 1 shows the interaction between chicken manure and mycorrhizal fertilizer on plant height at 21 days after planting (DAP), but no significant effect was observed at 35 and 49 days after planting. The highest plant heights were found in the K3M3 treatment (8.34 cm), 17.42 cm, and 38.03 cm, respectively, which were not significantly different from the K2M3 treatment (7.67 cm), 16.87 cm, and 37.49 cm, respectively). The lowest plant height was found in the K1M0 treatment, with heights of 4.59 cm, 14.52 cm, and 32.33 cm, respectively. These were not significantly different from the K1M1, K1M2, K1 M3, K2 M1, and K2M2 treatments.

The results of this study indicate that the interaction between chicken manure and mycorrhizal fertilizer has several factors that prevent it from producing a successful response for both interactions on peanut plants (Tu & Chuong, 2022). Certain aspects can indeed influence the ineffectiveness of both interactions due to changes in natural conditions and climate (Herman et al., 2016).

Number of Primary Branches

The data show that the analysis of variance (ANOVA) results from the application of chicken manure did not significantly affect the number of primary branches. However, the application of mycorrhizal fertilizer significantly affected the number of primary branches on peanut plants. Similarly, the interaction between the combination of chicken manure and mycorrhizal fertilizer did not significantly affect the number of primary branches.

Table 2. Results of the Difference Test on the Average Number of Primary Branches and the Number of Pods per Plant Due to the Application of Chicken Manure and Mycorrhizal Fertilizer

Treatments	Number of primary branches	Number of pods per plant
K_1	6.98	34.90
K_2	7.28	36.23
K_3	7.48	38.93
M_0	6.36 b	30.82 b
M_1	6.93 b	36.20 a
M_2	7.38 a	37.87 a
M_3	8.33 a	41.89 a
BNT 5% M	1.02	6.41
K_1M_0	6.07	26.93
K_1M_1	6.80	35.73
K_1M_2	7.20	37.20
K_1M_3	7.87	39.73
K_2M_0	6.47	31.07
K_2M_1	6.93	36.00
K_2M_2	7.47	37.40
K_2M_3	8.27	40.47
K_3M_0	6.53	36.47
K_3M_1	7.07	36.87
K_3M_2	7.47	39.00
K_3M_3	8.87	45.47

Description: Numbers followed by different notations in the same column are significantly different at the 5% LSD level

Table 2 shows that the chicken manure treatment produced the highest number of primary branches in the K3 treatment (7.48 branches), and the K1 treatment (6.98 branches) produced the lowest number of branches. This is because chicken manure improves soil conditions, such as aeration, water retention capacity, and soil microorganism activity. Plant roots more easily absorb nutrients for growth, thus facilitating the formation of primary branches.

Table 2 shows that the mycorrhizal fertilizer treatment produced the highest number of primary branches in the M3 treatment (8.33 branches), which was not significantly different from the M2 treatment and significantly different from the other treatments. Mycorrhizae expand the root absorption surface, thereby increasing the absorption of P, N, and

micronutrients. Phosphorus is crucial for the formation of meristem tissue and plant branching (Lin et al., 2023; Liu, 2021).

Table 2 shows that the interaction between the two treatments did not significantly affect the number of primary branches. The highest number of primary branches was produced by K3M3 (8.87 branches), and the lowest number was produced by K1M0 (6.07 branches).

Syofia et al. (2014) stated that the insignificant effect of unpredictable factors is believed to be due to the many factors influencing peanut growth and yield that cannot be combined, such as heredity, environmental conditions, and cultivation methods. If the impact of various interactions is insignificant, it tends to be concluded that the factors in both treatments act independently of each other.

Number of Pods per Plant (pods)

The data show that the analysis of variance (ANOVA) showed no significant effect on the number of pods per plant for chicken manure application, while the application of mycorrhizal fertilizer had a significant effect on the number of pods per plant in peanuts. Similarly, the interaction effect of the combination of chicken manure and mycorrhizal fertilizer had no significant effect on the number of pods per plant (Vallejos-Torres et al., 2023).

Table 2 shows that the chicken manure treatment with the highest number of pods was K3 (38.95), while the lowest was K1 (34.90). This is because increasing the dose of chicken manure increases the number of pods on peanut plants. Increasing the dose of chicken manure means greater nutrient availability for plant use, in line with the growth conditions of legume plants, which require fertile soil. This allows plants to utilize soil nutrients for growth and production (Anwar et al., 2023).

Table 2 shows that the application of mycorrhizal fertilizer resulted in the highest number of pods in the M3 treatment (41.89), which was not significantly different from the M2 and M1 treatments. The lowest number of pods was in the M0 treatment (30.82), which was significantly different from the other treatments. Mycorrhizal application affects the number of legume pods because mycorrhizae produce hormones such as cytokinins and auxins that support flower and pod formation. The leaves of mycorrhizal plants are generally greener due to increased photosynthesis, and greater assimilates are allocated to pod formation. This combination of factors results in a higher number of pods per plant in the mycorrhizal treatment without treatment (Habeahan et al., 2022).

Table 2 shows that the interaction between the two treatments on the number of pods per plant was not significant. The highest number of pods per plant was produced by K3M3 (45.47 pods), followed by K2M3 (40.47 pods), followed by K1M3 (39.73 pods), and the lowest number of branches was produced by K1M0 (26.93 pods).

Percentage of Fully Equipped Pods per Plant (%)

The data show that the analysis of variance (ANOVA) results showed no significant effect on the percentage of full-fledged pods per plant due to the application of chicken manure. Meanwhile, the application of mycorrhizal fertilizer significantly affected the percentage of full-fledged pods per plant in peanuts. Similarly, the interaction between the combination of chicken manure and mycorrhizal fertilizer had no significant effect on the percentage of full-fledged pods per plant.

