**FREQUENCY AND OLIGO-CRITOSAN CONCENTRATION ON RICE GROWTH AND RICE YIELDS**

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**ABSTRACT**

The research methods was arranged with split plot design consisting of two factors. The main plot was the frequency of oligochytosan comprising of three levels, F1: application of oligochitosan 3 times during planting period, given at age 20 dap (days after planting), 40 dap and 60 dap. F2: application of oligochitosan 4 times during planting period, given at age 20 dap, 33 dap, 46 dap, 60 dap. F3: application of oligochitosan 5 times during planting period, given at age 20 dap, 30 dap, 40 dap, 50 dap, 60 dap. Sub plot is the concentration of oligochitosan, K1: 50 ppm = 5 ml/5l/16m2, K2: 100 ppm = 10 ml/5l/16m2, K3: 150 ppm = 15 ml/5l/16m2. The parameters observed were the average of plant growth components at 63 dap (day after planting), such as plant height, number of leafs, number of tillers, dry weight of plant. Component of rice yield, such as the number of panicles per hill, weight of 1000 seeds, weight of grain per hill, weight of grain, and weight of grain per hectare (ton).

Treatment frequencies showed significant differences in leaf number parameters, number of tillers, dry weight of plants, number of panicles per hill, weight of grain per hill and weight of grain per hectare. The parameterof plant height was not significantly different. Consentration oligochitosan treatment had no significant effect to all parameters except on dry weight plant.

Keywords: *rice, oligochitosan, frequency and concentration*

**INTRODUCTION**

The fulfillment of National rice needs sourced from sustainable domestic production had been declared by the President of the Republic of Indonesia. For this purpose, the National rice production target was only 71.801.000 ton / ha in 2015 and 67,102,000 ton / ha in 2014, so that the production rate would increased 6.64 percent in 2014-2015. The rate of increase in production was still not balanced with the rate of population growth reaching 1.49 percent per year. To fulfill the needs of rice should import as much as 1.5 million tons in 2015 (BPS, 2015).

Rice is a major component in the National food security system and determines National stability. The application of green revolution technology to rice crops is oriented towards increasing production, by relying on fertilizers and pesticides continuously resulting in decreases in soil productivity, one of which occurs nutrient unbalance (Padmini et al., 2013). Nutrient unbalance in the soil, causing low fertilizer efficiency and low microbiological population of the soil and the vulnerability of plants to pest attack. Subsequent impacts production slant (leveling off). Limited fertilizer subsidies and high fertilizer prices are encouraged to further improve the efficiency of farming systems, especially fertilizer efficiency in wetland rice. Therefore, the effort to increase the production is very interesting to be done fertilizer technique improvement, that is substitution a part of inorganic fertilizer with application of Oligochitosan.

Oligochitosan is also known as chitosan oligomers which are obtained from the partial degradation of chitosan. Chitosan is the N-deacetylated derivative o f chitin which is a natural polysaccharide that occurs mainly in invertebrates, fungi and yeasts (Knaul et al., 1998). Chitosan (ˈkaɪtɵsæn) is a linear polysaccharide composed of randomly distributed β-(1-4)-linked D-glucosamine (deacetylated unit) and N-acetyl-D-glucosamine (acetylated unit) (Darmawan et al. 2007; Ramadhan et al., 2010; Kim et al., 2011). Chitosan and its derivatives have shown various functional properties and made them possible to be used in many fields including, food cosmetics, bi,medicine, agriculture, environmental protection, and wastewater management (Deepmala et al., 2014). Oligochitosan was used with different molecular weight and different concentrations. Smaller molecular weight of oligochitosan with smaller concentration showed better result than bigger molecular weight of oligochitosan as a plant growth promoter. This study also showed that conventional growth promoter can be replaced with oligochitosan as it is more effective as plant growth promoter as well as more environmental friendly. In agriculture, chitosan is used primarily as a natural seed treatment and plant growth enhancer, and as a ecologically friendly bio pesticide substance that boosts the innate ability of plants to defend them selfes against fungal infections. The natural bio control active ingredients, chitin/chitosan, are found in the shells of crustaceans, such as lobsters, crabs, and shrimp, and many other organisms, including insects and fungi. It is one of the most abundant biodegradable materials in the world. Degraded molecules of chitin/chitosan exist in soil and water. Chitosan applications for plants and crops are regulated by the EPA, and the USDA National Organic Program regulates its use on organic certified farms and crops. (https://www.thcfarmer.com/ community/threads/plant-hormones-and-growth-regulators.29938/page-2). The natural biocontrol ability of chitosan should not be confused with the effects of fertilizers or pesticides upon plants or the environment. Chitosan active biopesticides represent a new tier of cost effective biological control of crops for agriculture and horticulture.

