

Allelochemistry of Jengkol (*Pithecolobium jiringa* (Jack) Prain ex King) Coat Aqueous-Extract on Agronomical Processes of Rice Seed Germination

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ABSTRACT

Seed coat of jengkol fruit is a potential bioherbicide due to its phenolic content. An experiment was conducted to identify biochemical and physiological inhibitions of rice seed germination exposed to water extract of fresh fruit coat of jengkol. The experiment used a Randomized Complete Design of single factor of five extract concentrations in liquid formulation (water control, 20, 40, 60, 80 and 100 g/l), with five replications. Allelochemical inhibition of fresh jiringa hulls extract on rice seedling root components was stronger than those on shoot components. At day 7 of rice germination, reduction of root dry weight was 42%, root number 39%, and root length 70%; whereas at day 14, reduction of root dry weight was 63%, root number 36%, and root length 70%. In addition, shoot inhibition as indicated by dry weight at day 7 and day 14 of germination were 27% and 29%.

Key words: fresh jiringa hulls extract, liquid formulation, rice germination, physiological inhibition.

INTRODUCTION

Jengkol (*Pithecolobium jiringa* (Jack) Prain ex King) is an annual plant that grows in Bengkulu. Total production of fruit jiringa 70% of it in the form of rind, so that in one year dozens tons of waste generated in the province Bengkulu. Hereditary farmer wastes are used to control weeds in paddy fields. It turns out the weeds that grow in these lands are gradually reduced, but did not inhibit the growth of rice plants.

"Fresh jiringa hulls" contains a phenolic compound 39,000 ppm (equivalent to 3.95 mg/kg), flavonoids 3000 ppm (0.3 mg/kg), terpenoids and alkaloids (Muslim *et al.*, 2012 and Nurjanah, 2013). Phenolic compounds released from the fresh jiringa hulls is allelochemis, which can inhibit the growth of other plants through simultante of mechanisms alelopati indirectly (Blum, 2011). Inhibition process begins at the plasma membrane by the disruption of structure, membrane channel modification, or loss of function of the enzyme ATP-ase. This will affect the absorption and concentration of ions and water which then affect to stomatal opening and photosynthetic process. Next bottleneck may occur in the process of protein synthesis, pigment, and other carbon compounds, as well as the activity of some phytohormones. Some or all of these barriers lead to the disruption of cell division and enlargement which ultimately inhibits the growth and development of the target plant (Zeng *et al.*, 2008). This is consistent with research conducted by Nurjanah (2013) which proved allelochemical of fresh jiringa hulls applied pre-planting can inhibit the process of physiological and agronomic Barnian grass.

MATERIALS AND METHODS

The study was conducted from April to May 2015 in the Laboratory of Agronomy, Faculty of Agriculture, University of Bengkulu. The experimental design used was completely randomized design (CRD) with five replicates a single factor. Factors tested were concentrations of fresh jiringa hulls extract is 0 (no extracts), 50, 100, 150, 200 and 250 g/l. Fresh jiringa hulls extraction performed according to the method referenced by Nie (2007), and Sodaeizadeh *et al.* (2009). Solution were then stored in a refrigerator at a temperature of 4⁰ C (Sodaeizadeh *et al.*, 2009; Mutlu and Atici, 2009).

Test the germination response by using petridish. Two layers of Whatman filter paper No. 1 placed on petridish in diameter 12 cm, then the 25 rice grain arranged in petridish. Furthermore petridish watered with solution of 10 ml extract while the control was only given water by the same

amount. To keep moisture from the germination medium provision extract solution conducted once every two days to two weeks old seedling (Nie, 2007). The same was done on control.

Observations were made every day starting one day after the seeds germinate until the age of two weeks. Agronomical observations as the end result allelochemical effect is germination capacity, root number, root length, root and shoot dry weight. Quantitative data were analyzed using analysis variance test ($\alpha = 5\%$) and orthogonal polynomials test.

RESULTS AND DISCUSSION

Results of visual observation indicates that thejiringa hulls extract inhibit germination and seedling growth of rice. Increased levels showed a tendency that the plant is getting poisoned. Even at levels of 80-100 g/l grain is not capable of germination. The biggest obstacle occurs during radikel appearance and root growth. Looks at five days after provisison of the extract so growth radikel avoid allelopat (radikel curved upward) but over time can adjust (pointing down). Radikel abnormal growth occurred from levels of 20-60 g/l. Overall results of the analysis of orthogonal polynomials is presented in Figure 1-5.

Rice germination physiological inhibition

Measurement germination capacity is used to determine of seed quality. Exposure allelochemical the seeds may lead to a deterioration in the seeds so that germination decreases. Results of the analysis of orthogonal polynomials showed negative linear relationship exists between the levels of jiringa hulls extracts with observations of germination at the age of 7 and 14 dap (date after planting) described by the equation $Y7 = -0,7799x + 71,088$; $R^2 = 0,9636$ and $Y14 = -0,7852x + 68,731$; $R^2 = 0,8102$ (Figure 1).

