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Liquid Organic Fertilizer and Planting Space Influencing the Growth and Yield of Rice (*Oryza sativa* L.) in System of Rice Intensification (SRI) Methods

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Abstract: This research aimed to know the influence of liquid organic fertilizer and planting space to the growth and yield of rice in System of Rice Intensification (SRI) methods. The research was conducted in Palur, Sukoharjo, laid on 98 m above sea level from December 2008 to April 2009. Experimental design used was Randomized Completely Block Design with two factors of treatment. The first factor was liquid organic fertilizer; consist of control, cebreng leaf, rumen of goat, banana tree hump, and maja fruit. The second factor was planting space; consisting of 25 cm × 25 cm, 30 cm × 30 cm and 35 cm × 35 cm. There were 15 combinations of treatment and each repeated three times. Data analyzed with F test at 5% and DMRT at 5%. Research result showed that liquid organic fertilizer of maja fruit serves the best on variable of stalk length. Planting space of 35 cm × 35 cm serves the best on variable of plant height, number of total sapling, number of productive sapling, weight of dry plant, weight of rice per clump, and weight of 1,000 rice grains. There is no interaction between liquid organic fertilizer and planting space on all variables.

Key words: Liquid organic fertilizer, planting space, *Oryza sativa*, SRI (System of Rice Intensification).

1. Introduction

Paddy represents the very strategic and important food commodity because most Indonesia society consumes rice as staple food. Along with increasing residents in Indonesia, the request to rice became larger and larger though rice productions also experience the improvement. SRI (System of Rice Intensification) represents one of the most valuable approaches at management of land processing in the practice of paddy, crop and irrigation to pass the possibility of local wisdom and group being based on friendly environment. SRI develops the practice of paddy management paying attention to the condition of better crop growth, especially in root zone, compared by a conducting technique of traditional way.

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SRI suggests that planting the single young seed with distance will be more wider, so crops have enough room to expand and get reachable maximum sapling because of limited light and air. Distance plant estranged meant to be optimal of growth sapling and very facilitating of work of land conservancy, besides protected from emulation nutrition, energy and root activity [1].

SRI method is change of crop management pattern, water, fertilization without using inorganic or chemicals, both fertilizer and pesticide. SRI is also efficient in water and seed [2]. Agriculture with SRI doesn't apply chemical fertilizer and pesticide takes care of sustainable agriculture [3]. In Sri Lanka, agricultural product of SRI system is safe for environmental health and gives economic advantage and costs efficient, also be applicable in paddy farmer in small scale and becomes going the sustainable agriculture system [4]. That way in Indonesia is very

compatible because it can save water which its availability is limited.

In the case of transplanting of young seed age from seedbed need to be paid attention which will determine growth hereinafter. With transplanting of young seed age less than 15 day after seedling (DAS), crop is easy to adapt to area, root system is more intensive and more productive tiller. Because paddy seeds will start bearing after age of 7 day, so that transplanting of young seed will yield paddy with many tiller. Usage of young seed of age 8-15 DAS gives the best result [3].

At SRI research, the transplanting seed at the age of 7 and 14 days will simply be ready to yield more productive tiller [5]. Beside that the SRI system can economize seed around 5-10 kg/ha compared to cultivation of conventional system around 100 kg/ha [6]. The real interesting result from SRI is that: 78% increasing of yield, 50% reduction of inorganic fertilizer, 80%-90% reduction of seed, 25-50% reduction of water required, and 20% reduction of input [7].

SRI method suggests that the organic materials can improve the land structure so root can grow better and nutrient providing to crop will be slowly. The organic materials in the land provide various advantages to crop growth like vitamin, amino acid, auxin, and gibberellin formed through the organic materials decomposition [8].

Organic manure melt is the local microorganisms. The local microorganisms (MOL) is micro corps of organism which cans “bred”. It’s function as starter in organic compost development. Organic manure melt is made from the fishbone, animal slaughtering waste, fruits, and irrigate the rice which ferment with the *nira* water or irrigate the coconut water during 15 days [9].

This research aims to know the influence of kinds of organic manure melt the MOL (Local Microorganisms), planting space appropriate and also interaction among planting space with the organic manure melt the MOL (Local Microorganisms) which is used to growth and yield of rice with the System of Rice Intensification (SRI) method.

2. Materials and Methods

This research was conducted in Palur, Mojolaban, Sukoharjo which lay at 98 m above sea level, start from December 2008 to April 2009. This research uses the Complete Random Block Design with two treatment factors. The first factor that is organic manure melt the MOL (Local Microorganisms), consisting of the: control, cebreng leaf (*Glyrysidia maculate*), goat rumen, banana cusp (*Mozes* sp.) and maja fruit (*Aegle marmelos* L.). The second factor that is planting space, consisting of: planting space 25 cm × 25 cm, 30 cm × 30 cm, and 35 cm × 35 cm. Treatment consisted of 15 combinations and each repeated three times.