Researcher indicated increased in grain yields of rice (10.29%), spring maize (10.93%), soybean (16.74%), winter wheat (28.81%) and vegetables (12.34-19.76%) after applying fertilizer together with nano-materials. As reported by Liu *et al*. (2009), Nano-materials could promote germination and rooting early for rice seeds and seedings and the growth of rice at tillering stage was affected obviously by nano-composites. They indicated that the grain yield of rice and nitrogen agronomic utilization efficiency was increased after applying nano-carbon-incorporated SRF. Chitosan possesses a high growth stimulating efficacy combined with antifungal and antibacterial activity of systemic character. **The aim of this research was to know the interaction of frequency treatment and olio-chitosan concentration, to get the best frequency and concentration on growth and yield of Diah Suci rice variety**.

**RESEARCH METHODS**

The research was conducted in Sentono village, Karangdowo subdistrict, Klaten Regency of Central Java Province. The study was prepared based on a separate plot design consisting of two factors. The main plot was the frequency of oligochytosan comprising of three levels, F1: application of oligochitosan 3 times during planting period, given at age 20 dap (days after planting), 40 dap and 60 dap. F2: application of oligochitosan 4 times during planting period, given at age 20 dap, 33 dap, 46 dap, 60 dap. F3: application of oligochitosan 5 times during planting period, given at age 20 dap, 30 dap, 40 dap, 50 dap, 60 dap. Sub plot is the concentration of oligochitosan, K1: 50 ppm = 5 ml/5l/16m2, K2: 100 ppm = 10 ml/5l/16m2, K3: 150 ppm = 15 ml/5l/16m2. The parameters observed were the average of plant growth components at 63 dap (day after planting), such as plant height, number of leafs, number of tillers, dry weight of plant. Component of rice yield, such as the number of panicles per hill, weight of 1000 seeds, weight of grain per hill, weight of grain, and weight of grain per hectare (ton). Analysis of varians at 5% level was used to observe the effect between treatments. Further analysis was done by using Duncan's Multiple Range Test at 5% level.

**RESEARCH RESULTS**

There were no interaction between treatment of frequency and concentration of oligochitosan to the all growth component. Frequency of oligochitosan had significant effect on the number of leaves, number of tillers and weight of stover, but did not significantly affect height plant. Concentration of oligochitosan treatment had no significant effect on all parameters expected weight of plant.

Table 1. Effect of frequency and concentration of oligochitosan to the all growth component

|  |  |
| --- | --- |
| **TREATMENTS** | **Components of growth** |
| Plant height (cm) | Number of leaves | Number of tillers | Dry weight of plant (g) |
| Application of oligochitosan | Spraying 3 times  | 111,5 a | 46,3 b | 15,7 b | 24.0 b |
| Spraying 4 times  | 113,3 a | 47,9 ab | 14,9 b | 22,2 b |
| Spraying 5 times  | 119,9 a | 67,5 a | 20,5 a | 30,2 a |
| Concentration of oligochitosan | Consentration of 50 ppm  | 112.3 p | 54,4 p | 15,3 p | 22,7 q |
| Consentration of 100 ppm  | 109,6 p | 59,6 p | 15,7 p | 28,3 p |
| Consentration of 150 ppm  | 114,7 p | 63,9 p | 17,6 p | 29,4 p |
| Interaction | - | - |  | - |

Note: Numbers of each column followed by the same letter show no significant difference in Duncan't at the level of 5%. (-) There is no interaction between the two factors

From table 1, was indicated that frequency of the five- olygochitosan spraying produced the number of leaves, number of tillers, and weight of plant than the three and four times. Concentrations of oligochitosan 100 ppm and 150 ppm resulted in significantly greater dry weight than the concentration of 50 ppm oligochitosan.

There were no interaction between treatment of oligochitosan application and Concentration of oligochitosan to the all yield component. Oligochitosan application treatment had significant effect on the number of panicle, number of grain per hill and weight of grain per hectare. Concentration of oligochitosan treatment had no significant effect on all parameters

Table 2. Effect of frequency and concentration of oligochitosan to the all yield component

|  |  |
| --- | --- |
| **TREATMENTS** | **Yield components** |
| Number of panicle | length of panicle (cm) | weight of grain per hill  | weight of grain per ha (tons) |
| Application of oligochitosan | Spraying 3 times  | 12,7 b | 26,1 a | 32,8 b | 5,33 b |
| Spraying 4 times  | 11,0 b | 26,4 a | 30,1 b | 5,36 b |
| Spraying 5 times  | 17,8 a | 26,7 a | 42,3 a | 5,67 a |
| Concentration of oligochitosan | Consentration of 50 ppm  | 13,0 p | 25,0 p | 38,8 p | 5,63 p |
| Consentration of 100 ppm  | 13,0 p | 26,4 p | 38,6 p | 5,92 p |
| Consentration of 150 ppm  | 13,6 p | 26,3 p | 37,9 p | 5,70 p |
| Interaction |  | - |  | - |

Note: Numbers of each column followed by the same letter show no significant difference in Duncan't at the level of 5%. (-) There is no interaction between the two factors

From table 2, was indicated that frequency of the five-olygochitosan spraying produced the number of panicle, weight of grain per hill, and weight of grain per hectare than the three and four times.

