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Article

The Impact of Chitosan and Tithonia Diversifolia Compost on the Growth and Yield of Peanut Plants (Arachis hypogaea L.)

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Abstract. This study aims to investigate the combined impact of Chitosan and Tithonia (Tithonia diversifolia) Compost on the Growth and Yield of Peanut Plants (Arachis hypogaea L.). A factorial randomized block design (RBD) was utilized for the experiment. The first factor was Tithonia compost in quantities of 0 tons/ha-1, 5 tons/ha-1, and 10 tons/ha-1. The second factor was Chitosan, applied at three dosage levels: 0 ml/l water, 3 ml/l water, and 6 ml/l water. The results suggest that the use of Tithonia compost effectively enhances plant height, flowering age, harvest age, 100-seed weight, and dry pod weight per hill when applied at a dose of 10 tons/ha. Furthermore, Chitosan administration was found to increase the number of effective root nodules when used at a concentration of 6 ml/l water. The interaction between Tithonia compost and Chitosan also resulted in an extended flowering life and an increase in dry pod weight per hill of peanut plant. Based on these findings, we recommend using 10 tons/ha of Tithonia compost and 3 ml/l water of Chitosan in peanut cultivation for optimal results.

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1. Introduction

Peanuts, which are legume shrubs originating from America, particularly the Brazil region, were introduced to Europe and later spread to Asia, including Indonesia. Peanuts are highly nutritious, containing fats, proteins, iron, vitamin E, B complex vitamins, phosphorus, vitamins A and K, and calcium [1-2]. They are a source of polyunsaturated fat (Omega 3) and monounsaturated fat (Omega

9), and can be used as a vegetable oil. In Indonesia, the average demand for peanuts is approximately 816 thousand tons [3-4]. However, peanut production in the country has been inconsistent, particularly between 2014 and 2018. For instance, in 2016, the production reached 570.477 tons ha-1, but it declined to 495.477 tons ha-1 in 2017. Similarly, peanut production in West Sumatra decreased from 15.73 tons ha-1 in 2016 to 13.34 tons ha-1 in 2017 [5].

Efforts to enhance soil fertility involve the use of fertilizers, such as organic fertilizers derived from plant residues and animal manure, which can be combined with synthetic fertilizers. Composting is an important process in improving the quality of organic fertilizers. Compost is produced through the decomposition of plant, animal, and organic waste and is known to provide valuable nutrients for plant growth [6-7]. Shrubs like Tithonia diversifolia, which are commonly found along highways and in highlands, have the potential to be used as organic materials for composting. Tithonia has been shown to increase soil fertility, reduce aluminum levels, improve soil pH, and enhance nutrient content, including organic matter, nitrogen, phosphorus, potassium, calcium, and magnesium. These factors contribute to increased plant productivity [8-10].

Another approach to nutrient provision is through the use of chitosan, a compound derived from chitin found in the shells of shrimp, crabs, and fungi. Chitosan undergoes a process of deproteination, demineralization, and deacetylation to obtain its beneficial properties [11-12]. It contains organic carbon, nitrogen, phosphorus, potassium, and microelements such as iron, manganese, copper, zinc, and boron. Research has focused on investigating the interaction between chitosan and tithonia compost and their impact on the growth and production of peanuts [13-14]. Overall, the aim of this research is to explore the potential benefits of combining chitosan and tithonia compost in promoting the growth and production of peanuts. By understanding their interaction, the study aims to contribute to the improvement of peanut cultivation practices.

2. Methods

The materials used in this experiment included R&D Garuda 5 variety peanut seeds, thitonia compost, Super Biovit liquid chitosan, ZA, SP-36, Urea, insecticide, and fungicide Dithane M-45. The experiment followed a factorial Randomized Block Design (RBD) with two factors. The first factor was tithonia compost, consisting of three levels: 0 tons/ha-1 (T0), 5 tons/ha-1 (T1), and 10 tons/ha-1 (T2). The second factor was chitosan (D), with three dose levels: 0 ml/l water (D0), 3 ml/l water (D1), and 6 ml/l water (D2).

Land preparation involved clearing the land of weeds, followed by hoeing, loosening, and smoothing the soil. Plots were then created with dimensions of 1.5 m x 1.5 m and a distance of 30 cm between them. The treatment of thitonia compost was conducted by digging 3 cm deep and placing 2 peanut seeds in each hole. The treatment was applied once a week from 2 weeks after planting (WAP) until the beginning of flowering. Harvesting involved removing the stems and pods from the plant.

