

Minapadi-Sri Pattern on Rice Cultivation with IR42 Varieties

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Abstract— Food needs of Indonesia's population is still dominated by rice. Meanwhile, the conversion of irrigated rice fields seems unstoppable. This fact should be addressed by policy and the application of technology for rice production so that it is still possible to meet the national food need while increasing the income of rice farmers. The experiment on Minapadi-SRI pattern of rice cultivation with variety IR42 conducted. SRI (the system of rice intensification) is the formation of phyllochron 12 times and many phytomers. The experiment was conducted from April to September 2017 at Sungai Bangek village, Balai Gadang, Koto Tengah, Padang, West Sumatera. The objective of the study was to get the best technology for food production which is profitable. A Randomized Block Design with split plots was used with two water levels (20 cm and 10 cm) and three trench widths (50 cm, 75 cm and 100 cm). Data were analyzed using the F test at the 5% level and the Honest Significant Difference test at the 5% level. Observation of the yield and yield components of rice crops; height of plants, number of tiller/clump, number of productive tiller/clump, panicle length, number of grains/panicle, number of pithy rice/panicles, weight of 1000 grains, and yield/plot were made. The result of this research is that 10 cm inundation with 50cm wide trenches are better for rice plant growth and yield/plot.

Keywords — Appropriate technology, Minapadi, SRI, transformation of land, yield.

I. INTRODUCTION

Rice is the staple diet of the Indonesina and most people in the world. National rice needs every year continue to increase as the population increases , on the other hand the area of rice fields cultivations continues to decrease for varous reasons. Various efforts to increase production have been implemented both through extensification and intensification. According to the Central Bureau of Statistics of rice production (kiloton) in Indonesia, was: 71,280 in 2013; 70,846 in 2014; 75,398 by 2015; 79,355 in 2016; and 81,382 by 2017.

Efforts to increase food production embodied in the Tujuh Gema Revitalitas Pertanian are: 1) Land Revitalization; 2) Revitalization of Seedlings; 3) Revitalization of Infrastructure and Facilities; 4) Revitalization of Human Resources; 5) Revitalization of Farmers Finance; 6) Revitalization of Farmer's Institutions; and 7) Revitalization of Downstream Technology and Industry (Nuryati *et al.*, 2015). Various efforts to increase production have been implemented both through intensification (which is the best cultivation of agricultural land by utilizing existing facilities, for example: the use of purple seeds, the use of fertilizers, the

use of irrigation and so on) or extensification (opening up new farmland).

One of the efforts of the last decade to give hope is the application of SRI (*System of Rice Intensification*) in rice cultivation. Various research reports and farmers' cultivation results show an increase in yields of up three fold. SRI is a method in rice cultivation that has the potential to increase rice productivity by changing the planting system, plant spacing, water delivery, and fertilizer use. Barkelaar (2001) stated that the advantages of rice cultivation with the SRI method include: water-saving, being cost-effective, time-saving, saving seed, being environmentally friendly, and increased production. With the SRI method tillers production double, because with this method phyllocron is formed up to 12 times. Phyllochron is something circuit Phytomer formed for 35 days depends on temperature (Bakelaar, 2002). The phyllochron is affected by temperature, time of seedling transfer and nursery methods (Veeramani *et al.*, 2012). The most suitable rice fields for SRI development are irrigated rice fields whose water availability is more secure. The water does not need to flood the entire surface of the rice field, just enough to ensure the soil remains saturated (around field capacity).

The crops' microenvironment will be crucially influenced by the agronomic management practices, setting in motion important interactions. For example, the water management regime will affect soil aeration, the soil microbial communities, the organic matter mineralization process, and as a result the dynamics and availability of soil nutrients. It will also affect the build-up of various insect pests, diseases and weeds (Stoop *et al.*, 2002). SRI will be defined technically by key practices (principles) mentioned above, but not a fixed package to be followed strictly. Even though only a part of key practices is adopted, it can be considered as SRI as far as SRI effects appear.

Kasli and Effendi's (2011) study provides hope for future modification of the SRI system. They reported that the best results with potted plants were obtained with water about 10 cm from the surface. Rice could be planted in the surface layer part and enough water provided in a trench between the rice plots. This means it is sufficient for water to remain in the trench between plots of rice from planting until close to harvest. If rice plants are about 100 days old of planting, then there would be a puddle for about 80 days. Sufficient time to grow fish in the water.

