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# THE EFFECT OF IMMERSION CONCENTRATION OF COCONUT WATER AND DOSAGE OF NPK FERTILIZATION ON GROWTH AND YIELD OF PEANUT (*Arachis hypogeae* L.)

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***Abstract****. One problem of peanut cultivation is the inability of peanut seeds to be stored long-term. Prolonged storage of seed peanuts causes seed deterioration due to seeds losing reserves of food and nutrient that cause the seeds difficult to germinate. As well as other problems, namely Nitrogen, Phosphorus and Potassium fertilization which has not been based on plant needs, fertilizer application tends to be excessive. The purpose of this study is to know the interaction and the main effect of the concentration treatment of coconut water immersion and NPK fertilization doses. This study used a factorial randomized block design with three replications. The first factor was the immersion concentration of coconut water (A) which consisted of 3 levels, namely: 0% coconut water (A1), 15% coconut water (A2), and 30% coconut water (A3) and the second factor was the dose of NPK fertilization (B) consisting of 4 levels, namely: NPK 0 g/plot (B1), NPK 22.5 g/plot (150 kg/ha) (B2), 45 g/plot (300 kg/ha) (B3), and NPK 67.5 g/plot (450 kg/ha) (B4). The results showed that (1) there was a significant interaction only on the number of primary branches with the applied treatment, 15% coconut water immersion concentration and NPK fertilization dose of 22.5 grams/plot (A2B2) (7.7 branches). (2) Concentration immersion in coconut water significantly affected the percentage of pithy pods, the percentage of empty pods, and the weight of 100 seeds, with the best treatment being the concentration of 15% coconut water immersion (A2). (3) Dose of NPK fertilization factor had a significant effect on harvesting age, percentage of empty pods, wet pod weight and productivity with the best treatment of 67.5 gram/plot NPK fertilization (B4).*

***Keywords:*** *coconut water; peanut; fertilizer.*

## 1. Introduction

Peanut (*Arachis hypogeae* L.) is a legume or legume plant that has important role in producing the second largest protein after soybeans. According to Trianto *et al*. (2019), the protein in peanuts is 24.41%, and the fat contained is 31% -46% (Bonku & Yu, 2020). The need for peanuts will always increase every year to meet the needs of the community. According to BPS in the Ministry of Agriculture (2018), peanut production in East Java in 2018 reached 150,180 tons with a growth percentage of -1.98% from 2017, while the productivity was still relatively low, namely 1.28 tons/ha with a growth percentage of - 3.36% from 2017. One of the causes of the low productivity of peanuts is the minimal use of superior seeds used as planting material.

The main obstacle to the low productivity of peanuts is the use of seeds passed down from generation to generation without going through certification procedures. According to Rato (2019), farmers use more local seeds from previous harvests which are stored at a price range of



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10,000/kg compared to using superior seeds. The price offered by shops for superior seeds is still too expensive and sometimes the available seeds are seed stocks that have been stored for a long time, so the quality has decreased. According to Hermawan *et al.* (2021), storing seeds in an open space tend to accelerate respiration and deterioration rates faster than in a controlled room, so the decrease in seed viability is faster. Storage at high temperatures significantly affects nutrient loss (Liu *et al*., 2021). Seeds lose food or nutrient reserves so that the seeds are difficult to germinate. The increase respiration and deterioration in peanut seeds is caused by the high protein and fat content in peanuts. These are internal factors of peanut seeds and is a differentiator from other orthodox seeds, so their storage period is relatively short. The second obstacle to the low productivity of peanuts is related to fertilization which needs to be in the appropriate dose. Applying fertilizers that are not adjusted to the dosage can result in a deficiency or excess of nutrients. The risk is that the nutrients will be converted or lost into a form that is not available and there is the potential for soil contamination due to metal at fertilization process (Wang et al., 2020). Excessive fertilizer application will cause a concentrated soil solution so that it cannot be absorbed by plants (Nuryani *et al*., 2019).