Observations were made on various growth components, yield components, and overall yield. Growth components included plant height and the number of primary branches. Yield components included the number of root nodules, age at first flower appearance, age at harvest, number of pods per plant, number of fruitful pods, weight of 100 seeds, and dry weight of pods per clump. Yield was measured in terms of the weight of dry pods per plot and the overall dry seed production per hectare [15-16].

Data collection for this experiment involved regular observations and measurements of various parameters. Growth components such as plant height and number of primary branches were measured using a measuring tape and by counting the branches, respectively. Yield components, including the number of root nodules, age at first flower appearance, age at harvest, number of pods per plant, number of fruitful pods, weight of 100 seeds, and dry weight of pods per clump, were recorded by carefully examining and counting the respective features on the plants.

After collecting the data, the next step involved data analysis. Statistical analysis techniques were employed to analyze the collected data. The factorial Randomized Block Design (RBD) allowed for the examination of the effects of the tithonia compost and chitosan factors on the various growth and yield components. Statistical software or tools were used to perform analysis of variance (ANOVA), which helped determine the significance of the observed differences among the treatment groups [17]. Post-hoc tests, such as Tukey's Honestly Significant Difference (HSD) test, may have been conducted to identify specific differences between treatment means.

Upon completion of data analysis, the results were interpreted to draw meaningful conclusions. The interpretation involved assessing the impact of tithonia compost and chitosan on the growth and yield of peanuts. It also considered any observed trends, significant differences, or patterns in the data. The interpretation process involved comparing the treatment groups, examining the magnitude of the observed effects, and relating the findings back to the research objectives. Additionally, any limitations or potential sources of error in the experiment were considered during the interpretation of the data.

3. Result and Discussions

3.1. Plant Growth

Plant height and number of main branches of peanut plants showed no significant interaction between Tithonia and chitosan compost and both factors had no significant effect individually. Plant height and number of main branches of peanut plants are presented in Table 1.

Table 1. Plant height and number of main branches of peanut plants by applying Tithonia and chitosan compost.

Tithonia Compost	Chitosan (ml/l water)			Average
(t ha^{-1})	0	3	6	
	.... Plant height (cm)................			
0	25.33	26.67	26.67	26.22 b
5	27.21	26.50	26.87	26.86 ab
10	28.04	27.17	27.50	27.57 a
	26.86	26.78	27.01	
KK= 3.55%				
	.... Number of Primary Branches......			
0	6.83	7.33	7.50	7.22
5	7.42	7.17	7.50	7.36
10	7.58	7.50	7.50	7.53
	7.28	7.33	7.50	
KK= 3.50%				

Table 1 shows the effect of Tithonia compost on increasing peanut plant height. The effect of Tithonia compost 10 tonnes/ha has the highest plant height of 27.57 cm. The effect of 5 ton/ha Tithonia compost had a plant height of 26.86 cm, and the effect of 0 ton/ha Tithonia compost had the lowest plant height of 26.22 cm.

The application of Tithonia compost has been observed to positively impact plant growth. Tithonia can increase soil fertility and productivity by reducing aluminum levels, increasing soil pH, organic matter, and nutrient content such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). Tithonia compost contains N levels of 3.50-4.00%, P levels of 0.35%, and K levels of 3.50-4.10% [18-19].

In contrast, Table 1 shows that chitosan did not have a significant effect on increasing the height of peanut plants. The plants treated with 6 ml/l water chitosan had a height of 27.50 cm, while those treated with 0 ml/l and 3 ml/l water chitosan had heights of 26.86 cm and 26.78 cm, respectively. This may suggest that the provided amount of chitosan was insufficient to promote the desired growth of peanut plants.

Furthermore, Table 1 demonstrates that the application of Tithonia compost did not lead to a significant increase in the number of primary branches in peanut plants. The plants treated with 10 tons/ha Tithonia compost had an average of 7.53 branches, while those treated with 5 tons/ha and 0 tons/ha Tithonia compost had averages of 7.36 branches and 7.22 branches, respectively. The number of primary branches can be influenced by environmental factors such as nutrient availability, as well as genetic factors.

Similarly, the effect of chitosan did not result in a significant increase in the number of primary branches in peanut plants. The plants treated with 6 ml/l water chitosan had an average of 7.50 branches, while those treated with 3 ml/l and 0 ml/l water chitosan had averages of 7.33 branches and 7.28 branches, respectively. Although chitosan can enhance soil biological properties and promote better soil structure, as well as potentially increase nitrogen fixation, which is crucial for plant growth, it did not show a substantial impact on the number of primary branches in this experiment [20-21].