Table 3. Results of the Difference Test for Average Full Pods (%) and Seed Production per Plot Due to Application of Chicken Manure and Mycorrhizal Fertilizer

Treatment	Nutty pods (%)	Seed production per plot
K_1	37.07	1106.92
K_2	39.03	1143.75
K_3	40.80	1186.00
M_0	33.93 b	1035.11 b
M_1	38.02 b	1082.67 a
M_2	40.31 a	1140.11 a
M_3	43.58 a	1325.67 a
BNT 5% M	5.12	106.89
K_1M_0	29.20	982.67
K_1M_1	37.33	1076.33
K_1M_2	39.60	1107.33
K_1M_3	42.13	1265.33
K_2M_0	35.33	1061.00
K_2M_1	38.33	1082.00
K_2M_2	40.00	1122.00
K_2M_3	42.27	1310.00
K_3M_0	37.33	1061.67
K_3M_1	38.40	1089.67
K_3M_2	41.33	1191.00
K_3M_3	46.13	1401.67

Description: Numbers followed by different notations in the same column are significantly different at the 5% LSD level.

Table 3 shows that the chicken manure treatment with the highest average number of full pods was K3 (40.80%), and the lowest was K1 (37.07%). The organic matter in chicken manure improves soil microbial life, including Rhizobium. More active root nodules can increase the number of full pods in peanuts (Marlina et al., 2015).

In Table 3, the application of mycorrhizal fertilizer resulted in the highest average percentage of full pods in the M3 treatment (43.58%). This was not significantly different from the M2 treatment, but significantly different from the M1 and M0 treatments. Mycorrhizae increase the percentage of full pods by increasing nutrient absorption, nitrogen synergy, environmental resilience, and increased photosynthesis. The more effective the microorganisms, the fewer empty pods and the higher the yield.

In Table 3, the interaction between chicken manure and mycorrhizal fertilizer had no significant effect on the percentage of full pods per plant, indicating that the mechanisms of action of chicken manure and mycorrhizal fertilizer tend to be independent of each other. Chicken manure acts as a source of macronutrients and improves soil physical properties, while mycorrhizal fertilizer plays a greater role in increasing the absorption of certain nutrients, especially phosphorus. However, under the conditions of this study, the increased nutrient availability from chicken manure is thought to be sufficient to meet plant needs, so the contribution of mycorrhizal fertilizer does not provide a significant additional increase in full pod formation.

Seed Production per Plot (grams)

The data show that the analysis of variance (ANOVA) showed no significant effect on seed production per plot due to the application of chicken manure. Meanwhile, the application of mycorrhizal fertilizer significantly affected seed production per plot in peanuts. Similarly, the interaction between the combination of chicken manure and mycorrhizal fertilizer had no significant effect on seed production per plot.

Table 3 shows that the chicken manure treatment had the highest average seed production per plot, namely K3 (1,186.00 grams), and the lowest was found in K1 (1,100.75 grams). Research Marlina et al. (2015) indicates that chicken manure can provide both large-scale nutrients (nitrogen, phosphorus, potassium, calcium, and sulfur) and small supplements (iron, zinc, boron, cobalt, and so on). Organic matter's natural ability to act as a source of energy and nutrients for soil microorganisms, thereby increasing the movement of soil microorganisms, which is very useful in providing nutrients to plants. Applying this natural compost will ultimately increase peanut growth and production. Table 3 shows data on mycorrhizal fertilizer treatments. The highest seed production per plot was in the M3 treatment (1,325.67 grams), which was not significantly different from M2 and M1 but significantly different from M0. Mycorrhizae are also known to increase plant tolerance to environmental stress, improve soil structure through the formation of soil aggregates, and increase the activity of soil microorganisms that support plant growth. Therefore, the increased seed production in the mycorrhizal treatment indicates that mycorrhizal inoculation can create more optimal plant growth conditions, resulting in increased crop yields.

Table 3 shows the highest seed production per plot was in the K3M3 treatment (1,401.67 grams), followed by the second-highest seed production per plot in the K2M3 treatment (1,310 grams), and the lowest was in the K1M0 treatment (982.67 grams), which was not significantly different from the other treatments. This may be due to suboptimal mycorrhizal adaptation, either due to environmental conditions, the already high soil organic matter content, or interactions with other microorganisms in the soil that can inhibit mycorrhizal colonization. These factors can cause mycorrhiza to be unable to show its role optimally in supporting the formation of seed production per plot.

Conclusion

Application of chicken manure significantly affected plant height growth at 21, 35, and 49 days after planting. However, it did not significantly affect the number of primary branches, the number of pods per plant, the percentage of full pods per plant, or seed production per plot. The application rate of chicken manure that provided the best growth and production was 5 kg/plot = 25 tons/ha. Application of mycorrhizal fertilizer significantly affected plant growth and height at 21, 35, and 49 days after planting, the number of primary branches, the number of pods per plant, the percentage of full pods per plant, and seed production per plot. The application rate of mycorrhizal fertilizer that provided the best growth and production was 6 g/plot = 30 kg/ha. The interaction resulting from the combination of chicken manure and mycorrhizal biofertilizer significantly affected plant height at 21 days after planting, but did not significantly affect plant height at 35 and 49 days after planting, the number of primary branches, the number of pods per plant, the percentage of full pods per plant, or seed production per plot. The interaction of the two treatments that provided the best growth and production was with the application of a dose level of Chicken Coop 5 kg/plot: 25 tons/ha and Mycorrhiza 6 g/plot: 30 kg/ha.

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The authors declare no conflict of interest.

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