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LIFE SCIENCE CHAPTER

Response of Three Varieties of Patchouli (*Pogostemon cablin*, Benth) to Varies Range of Drought Stress and Fertilization

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Abstract

The aim of this research was to response the growth and yield of three varieties of patchouli on a variety of drought stress conditions and fertilization. Research was conducted at Reuleut Timu village of Muara Batu sub-district North Aceh District from July to October 2015. The study was designed by using Split-split Plot with two replications of three factors in plastics home which consist of provision of water factor (K) at field capacity (fc), patchouli varieties factor (V) and fertilizers factor (P). Parameters measured were the number of leaves, plant height, and number of branches, root length and wet weight of the plant canopy. The result showed that the provision of water at field capacity has very significant effect on the wet weight of the plant canopy. Best field capacity found in K_1 (100% fc) and K_2 (75% fc). Variety treatment has significant influence to wet weight of the plant canopy shown by Tapaktuan variety (V_2). Fertilizers has very significant effect on the number of leaves and plant canopy wet weight and significantly affect on number of branches indicated by the recommended dosage Balittro (P_1).

Keyword: Patchouli, Drought Stress, Verieties, Fertilization

Introduction

Patchouli (*Pogostemon cablin* Benth) is one kind of aromatic essential oil plant that is included in the family of Lamiaceae. Originating from the subtropical regions of the Himalayas, Southeast Asia and the Far East, cultivated in Indonesia, Malaysia, China and Brazil (Carbone *et al.*, 2013). Production centers of patchouli in Indonesia are Aceh, North Sumatra, West Sumatra, South Sumatra, Bengkulu, Lampung, West Java, Central Java and East Java, South Kalimantan, Central Kalimantan, Central Sulawesi, South Sulawesi, West Sulawesi and Southeast Sulawesi (Dirjenbun, 2012).

Patchouli plants are included in shallow roots plant, so less resistant to drought. Such roots morphological characters caused patchouli sensitive to soil moisture deficits (Pitono *et al.*, 2007). Generally, patchouli plants are cultivated on dry land under fain-fed irrigation and no fertilization in accordance with the needs of the plant. Patchouli plants need water or rainfall ranging between 2500-3000 mm per year to grow and

produce well. The average rainfall per year in North Aceh amounted to 1,478 mm. With such amount of rainfall, patchouli will experience shortage of water and drought stress.

The use of varieties that have response to drought is one of the most technologically efficient and inexpensive. Several national superior patchouli varieties have been released in Indonesia, three of which are Sidikalang, Tapaktuan, and Lhokseumawe varieties which have high yield production (Nuryani *et al.*, 2005). All three are still relatively vulnerable to high drought stress, and unknown suitable dose of fertilizer to increase production.

For efficient fertilization, fertilization process does not only consider soil condition and environment only, but also should consider the basic needs of the plant nutrients. Right use of type and dose of fertilizer should be based on the results of soil and plant analysis thus thefore can be used as recommended fertilization within the area. This study aims to study the response in term of growth and yield of three varieties of patchouli on varies range of drought stress conditions and fertilization.

Materials and Methods

The study was conducted in the village of Reuleut Timu sub-district of Muara Batu district of North Aceh with altitude of ± 8 m above sea level (asl). Research was performed in the plastic housing from July 2015 to October 2015. The materials used are patchouli *pogostemon cablin* Benth seeds Tapaktuan, Lhokseumawe and Sidikalang varieties, cow manure, polybag, urea, SP-36 and KCl, MgO, Sevin 85 SP and Dithane M 45. The tools used are digital scales, sprayer, scissors, yells, plastic rope, ruler, computer, stationery and other tools. Using random group split plots design as the basic design with two replications of three factors, namely, the factor of irrigation (K) at field capacity (fc) as main plot, K_1 = water supply 100% fc, K_2 = water supply 75 % fc, K_3 = 50% fc water supply, water supply K_4 = 25% fc. Patchouli variety factor (V) as a subplot, V_1 = Lhokseumawe (origin Lhokseumawe / North Aceh), V_2 = Tapaktuan (origin Tapaktuan / South Aceh), V_3 = Sidikalang (origin Sidikalang North Sumatra) and fertilizers factor (P) N, P, K and Mg as sub-sub plot, P_1 = 284 kg urea / ha (128.8 kg N / ha) + 70 kg SP36 / ha (25 kg P_2O_5 / ha) + 140 kg KCl / ha (84 kg K_2O / ha) + 140 kg Mg / ha (42 kg MgO / ha) (Balittro, 2011), P_2 = 518 kg urea / ha (233 kg N / ha) + 544 kg SP-36 / TSP / ha (196 kg P_2O_5 / ha) + 200 kg KCl / ha (120 kg K_2O / ha) + 450 kg Mg / ha (135 kg MgO / ha) (Emmyzar & Fery, 2004), P_3 = 691 kg urea / ha (311 kg N / ha) +220 kg SP-36 / TSP / ha (35 kg P_2O_5 / ha) + 790 kg KCl / ha (394 kg K_2O / ha) +208 kg Mg / ha (63kg MgO / ha). There are 72 (seventy-two) experimental plots and each plot has 7 (seven) polybag planted 1 (one) patchouli seed.