3.2 Result Components

The interaction between Tithonia compost and chitosan did not have a significant effect on the number of effective root nodules and the age of the first flower. However, a single application of chitosan had a significant effect on these parameters, while a single application of Tithonia compost did not show a significant effect (Table 2). Regarding the harvesting age, the interaction between Tithonia compost and chitosan did not show a significant effect. However, the single application of Tithonia compost had a highly significant effect, while the single application of chitosan did not have a significant effect (Table 3).

The number of pods per plant and the number of fruitful pods did not show any significant effects from the interaction or single application of Tithonia compost and chitosan (Table 4). In terms of the weight of 100 seeds (Table 5), a single application of Tithonia compost had a significant effect. Additionally, the interaction between Tithonia compost and chitosan influenced the dry pod weight per clump (Table 6). However, there was no significant effect observed on the dry pod weight per plot (Table 7) from the application of Tithonia compost or chitosan. Overall, these findings indicate that while Tithonia compost and chitosan showed limited interactions and single effects on certain parameters such as root nodules, flowering age, weight of 100 seeds, and dry pod weight per clump, there were no significant effects observed on other parameters such as the number of pods per plant, fruitful pods, and dry pod weight per plot.

Table 2. Number of effective root nodules and age of the first flower of peanut plants by adding Thitonia and chitosan compost.

Tithonia Compost ($t\ ha^{-1}$)	Chitosan (ml/l air)			Average
	0	3	6	
	Number of effective root nodules (fruits)			
0	35.33	43.67	44.33	41.11
5	37.00	43.67	40.33	40.33
10	40.67	40.67	45.67	42.33
	37.67 B	42.67 A	43.44 A	
KK = 9.48%				

	.... First Flower Age HST.....................		
0	28.00 Aa	28.17 Aa	28.08 Aa
5	28.25 Aa	28.58 Aab	28.58 Aa
10	29.67 Cb	28.83 Bb	28.25 Aa
KK = 1.09%			

Table 2 illustrates the effect of chitosan on increasing the number of nodules in peanut plants. The application of chitosan at a concentration of 6 ml/l water resulted in the highest number of effective root nodules, with an average of 43.44 nodules. The treatment with 3 ml/l water chitosan had an average of 42.67 nodules, while the treatment with 0 ml/l water chitosan had the lowest number of root nodules, with an average of 37.67 nodules. The presence of reactive N groups in chitosan aids in nitrogen fixation and facilitates the symbiosis between plants and Rhizobium bacteria in the roots. Additionally, the carbon and nitrogen content in chitosan can stimulate soil populations, thereby affecting root nodule formation in legume plants. Chitosan's cationic properties enhance nutrient uptake from the soil, contributing to plant growth [22-23].

Table 2 also reveals that Tithonia compost did not significantly increase the number of root nodules in peanut plants. The treatments of 0 tons/ha, 5 tons/ha, and 10 tons/ha of Tithonia compost resulted in average numbers of root nodules of 41.11, 40.33, and 42.33, respectively. This can be attributed to competition among plants for nutrients, limiting the ability of each plant to meet its requirements.

Furthermore, the combined application of 5 tons/ha Tithonia compost and various concentrations of chitosan did not significantly accelerate the flowering period of peanut plants. However, the treatment with 0 ml/l water chitosan and 5 tons/ha Tithonia compost displayed the fastest flowering age at 28.08 days after planting. Flowering age is influenced by genetic factors and environmental conditions in which the plant grows. The nutrient content of Tithonia, including nitrogen, phosphorus, and potassium, contributes to biological activity in the soil and can promote root growth, flower formation, and seed development [24-25].

Regarding flower senescence, the treatment with 0 ml/l water chitosan and 5 tons/ha Tithonia compost accelerated the aging of peanut flowers, while the treatment with 10 tons/ha Tithonia compost did not significantly affect flower senescence. The treatment with 3 ml/l water chitosan and 5 tons/ha Tithonia compost accelerated flower life, while the treatment with 6 ml/l water chitosan did not have a notable effect. Chitosan contains hormones that positively influence plant growth and flower formation. The age at first harvest in peanut plants is influenced by environmental factors, including soil fertility, as well as genetic factors inherited from parent plants [26].