Research execution covered the seed selection, planting, land processing, dispersion fertilize the cage, cultivation, mowing, irrigating, MOL spraying, pest and disease management, and harvesting. Variable perceived to cover plant height, sum of total sapling, sum of productive sapling, length of stalk, fresh weight of straw, dry weight of straw, amount of filled out rice per stalk, weight of unhulled rice per clump, and weight of 1,000 filled out rice. Resulted data of perception analyzed by manner of pursuant to F test at 5% level. If there is significantly different influence, the doubled distance test of Duncan (DMRT) with the 5% level will be used.

3. Results and Discussion

3.1 Plant Height

Result of manner analysis to height of plant indicated that the treatment of giving of MOL did not have significant influence on increasing of plant height, while the planting space treatment gave the significant influence to height of plant. The interaction among giving of MOL and usage planting space showed no significant influence to plant height.

Treatment of giving of MOL did not have a significant effect on the plant height because content of element nutrient within land as media had answered the

demand for the growth of crop so that MOL addition did not give the influence to crop growth. Besides, not all liquid leaf manure can be consumed by crop except the parts can be used which depended by the nature of genetic crop, application time, and climate also the nature of manure which quickly the condense [10].

SRI applies the pattern plant with the distance plant wide. The distance plant wide give the bigger possibility to root to grow freely. Crop also will permeate the more sunshine, air and nutrition. Its result grows on and bar will grow better. This matter will cause at increasing of crop ability in permeating nutrition so that photosynthesis that happened progressively mount. Growing of photosynthesis will cause at assimilate yielded which is later channeled at crop shares, including stem [11].

Pursuant to Table 1, the authors knew that high average of highest plant obtained at cultivation with the distance plant 35 cm × 35 cm equal to 100.15 cm. Treatment of 35 cm × 35 cm space manifestly improve of plant height compare with planting space of 30 cm × 30 cm and 25 cm × 25 cm. Usage to wide planting space enable the root to grow freely so that crop also will permeate more sunshine, air and nutrition.

3.2 Sum of Total Sapling

From the result of manner analysis to amount of total saplings, it is shown that the treatment of giving of MOL did not have a significant effect on the amount of total sapling. The treatment of planting space has an effect on very significant to amount of total sapling. Interaction among treatment planting space with the giving of MOL did not have a significant effect on the amount of total sapling of crop.

Table 1 Influence of planting space to plant height at 11 weeks after planting.

Planting space ttreatments	Average
25 cm × 25 cm	97.43 b
30 cm × 30 cm	99.69 b
35 cm × 35 cm	100.15 a

The number followed with the same letter mean no significant difference by Duncan test at 5% level.

Table 2 Influence planting space to amount of total sapling.

Planting space ttreatments	Average
25 cm × 25 cm	9.75 b
30 cm × 30 cm	12.19 a
35 cm × 35 cm	13.24 a

The number followed with the same letter mean no significant difference by Duncan test at 5% level.

Giving of MOL has an effect on is not significant to amount of total sapling. Do not all liquid leaf manure can be consumed by crop except the parts can be used which depended by the nature of genetic crop, application time, and climate also the nature of manure which quickly of condense [10].

Pursuant to Table 2, the author knew that highest amount of total sapling obtained at distance plant 35 cm × 35 cm. Treatment of planting space 35 cm × 35 cm manifestly improve the amount of total sapling from treatment planting space 25 cm × 25 cm and non significant to distance plant 30 cm × 30 cm. Treatment of planting space 30 cm × 30 cm manifestly improve the amount of total sapling from distance plant 25 cm × 25 cm.

Wide planting space gave more free room for crop growing. Planting space estranged meant to be optimal of growth sapling and very facilitating of work of land conservancy, besides protected from emulation nutrition, energy and root activity [1].

3.3 Sum of Productive Sapling

Pursuant to result analyze the manner, we knew that giving of MOL do not have an effect on the significantly to amount of productive sapling of paddy crop while planting space treatment to give the influence very significant to amount of productive sapling. Interaction among both treatment have an effect on is not significant to amount of productive sapling.

