Performance of neem (*Azadirachta indica*) seedlings on compost and urea fertilizer dose treatment

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Abstract. Neem (*Mimba*) is one of the types of plants that are the potential to be developed commercially as plantations and community forests. The purpose of this research is to find out performance of neem seedlings on compost and urea fertilizer dose treatment. This experiment consisted of two factors arranged factorially using a Randomized Block Design. The first factor is the dose of compost with three levels, namely 200 g, 400 g, and 600 g per pot. While the second factor is the dose of urea fertilizer which consists of two levels, namely 2.5 g and 5 g per pot. The results showed that there was an interaction between compost dose and urea dose and had a very significant effect on root length per seed and significantly affected oven-dry weight per seedlings of neem. The highest root length of the neem seedlings of this experiment indicates that the doses of compost at a 200 g per pot and urea fertilizer of 2.5 g per pot was 28.00 cm and oven-dry weight of the roots of neem plant seeds was 2.81 g.

1. Introduction
Mimba (*Azadirachta indica* A.Juss.) is one of the potential plant species to be developed commercially as plantations and community forests. This plant has many uses including wood for building materials and household furnishings, as ornamental plants, animal feed or roadside shelter, and soil conservation, leaf extract and fruit are very potential for soap, bioenergy, traditional or herbal medicines and vegetable pesticides [1-3]. The content of active compounds such as gedunin, nimbidin, nimbin, nimbolide, salannin, meliantriol, and azadirachtin in leaf extracts of neem fruit is believed by experts to be nematicidal [4-8].

Neem nurseries are generally done generatively although vegetative methods can also be used. In general, neem seeds can germinate with a high success rate, which is 55-90% [9]. Efforts can be made to increase the growth of good seedlings by fertilizing both with organic fertilizer, which is compost or organic fertilizer or urea. Compost is an organic fertilizer made from organic materials such as leaves, stems, twigs, or livestock manure [10-12]. Compost can improve soil structure, increase microorganisms, enhance water absorption and storage capacity, so that soil fertility increases [13,14].

Nitrogen is the fourth most abundant element in plant tissue after carbon, hydrogen, and oxygen, but its availability in the soil is often insufficient for plant growth. Nitrogen fertilizer (urea) is a fertilizer that is very important for all plants because nitrogen is a constituent of protein compounds, the lack of nitrogen in plants that are often pruned will affect the formation of food reserves for plant growth [15]. The administration of 600 g manure and 7 g urea can increase the growth of seeds of mahogany plants.
From the description above, it is necessary to know about the growth of neem seeds by providing compost and urea.

2. Materials and methods

This research was conducted at the nursery of West Bali National Park Hall Jl. Raya Cekik - Gilimanuk Bali with a height of about 10 meters above sea level. This research was conducted from 1 March to 9 June 2019. The materials used in this study are seeds derived from neem plants that have been aged for decades and grow in the area of Labuan Lalang, District of Gerokgak, Buleleng Regency. As a planting medium for neem seedlings, the soil is in the area of West Bali National Park, which is located in Gilimanuk, Melaya District, Jembrana Regency, and compost and urea fertilizer as a treatment. The tools used in this research are stationery, calipers, weighing scale, polybags, bucket, poker, hoe, paranet, wire, pliers, sacks, and sifting the soil.

This experiment consisted of two factors arranged factorially using a Randomized Block Design (RCBD). The first factor is the dose of compost (K) with three levels, namely (K1) 200 g/pot, (K2) 400 g/pot, and (K3) 600 g/pot. While the second factor is the dose of urea fertilizer (N) which consists of two levels, namely (N1) 2.5 g/pot and (N2) 5 g/pot. Based on these two factors, 6 pot combination experiments were obtained and repeated three times so that 18 pots experiments were obtained.

3. Results and discussion

Based on the analysis of variance results obtained the significance of the effect of compost (K) with urea (N) and its interactions (K x N) on all observed variables can be seen in Table 1.

| No.  | Variables                              | Treatment |
|------|----------------------------------------|-----------|
| 1.   | Maximum plant height per seedling (cm) | ns        |
| 2.   | Maximum number of leaves per seedling (strands) | ns        |
| 3.   | Stem circumference per seedling (cm)   | ns        |
| 4.   | Root length per seedling (cm)         | ns        |
| 5.   | Fresh weight of leaves per seedling (g) | ns        |
| 6.   | Fresh weight of roots per seedling (g) | ns        |
| 7.   | Fresh weight of stem per seedling (g)  | ns        |
| 8.   | Oven dry weight of leaves per seedling (g) | ns        |
| 9.   | Oven dry weight of roots per seedling (g) | ns        |
| 10.  | Oven dry weight of stems per seedling (g) | ns        |

Note: ns (no significant), * (significant), ** (very significant)

3.1. Root length per seedling (cm)

Results of analysis of variance showed that the effect of doses of compost (K) does not affect significantly (P≥0.05) whereas the effect of urea (N) and interaction (KxN) was highly significant (P <0.01) to the length of root per seedling (Table 2).