SRI among the methods has an edge over other water saving methods as water saving does not have a yield penalty in this system. Therefore, efforts are being made in many countries to popularize SRI to overcome the challenges of water shortages. System of rice intensification management purpose the use of single young seedling raised in raised bed under aerobic conditions, drastically reduced plant densities (16 hills/m²), keeping fields unflooded and use of a mechanical weeder which aerates the soil and use of more organic manures, all the practices with the aim of providing optimal growth conditions for the plant, to get better performance in terms of yield and input productivity. SRI has been promoted for more than a decade as a set of organic management practices for rice cultivation that enhances the yield and reduce water requirements (Satyanarayana *et al.*, 2005 *cit* Kumar *et al.*, 2013).

Farmer's in some areas of Indonesia usually use water in their rice fields to keep fish, either directly among the flooded rice clumps or by making a special plot in the middle or on the edge of their rice fields, or by alternating fish farming with rice planting. This cultivation method is known as minapadi. West Sumatra is one of the areas where farmers are used to doing this. Ramli (2010) reported that in Kabupaten Lima Puluh Kota about 150 ha of rice fields are used for minapadi.

Farmer's are in the habit of flooding the fields continuously from when the seed is planted until the plants close to harvest time, both in the rainy season and the dry season. To solve the problem, there needs to be technological improvements at the farm level to improve the efficiency of water use, such as an appropriate water management system. Generally, plant spacing and flooding time is known to have an effect on the growth and yield of rice.

Combining SRI with minapadi is possible. The merger is a form of product diversification. But some issues still need to be answered so that application at the farm level is more practical, scientifically accountable and profitable not only for farmers' incomes, but also nationally beneficial because it can play a role in strengthening food security. Rozen *et al.*, (2011) studied minapadi-SRI in paddy fields with tilapia fish and this can increase farmer's income, but they did not study the best depth of water is profitable for fish life in the trench. Intensification of rice minapadi is one aspect of fish farming in rice fields. Rice farming is an agricultural activity that combines fish farming with rice field cultivation. According to Dio denha (2011), the minapadi farming system is not new since it has been used since the 1950-1960s but the profit earned is still low. This is because the cultivation technique is still simple (traditional) and diverse. Farming fish in the rice fields is one way to improve the efficiency of land use.

Some of these problems can be formulated as follows: if SRI rice cultivation is coupled with fish farming what depth of water in the trench is most advantageous for both, what is the most appropriate trench width, what type of fish is most profitable, what is good management, how should the products be processed and marketed. These questions need answers that can be justified. For this reason the research described below was conducted.

In general, this study aims to increase the value of irrigated rice fields, whose area is believed to be shrinking, while still producing rice as the main national food in addition to the producing products such as fish. Although some rice fields are used for fish maintenance, this will not interfere with the production of rice because the SRI system yields 2-3 times the national average, rather additional income from fish will benefit farmers. Even more so, if the fish produced are used to make processed foods like babyfish by adding a particular flavor, perhaps chili babyfish, babyfish, rendang flavoured and so on.

The most beneficial combination between water and trench width on SRI rice cultivation with minapadi, hereinafter abbreviated as MINAPADI-SRI was

determined. Combinations of varieties and types of fish that are most profitably cultivated/processed were examined. The results of this sort of study this sort of study are often not well explained to the target community so outcomes are often forgotten ends. Therefore, Banda Langik farmer's group was involved as a partner, to try and guarantee continue the application of MINAPADI-SRI and possibly its introduction to other areas.

II. MATERIAL AND METHOD

Field trials were conducted on land farmerd by members of the Banda Langik, Sungai Bangek, Koto Tengah, Padang from April- September 2017. The farmers were already using the SRI. A Split Plot Random Group divided plot design with two factors and three groups was used. Ditches were either 50 cm, 75 cm, or 100 cm wide (main factor) and contained either 10 cm (± 2 cm), 20 cm (± 2 cm) of water (subplot factor). Data were analyzed using the F test at the 5% level. Benchmarking value middle treatment use Median values were tested using Turkey's Honest Significant Difference test also at the 5% level..