Efforts were made to overcome the first problem by immersing the seeds using a natural growth regulator, coconut water. The increase in germination percentage is affected by the nutrient content and ZPT in coconut water which can stimulate seeds to germinate (Un *et al*., 2018). Seeds that have begun to decline will generally have difficulty germinating, resulting in abnormal seed germination and requiring a long time for seeds to germinate. Effort made to overcome the second problem is to do the right dose of fertilization. Determination of the right dose of fertilization is needed so that the purpose of fertilization in supporting plant growth and development can be realized optimally. On the other hand, peanuts have rhizobium bacteria which can provide nitrogen to increase crop yields (El-sherbeny *et al*., 2022). Nutritional balance is urgently needed to achieve high crop yields and increase profits while maintaining environmental sustainability (Zhao *et al*., 2021). The purpose of this study is to exmine the effect of immersing coconut water concentration and NPK fertilization doses, because the nutritional content of coconut water is needed for plants to improve the growth and yield of the peanut. Moreover, the price of coconut water is relatively cheap and NPK fertilization doses on the growth and yield of peanuts can be used as an effort to overcome problems that commonly occur in peanut commodities.

## 2. Methods

The research was conducted for three months from November 2022 – January 2023 at the Agrotechno Park Experimental Field, Jember University, Jubung Lor, Jubung, Sukorambi District, Jember Regency: This research used a factorial Randomized Block Design with two factors and three replications. The first factor was the immersion concentration of coconut water (A) which consisted of 3 levels, namely: 0% coconut water (A1), 15% coconut water (A2), and 30% coconut water (A3). Coconut water contains growth regulators auxin, gibberellins, cytokines, and absisic acid which play an important role in the germination process (Trisnaningsih & Wahyuni, 2020) .econd factor was the dose of NPK fertilization (B ) consisting of 4 levels, namely: NPK 0 g/plot (B1), NPK 22.5 g/plot (150 kg/ha) (B2), 45 g/plot (300 kg/ha) (B3), and NPK 67.5 g/plot (450 kg/ha) (B4), so there are 36 experimental units.

The implementation procedure consists of several activities: preliminary analysis, coconut water immersion, cleaning and cultivating the soil, planting, fertilizing, maintaining, and harvesting. In the preliminary examination, soil chemical analysis was carried out to determine the available NPK content. Coconut water immersion was carried out according to the level of treatment. The immersion concentration of coconut water was treated with concentrations of 0%, 15%, and 30%.  The control treatment was carried out by immersion of the peanut seeds in 1000 ml of distilled water. The 15% coconut water immersion treatment combined 150 ml of coconut water into water. The seed immersion at each treatment level was carried out for 24 hours. The fertilizer used was NPK fertilizer (16-16-16) which was given twice, namely the first week after planting and six weeks after planting, as much as half of the treatment dose each. Maintenance activities include weeding, planting hoarding, watering, and pest control. Harvesting peanuts was done by looking at the characteristics of 50% of the yellowed leaves. The observed variables included plant height, flowering age, number of primary branches, harvesting age, wet pod weight, dry pod weight, percentage of pithy pods, percentage of empty pods, productivity, and weight of 100 seeds. The observed data were analyzed using analysis of variance and if there were significant differences between the treatments, a follow-up test was carried out using Duncan's Multiple Range Test at the 5% level.

## 3. Results and Discussion

The soil contained in the field was analyzed with soil chemical which include N-Total, $K_2O$, $P_2O_5$, pH, and soil water content. Soil chemical analysis results presented in the Table 1.

Table 1. Results of soil chemical analysis

| Parameter | Content | Unit | Criteria |
|---|---|---|---|
| N-Total | 0.11 | % | Low |
| $P_2O_5$ (Olsen Methods) | 9.00 | Ppm | Very Low |
| $K_2O$ | 0.15 | me/100g | Very Low |
| pH | 6.40 | - | Slightly Acid |

Based on the results of soil analysis in (Table 1), it showed that the availability of N-Total was low, $K_2O$ and $P_2O_5$ were very low, while the pH was classified as slightly acidic.

Determination of these criteria is based on the criteria for assessing the chemical properties of the Soil Research Institute (1983), that the criteria are low if the total N is 0.1% -0.2%, $P_2O_5$ is very low at <10 ppm, $K_2O$ is very low at <10 me /100g, and a slightly acidic pH of 5.5-6.5. The results of the analysis of variance showed that the effect of the interaction between immersion concentration of coconut water (A) and NPK fertilization dosage (B) showed significantly different result to the variable number of main branches which is presented in Table 2.