Implementation of Research

The plant materials derived from shoot cuttings with a diameter of 0.8 to 1.0 cm and were taken from young branches but have woody. Shoot cuttings were cut with a length of 20 cm. Cuttings are grown in 1 kg polybags size containing a mixture of soil and cow manure. Seedlings that already have buds and leaves are moved to big polybag with the size of 60 kg of land. Drought stress treatment is given at the age of 1 month after planting in accordance with the treatment. Polybag plants are arranged with a

distance of 60 cm x 40 cm on randomized plots. Maintenance includes watering, weeding and pest eradication. Patchouli fertilization was done two weeks before planting in accordance with the treatment.

Soil water content at field capacity was measured every day with a tensiometer (soil moisture tester) to determine when and how much water should be given to each experimental plot. Growth and yield observations was made at the age of 120 days after planting (dap) to the number of leaves, plant height, number of branches, root length and weight of the wet canopy. The data were analyzed by ANOVA. Should real differences occur, further test using BNT at the level of 5% was conducted.

Results and Discussion

The Number of Leaves (NL)

Analysis of variance showed that the dose of fertilizer given to patchouli significantly affect the amount of plant leaves. Best dose of fertilizer is the recommended dosage of Balitro (P_1). Although it did not give a noticeable difference in the treatment of varieties, but the varieties Tapaktuan (V_2) has more leaves than other varieties. Water provision levels at field capacity did not significantly affect the number of leaves of the plant, but the highest number of leaves reached on the provision of water treatment at 75% fc (K_2).

The recommended dosage of fertilizer of Balitro has more leaves compared to the others. Large number of leaves due to the recommended fertilizer dose of Balittro was believed to be the doses as required by patchouli. This recommended doseo of Balitro has been tested to different types of soil and various patchouli production centers in Indonesia. Besides, this dose is the optimal and balanced dose for the development and growth of patchouli (Mawardi & Dzajuli, 2006).

Plant Height (PH)

Analysis of variance showed that the provision of water at field capacity, varieties and fertilizers do not provide a real difference on plant height at 120 dap. The highest plant as a result of concecutive treatment was achieved at K_2 (75% fc), Tapaktuan variety (V_2) and fertilizers P_2. Although statistically not significant, plant height was predicted to be caused by nutrient uptake by the roots due to the availability of sufficient water in the soil, resulting in the increase of plant height. Plants will easily absorb nutrients when water is sufficient in the soil. This is consistent with Mukhlis (2013), that the uptake of nutrients by plants is influenced by the availability of nutrients and water in the soil. Plants absorb the nutrients dissolved in soil water through the roots. Water plays an important role in the process of absorption of nutrients, the water can play a role in dissolving nutrients and transport it into the plant tissue.

Number of Branches (NB)

Analysis of variance showed that there are visible differences in number of branches as a result of the treatment dose of fertilizer at the age of 120 dap. Number of higest branches at the age of 120 dap was achieved at P_2 which is significantly different with the dose of P_3. There were no significant differences in water treatment at field capacity (K) and the treatment of varieties (V). Low number of patchouli branches at the P_3 dose was expected because the dose applied was not optimal for patchouli. According to Sugiarti *et al.* (2004) to obtain optimum plant growth, fertilizers must be administered in an amount

corresponding to the needs of the plant. Fertilizer administered was predicted to exceed the nutrient needs of patchouli.