**DISCUSSION**

The result of the analysis using 5% level of verbalization, Duncan Multiple Range Test (DMRT) showed no interaction between frequency treatment and concentration oligochitosan in all parameters. Treatment frequencies showed significant differences in leaf number parameters, number of tillers, dry weight of plants, number of panicles per hill, weight of grain per hill and weight of grain per hectare. The parameters of plant height and weight of 1000 seeds were not significantly different. Consentration oligochitosan treatment had no significant effect to all parameters except on dry weight plant.

The five-oligochitosan application is capable of producing better growth and yield compared to three and four times. The frequency of giving more means the plants get more oligochitosan. Chitosan increases photosynthesis, promotes and enhances plant growth, stimulates nutrient uptake, increases germination and sprouting, and boosts plant vigor.  Chitosan stimulates the plants hormones responsible for root formation, stem growth, fruit formation and development (Deepmala et al., 2014). Chitosan effects on plant response were first characterized as an elicitor. Chitosan was also involved in the stomatal response where stomatal opening provides in the stomatal response where stomatal opening provides access to inner leaf tissue for plant pathogens. Chitosan increase respiration rate of germination seeds, root vigor, chlorophyll, protein content (Darmawan , 2015). Oligochitosan also contains phytohormone (auksin, cytokinin, giberelin). The hormones affects number of leaves. One of the functions of gibberellins affects the elongation and cell division that stimulates the growth of the leaves. Cytokines can delay the leaf's abortion by increasing the transport of the food substance to the organ.

Oligochitosan was also able to increase the photosynthesis of rice plants. According to (Zen et al. 2000), that if the results of photosynthate were more widely used for growth and development of rice plants in the vegetative period, will affect the number of panicles that will be formed. Photosynthesis increases better cell differentiation resulting in increased number of leaves and number of tillers. The growth of the number of leaves per hill influenced by the nutrient content in oligochitosan, thus affecting vegetative growth of plants. Leaf number growth correlated with number of tillers. The availability of sufficient nutrients during plant growth will increase photosynthesis activities so that cell differentiation will be better and lead to increased number of tillers. The difference in the number of tillers per clump of rice is thought to be due to differences in the phyllochrons phases of each plant. According to (Barkelaar, 2001) phyllochrons is the period of time between the appearance of a single phytomer (a stem cell, a leaf and a root emerging from the based of the plant). The number of panicles per hill is correlated with the ability of the plant to produce the seedlings and the ability to maintain the various physiological functions of the plant. The more tillers were formed, the chances of the tillers formation that produce panicle was better. At the time the plant begins to bloom, almost all photosynthetic results were allocated to the plant's generative part. In addition, there was mobilization of carbohydrates, proteins and minerals in the leaves, stems and roots moved to panicles. Chitosan has an effect on agriculture, for example acting as a carbon source for microbes in the soil, accelerating the process of transforming organic compounds into inorganic compounds and helping root systems in plants to absorb more nutrients from the soil.

During seed filling, most of the assimilates formed in leaves and stems are used to improve seed formation (Gardner, 1991). The result of weight parameter analysis of 1000 seeds showed no significant difference because more determined by varieties used. Rafarahahly (2002), showed that the weight of 1000 seeds of rice was usually a stable feature of a variety, the grain size is also determined by the caryopsis size, consisting of lemma and palea. The development of caryopsis in the filling of the grains, depending on the assimilate yield that can be stored (Yoshida 1981). The highest concentration of oligochitosan treatment (150 ppm) was only able to increase dry weight plant, no effect on rice yield improvement. Dry weight plant describes assimilates content. High assimilates in the vegetative phase are not all translocate to the generative phase. Photosynthesis is still needed for vegetative growth of rice crops. The growth of rice crop is classified as sigmoid. At the time of primordial phase and the formation of panicles, the addition of plant height and even the number of rice leaves are still ongoing

The application of various oligochitosan consentration was not significantly different in growth and the result was probably due to inappropriate spraying time. Spraying on closed stromata is not very effective (Abdelbassed et al., 2010). Some Chitosan does not enter the plant tissue. Stomata rice plants partially located on the lower surface of the leaves. Spraying on the wrong way (above the leaf surface) also caused the oligochitosan solution not to enter the plant tissue

**CONCLUSION**

There was no interaction between frequency treatment and concentration oligochitosan in all parameters. Treatment frequencies showed significant differences in leaf number parameters, number of tillers, dry weight of plants, number of panicles per hill, weight of grain per hill and weight of grain per hectare. The parameter of plant height was not significantly different. Consentration oligochitosan treatment had no significant effect to all parameters except on dry weight plant.

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