Table 2. Effect of coconut water immersion concentration and NPK fertilization dose on the number of main branches.

| Coconut Water | NPK | | | |
|---|---|---|---|---|
| | B1 (0 g/plot) | B2 (22.5 g/plot) | B3 (45 g/plot) | B4 (67.5 g/plot) |
| A1 (0%) | 5.7 b | 6.0 ab | 5.7 b | 6.8 a |
| | A | B | B | AB |
| A2 (15%) | 6.5 b | 7.7 a | 8.0 a | 7.2 ab |
| | A | A | A | A |
| A3 (30%) | 6.3 b | 7.5 a | 6.3 b | 6.2 b |
| | A | A | B | B |

Note: numbers followed by the same letters were not significantly different in the 5% Duncan's multiple range test. Capital letters (vertical) indicate the simple effect of the coconut water immersion concentration factor at the same treatment level of NPK fertilization doses and lowercase letters (horizontal) indicate the simple effect of the NPK fertilization dose factor at the same treatment level of coconut water immersion concentration.

The results of Duncan's 5% multiple range test in (Table 2) show the effect of the concentration factor of coconut water immersion. The best number of main branches was shown by the combination treatment of 15% coconut water immersion concentration with 45 gram/plot NPK fertilization dose (A2B3) of 8.0 branches, which was significantly different from the treatment (A1B3) and (A3B3). The same NPK fertilizer dose (B3) treatment should use a combination of treatment 15% coconut water (A2B3).

The results were not significantly different for all observation variables except for the number of main branches indicating that the simple effect on each factor was the same, but the two factors did not support each other in all variables so that the interaction of the two factors was not significantly different except for the variable number of main branches. The hormone content found in coconut water plays a role in optimizing cell metabolism and increasing plant growth so that it helps in increasing the number of branches (Ariyanti *et al.*, 2020). NPK nutrients are included in the macro nutrients that are absolutely needed by plants in large quantities. NPK has an essential function in plant growth, as a component of enzyme molecules which play an important role in the energy transfer process in cell (Sudding *et al.*, 2021). The vegetative phase, the role of the elements N is needed to stimulate branch growth (Juleo *et al.*, 2022). Appropriate NPK fertilizer dosage supports the growth and development of plants optimally. According to

Waruwu *et al.* (2021), every increase in the dose of NPK fertilizer by 1 gram/plot can increase the number of main peanut branches by 0.02 branches.

The results of the analysis of variance showed the main effect of immersion concentration of coconut water had very significantly different results observation on variables which included the percentage of pithy pods, the percentage of empty pods, and the weight of 100 seeds.

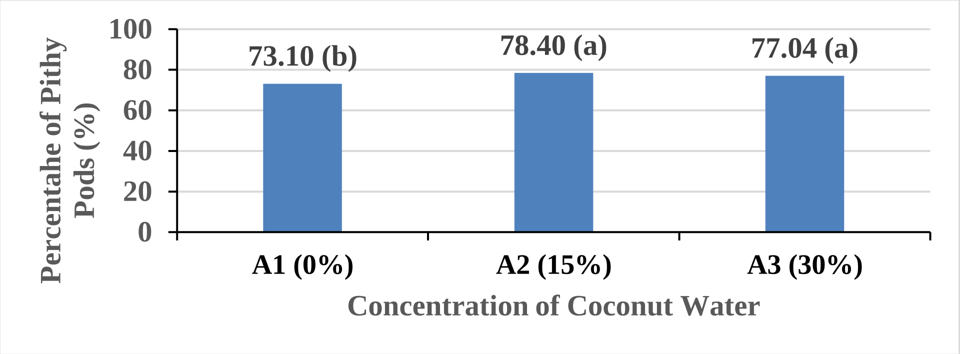


Figure 1. Effect of immersion concentration of coconut water on the percentage of pithy pods

The results of Duncan's multiple range test of 5% (Figure 1) on the main effect of the coconut water immersion concentration factor (A) showed that the treatment of 15% coconut water immersion concentration (A2) produced the best percentage of pithy pods, namely 78.40%. This is because the hormone gibberellin and cytokinins in coconut water can increase biomass due to increased photosynthetic results. In line with the statement of Wisuda *et al.* (2022), gibberellin is closely related to cell elongation and cell division so it can reduce empty pods and increase pithy pods and cytokinins which regulate a wide range of growth and development processes (Deshi *et al.*, 2021)