Giving of MOL did not have a significant effect on the amount of productive sapling of crop. No effect on giving fertilize the leaf to a crop caused by not entire the manure permeated because that manure quickly lost

from leaf surface [1]. Treatment of planting space very has an effect on to amount of productive sapling of paddy crop. Many at least sum up the productive sapling differ at each variety. But that way, at least sum of the productive sapling earn because of the happening of shading (leaf is closing over each other), emulation among sapling or insufficiency of element nutrient especially nitrogen, less precise manure usage, water insufficiency or because attack of pest and disease at early stadia [12].

Pursuant to Table 3, we knew that distance plant 35 cm × 35 cm gave the amount of productive sapling at most compared to other. Treatment of planting space 35 cm × 35 cm differ the significantly from treatment of planting space 25 cm × 25 cm and do not differ the significantly from distance plant 30 cm × 30 cm to increasing of amount of productive sapling. With progressive planting space, progressive mount of sapling yielded by paddy crop. The reason is that sunshine can be fully shared by crop so that the photosynthesis can be carried out in optimal conditions.

3.4 Length of Stalk

Result of manner analysis indicated that the giving of MOL had a significant effect on the length of stalk crop. The treatment of planting space do not have an effect on the significantly to length of stalk. Interaction of among MOL and planting space not has an effect on significantly.

Using of MOL in paddy with SRI method have been well done since early at the time of farm processing, vegetative phase, forming of stalk and admission filling of paddy seed. Ability of MOL condensation as organic manure of paddy SRI besides containing bacterium also there are obstetrical of micro and also macro element nutrient required by paddy crop [13]. If element of nutrient crop fulfilled, hence crop growth is including in it forming stalk also go well.

Table 3 Influence of planting space to productive sapling.

Planting space ttreatments	Average
25 cm × 25 cm	9.79 b
30 cm × 30 cm	11.73 a
35 cm × 35 cm	13.23 a

The number followed with the same letter mean no significant difference by Duncan test at 5% level.

Table 4 Influence of MOL kinds to length stalk of rice.

MOL Treatments	Average
Without MOL	25.00 b
MOL of cebreng leaf	25.59 ab
MOL of goat rumen	25.57 ab
MOL of banana tree hump	25.01 b
MOL of maja fruit	26.18 a

The number followed with the same letter mean no significant difference by Duncan test at 5% level.

Pursuant to Table 4, we knew that MOL of maja fruit represented the organic manure melt capable to yield the highest length of stalk at paddy crop and did not differ between treatment of MOL of goat rumen and MOL of cebreng leaf and also differ between the treatment of cusp of banana MOL and treatment without MOL. MOL of maja fruit known to have the highest content S compared to other MOL. Sulphur represents the important element in a few protein types like amino acid. Amino acid represent the elementary materials in forming of crop tissue [10]. Besides, anticipated by bacterium isolates obtained from condensation of MOL of maja fruit have ability as growth incentive (*Plant of Growth Promoting Rhizobacteria*) [14].

3.5 Fresh Weight of Straw

The analysis result of manner shown that giving of MOL and planting space treatment did not have a significant effect on the fresh weight of crop straw. Interaction of both treatments also gave no significant influence to fresh weight of straw of paddy crop.

Giving of MOL did not have a significant effect on the fresh weight of straw. Not all the manure permeated because that manure quickly lose from leaf surface [10]. Treatment of planting space did not have an effect on fresh weight of straw. Fresh weight of straw caused of intake water by crop. Equally, absorption effectiveness irrigate by crop and also its role in crop growth

expressed by fresh weight [15]. Absorption irrigation and elements of nutrient crop influenced by some factors among nature of genetic crop and condition of crop environment, so that treatment of planting space did not give the different influence to fresh weight of straw.

3.6 Dry Weight of Straw

The analysis result of manner shown that giving of MOL do not have a significant effect on the dry weight of crop straw. The treatment of planting space to give the significant influence. Interaction among both treatment give the influence is not significant to dry weight of straw of paddy crop.

The treatment of planting space shown the significant influence to dry weight of straw. The distance plant estranged give the wind facility assist the acceleration process the transpiration [16]. In this case, planting space estranged do not only enlarging evaporation level also improve the transpiration which finally increase product the dry materials.

Pursuant to Table 5, we visibly knew that treatment of planting space 35 cm × 35 cm give the best influence to dry weight of straw. Treatment of planting space 35 cm × 35 cm differ the significantly to treatment of planting space 25 cm × 25 cm and do not differ the significantly to distance plant 30 cm × 30 cm. At wide distance plant, emulation in getting sunshine and also element nutrient became easy so that its absorption will be more by crop.

3.7 Amount of Filled Out Rice Per Stalk

The analysis result of manner shown that giving of MOL and treatment of planting space do not have a significant effect to the amount of unhulled rice fill per stalk. Interaction of both treatments also give the influence is not significant to amount of unhulled rice fill per stalk of paddy crop.

