Low phosphate latosol soil utilization for cotton plants cultivation by modifying soil structure and vam fertilizer application

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Abstract. According to the need of land to fulfill the program of Intensifikasi Kapas Rakyat (IKR), such alternative land that has been underutilized optimally is needed to be found to anticipate the low capacity of growth. This research tries to improve the soil structure of latosol which has massive structure but has low phosphate availability for cotton cultivation Delta Pine 45 A varieties. A. Biological fertilization in the form of VAM spore inoculant is expected to help phosphate soil is absorbed by the plant. Improved soil structure of latosol by mixing its top soil part with river sand in comparison of 2:1. VAM mushroom spores were isolated by wet sieving and inoculated when cotyledon plants formed a broadcast inoculation with a dose of 50 spores per plant. Observations on cotton plant growth include plant dry weight, cotton fruit, phosphate levels of plant tissue during vegetative and reproductive phases, and the calculation of the intensity of VAM infections in plant roots. Soil with repaired structure and VAM-infected showed significant cotton growth carrying capacity to its control. Plant dry weight increased by 85%, the intensity of infection increased by 28%, tissue phosphate level increased by 83%, and cotton fruit increased by 92%. Restoration of latosol soil structure and use of VAM biological fertilizer could be an alternative extensification of agricultural land for cotton plants.

1. Introduction
Efforts to modify the latosol soil structure by mixing river sandstone with a certain diameter, with certain proportions expected to improve aeration and drainage of the soil. The use of Vesicular-Arbuscular Mycorrhiza (VAM) on soil with low availability of the phosphate cations is an effective means [3]. VAM root mushrooms will be internally symbiotic within the plant roots cortex network and help provide phosphate cations, as well as other nutrients. In the cortex cells of rooting plants, fungal hyphae form a hyphae-like branching structure called the arbuscular and function as a mushroom absorbing organ, as well as a rounded-hyphae end structure called vesicles as a fungal food reserve. The presence of root mushroom microsymbiont in plant roots can increase the intensity of plant absorbent organs due to the presence of external fungal hyphae. Also, the aggregation process in the formation of mechanical soil structures is also helped by the presence of external mycelium mushrooms. Various crops that VAM found in its root system are including apples, cocoa, coffee, cotton, and rice.

Cotton plant (Gossypium var Delta Pine 45), is a shrub with age up to four months. Grows on areas with an altitude of 10 to 150 m above sea level. Until the age of 35 days, plants are in the vegetative phase [8]. During this phase, this plant requires an average rainfall of 1500-1800 mm. While in
generative, it requires an average rainfall of 150-175 mm. Structured crumbs sandy soil and able to retain groundwater is a land that meets for the cultivation of this plant.

2. Methods
The study used VAM fungus spore inoculant, isolated from cotton rhizosphere from cotton plantations in Purwodadi Kradenan area. Isolation of fungal spores using a wet filtration method of 0.42 mm, 0.25 mm and 0.105 mm [3]. The fungus spores obtained are collected in a flacon bottle filled with sterile water. Each bottle is filled with 50 spores.

Latosol soil is obtained from Nglanggeran, the Yogyakarta province area. After experiencing sieving with a 3mm sieve size, the soil is mixed with sand times with the proportion of 2:1. Soil mixture of sand pocketed as much as 5 kgs and sterilized using an autoclave. Control of latosol soil media without mixing of sand. Urea and KNO₃ base fertilizers were administered at a dose of 0.5g per plant.

Delta Pine 45 cotton seeds obtained from Malang Industrial Plants Research Office are added into pot soil. After growing, a VAM spore inoculant spreading at a circular aperture within a radius of two cm from the stem of the plant. Watering is done every morning. Observation of cotton growth and growth response includes the dry weight of cotton plants at 35 days and 120 days. The intensity of fungus infection was measured by cutting the root of plant fibers along one cm and then colored using Phillips and Hayman method (1970). The intensity of infection is determined by the number of infected root pieces per 100 root pieces. The phosphate content of the cotton plant tissue was measured by the Yoshida method (1970).

3. Results
Observation of dry weight of cotton plant, Phosphate concentration of plant tissue, intensity of VAM infection, at 35 and 120 days growing and some cotton fruit calculated during the vegetative period until the end of the growth period, the plants are tabulated in the following table:

| Table 1. Observation of dry weight of Apple |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Duration (day)  | Treatment       | Nett Weight (gr)| Infection Intensity (%) | Phosphate Tissue Levels (%) | Amount of Cotton Fruit |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 35              | K               | 3,03            | 29              | 10,76           |                  |
| LPS             | 9,90            | 37              | 19,70           |                  |                  |
| 120             | K               | 161,62          | 9               | 4,63            | 18              |
| LPS             | 298,70          | 37              | 8,48            | 35              |

K = Latosol Soil Control, LPS= Spore Sand Latosol

Based on the result data, the effect of soil structure improvement and VAM fungus spore inoculum can increase dry weight of cotton plant, both when the plant is in the vegetative and generative phase. Increased plant dry weight as a reflection of plant growth, is a result of the resultant aeration improvement as well as drainage of soil in which the plant grows and the presence of microsymbiont of VAM fungi on plant roots. The intensity of VAM infections in cotton planting occurs and increases during vegetative and generative periods. Increased levels of infection during vegetative period are suspected in that phase more photosynthate products are transplanted into rooting resulting in abundant rhizodeposition products, which result in extensive mycelial growth of mycelium. The symbiotic mutualism causes the provision of the P element for plant growth to be fulfilled. This condition is traced from the analysis of P content on the tissue. Element P on plant growth is required for the biosynthesis of growth hormones including hormones for florigen flaring, ATP fitin compounds, and nucleic acids. According to Meyer, 1974. Besides the provision of element P, the microsymbiont of the VAM fungus also helps the absorption of Zn and Cu minerals needed as cofactors of plant anabolic enzymes. The period of plant reproduction, from the time of flower formation when the plant is 40 days old, until the fruiting period at the age of 120 days decreases the intensity of the infection. The need for ATP for protein biosynthesis of both structural and functional
proteins when differentiation of reproductive cells is high. Cotton plants that do not get enough P intake causing the process of formation of reproductive or fruit organ experiencing abortion.

4. Conclusion
Latosol soil can be used as a field for cultivation of cotton. Modification of the latosol soil structure done by formulating two parts of the soil and one part of the sand. The inoculum spores of VAM mushroom can increase the dry weight of the plant by 85%, the intensity of fungal infection by 28%, increase the phosphate level of plant tissue by 83% and increase the amount of cotton fruit by 92%.

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