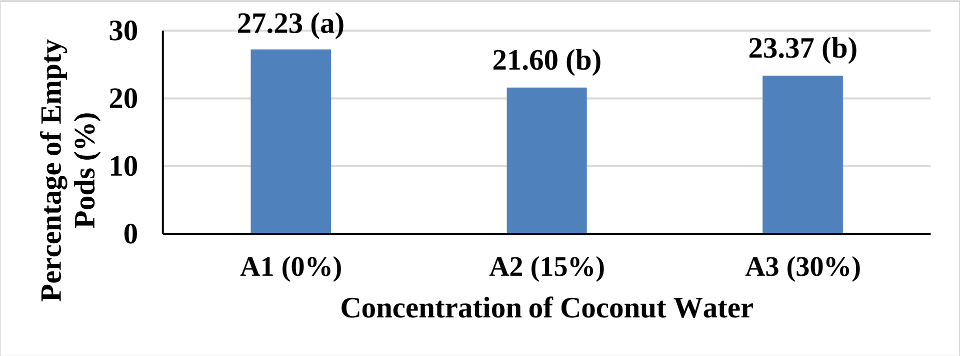


Figure 2. Effect of immersion concentration of coconut water on the percentage of empty pods

The results of Duncan's multiple range test of 5%, Figure 2, on the main effect of the coconut water immersion concentration factor (A) showed that the treatment of 15% coconut water immersion concentration (A2) produced the lowest percentage of empty pods which was 21.60%. It was significantly different from treatment (A1) but not significantly different to treatment (A3).

So, to get the lowest percentage of empty pods, treatment (A2) can be applied. This is because the hormone gibberellin in coconut water can increase biomass due to increased photosynthetic results. In line with the statement of Wisuda *et al.* (2022), gibberellin is closely related to cell elongation and cell division so that it can reduce empty pods and increase pithy pods.

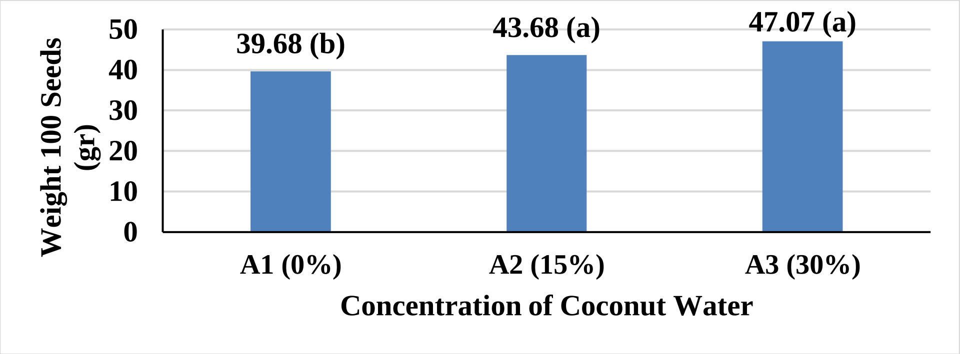


Figure 3. The effect of the coconut water immersion concentration on the weight of 100 seeds

The results of Duncan's multiple range test 5%, Figure 3, on the main effect of the coconut water immersion (factor A) showed that the 30% coconut water immersion treatment (A3) produced the highest 100 seed weights of 47.07 grams. Treatment with 15% coconut water immersion concentration (A2) was not significant to 30% coconut water immersion (A3) concentration. The most efficient 100 seed weights can apply treatment (A2). Good seed weights are affected by the hormones and nutrients contained in coconut water, which optimize the ongoing metabolic processes so that more photosynthate can be stored and it can increase the weight of 100 seeds (Wijaya *et al.*, 2019). The amount of K elemen from coconut water can increase cell size and plays an important role in cell physolohy (Rosniawaty *et al.*, 2020). From all observation, it was achieved that treatment with 15% coconut water immersion concentration (A2) was the best treatment compared to the treatment with higher concentration. Higher concentration inhibit the growth because concentration auxins, cytokinin, and gibberellins contained in it will be in suboptimal (Setiawati *et al.*, 2018).