Giving of MOL did not influence the amount of unhulled rice fill per stalk because land as media grew to contain the compound answering the demand for the growth of good crop at vegetative and also reproductive phase. The planting space did not have an effect on the amount of unhulled rice fill per stalk. Old progressively a crop of hence root had to gain strength so that will be more strong in face of emulation nutrition that happened. At the time of admission filling seeds and at the time of reproductive phase crop showned old enough so that in face of emulation that happened between crop.

3.8 Weight of Unhulled Rice Per Clump

Result of manner analysis indicated that the giving of MOL do not have a significant effect on the weight of unhulled rice per clump while treatment of planting space shown the significant influence. Interaction of both treatments give the influence is not significant to weight of unhulled rice per clump of paddy crop.

The treatment of planting space gives the significant influence to weight of unhulled rice per clump. One of the factors determining the quality of crop materialslike seed is amount substrat like available carbohydrate to metabolism supporting growth of early crop.

Pursuant to Table 6, we visibly knew that treatment of planting space 35 cm × 35 cm gave the best result to weight of unhulled rice per clump. Treatment of planting space 35 cm × 35 cm manifestly improve the weight of unhulled rice per clump from treatment

Table 5 Influence of planting space to dry weight of straw.

Planting space ttreatments	Average
25 cm × 25 cm	25.18 b
30 cm × 30 cm	28.93 a
35 cm × 35 cm	29.77 a

The number followed with the same letter mean no significant difference by Duncan test at 5% level.

Table 6 Influence of planting space to weight of unhulled rice per clump.

Planting space ttreatments	Average
25 cm × 25 cm	22.69 b
30 cm × 30 cm	25.26 b
35 cm × 35 cm	32.39 a

The number followed with the same letter mean no significant difference by Duncan test at 5% level.

planting space 30 cm × 30 cm and 25 cm × 25 cm. Planting space wide enable the absorption of element of more optimal nutrient sunshine and. This matter will have an effect on to photosynthesis process that happened. Photosynthesis go well which will have an effect on increasing of seed weight.

3.9 Weight of 1,000 Filled Out Rice

Result of analysis of manner shown that giving of MOL do not have an effect on the weight of 1,000 filled out rice while treatment planting space to give the significant influence. Interaction between both treatments gave no significant influence to weight of 1,000 filled out rice of paddy crop.

Pursuant to Table 7, we visibly knew that treatment of planting space 35 cm × 35 cm gives the best result to weight of 1,000 filled out rice. Treatment of planting space 35 cm × 35 cm manifestly improve the weight of 1,000 filled out rice compare the treatment of planting space 30 cm x 30 cm and is not significant to distance plant 25 cm × 25 cm. Treatment of planting space 30 cm x 30 cm do non significant different to treatment of planting space 25 cm × 25 cm in improving weight of 1,000 filled out rice item. Wide planting space will improve result of dry seed per crop but not yet of course increase product [17].

This matter relate to the crop population per set of wide. Using estranged planting space caused that the sunshine could be shared by all crop eminently so that process of photosynthesis and crop growth happened in optimal conditions.

Quality of rice represents one of the factors which must be considered in pre-eminent forming variety of paddy. Amylose of rice very having an effect on to rice quality. Comparison among amylose and amilopectin can be made base of quality of feeling and texture of rice. Pursuant to rate of rice amylose classified to become the soft rice or very low amylose-rice (< 10%), low amylose-rice (10%-20%), amylose-rice is (20%-24%) and high amylose-rice (> 25%) [18]. Amylose rate influenced by fertilization difference at crop. Pursuant to result analyzed by the laboratory, it was concerning that amylose rate of rice that giving organic manure melt the MOL will assign value the rate of amylose-rice.

Table 7 Influence planting space to weight of 1,000 filled out rice.

Planting space ttreatments	Average
25 cm × 25 cm	28.78 ab
30 cm × 30 cm	28.35 b
35 cm × 35 cm	29.68 a

The number followed with the same letter mean no significant difference by Duncan test at 5% level.

4. Conclusions

The treatment of the MOL having an effect on increasing of length of stalk was equal to 4.72%. Treatment of planting space having an effect on high improvement of crop was equal to 2.79%; amount of total sapling equal to 35.79%; amount of productive sapling equal to 35.14%; dry weight of straw equal to 18.23%; weight of unhulled rice per clump equal to 42.75%; and weight of 1,000 filled out rice equal to 3.13%. It did not happened that the interactions between organic manures melt the MOL and planting space at all of observation variable.

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