Tabel 1.The number of leaves (NL), Plant Height (PH), Number of Branches (NB), Root Length (RL), Wet Weight of The Plant (WWP) Patchouli at the age of 120 days after planting (dap) due to the treatment of the provision of water at field capacity varieties and fertilizers.

Treatment /Parameter	NL	PH	NB	RL	WWP
Water field capacity					
K_1	45.12 a	41.71 a	8.44 a	22.01 a	23.52 a
K_2	45.62 a	42.48 a	8.30 a	26.43 a	21.93 a
K_3	37.81 a	38.33 a	7.62 a	19.82 a	16.09 b
K_4	39.56 a	39.63 a	8.97 a	27.24 a	15.25 b
BNT 0,05	14.24	6.04	1.86	10.68	5.49
Varieties					
V_1	41.61 a	37.62 a	7.69 a	24.96 a	18.24 b
V_2	43.87 a	47.22 a	9.15 a	21.96 a	24.08 a
V_3	40.59 a	36.77 a	8.15 a	24.71 a	15.27 c
BNT 0,05	9.03	2.35	1.62	7.37	1.42
Dose fertilizer					
P_1	48.58 a	42.22 a	8.82 a	23.92 a	21.39 a
P_2	42.97 a	42.54 a	8.88 a	24.85 a	19.05 ab
P_3	34.52 b	36.87 a	7.29 b	22.87 a	17.14 b
BNT 0,05	8.05	4.00	1.42	7.98	2.45

Note: The numbers followed by the same letters in the same column are not significantly different according to LSD test 0.05 level.

Root Length (RL)

Analysis of variance showed no significant differences in patchouli root length due to the provision of water treatment at field capacity, varieties and fertilizer at the age of 120 dap. Although it does not have significant differences due to treatment, but the highest root length is achieved at the level of 25% fc (27, 24) on the provision of water at field capacity, varieties of Lhokseumawe (24.96) and fertilizers P_2 (24.85).

Root length at 25% moisture content level was allegedly due to drought at the top soil, the plants extend their roots to find water at the bottom part of polybag which is still damp. It is as expressed by Djazuli (2010) that patchouli was able to search the water by extending its roots into the bottom soil of the pot for more moist. Similarly, as was expressed by Dubrovsky dan Gomez-Lomeli (2003), that the extension of roots in drought conditions with the formation of deep roots and many branches. From the data shown at the above, Lhokseumawe varieties have more long roots than others due to the provision of water treatment at field capacity. The recommended dose of fertilizer of Balittro was an optimal and balanced fertilizer for patchouli.

Wet Weight of the Plant (WWP)

Analysis of variance showed that there were significant differences on the wet weight of patchouli plant canopy due to the provision of water treatment at field capacity. The highest canopy wet weight was achieved at the level of K_1 (100% fc) followed by K_2 (75% fc) are significantly different from K_3 (50% fc) and K_4 (25% fc). Tapaktuan variety (V_2) has the highest canopy weight and highly significant compared with other varieties. Balittro fertilizer recommendation (P_1) provides the highest canopy wet weight and highly significant at a dose of P_3.

Low water supply treatment caused lower wet weight of plant canopy, as was the case in the K_3 and K_4. Plants slow organ growth and development as mechanism to face drought stress. Therefore, the wet weight of patchouli plant canopy to the scenes has a lower weight plants than plants with enough water. Tapaktuan varieties have a high canopy wet weight because it can adapt to a variety of stress conditions given. The study produced similar results to the study conducted by Djazuli (2010) who found that Tapaktuan varieties show best resistance level of all types of patchouli in Aceh. The amount of the plant canopy wet weight gained due to the dose of fertilizer P_1 indicates that the dose is adequate to support optimum plant growth (Prawoto & Sholeh, 2006).

Conclusion

The provision of water at field capacity has significant effect on the wet weight of patchouli plant canopy. Water provision at field capacity was found in the K_1. Best response of patchouli vegetative growth to drought stress obtained at Tapaktuan varieties that showed the highest plant canopy fresh weight compared to other varieties. Balittro recommended dose of fertilizer showed significant effect on the number of leaves and wet weight of the plant canopy. The provision of water for patchouli plant growth should be given to soil moisture content between 75% fc to 100% fc, using Tapaktuan variety with the Balittro recommended dose of fertilizer.

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