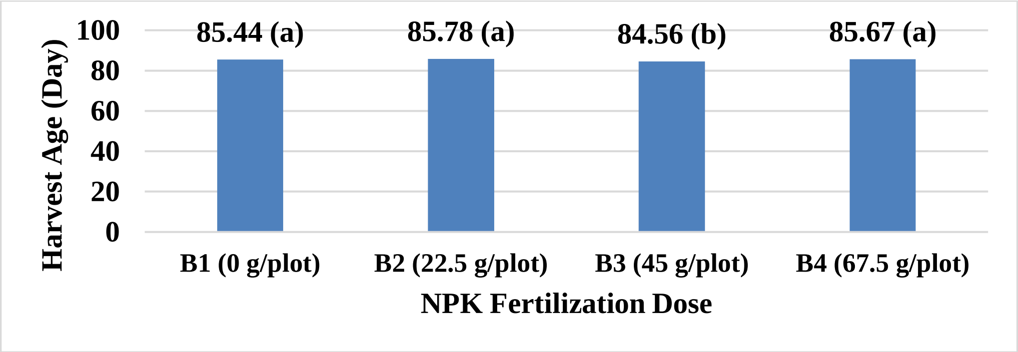


Figure 4. Effect of NPK fertilization dose on harvest age

The results of the analysis of variance showed that the main effect of fertilization dosage NPK had significantly different results observation on variables which included harvest age, percentage of empty pods, wet pod weight, and productivity.

The results of Duncan's multiple range test of 5%, Figure 4, on the main effect of the NPK fertilization dose factor (B) showed that the 45 gram/plot NPK fertilization treatment (B3) produced the best harvesting age of 84.56 days. It was significantly different from treatment (B1), (B2), and (B4). So, to get the best harvest age, treatment (B3) can be applied. The availability of NPK nutrients is sufficiently optimal so that it can affect the age of harvest. According to Juleo *et al.* (2022), sufficient NPK nutrients, especially element N, can affect the harvesting age of peanuts. The availability of nitrogen in small quantities will be a factor inhibiting plant growth (Khalofah *et al*., 2022).

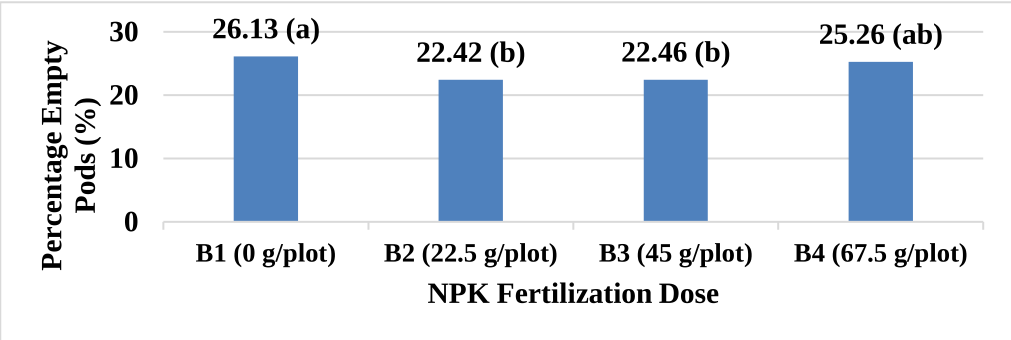


Figure 5. Effect of NPK fertilizer dose on the percentage of empty pods

The results of the 5% Duncan multiple range test, Figure 5, for the main effect of the NPK fertilization dose factor (B) showed that the 22.5 gram/plot NPK fertilization treatment (B2) resulted in the lowest percentage of empty pods 22.42%. It was significantly different from treatment (B1), but not significantly different from treatment (B3) and (B4). So, to get the lowest percentage of empty pods, treatment (B2) can be applied. Doses of 22.5 grams/plot have a good effect so that it can reduce the percentage of empty pods even though it is given at low doses. Appropriate NPK fertilization can multiply results such as increasing the percentage of pithy pods and decreasing the percentage of empty pods (Juleo *et al*., 2022). An increase of 1 gram/plot can increase the filled pods by 0.05 pods, decrease the empty pods by 0.01 pods (Gulo *et al*., 2020) and if the dose is increased again, the increase in growth is not significant (Hariyadi *et al*., 2020).

The results of the 5% duncan multiple range test, Figure 6, for the main effect of the NPK fertilization dose factor (B) showed that the 67.5 gram/plot NPK fertilization treatment (B4) produced the best wet pod weight of 87.42 gram. So, to get the best wet pod weight, treatment (B4) can be applied. NPK fertilizer plays a role in increasing the wet pod weight. In line with the statement of Zohaib *et al.* (2021), to increase the grain weight, NPK fertilization can be applied.

