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Response of Cuttings Material and Auxin Concentration to the Growth of Lemon Citrus Cuttings (Citrus limon L.)

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Abstract
The experiment was carried out in Cikadu Village, Cijambe District, Subang Regency with an altitude of 250-400 above sea level and this experiment will be carried out from September to November 2022. The experimental design used is a factorial Randomized Group Design (RAK) with two treatment factors, namely factor cutting material (S) and Auxin concentration (A) and repeated 3 times. Based on the results of the analysis of observation data in the field, it can be concluded that the treatment of the cutting material has a significant effect on the age of germination, percentage of survival, number of shoots, number of leaves, number of roots and root volume. Treatment with a concentration of the auxin hormone at a concentration of 300 ppm (A4) affected the age of germination, percentage of life, number of shoots, number of leaves, number of roots and root volume.

Keywords: Lemon, Cuttings, Auxin

1. Introduction

Lemon (Citrus limon L.) is a plant native to Southeast Asia. Lemons were first grown in India, Northern Burma and China. In 1493, Christopher Columbus brought lemon seeds to Hispaniola. In the 18th and 19th centuries, lemons were grown in Florida and California. The parts of this plant that are often used are the fruit peel, flowers, leaves, juice. Lemons are no stranger to Indonesian people and have a wider variety of uses for Root UP compared to other types of citrus, so they are often referred to as multi-purpose fruit.(Prastowo et al., 2006). The success of propagation by cuttings depends on the formation of roots of the cuttings for survival. The process of root formation is greatly influenced by endogenous and exogenous hormones. Where endogenous hormones are natural hormones that come from within the cutting material itself. Apart from the cutting material, the problem that often arises when cultivating plants using cuttings is that it is difficult and takes a long time for the plant to root.

2. Methods

The research method used is an experimental method, the experiment was carried out in Cikadu Village, Cijambe District, Subang Regency at an altitude of 250-400 above sea level and this experiment will be carried out from September to November 2022. The material used in this experiment is cuttings from secondary branches. lemons taken from the mother tree, top soil and organic fertilizer as planting media, ZPT Root U Auxin hormone as research factor, distilled water, 15 cm x 10 cm polybags as planting media containers, bamboo as shade poles, clear plastic as a hood, 70% black paranet as a roof shade and water for watering. The tools used in this research were a hoe as a tool for making plots, a ruler or meter for measuring shoot length and land area, a hand sprayer and gembor as a tool for watering plants, scissors and cutters for cutting cuttings, machetes for cutting bamboo, stationery and other tools. The experimental design used was a factorial

Randomized Block Design (RAK) with two treatment factors, namely the cutting material factor (S) and Auxin concentration (A) and was repeated 3 times.

Table 1. Combination of treatment factor levels.

Cutting material (S)	Auxin (A) Concentration			
	A1 (Without Root up)	A2 (100 ppm Root up)	A3 (200 ppm Root up)	A4 (300 ppm Root up)
S1 (Top)	a1s1	a2s1	a3s1	a4s1
S2 (Middle)	a1s2	a2s2	a3 s2	a4s2
S3 (Base)	a1s3	a2s3	a3 s3	a4s3

Table 2. Variety Print Analysis

Source of Diversity (SK)	Degrees of Freedom (db)	Sum of Squares (JK)	Middle Square (KT)	F Count	F Table 0.05
Cutting Material (S)	2	JKs	KTs	KTs/KTg	3.49
Auxin (A)	3	JKa	KTa	KTa/KTg	3,049
SA interactions	6	JKsa	KTsa	KTsa/KTg	2.55
Group (r)	2	JKKi	KTKr		3.44
Error (g)	22	JKg	KTg		-
Total	35	JKT			-

3. Results and Discussion

3.1 Germination Age (Days)

There was a real interaction between the combined effects of stem cutting material and ZPT Auxin on the growth of shoots in lemon cuttings at the ages of 7, 14, 21, 28, 35, 42, 49, 56 and 63 days after. Meanwhile, the single factor, the influence of the stem cutting material, had a significant influence on the growth of new shoots at the observation ages of 7, 14, 21, 28, 35, 42, 49, 56 and 63 days old. The cutting material factor had a very real influence on the ages observed at 7, 14, 21, 28, 35, 42, 49, 56 and 63 HSS.

Table 3. Average Number of Shoots at Age 14 DAP Due to the Effect of Stem Cutting Material and auxin concentration on shoot growth of lemon planting cuttings.