Based on Table 2 it can be explained that the influence of K1 and K3 dose levels on the compost fertilizer dose factor at N1 and N2 levels on the urea dose factor shows a different effect that is not significant, but at the K2 dose level at N1 and N2 levels shows significantly different and root length per seedling in K2N1 that is 30.00 cm, whereas in K2N2 it is 13.33 cm. The effect of N1 dose level interaction on compost fertilizer dosage level was not significantly different, whereas at N2 level K3N2 interaction gave root length per seedling which was 24.00 cm and not significantly different from K1N2 which gave root length per seedling which was 23.97 cm, but it was different real with K2N2.
Table 2. The average length of root per seed on the interaction of compost with urea (KxN).

| Treatment | Urea Dose (N) | 2.5 g/pot (N1) | 5.0 g/pot (N2) |
|-----------|--------------|----------------|----------------|
| Compost Dose (K) | | | |
| 200 g/pot (K1) | | 28.00 a | 23.97 a |
| | | A | A |
| 400 g/pot (K2) | | 30.00 a | 13.33 b |
| | | A | B |
| 600 g/pot (K3) | | 23.83 a | 24.00 a |
| | | A | A |

LSD 0.05

Note:
1. The numbers followed by the same lowercase letters in the same column are not significantly different at the LSD test level of 5%
2. The numbers followed by the same uppercase letters in the same line are not significantly different at the LSD test level of 5%

3.2. Oven dry weight of roots per seedling (g)

Results of analysis of variance showed that the treatment of compost (K) and urea (N) fertilizer had a very significant effect (P < 0.01) and interaction (KxN) had a significant effect (P < 0.05) on the oven-dry weight of roots per seedling (Table 3).

Table 3. The average oven-dry weight of roots on interaction dose of compost with urea (KxN).

| Treatment | Urea Dose (N) | 2.5 g/pot (N1) | 5.0 g/pot (N1) |
|-----------|--------------|----------------|----------------|
| Compost Dose (K) | | | |
| 200 g/pot (K1) | | 2.81 a | 1.07 ab |
| | | A | B |
| 400 g/pot (K2) | | 1.23 b | 1.11 a |
| | | A | A |
| 600 g/pot (K3) | | 1.50 b | 0.24 b |
| | | A | B |

LSD 0.05 0.86

Note:
1. The numbers followed by the same lowercase letters in the same column are not significantly different at the LSD test level of 5%
2. The numbers followed by the same uppercase letters in the same line are not significantly different at the LSD test level of 5%

Based on Table 3, it can be explained that the effect of K3 dose level on the compost fertilizer dose factor on changes in urea dose level, namely N1 and N2 shows that the interaction effect is not significantly different, whereas at the dose level K1 and K2 show the effect of interaction that is significantly different between K2N1 and K2N2 and K3N1 with K3N2. The influence between the level of N1 dose on the urea dose factor on the change in the level of compost fertilizer dosage shows that the K1N1 interaction shows the highest dry weight of the root oven per seed is 2.81 g and is significantly different from the influence of the interaction of K2N1 and K3N1. on the effect of N2 interaction on the urea dose factor on changes in the level of compost fertilizer dosage showed the highest oven-dry weight per seedling on the influence of K2N2 interaction was 1.11 g and significantly different from K3N2, but different from K1N2 with the oven dry weight per seedling respectively 0.24 g and 1.07 g.

The results showed that there was an interaction between compost dose and urea dose and had a very significant effect on root length per seed and significantly affected oven-dry weight per seedlings of neem (Table 1). The interaction of compost treatment at each level of urea fertilizer shows that increasing the level of compost fertilizer dosage from 200 g to 600 g per seed (K1 to K3) at the level of dose N1 on the urea fertilizer factor shows a different effect that is not significant as well at the dose
level N2, the interaction of K1N2 has a significantly different effect than K3N2 but it is significantly different from K2N2 (Table 2). The interaction of urea fertilizer treatment at each level of compost showed that increasing levels of urea fertilizer from 2.5 g per seed to 5 g per seed (N1 to N2) showed no significant effect (Table 2).

On the dry weight of the root oven per neem plant seedlings, it was shown that giving K1 dose level in the compost fertilizer treatment had increased the dry weight of the root oven per seedling and was not significantly different in increasing the K2 to K3 dose at each level of urea fertilizer dosage, both at N1 level and N2 (Table 3). Likewise, the increase in the dose of urea fertilizer from levels N1 to N2 gives a different interaction effect that is not significant at each level of compost dose from K1 to K3 (Table 3). This is because the results of the analysis of the soil on the growth media of neem plant seeds showed high organic C status of the soil, and the total N of the soil was medium. During the composting process, if the temperature was mostly above 55 °C and decreased to mesophilic conditions in the matured stages. Different types of bacteria were dominant in every stage of composting and bacterial diversity changed mainly by temperature [17]. The change of microbial community could be the cause of continuous high temperature in HTC and thus improve composting efficiency by accelerating the maturation process [18-21]. Besides, compost also contains organic C and elements N, P, and K [22-25]. The efficiency of fertilizer and nitrification inhibition was measured by nitrate and ammonium changes and fluxes of N₂O gas. The results showed that the application of urea coated with 5% neem on cabbage plants yielded the highest plant height. However, the leaf length and width were not significantly different from other urea treatments. Application of urea coated neem reduced nitrification rate and N₂O emissions in the soil. Soil CO₂ levels treated either with 2.5% or 5% neem coated urea showed the lowest levels of CO₂ soil. This suggests that neem can reduce N₂O and CO₂ emissions from urea fertilizer as well as the capacity to reduce nitrification rate [26, 27].

4. Conclusions
Based on the results of the discussion it can be concluded that the application of compost at a dose of 200 g per seedling and urea fertilizer at a dose of 2.5 g per seedling is enough to provide the best root length of the neem plant seedlings which is 28.00 cm and the dry weight of the oven roots of the neem plant seeds which is 2.81 g.

Acknowledgments
The researcher would like to thank the Head of Experiment Station of the Faculty of Agriculture, Warmadewa University for facilitating this research.

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