This is due to the availability of the right potassium nutrient so that there is an increase in photosynthate yields which are translocated to the pods (Pulungan *et al*., 2021). Wet pod weight determines how much photosynthesis can be stored in the seeds (Rahmawati *et al*., 2016). When filling the pods, the pod becomes the center assimilation which mostly use as seeds so that productivity can increase.

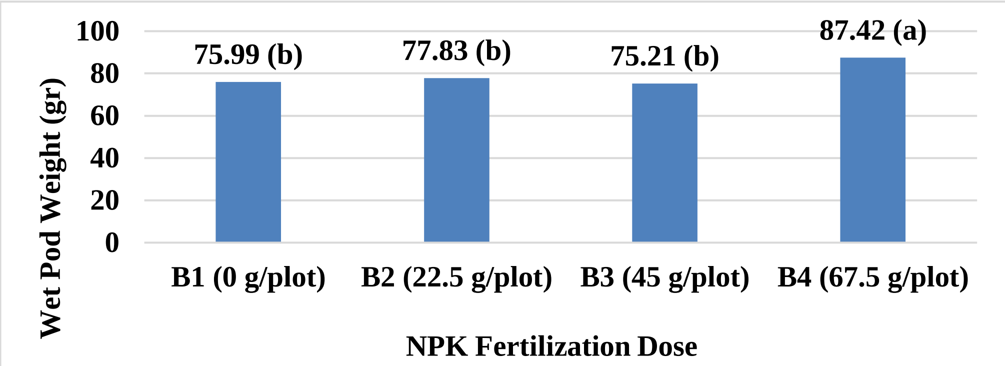


Figure 6. Effect of NPK fertilizer dose on wet pod weight

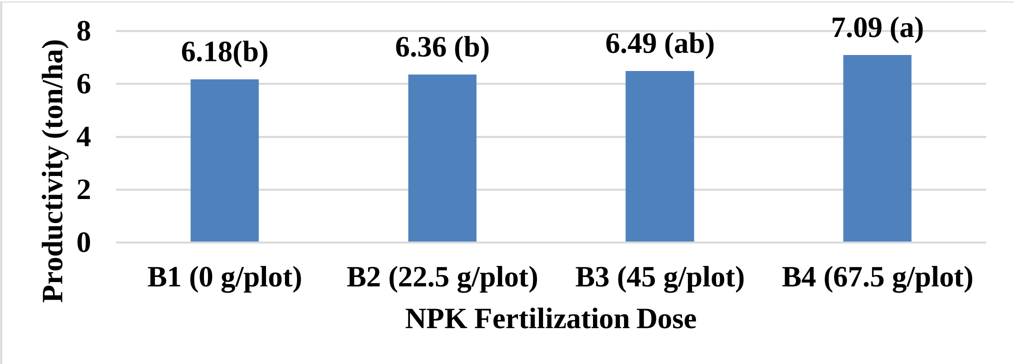


Figure 7. Effect of NPK fertilizer dose on productivity

The results of Duncan's 5% multiple range test, Figure 7, for the main effect of the NPK fertilization dose factor (B) showed that the 67.5 gram/plot NPK fertilization treatment (B4) produced the best productivity of 7.09 tons/ha. It was significantly different from treatment (B1) and (B2) but not significantly different from treatment (B3). The highest productivity was obtained by the applyingtreatment B4 because providing optimal NPK elements can maximize pod filling, which is closely related to productivity. In line with the statement of Silitonga *et al*. (2018), the relationship between the wet weight of the plant and the dose of NPK fertilizer was positive quadratic to increase productivity. Pod filling is influenced by insufficient phosphorus and potassium nutrients (Hartanti & Yumadela., 2018).

## 3. Conclusions

The results showed that there was a significant interaction only on the number of main branches with treatment of 15% coconut water immersion concentration and NPK fertilization dose of 22.5 grams/plot A2B2 (7.7 branches). The coconut water immersion concentration factor had a significant effect on the percentage of pithy pods, the percentage of empty pods, and the weight of 100 seeds, with concentration of coconut water immersion 15% (A2). The dose of NPK fertilization factor had a significant effect on harvesting age, percentage of empty pods, wet pod weight and productivity with the best treatment of NPK fertilization 67.5 gram/plot (B4). Applying treatment of immersion of coconut water 15% and NPK fertilization dose 67.5 grams/plot enhances the growth and yield of the peanut.

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