Treatment	Average	Average + DMRT
Without Auxin (A1)	1,167 a	1.38
Auxin concentration 100 ppm (A2)	1,667 b	1.89
Auxin concentration 200 ppm (A3)	2,042 c	2.27
Auxin concentration 300 ppm (A4)	2,283 d	

Note: Numbers followed by the same letter in the same column and the same treatment show that the effect is not significantly different from the DMRT test at the 5% level.

Table 4. Average Number of Shoots at the Age of 21 DAP Due to the Influence of Stem Cutting Material and Auxin concentration on the emergence of shoots from lemon planting cuttings

Treatment	Average	Average + DMRT
Without Auxin (A1)	1.33 a	1.54
Auxin concentration 100 ppm (A2)	2.04 b	2.26
Auxin concentration 200 ppm (A3)	2.42 c	2.64
Auxin concentration 300 ppm (A4)	2.67 d	

Note: Average numbers marked with the same letter in each column are not significantly different according to Duncan's Multiple Range Test at a 5% significance level.

Table 5. Average Number of Shoots at the Age of 28 DAP Due to the Influence of Stem Cutting Material and Auxin concentration on the emergence of shoots from lemon planting cuttings

Treatment	Average	Average + DMRT
Without Auxin (A1)	1.67 a	1.87
Auxin concentration 100 ppm (A2)	2.42 b	2.63
Auxin concentration 200 ppm (A3)	2.79 c	3.01
Auxin concentration 300 ppm (A4)	3.04 d	

Note: Average numbers marked with the same letter in each column are not significantly different according to Duncan's Multiple Range Test at a 5% significance level.

Table 6. Average Shoot Appearance at Age 35 DAP Due to the Influence of Stem Cutting Material and Auxin concentration on the emergence of shoots from lemon planting cuttings

Treatment	Average	Average + DMRT
Without Auxin (A1)	1.83 a	2.10
Auxin concentration 100 ppm (A2)	2.79 b	3.07
Auxin concentration 200 ppm (A3)	3.25 c	3.53
Auxin concentration 300 ppm (A4)	3.42 d	

Note: Average numbers marked with the same letter in each column are not significantly different according to Duncan's Multiple Range Test at a 5% significance level.

Table 7. Average Number of Shoots at the Age of 42 DAP Due to the Influence of Stem Cutting Material and Auxin concentration on the emergence of shoots from lemon planting cuttings

Treatment	Average	Average + DMRT
Without Auxin (A1)	2.17 a	2.46
Auxin concentration 100 ppm (A2)	3.04 b	3.35
Auxin concentration 200 ppm (A3)	3.54 c	3.86
Auxin concentration 300 ppm (A4)	3.83 d	

Note: The average numbers marked with the same letter in each column are not significantly different according to Duncan's Multiple Range Test at a significance level of 5%5%.

Table 8. Average Number of Shoots at the Age of 49 DAP Due to the Influence of Stem Cutting Material and Auxin concentration on the emergence of shoots from lemon planting cuttings

Treatment	Average	Average + DMRT
Without Auxin (A1)	2.63 a	2.91
Auxin concentration 100 ppm (A2)	3.42 b	3.71
Auxin concentration 200 ppm (A3)	3.92 c	4.22
Auxin concentration 300 ppm (A4)	4.29 d	

Note: Average numbers marked with the same letter in each column are not significantly different according to Duncan's Multiple Range Test at a significance level of 5%

Table 9. Average Shoot Appearance at Age 56 DAP Due to the Influence of Stem Cutting Material and Auxin concentration on shoot growth of lemon planting cuttings

Treatment	Average	Average + DMRT
Without Auxin (A1)	3.00 a	3.27
Auxin concentration 100 ppm (A2)	3.79 b	4.07
Auxin concentration 200 ppm (A3)	4.29 c	4.58
Auxin concentration 300 ppm (A4)	4.71 d	

Note: Average numbers marked with the same letter in each column are not significantly different according to Duncan's Multiple Range Test at a significance level of 5%

Table 10. Average Shoot Appearance at Age 63 DAP Due to the Influence of Stem Cutting Material and Auxin concentration on shoot growth of lemon planting cuttings

Treatment	Average	Average + DMRT
Without Auxin (A1)		3.27
Auxin concentration 100 ppm (A2)		4.07
Auxin concentration 200 ppm (A3)	4.29 c	4.58
Auxin concentration 300 ppm (A4)	4.71 d	3.00 a

Note: Numbers followed by the same letter in the same column and the same treatment show that the effect is not significantly different from the DMRT test at the 5% level.

