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Response of five soybean varieties under saturated soil culture and temporary flooding on tidal swamp

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Abstract

Saturated soil culture (SSC) is a cultivation technology that gives continuous irrigation and maintains water depth constantly and makes soil layer in saturated condition. This technology is appropriate to prevent pyrite oxidation on tidal swamp and has been proved to increase the soybean productivity on tidal swamp. The objective of the research was to study the effect of temporary flooding under saturated soil culture on the growth and productivity of soybean. The experiment was conducted at Mulyasari Village, Tanjung Lago Sub District, Banyuasin District, South Sumatra Province (11 feet above sea level, 2°38'42.35" South Latitude, and 104°45'5.92" East Longitude), from May to September. The experiment used a split plot design with three replications. The main plot is flooding condition, consisted of: 1) saturated soil condition continuously, from planting until harvesting time (as control), and 2) saturated soil condition from 0-10 DAP (Days after Planting) + flooding from 11-13 DAP + saturated soil condition from 14-28 DAP + flooding from 29-31 DAP + saturated soil condition from 32 DAP until harvesting time. The sub plot is variety, consisted of: Tanggamus, Anjasmoro, Wilis, Detam-2, and Malika. Irrigation on saturated soil culture was made with water depth 20 cm under soil surface, and temporary flooding was made with 5 cm upper soil surface. The result showed that Tanggamus, Anjasmoro, and Detam-2 were grouped as sensitive variety, while Wilis, and Malika were grouped as moderate-tolerant variety.

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Keywords: soybean; sensitivity of variety; temporary flooding and tidal swamp

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1. Introduction

The national productivity of soybean in Indonesia is still low, it was only 1.4 tone/ha in 2012. The national production only fulfill by 30 % of national demand [1]. Therefore, a special effort is needed to fulfill the national demand on soybean, i.e. either to increase crop productivity or to expand the production sites.

One of the alternatives to develop soybean cultivation in Indonesia is to optimize the use of marginal land, and tidal swamp is one of the potential ecosystems for future soybean production. Indonesia has ± 20 million ha tidal swamps, and 9 million ha are appropriate for agriculture, and 2 million is suitable for soybean [2].

The major constrain of soybean production in tidal swamp is high pyrite content, when pyrite is oxidized, soil pH will decrease. “Reference [3]” reported that high pyrite content suppressed the productivity of soybean on tidal swamps, approximately 800 kg/ha.

Saturated soil culture is a technology in cultivation that gives water permanently, maintains and keeps its depth constantly (± 5 cm USS). This makes soil layer in saturated condition. In SSC, watering is started from the beginning of growth to maturity stage. By keeping the water-table constantly, soybean will be avoided from negative effect of inundation on soybean growth, because soybean will acclimatize and improve its growth [4, 5].

Soil water management can be applied to reduce pyrite content where the soil is in reductive condition and able to support soybean growth. SSC technology is one of soil water managements that has been studied in highland and succeed to increase soybean production [6, 7]. This offers the chance to reduce the pyrite, hence increase soybean production on tidal swamps.

Response of soybean to saturated condition varied between varieties and the later maturing soybean was better than the earlier one [4, 6, 8, 9]. “Reference [9, 10]” found on yellow soybean that Tanggamus and Anjasmoro as adaptive varieties, while on black soybean that Cikuray, Ceneng, and Lokal Malang as adaptive varieties under saturated condition on tidal swamps.

Flooding can change markedly the direction of root growth. It has been found that root of plant become horizontally growing rather than downward growing when they contact the water table. Furthermore, in maize the adventitious roots have been promoted to emerge from the shoot base in whorls of 4-6 from preformed initials by soil waterlogging. And such roots are thought to absorb mineral nutrients in deeply flooded condition [11].

Temporary flooding (TF) can happen on tidal swamp if the high rainfall met with tide water. The temporary flooding will decrease soybean productivity [12]. Therefore, the objective of the research was to study the effect of temporary flooding under saturated soil culture on the growth and productivity of soybean.

2. Methods

This experiment was conducted on tidal swamps land in Mulyasari Village of Tanjung Lago Sub District, Banyuasin District, South Sumatera Province, Indonesia (11 feet above sea level, 2°38'42.35" South Latitude, and 104°45'5.92" East Longitude) (Fig. 1) from May to September. The experiment used a split plot design with three replications. The main plot is flooding condition, consisted of: 1) saturated soil condition continuously, from planting until harvesting time (as control), and 2) saturated soil condition from 0-10 DAP (Days after Planting) + flooding from 11-13 DAP + saturated soil condition from 14-28 DAP + flooding from 29-31 DAP + saturated soil condition from 32 DAP until harvesting time. The sub plot is variety, consisted of: Tanggamus, Anjasmoro, Wilis, Detam-2, and Malika. The main plot with size 2 m x 20 m was surrounded by furrow irrigation. Irrigation on saturated soil culture was made with water depth 20 cm under soil surface, and temporary flooding was made with 5 cm upper soil surface. On saturated soil culture, water was given at planting time and kept until the maturity stage and made plots in wet condition. The bed width and trench size on SSC and TF can be seen in the Fig. 2.