Application of Quadratic and Jajar Legowo Planting Design on Soybean in No-Tillage After Paddy Field

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Abstract

Soybeans are the most important food commodity in Indonesia with needs that continue to increase each year. The high projection of consumption growth that is not balanced with productivity is a tough challenge for Indonesia in meeting soybean needs in the future. This requires the government to import. This study was aimed to determine the quadratic and jajar legowo planting design on soybean cultivation in no-tillage field after paddy. Jajar legowo planting design is able to increase the plant density through planting distance, thus interception of light will be increased. The use former paddy field without tillage is intended to utilize the remaining water in the soil. This research was conducted in June-August 2018 using RCBD of 1 factor with 4 levels and 6 replications. The level of treatment factor was based on the type of jajar legowo which affects the space and plant density. Observations were recorded on growth and yield variables that are carried out periodically every week, during the maximum vegetative phase, and during post-harvest. The results showed that the treatment of Jajar Legowo 3:1(The 3 rows are 20cm apart and the 4th row is empty,the first and third rows are line spaced 10cm apart while the second row or the middle row is line space 20cm) did not give a significant difference in the variable growth of quadratic system 20 cm x 20 cm but increased the LAI value. Other jajar legowo treatments reduce the yield component number of pods, seed weight per plant, and weight of 100 seeds.

Keywords: *no tillage soybean, after paddy field, planting density*

INTRODUCTION

Soybean is the most important food commodity for beans in Indonesia with a growing level of demand each year. The high projection of consumption growth that is not balanced with productivity is a tough challenge for Indonesia in meeting soybean needs in the future. This requires the government to import [25]. According to Statistic Center Institution or BPS [3]the government imports 2.6 million tons of soybeans to meet last year's consumption of 2.83 million tons. The deficit figure can be lowered, one of which is by applying advanced technology and intensive cultivation systems, such as the planting design in no-tillage field after paddy.

Jajar legowo planting pattern is able to increase plant density through plant spacing so that the plants will get more sunlight and is expected to have higher production. The use of the ex-paddy field without tillage is intended to utilize the remaining water in the soil from the previous plantations and to reduce the cost of tillage. This study was aimed to determine the best planting design on soybean cultivation in no-tillage field.

MATERIAL AND METHODS

The research was conducted in June-August 2018 in Celep Village, Kedawung District, Sragen Regency, Central Javawhich is located at 7°31'4" south latitude dan 110°59'57" east longitude with an altitude 182 meters above sea level. The field is a former agricultural land of paddy plantations. The type of soil on the field is Grumusol. The results of soil chemical analysis from the land showed that the total N content was 0.27% (Medium), P2O5; 15.61 ppm (very high), and K2O; 0.32 me% (medium). The organic C content of the analysis showed 1.59% (low) and the results of the analysis of C / N ratio; 5.89 (low). The pH of the soil on the land used shows 6.78 and that means the soil pH is neutral. Organic material in the research soil is included in the medium criteria with a value of 5.89.

The tools used are: hoes, stakes, sickles, scissors, steples, meters, cameras, stationery, digital scales, raffia straps, waterproof nameplate, markers, label paper, newsprint, and envelopes. The materials used in this study were Anjasmoro varieties of soybean seeds from the Balai Pengembangan Benih Pangan dan Hortikultura Yogyakarta, Indonesia.

The research used the randomized completed block design of 1 factor, which is the application planting design consisted of 4 levels; J1 = control (20cm x 20 cm spacing), J2 = Jajar legowo 2:1 (2 rows of plants interspersed with 1 empty row), , J3 = Jajar legowo 3:1 (3 rows of plants interspersed with 1 empty row, , dan J4 = Jajar legowo 4:1 (4 rows of plants interspersed with 1 empty row. Each treatment

level is repeated by 6 times, thus, there are 24 experiment unit.

Observations were recorded on growth and yield variables that are carried out periodically every week, during the maximum vegetative phase, and during post-harvest.Periodic observations are intended for variable plant height and number of leaves. Observation of the maximum vegetative phase is intended for variable leaf area indices by measuring the length and width of leaves, stem diameter, and number of branches per plant. After harvest observations were intended for the fresh strawweight, dry straw weight, number of pods per plant, weight of 100 seeds, seed weight per plant, and yield per plot.

The data obtained were then analyzed using analysis of variance based on the F test at the level of 5%. If the F test shows the results that the treatment given has a significant effect on the variables measured, then testing the data then proceed with DMRT at the 5% level to compare the mean of each treatment.