3.2 Germination Age (Days)

The results of the analysis of variance above show that the treatment of cutting material and auxin concentration on the percentage of survival has an effect on the shoot

growth of lemon cuttings. Auxin concentration has a very significant effect on the growth of lemons.

Table 11. Percentage (%) of living lemon cuttings, due to the influence of stem cutting material and auxin concentration on the growth of lemon planting cuttings.

Treatment	Average	Average + DMRT
Without Auxin (A1)	44,722 a	61,582
Auxin concentration 100 ppm (A2)	76,389 b	94,094
Auxin concentration 200 ppm (A3)	79,167 c	97,406
Auxin concentration 300 ppm (A4)	81,944 d	

Note: Numbers followed by the same letter in the same column and the same treatment show that the effect is not significantly different from the DMRT test at the 5% level.

3.3 Shoot Length (cm)

The results of analysis of variance showed that shoot length at 30 DAS had a real influence on auxin concentration. And the results of analysis of variance showed that there was a very significantly different interaction in auxin concentration.

Table 12. Percentage (%) of living lemon cuttings, due to the influence of stem cutting material and auxin concentration on the growth of lemon planting cuttings.

Treatment	Average	Average + DMRT
Without Auxin (A1)	4,708 a	5,496
Auxin concentration 100 ppm (A2)	7,042 b	7,868
Auxin concentration 200 ppm (A3)	6,792 c	7,643
Auxin concentration 300 ppm (A4)	7.125 d	

Note: Numbers followed by the same letter in the same column and the same treatment show that the effect is not significantly different from the DMRT test at the 5% level.

3.4 Number of Shoots

The effect of cutting material and auxin concentration on the growth of lemon planting cuttings shows that there are real differences in cutting material and auxin concentration.

Table 13. Duncan's Further Test Effect of Cutting Material and auxin concentration on the number of shoots

Treatment	Average	Average + DMRT
Without Auxin (A1)	13,000 a	14,299
Auxin concentration 100 ppm (A2)	18,000 b	19,364
Auxin concentration 200 ppm (A3)	22,333 c	23,739
Auxin concentration 300 ppm (A4)	22,333 d	

Note: Numbers followed by the same letter in the same column and the same treatment show that the effect is not significantly different from the DMRT test at the 5% level.

3.5 Number of Leaves

The effect of cutting material and auxin concentration on the growth of lemon planting cuttings shows that there are real differences in cutting material and auxin concentration.

Table 14. Duncan's Further Test Effect of Cutting Material and auxin concentration on the number of leaves.

Treatment	Average	Average + DMRT
Without Auxin (A1)	5,028 a	11,126
Auxin concentration 100 ppm (A2)	8,167 b	14,570
Auxin concentration 200 ppm (A3)	8,861 c	15,458
Auxin concentration 300 ppm (A4)	10,667 d	

Note: Numbers followed by the same letter in the same column and the same treatment show that the effect is not significantly different from the DMRT test at the 5% level.

3.6 Root Volume

The average root volume in the cutting material treatment and lemon auxin concentration at the observation age of 60 DAP showed that there were significant differences in all treatments.

Table 15. Duncan's Advanced Test Effect of cutting material and auxin concentration on root volume

Treatment	Average	Average + DMRT
Without Auxin (A1)	3,400 a	5,202
Auxin concentration 100 ppm (A2)	4,689 b	6,582
Auxin concentration 200 ppm (A3)	5,111 bc	7,061
Auxin concentration 300 ppm (A4)	6,200 bc	

Note: Numbers followed by the same letter in the same column and the same treatment show that the effect is not significantly different from the DMRT test at the 5% level.

4. Conclusion

The treatment of the cutting material had a significant effect on the age of germination, survival percentage, number of shoots, number of leaves, number of roots, and root volume. Treatment with a concentration of the auxin hormone at a concentration of 300 ppm (A4) affected the age of germination, percentage of life, number of shoots, number of leaves, number of roots and root volume. The treatment of the type of cutting material and the concentration of the Auxin hormone had a significant effect on the age of germination, survival percentage, number of shoots, number of leaves, number of roots and root volume. It is recommended that lemon farmers use the lower branches for wider breeding through propagation by cuttings, in order to meet the seed needs of the farmers themselves. It is recommended that future researchers conduct further research using lower branch cuttings but with a higher concentration of the auxin hormone than 300 ppm.

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