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The Growth Of Several Soybean Genotypes In The Saline Soil

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Abstract.

One of the strategic efforts to increase soybean production towards self-sufficiency with 2.8 million tons of production is through the expansion of suboptimal planting areas, among others, by using saline soil. The area of potential saline land in Indonesia is 140,300 ha. This study aims to determine the growth of several genotypes at a salinity soil level of 10 dS/m. This experiment was conducted using a randomized block design (RBD) repeated three times. The treatments tested were genotypes consisting of Deja 2, Dering, Karat 13, Panderman, Gepak Kuning, Daun Lancip, Dega1 and Tanggamus. Variables observed in this study include: plant height, root length, stover weight, root dry weight and soil salinity level at the age of 24 days, 45 days, 60 days and 75 days. All genotypes still live up to 45 days, but at 60 days after Dering, Tanggamus, Gepak kuning is dead, and only Daun Lancip can survive up to 75 days.

Keywords: soybeans, growth, saline soil

1. Introduction

One strategic efforts to increase soybean production towards self-sufficiency with 2.8 million tons of production is through the expansion of planting areas, considering that fluctuations in national production have been closely linked to fluctuations in harvested areas, and in the past six years (in 2009-2015) soybean harvested area was only 493-723 thousand hectares with low productivity, 1.2-1.3 t/ha. Based on calculations, to achieve soybean self-sufficiency, national productivity needs to be increased to 1.4-1.5 t/ha in the 2.0 million ha harvested area (BPS, 2017). Expansion of the area can be done by utilizing marginal land such as dry land, acid dry land, and saline land. In Indonesia it is estimated that the total of saline land 440.300 ha which were 304.000 ha rather saline and 140,300 ha saline (Rachman et al., 2008).

Salinity stress causes changes morphology of soybean genotype. Stress salinity affect the roots, canopy of plants soybeans and plant height decreased (Purwaningrahayu and Taufiq, 2017; Bustingorri and Lavado, 2011; Hashi et al., 2015, Sabagh et al., 2015; Farhoudi and Tafti, 2011, Aini, 2014[b]). Legumes have different respons against stress salinity depend on both interspecies and varieties. Based on decreasing yield, critical point salinity stress on soybean, peanut, and green beans are 5 dS/m, 3.2 dS/m, and 1–2.65 dS/m respectively (Kristiono et al., 2013). At the soil salinity 3.91 dS m-1 soybean biomass could decreased up to 48.14% (Aini et al., 2014). Plant height and number of leaves have not decrease yet at the level of salinity of 3 dS/m up to the fourth week of Dering1, Demas1, Devon1 varieties. But the number of pods, pod weight and 100 seeds that genotypes were decreased since at level 3 dS/m of soil salinity (Yunita, 2018). The research objective was to study the growth of several genotypes at 10 dS/m soil salinity level.

2. Materials and methods

The study was carried out in a greenhouse Balitkabi in July - September 2017 used slight alfisol soil from Muneng Probolinggo. The soil was dried and put in polibag 12 kg capacity, filled with 8 kg of soil. The soil in polybag was irrigated up to 100% moisture content. Phonska inorganic fertilizers are distributed alongside the plants during planting. Each pot is fertilized as much as 4 g per pot. At the beginning of planting, each pot planted with four seeds and then thinned at 15 days so that there were only two plants per pot. Saline water was applied when entering V1 phase (after the first trifoliate is fully formed). During the study, the crop is protected from pest, disease and weed disturbances for getting optimal growth of plants.

The study was arranged using a Randomized Block Design with the various of genotype as treatment. The various of genotypes were Deja 2, Dering, Karat 13, Panderman, Gepak Kuning, Daun Lancip, Dega1 and Tanggamus. Variables observed in this study include: plant height, root length, stover weight, root dry weight and soil salinity level at the age of 24 dap, 45 dap, 60 dap and 75 dap.

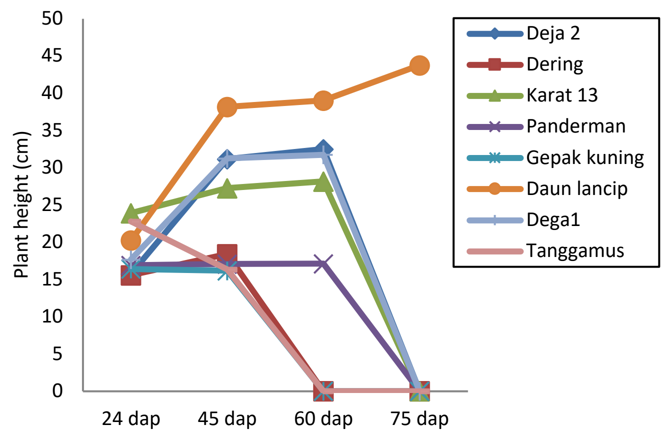
3. Results and discussion

There were variety response of several genotypes in this research. That response show that every genotype have different defense attact to salinity. Firstly, all genotypes still alive at 45 days after planting (dap), but at 60 dap Dering, Tanggamus, Gepak kuning were dead, and only genotype Daun Lancip could survive up to 75 dap.