Table 3. Age of harvesting peanut plants by applying Tithonia compost and chitosan

Tithonia Compost	Chitosan (ml/l air)			Average
($t\ ha^{-1}$)	0	3	6	
	.........................HST.........................			
0	95.33	95.33	94.67	95.11 b
5	94.00	93.00	94.00	93.67 b
10	92.67	92.67	92.67	92.67 a
	94.00	93.67	93.78	
KK= 1.13%				

Table 3 shows that the effect of Tithonia compost accelerates the harvesting age of peanut plants. The treatment with 10 tons/ha Tithonia compost has the fastest harvest age, averaging 92.67 days after planting (HST). The treatment with 5 tons/ha Tithonia compost has a harvest age of 93.67 HST, while the treatment with 0 tons/ha Tithonia compost has a late harvest age of 95.11 HST. Tithonia compost is an organic fertilizer that improves the physical, chemical, and biological properties of the soil, providing nutrients and enhancing soil fertility. The speed of harvest is influenced by early flowering, and phosphorus plays a role in accelerating flower formation and seed ripening, thereby speeding up harvesting [27-28].

Table 3 also shows that chitosan does not significantly accelerate the harvesting age of peanuts. The treatment with 3 ml/l water chitosan has a harvest age of 93.67 HST, while the treatments with 6 ml/l water chitosan and 0 ml/l water chitosan have harvest ages of 93.78 HST and 94.00 HST, respectively. Chitosan acts as a carbon source for soil microbes, facilitating the transformation of organic compounds into inorganic ones and aiding in nutrient absorption by plant root systems [29]. However, in this experiment, the application of chitosan alone is not sufficient to accelerate the harvesting age of peanut plants.

Table 4. The number of pods per plant and the number of pods filled with peanuts by adding Thitonia and chitosan compost

Tithonia Compost (t ha^{-1})	Chitosan (ml/l air)			Average
	0	3	6	
	.... Number of Pods per Plant...........			
0	35.98	35.94	31.53	34.48
5	37.00	34.46	42.67	38.04
10	37.89	39.58	41.74	39.74
	36.96	36.66	38.65	
KK= 11.73%				
	.... Number of Healthy Pods..............			
0	31.93	31.75	27.88	30.52
5	32.73	30.56	36.42	33.24
10	31.26	32.61	35.56	33.14
	31.97	31.64	33.29	
KK= 16.52%				

Table 4 indicates that the application of Tithonia compost did not result in an increased number of pods per peanut plant. The treatments with 10 tons/ha, 5 tons/ha, and 0 tons/ha of Tithonia compost yielded average numbers of pods per plant of 39.74, 38.04, and 34.48, respectively. Although Tithonia compost contains essential nutrients such as nitrogen, phosphorus, and potassium, the availability of nutrients might still be insufficient to significantly enhance pod production in peanut plants.

Similarly, the application of chitosan did not lead to an increased number of pods per plant in peanut plants. The treatments with 6 ml/l water chitosan, 0 ml/l water chitosan, and 3 ml/l water chitosan resulted in average numbers of pods per plant of 38.65, 36.96, and 36.66, respectively. Chitosan can improve soil chemical properties and nutrient availability for plants, as well as increase the cation exchange capacity (CEC) of the soil [30]. However, in this experiment, the application of chitosan alone did not significantly affect pod production in peanut plants.

Furthermore, Table 4 reveals that the effect of Tithonia compost did not increase the number of fruitful pods in peanut plants. The treatments with 5 tons/ha and 10 tons/ha of Tithonia compost had average numbers of fruitful pods of 33.24 and 33.14, respectively, while the treatment with 0 tons/ha Tithonia compost had the lowest number of fruitful pods, with an average of 30.52. Applying organic compost can increase the cation exchange capacity (CEC) of the soil, which enhances nutrient uptake for both vegetative and generative growth in plants [30]. However, the nutrient content in Tithonia compost might still not be sufficient to significantly improve the number of fruitful pods in peanut plants.

Similarly, the application of chitosan did not lead to an increased number of pithy pods in peanut plants. The treatments with 6 ml/l water chitosan, 0 ml/l water chitosan, and 3 ml/l water chitosan resulted in average numbers of pithy pods of 33.29, 31.97, and 31.64, respectively. Chitosan contains auxin hormone, which can optimize the photosynthetic process and light absorption in plants [31]. However, in this experiment, the application of chitosan alone did not significantly affect the number of fully filled pods in peanut plants.