Germination capacity decrease is caused by the barrier fluid imbibition into the seed so that the process of respiration and metabolism to be inhibited. Moenandir (1990) suggested that the absorption of water, decaying plant organ that has the potential residues will produce organic compounds and aromatic such as acids vanilat, siringat, kafeat, ferulic and p-hydroxybenzoates. These compounds are known to increase the levels of solution around the seed so that the lower pressure water diffusion, so that the seeds absorb water hampered, as a result of failure or experiencing barriers to germinate.

Yudono (2012) stated the water was instrumental in the process of germination because it serves to hydration, enzyme activity, break down complex compounds, translocation, and keep the moisture of seeds. Furthermore Olievera *et al.* (2008) and Hooper *et al.* (2010) reported a water extract of *Lonchocarpus muehlbergianus* and root exudates *Desmodium umbellatum* can inhibit germination of lettuce and *Striga* sp.

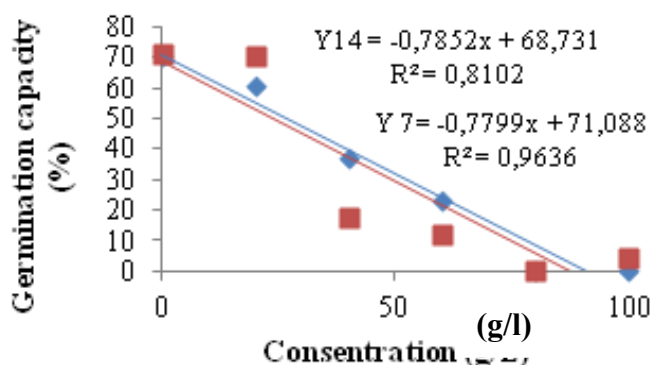


Figure 1. Germination capacity of rice at various concentration of jiringa hulls extract

Root number is the variables of root that can be measured directly. The number of roots will determine the number of root hairs that will determine the absorption of nutrients and water. Analysis of orthogonal polynomials showed negative linear relationship exists between the levels of jiringa hulls

extracts with the number of roots at 7 and 14 dap (Figure 2). The longer seedling to exposure jiringa hulls extracts so the root number more and more the less. This is due to increased levels of jiringa hulls extracts the increased availability of substances that enhance the response inhibition allelopat. The longer the seedling roots in contact with the source of allelopat so the more allelopat accumulated at the seedlings so that the formation of new roots also inhibited.

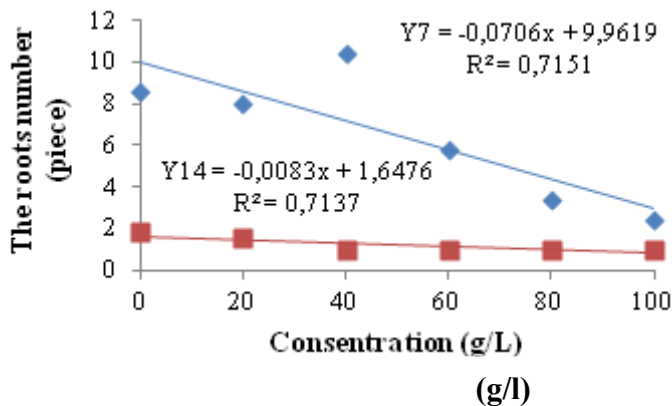


Figure 2. Root number of rice seedlings at various concentration of jiringa hulls extract

Root is the part of the principal in addition to the stem and leaves for the growth of plants that have grown to be perfect. Root length is influenced by external factors such as the porosity of the soil, availability of water and minerals, soil moisture, as well as allelochemical compound content in the soil.

Based on Figure 3, the higher levels of jiringa hulls extracts so the roots will become shorter. This is due to increased the levels of jiringa hulls extracts so the increased availability of substances that enhance the response inhibition allelopat. Batish et al. (2006) reported the phenolic compounds from the decomposition of the residue bandotan can inhibit the growth of bean root length. Length of root growth inhibition at 14 dap greater when compared to 7 dap because at the age of 14 dap seedling longer exposure to toxins jiringa hulls. Increased plant dry weight is an indicator of the ongoing growth of plants is the result of plant photosynthesis process.

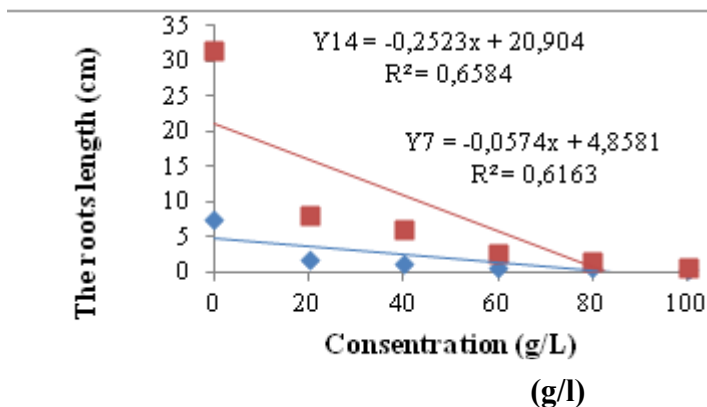


Figure 3. The roots length of the rice seedlings at various of jiringa hulls extract concentration.