3.1 Plant height

When it was 24 dap, Karat 13 was the highest plant among 7 other genotypes, it was 23,9 cm. Then, when at 45 dap, the height of the Gepak Kuning and Tanggamus didn't increased since 24 dap, which is about 16 cm. While the height of Deja 2, Dering , Karat 13, Panderman, Daun Lancip, Dega1 increased 97.9%; 18.2%; 13.9%; 1.0%; 88.6%; and 76.9% from the height plant at 24 dap. Its very slight increased plant growth when entering 60 dap, Deja 2 only increased by 4.3%; Karat 13 increased by 3.4%, Panderman increased by 0.3%; Daun Lancip increased by 2.2%; and Dega 1 increased 1.6% compared to 45 dap, while Dering, Tanggamus, Gepak Kuning were dead. Then at 75 dap, the height of Daun Lancip increased 12.2% compared to 60 dap, while the others had died (Figure 1)

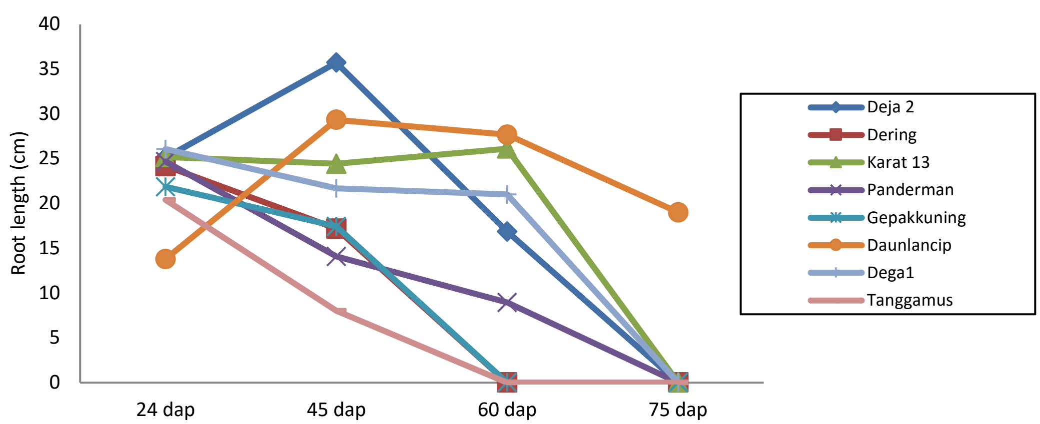
Fig 1. The Plant height of several genotypes at several observation



3.2 Root length

Only Deja 2 and Daun lancip whose roots continued to grow up from 24 dap to 45 dap, that were 42.4% and 112% respectively. While Dering, Panderman, Gepak kuning, Daun lancip, Dega1 and Tanggamus approximately decreased 29.0%, 42.9%, 20.3%, 16.9% and 60.8% compared to the root length at 24 dap respectively. The root length of Karat 13 tends to be stable until 60 dap. Generally, the root length of the plant decreases at 60 dap, it could caused by the roots begin to fragile before the plant dies (at 75 dap). The only one Daun Lancip that still alive but also get decreasing the length of roots at 75 dap. It was 31.3% decreased length of root compared to 60 dap (Figure 2).

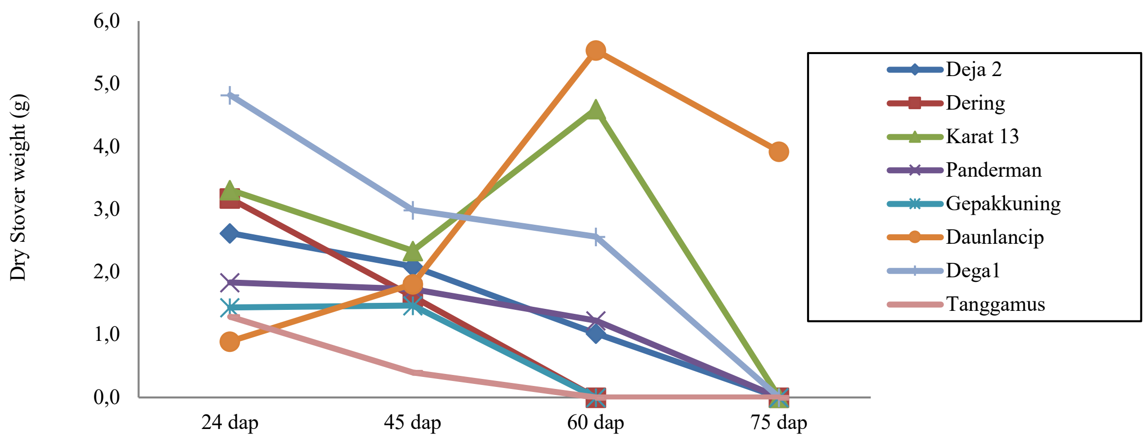
Fig 2. The Plant height of several genotypes at several observation