Table 5. Weight of 100 peanut plant seeds by adding Thitonia and chitosan compost

Tithonia Compost (t ha^{-1})	Chitosan (ml/l air) 0	3	6	Average
	...........................g...........................			
0	32.67	33.00	33.33	33.00 b
5	34.00	34.33	36.33	34.89 ab
10	34.33	38.67	38.67	37.22 a
	33.67	35.33	36.11	
KK= 7.02%				

Figures in a column followed by the same lowercase letter are not different according to the 5% DMRT.

Table 5 indicates that the application of Tithonia compost increased the weight of 100 peanut plant seeds. The treatment with 10 tons/ha Tithonia compost resulted in the highest weight, averaging 37.22 grams. The treatment with 5 tons/ha Tithonia compost had a weight of 34.89 grams, while the treatment with 0 tons/ha Tithonia compost had a weight of 33.00 grams. Tithonia compost contains significant levels of nitrogen, phosphorus, and potassium, which are essential macro-nutrients for plant growth. Nitrogen promotes cell division, phosphorus is involved in flower and seed formation, and potassium plays a role in the translocation of photosynthetic products, including seed production, thus contributing to an increase in seed weight [32-33].

Furthermore, Table 5 reveals that the application of chitosan did not significantly increase the weight of 100 seeds in peanut plants. The treatments with 6 ml/l water chitosan, 3 ml/l water chitosan, and 0 ml/l water chitosan resulted in average seed weights of 36.11 grams, 35.33 grams, and 33.67 grams, respectively. Chitosan can stimulate the production of growth-regulating hormones in plants, such as auxin and gibberellins, which are involved in plant growth and development. Auxin promotes photosynthesis, while gibberellins contribute to flower and fruit formation, potentially affecting seed weight [34]. However, in this experiment, the application of chitosan alone was not sufficient to significantly increase the weight of peanut seeds.

Table 6. Dry pod weight per clump of peanut plant by adding Thitonia and chitosan compost

Tithonia Compost (t ha^{-1})	Chitosan (ml/l air) 0	3	6
	...........................g...........................		
0	13.08 Bb	15.00 Aa	13.25 Ba
5	12.24 Bab	13.00 ABb	14.17 Aa
10	14.25 Aa	14.25 Aab	14.08 Aa
KK= 5.64%			

An inline number followed by the same capital letter and a column followed by the same lowercase letter did not differ according to DMRT 5%.

Table 6 demonstrates that the combination of 0 tons/ha Tithonia compost and 3 ml/l water chitosan increased the dry pod weight per peanut clump. The treatment with 5 tons/ha Tithonia compost and 3 ml/l water chitosan also led to an increase in the dry pod weight per clump of peanuts. Similarly, the treatment with 10 tons/ha Tithonia compost and 3 ml/l water chitosan resulted in an increased dry pod weight per peanut clump.

Organic fertilizers, including Tithonia compost, can enhance the physical, chemical, and biological properties of the soil, thereby improving nutrient availability for plants. Tithonia compost contains significant levels of nitrogen, phosphorus, and potassium, which are crucial for plant growth and development. Favorable environmental conditions, including optimal nutrient availability, play a role in pod formation and the production of fully filled seeds [35-36].

Furthermore, Table 6 reveals that the treatment with 0 ml/l water chitosan and 5 tons/ha Tithonia compost increased the dry pod weight per peanut clump, while the treatment with 10 tons/ha Tithonia compost did not show a significant increase. Additionally, the treatment with 3 ml/l water chitosan and Tithonia compost dosage resulted in an increased dry pod weight per clump of peanuts. The treatment with 6 ml/l water chitosan and 5 tons/ha Tithonia compost also increased the dry pod weight per peanut clump, while the treatment with 10 tons/ha Tithonia compost did not show a significant increase.

Chitosan contains various plant growth-regulating hormones, including ZPT hormones, which stimulate cell division in plants and promote increased cell tissue, thereby enhancing plant growth. This can result in increased photosynthesis and carbohydrate production, ultimately affecting the yield weight of cultivated plants. The presence of the IAA hormone in chitosan can also contribute to plant growth and yield enhancement [37].