Plants that are in contact with allelokimia be impaired at the cellular level. Disruption at the cellular level causing interference structural level, which in turn leads to decrease in growth and development. The amount of inhibitory compounds allelopat influenced by the levels of inhibitory compounds, types of crops, and the length of inhibitors along with the plant. The same thing also expressed by Setyowati and Suprijono (2001) that inhibition allelopat on plant growth and development are affected by levels of extract, extract source, temperature, species of plants were evaluated and the time of application.

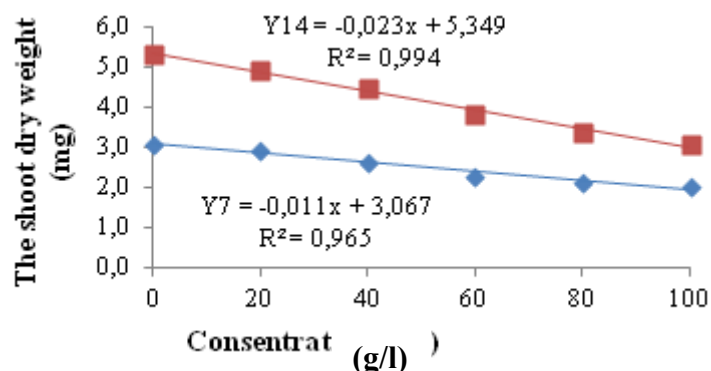


Figure 4. The shoot dry weight of rice seedling at various concentration of jiringa hulls extract.

There is a negative linear relationship between the levels of jiringahulls extracts with shoot dry weight at 7 and 14 dap (Figure 4). This is due to increased levels of jiringa hulls extracts the increased availability of substances that enhance the response inhibition allelopat. Togatorup *et al.* (2010) and Setyowati *et al.* (2010) reported the higher the extract bandotan then presses the dry weight of coleoptile mustard.

The role of the roots of the plant growth is equally important with the shoot. Root is the first organ to contact with allelochemical in the rhizosphere thus directly affect the absorption of nutrients and water. Root is the plant organs most sensitive and becomes a prime target for direct contact with allelochemical in risoster (Anonymous, 2009).

Results of the analysis of orthogonal polynomials showed negative linear relationship between the levels of jiringa hulls extracts with root dry weight at 7 observation and 14 dap (Figure 5). Response inhibition that occurs in root dry weight seedling showed residues that inhibit the activity of the elongation and multiplication of cells. The barriers caused by disruption of metabolic processes in the grain at each stage of the process of germination. Blum (2011) suggests the presence of allelopathic compounds can inhibit elongation and multiplicatin of cells. Olievera *et al.* (2008) reported a higher level of water extract of *L. muehlbergianus* so the vegetative growth lettuce seedlings obstacle is also higher.

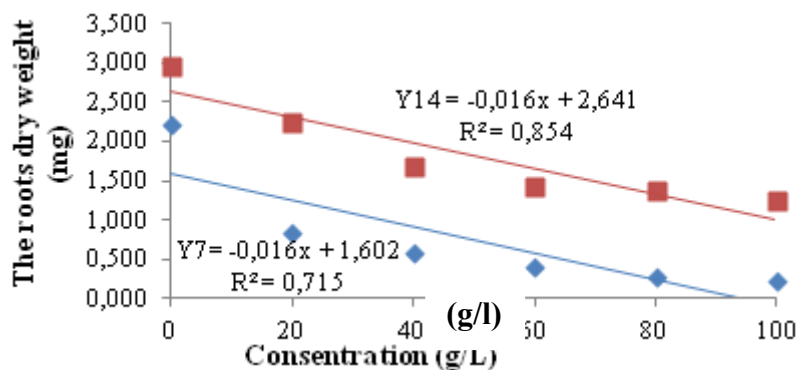


Figure 5. The roots dry weight of rice seedlings at various concentration jiringa hulls extract

CONCLUSION

Jiringa hulls extrac of 50-250 g /L can suppress the growth of rice seedlings but do not kill the seed. At day 7 of rice germination, reduction on root dry weight, root number, and root length respectively by 42%, 39%, and 70%. Whereas at day 14, reduction of root dry weight was 63%, root number 36%, and root length 70%. In addition, shoot inhibition as indiced by dry weight at day 7 and day 14 of germination were 27% and 29%. Absorption allelopat jiringa hulls is more effective than passing through the roots of the rice seed caoat. Mechanism allelochemicaljiringa hulls starting from the root inhibition followed by inhibition of the formation of chlorophyll (chlorosis) on rice seedling.

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