Processing of land done by handtraktor 2 times then left for a week, made a plot of 18 plots with the size of each ran 1 m x 12 m = 12 m². After that made the channel as wide as 50 cm, 75 cm, or 100 cm then water is grabbed as high as 10 cm and 20 cm. IR42 rice seedlings planted 15 days after seedling 1 seeds per planting holes with spacing 25 cm x 25 cm. fertilization is done by giving urea 200 kg/ha, TSP 100 kg/ha, KCl 100 kg/ha. KCl and TSP are well matched at planting time along with a third-quarter urea. Giving urea second and third age 21 days and 42 days after planting. Weeding done in 10 days after planting and next done 21 days after panting with manually. Water regulation is done during vegetative not stagnant. Enter the generative phase of the land is flooded until 20 days before harvest.

For rice plants (variety IR42) the following data collected: high plant, number of tillers, number of productive tillers, length of the panicle, weight of 1000 grains, the number of grains per panicle, the number of unhulled grains per panicle, yield of grain per panicle and per plot from which the yield (dry weight was calculated). While for fish, the data collected was their initial and final weight.

III. RESULTS AND DISCUSSION

Plant height at 63 days after planting for different depths of water and channel widths are shown in Table 1. Only the depth of water showed a significant difference. The

deeper water gave taller plants perhaps because of better soil moisture levels. The was no interaction between water depth and channel width, and no significant effect of channel width on plant height.

Table 1. Plant Height at 63 days after planting

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	66.56	66.06	64.78	65.80 b
20 cm	76.61	71.00	72.39	73.33 a
Average	71.59	68.53	68.59	

Numbers in the same column followed by the same lower case letters are not significantly different, Tukey's Honest Significant Difference test at the 5% level

In the SRI method, the humid state will make the soil aeration better so that sufficient oxygen will be available in the soil for root growth and development. The roots will be healthy so that the aerial parts of the plant will also be healthy. According to Kawano *et al.*, (2009) inundation will spur stem elongation as an escape strategy against flooding to help meet the need for oxygen and carbon dioxide to support aerobic respiration and photosynthesis

The total number of tillers is shown in Table 2. No significnt differences were found.

Table 2. Number of tillers at 63 days after planting

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	45.39	47.61	55.00	49.33
20 cm	46.28	43.83	47.17	45.76
Average	45.84	45.72	51.09	

Numbers in the same row and column are not significantly different F test at the 5% level

The formation of tillers is influenced by the SRI method because in this method the seedlings are planted early to increase the number of tillers formed and phyllochron will be formed up to 12 times. In the third phyllochron will form a multiply tillers. Supported by Bakelaar (2002) report that with the SRI method the number of tillers will double, because the phyllocron formed up to 12 times.

Rozen *et al.*, (2017) states that from rod main varieties of Batang Piaman SRI method formation puppies on phyllochron both of which amounted to 1 tillers. On puppies first formed again puppies start phyllochron to 4 to 9 with the number of 6 tillers. On puppies secondary

formed puppies start phyllochron to 7 to 12 with amount tillers 14 cigarettes. On puppies third formed puppies start phyllochron to 8 to 12 with the number of 14 stems. While from puppies to four formed puppies start phyllochron to 10 to 12 amounted to 4 tillers. On puppies fifth appear puppies on phyllochron to 12 as many as 1 bar. Total tillers are erratic as many as 40 stems.

The number of productive tillers is related to the total number of tillers, the more tillers formed the more productive tillers. With respect to number of productive tillers no interaction and no significant differences were observed (Table 3).

Table 3. Number of productive tillers

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	28.67	34.11	31.56	31.45
20 cm	30.61	31.50	27.28	29.80
Average	29.64	32.80	29.42	

Numbers in the same row and column are not significantly different F test at the 5% level

As expected for the SRI system more productive tillers were formed compared with conventional methods (average 16-20 stems) because of the early transfer of seedlings. Increased number of tillers is, among others, due to increased nitrogen uptake during the vegetative phase (Ded atta, 1981). Flooding treatment in early rice growing increases the number of saplings. This is in the opinion of Vergara (1976), that the need for water for rice plants at the beginning of the vegetative phase is critical, where the vegetative phase is the phase of the formation of the active tiller and the maximum tiller.

No interaction and no significant differences in the length of the panicle were found (Table 4).

Table 4. Panicle length (cm)

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	28.17	27.38	27.69	27.75
20 cm	26.84	28.04	28.04	27.64
Average	27.51	27.71	27.87	

Numbers in the same row and column are not significantly different F test at the 5% level

No interactions and no significant differences in either the number of grains or the number of filled grains per panicle were found (Table 5 and 6).