Table 7. Dry pod weight per peanut plant plot with application Tithonia and chitosan compost

Tithonia Compost ($t\ ha^{-1}$)	Chitosan (ml/l air)			Rata-rata
	0	3	6	
	..............................kg..............................			
0	1.09	1.24	1.40	1.24
5	1.24	1.41	1.24	1.30
10	1.33	1.34	1.31	1.33
	1.22	1.33	1.32	
KK= 14.85%				

Table 7 demonstrates that the application of Tithonia compost did not significantly increase the dry pod weight per peanut plant plot. The treatments with 10 tons/ha Tithonia compost, 5 tons/ha Tithonia compost, and 0 tons/ha Tithonia compost resulted in pod weights of 1.33 kg, 1.30 kg, and 1.24 kg, respectively. Organic matter application to the soil can improve soil binding capacity and enhance the physical, chemical, and biological properties of the soil. Tithonia compost, which contains significant levels of nitrogen, phosphorus, and potassium, contributes to root growth stimulation and nutrient absorption in plants. Optimal nutrient availability promotes the formation of proteins, carbohydrates, and starch, which are then translocated to the pods, potentially resulting in heavier pod weights [36].

Furthermore, Table 7 reveals that the application of chitosan did not significantly increase the dry pod weight per peanut plant plot. The treatments with 3 ml/l water chitosan, 6 ml/l water chitosan, and 0 ml/l water chitosan resulted in pod weights of 1.33 kg, 1.32 kg, and 1.22 kg, respectively. Providing different concentrations of chitosan to plants can enhance plant metabolism and promote plant growth. Chitosan, as a polysaccharide, acts as a biological signal in plant tissue cells, regulating symbiotic processes and influencing plant growth and production. However, in this experiment, the application of chitosan alone did not lead to a significant increase in the dry pod weight per peanut plant plot [38].

Table 8 reveals that there was no significant effect on dry seed production per hectare for both the interaction and single application of Tithonia compost and chitosan. Neither Tithonia compost nor chitosan led to an increase in dry seed yield. Adequate nutrient availability is crucial for the growth and development of plants. When plants have access to sufficient nutrients, they can thrive and achieve optimal results in terms of yield. However, in this study, the application of Tithonia compost and chitosan did not show a significant impact on the dry seed production per hectare.

Table 8. Dry seed production per hectare of peanut crop by application Tithonia and chitosan compost

Tithonia Compost ($t\ ha^{-1}$)	Chitosan (ml/l air) 0	3	6	Average
	...............................ton/ha............................			
0	4.86	5.52	6.21	5.53
5	5.50	6.26	5.51	5.76
10	5.93	5.95	5.81	5.89
	5.43	5.91	5.84	
KK= 14.85%				

Table 8 illustrates that the application of Tithonia compost did not result in a significant increase in dry seed production per hectare of peanut plants. The treatments with 10 tons/ha Tithonia compost, 5 tons/ha Tithonia compost, and 0 tons/ha Tithonia compost yielded seed productions of 5.89 tons, 5.76 tons, and 5.53 tons, respectively. Compost, as an organic fertilizer, can improve soil structure, water retention capacity, and air circulation in the soil. Improved soil structure facilitates better photosynthesis rates, ultimately contributing to increased seed weight. However, in this study, the application of Tithonia compost did not lead to a significant increase in dry seed production per hectare.

Additionally, Table 8 indicates that the application of chitosan did not result in a significant increase in dry seed production per hectare of peanut plants. The treatments with 3 ml/l water chitosan, 6 ml/l water chitosan, and 0 ml/l water chitosan yielded seed productions of 5.91 tons, 5.84 tons, and 5.43 tons, respectively. Chitosan can stimulate the hormones kinetin and zeatin, which promote cell division in leaves and enhance leaf size and expansion. With larger leaves, the absorption of sunlight increases, leading to improved photosynthesis. The photosynthetic products are then translocated as seeds, potentially increasing overall plant production. However, in this study, the application of chitosan did not show a significant effect on dry seed production per hectare [39-40].

4. Conclusion

The experimental results indicate that the application of Tithonia compost at a dose of 10 tons/ha leads to significant improvements in various parameters, including increased plant height, accelerated flower and harvest ages, higher weight of 100 seeds, and enhanced dry pod weight per hill. Additionally, chitosan administration at a concentration of 6 ml/l water results in a significant increase in the number of effective root nodules. These findings suggest that Tithonia compost and chitosan can be effective treatments for enhancing peanut cultivation.

Considering these conclusions, it is recommended for peanut farmers to incorporate Tithonia compost at a dose of 10 tons/ha and use chitosan at a concentration of 6 ml/l water in their cultivation practices. These treatments have shown promising effects on plant growth, seed quality, and root nodule development. By adopting these practices, farmers may have the opportunity to increase peanut production and optimize their crop yields. However, further research and experimentation are necessary to explore the long-term effects and evaluate the efficacy of these treatments under various growing conditions and peanut cultivars.

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