3.2 Root length

When it was 24 dap, the Dega had the highest stover weight compared to 7 other varieties, but at the age of 45 dap, all genotypes decreased dry stover weight except Gepak kuning and Daun lancip genotypes. Deja 2, Dering, Karat 13, Panderman, Dega1 and Tanggamus decreased dry stover weight up to 20.4%; 49.4%; 29.2%; 6.0%; 38.0%; and 69.2% respectively compared to 24 dap. Whereas Gepak kuning and Daun Lancip increased dry stover by 2.3% and 102.2% compared to 24 dap respectively. Then at the 60 dap, Gepak Kuning was dead, while dry stover weight of Karat 13 and Daun Lancip increased dry stover weight 96% and 206.3% compared to 45 dap. While Deja 2, Pandeman, and Dega1 decreased dry stover weight by 51.1%; 29.0% and 14.2% compared to 45 hst. At 75 hst, only daun lancip genotypes that survived but also get dry stover weight reduction by 29.1% compared to 60 dap (Figure 3).

Fig 3. The dry stover weight of several genotypes at several observation

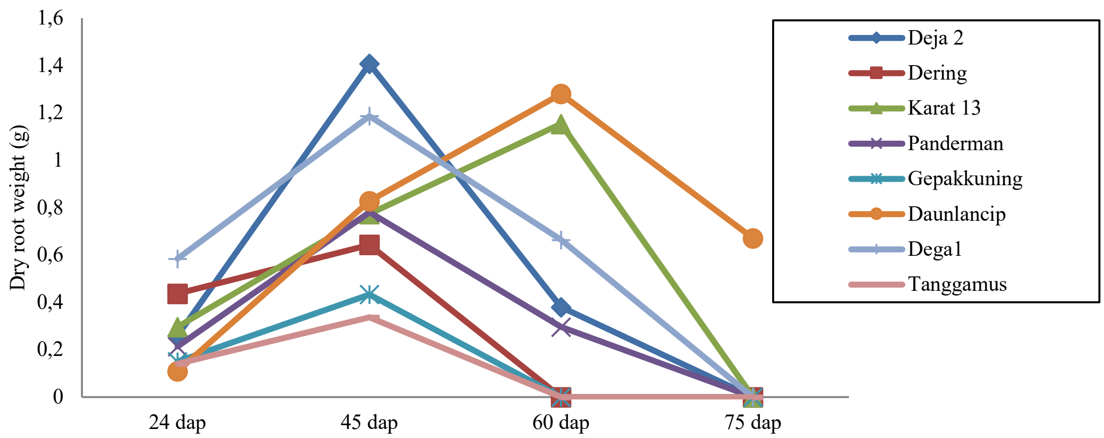


3.4 Dry Root Weight

Dega 1 was the genotype which has the highest root dry weight compared to the other seven genotypes at 24 dap, which is about 0.58 g/polybag. However, at the age of 45 days after planting Deja 2 was a genotype that had the highest dry root weight of 1.4 g/polybag or an increase of 441% from the 24 dap. The growth of roof of Daun Lancip was the highest of other although it wasn’t the most dry stover weight, but it increase 651,5% compared by 24 dap, its about 0,8 g/polybag. Dering, Karat 13, Panderman, Gepak Kuning, Dega 1 and Tanggamus only increased 47.3%, 160.7%; 265.6%; 188.9%; 103.4% and 140.5% respectively compared to 24 dap or 0.6 g/ polybag; 0.8 g/polybag; 0.8 g/polybag; 0.4 g/polybag; 1.2 g/ polybag; and 0.3 g/polybag. At 60 dap, only Karat 13 and Daun lancip genotypes that increased the dry weight of roots, as many as 49.1% and 54.8% compared to 45 dap as much as 1.15 g/polybag and 1.28 g/polybag. Deja 2, Panderman and Dega 1 decreased dry root weight by 73% ; 62.0% and 44.1% compared to 45 dap or about 0.4

g/polybag; 0.3 g/polybag; and 0.7 g/polybag. Dering, Gepak Kuning and Tanggamus are dead on this time (60 dap). At the age of 75 days, only genotypes Daun lancip that still alive and get decreasing dry root weight 47.7% compared to 60 dap or 0.7 g/polybag (Figure 4).