Table 5. Number of grains per panicle

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	185.33	171.00	183.53	179.95
20 cm	187.80	190.73	170.40	182.98
Average	186.57	180.87	176.97	

Numbers in the same row and column are not significantly different F test at the 5% level

The absence of interactions and significant differences with respect to panicle length and the number of grains per panicle is because genetic factors are more influential than environmental factors. Uphoof *et al.*, (2002) states that SRI can improve results two fold or more, because of the planting distance (25 cm x 25 cm), the seedlings are replanted individually after only 7-15 days (Rozen *et al.*, 2009). Rozen *et al.*, (2011) states that the SRI method can be give dry weights harvest of 10 tons/ ha. While production rice in West Sumatera only reached 4,6 tons / ha.

Table 6. Number of filled grains per panicle

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	134.94	125.47	138.60	133.01
20 cm	134.20	144.07	128.53	135.60
Average	134.58	134.78	133.57	

Numbers in the same row and column are not significantly different F test at the 5% level

Penggenangan lahan sawah setelah proses pengolahan lahan akan memberikan konsekuensi perubahan fisikokimia tanah. Pada kondisi tanah tergenang maka kadar oksigen dalam tanah dapat menurun drastis sampai titik nol dalam waktu kurang dari sehari sehingga mikroorganisme anaerob menjadi aktif, bahan organik akan terdekomposisi lebih lambat dan kurang sempurna (Sanchez, 1993 cit Regazzoni *et al.*, 2013). Maka dari itu diperlukan pengeringan lahan agar oksigen dapat masuk kembali ke dalam pori tanah. Apabila tanah sawah mempunyai periode pengeringan maka mikroorganisme aerob akan aktif dalam mendekomposisi bahan organik sehingga laju dekomposisi bahan organik menjadi lebih tinggi dan mempunyai hasil yang lebih sempurna. Pengeringan selama 6 dan 9 hari pada 30 hari setelah tanam dapat meningkatkan hasil gabah sebesar dua sampai tiga kali lipat dibandingkan tanpa pengeringan (Hartatik *et al.*, 2014 cit Regazzoni *et al.*, 2013).

With respect to the weight of 1000 grains of rice no significant interaction or differences were observed Table 7.

Table 7. Weight of 1.000 grains (gram)

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	22.18	21.42	22.01	21.87
20 cm	22.47	22.44	21.67	22.19
Average	22.32	21.93	21.84	

Numbers in the same row and column are not significantly different F test at the 5% level

Only the depth of water in the channel had a significant effect on the yield per plot (Table 8).

Table 8. Yield (kg/plot)

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	5.27	3.47	4.17	4.30 a
20 cm	3.40	3.43	3.43	3.42 b
Average	4.33	3.45	3.80	

Numbers in the same column followed by the same lower case letters are not significantly different, Tukey's Honest Significant Difference test at the 5% level

It turns out that the high puddle in the channel 10 cm heavier grain per plot compared to 20 cm high puddle. Plant height and yield may be inversely related. Lack of water during the flowering phase may result in the falling of flowers and empty grains, resulting in low yields (Rismaneswati, 2006).

The initial and final weights of fish are shown in Tables 9 and 10 respectively.

Table 9. Initial weight (kg) of Majalaya goldfish

Depth water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	0.10	0.08	0.09	0.09
20 cm	0.36	0.29	0.08	0.24
Average	0.23	0.19	0.09	

Numbers in the same column followed by the same lower case letters are not significantly different, Tukey's Honest Significant Difference test at the 5% level

Table 10. The final weight of Majalaya goldfish on the minapadi-SRI method

Depth of water in the channel	Water channel width			Average
	50 cm	75 cm	100 cm	
10 cm	0.37	0.30	0.21	0.29
20 cm	0.21	0.15	0.20	0.19
Average	0.29	0.23	0.21	

Numbers in the same column followed by the same lower case letters are not significantly different, Tukey's Honest Significant Difference test at the 5% level

Fish yields could not be followed because the fish were eaten by pests such as birds, frogs and other fish, so the fish harvest was very small. Although weight gain occurred (in 10 cm of water but not 20 cm) the result are not satisfactory.

IV. CONCLUSIONS

There is no interaction between the depths of water in the channel with the width of the channel. Ten cm of water in the channel is better for growth and yield of IR42 varieties of rice. The width of the ditch did not affect the growth and yield of IR42 varieties, but the 50 cm trench width is better.

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