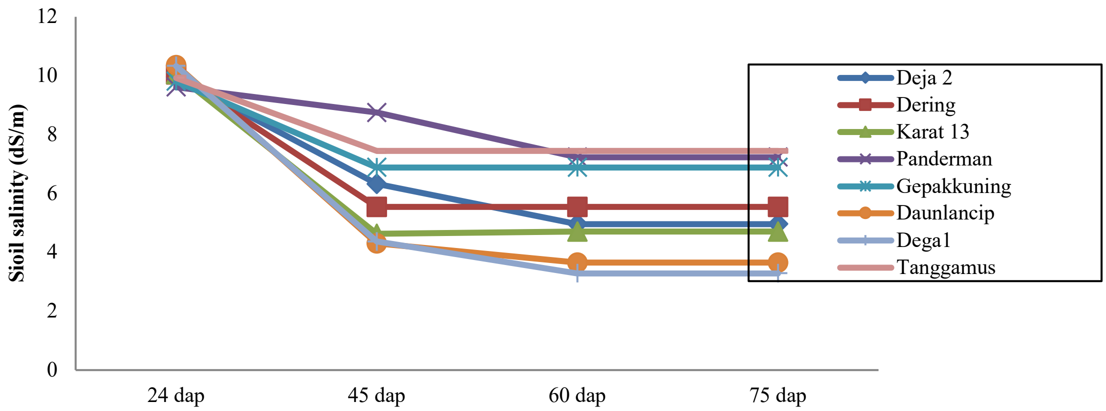
Fig 4. The dry root weight of several genotypes at several observation



3.5 Soil Salinity

Until the age of 24 dap, all genotypes still have the same soil salinity which is 10 dS/m then get decreasing at the age of subsequent observations. At 45 dap, the hardest decreased had occurred on Karat 13, Daun lancip and Dega 1 genotype. These three genotypes have soil salinity content between 4.3 dS/m - 4.6 dS/m. While the other five genotypes have soil salinity content ranging from 5.5 dS/m - 8.8 dS/m. The soil salinity content of Daun lancip and Dega 1 more decreased at 60 dap, its about 3.2 to 3.7 dS/m. While Deja 2, karat 13, Panderman, has soil salinity ranging from 4.7 dS/m - 7.23 dS/m. Dering, Gepak Kuning and Tanggamus are dead from the age of 45 dap, its caused the soil salinity does not change from the age of 60 hst up to 75 dap.

Fig 5. The soil salinity at several observation



Daun lancip was categorized as resistant plant to high salinity and Karat 13 was categorized as rather resistant. Dering, Tanggamus, Gepak Kuning, Deja 2, Panderman and Dega 1 were not resistant. Plants that can survive at saline condition were plants that can absorb the salt content in soil and able to excrete it. These plants relatively has low level of electrical conductivity in the soil and get high dry biomass weight. For these plants, K^+ and Na^+ content are needed for efficiency of cell membrane osmosis regulation and growth of leaf area (Shabala et al., 2010). This plant will have stability of K^+ and Na^+ content although the soil electrical conductivity levels were added (Aini et al., 2014[a]).

Genotypes that are not resistant to saline soil will get thickening of cuticle, thinning cortex, and widening xylem tissue diameter. The high K+ and Na+ content at these plant can reduce water potential cell which ultimately prevents water from being absorbed into the leaves (Dolatabadian et al., 2011). The other side, a wide xylem diameter will reduce cohesion speed that will affect the arrival of water to the leaves then caused water uptake decreased (Totoa and Yulismab, 2017; Hang and Mai, 2016; Khan et al., 2015), where water is the main element needed by plants to carry out photosynthesis. The high K^+ and Na^+ content in plant also reduced N and Mg uptake, where those are macro element that needed on photosynthesis process (Anitha and Usha, 2012, Subramanyam et al., 2012, Aini et al. 2014[a], Taufiq et al. 2015, El Sabagh et al., 2015).This phenomenon that caused the weight of soybean biomass and its growth decreased since 45 dap.

4. CONCLUTION

The soil salinity was decreased plant height, root length, dry stover weight and dry root weight of soybean. Decreasing of it variable were varied based on potential defences of it genotype. Based on this research could be said that all genotypes still live up to 45 days, but at 60 dap, Dering, Tanggamus, Gepak kuning is dead, and only Daun Lancip can survive up to 75 days**.**

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