RESULTS AND DISCUSSION

Growth Variable

Plant height was measured at 17, 24 and 31 days after planting as indicators of growth, environmental influences, or treatment given.Based on the graph of average soybean plant height figure 1 the soybean plant height is increasing high every week. J2 treatment (2 rows of plants interspersed with 1 empty line) had the best height growth of 27.11 cm. While the lowest high growth was seen in J4 treatment (4 rows of plants interspersed with 1 empty row) of 23.83 cm. In J2 treatment every plant becomes the edge plant in the plot. This allows the plant to get increased sunlight. These results are in accordance with the opinion of Nugroho and Bahrum [16] who say that the jajar legowo 2: 1 cropping system produces the best plant height in soybean plants no tillage field.The density of J2 treatment plants has the highest number so that competition between plants causes plants to grow taller to get sunlight [18]. The J2 treatment of each plant becomes an edging plant. This allows the plant to get increasing sunlight. According to Fan et al. [5] sunlight will affect growth and productivity

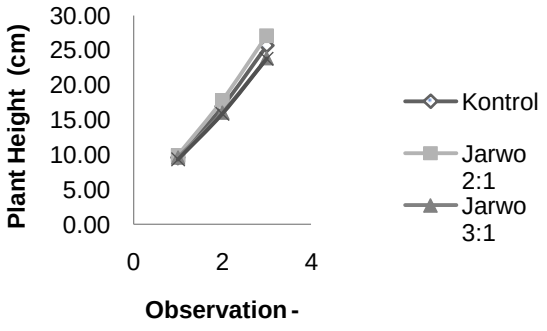

Figure 1. Graph of Average Soybean Plant Height (Kontrol=quadratic, Jarwo=Jajar Legowo)

Based on the graph of average soybean number of leaf figure 2 shows that the number of leaves has increased every week. The J1 treatment (control 20 cm x 20 cm) had the average growth of the best number of leaves as much as 9.76 leaves. While the lowest average growth of leaves was seen in J4 treatment (4 rows of plants interspersed with 1 empty row) as many as 8.77 leaves. The control treatment has fewer plant populations than other treatments, according to Rahmasari et al. [17] competition between plants that occur is thought to be smaller. The jajar legowo treatment gives wider empty space which allows more weed growth. According to Lamptey et al. [12] the presence of weeds around plants can increase nutrient competition, sunlight, water, and growing space.

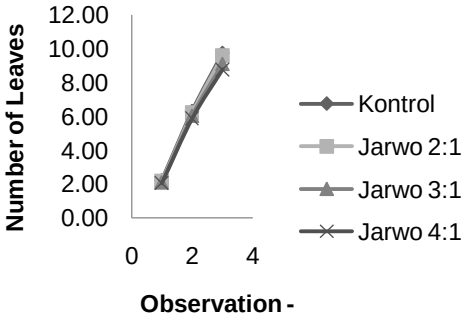

Figure 2. Graph of Average Soybean Number of Leaves (Kontrol=quadratic, Jarwo=Jajar Legowo)

J2 treatment (2 rows of plants interspersed with 1 empty row) has the highest LAI value of 7,47 while treatment J1 (control/quadratic 20 cm x 20 cm) has the lowest LAI value of 3,83. Differences in the value of LAI are thought to be due to different plant responses to the jajar legowo planting design applied. The J1 treatment does have a wider spacing, but in the J2 treatment every individual plant becomes an edging plant, in this case the process of absorption of nutrients and interception of sunlight is more maximal. This is explained by Ni'am and Bintari [15] that leaf area will increase along with fulfilled nutrient requirements. According to Koester et al. [8] broad leaves will increase light interception so that the carbohydrates produced from photosynthesis increase.

J1 (control) has a larger size of stem diameter that is 0.49 cm and treatment J3 (3 rows of plants interspersed with 1 empty line, 10 cm x 20 cm x 40 cm) showing the size of the stem diameter which tends smaller, 0.45 cm. The application of a no-tillage field on former paddy fields here results in not much residual water in the soil evaporating due to processing so that it can be used for the process of plant growth. This is in accordance with the statement of Lakitan [11] which explains that the role of water

and nutrients will support vegetative growth, one of which is stem diameter growth. According to Kuntyastuti et al. [9] Fertilizer residues such as contained potassium can also support growth but do not increase yield.

J3 treatment (3 rows of plants interspersed with 1 empty row) has a higher number of soybean branches which are 4.71 branches and J2 treatment (2 rows of plants interspersed with 1 empty row) showed that the number of branches of soybean plants which tended to be lower was 3.72 branches while for control plants there were 4.49 branches. According to Worku and Astatkie [24] spacing will affect the number of branches per plant that grows. This is explained by Suprapto [22] that the distance between plants in a tight row will reduce the number of branches that grow.

J3 treatment (3 rows of plants interspersed with 1 empty row) has a wet weight of soybean straw which tends to be larger ie 10.48 grams and J2 treatment (2 rows of plants interspersed with 1 blank line) shows that the fresh weight of soybean stover tends to be lower at 6.21 grams, while for control plants it is 9.78 grams.

Table 1. Observations of Growth Variables

Treatment	Observation Variable				
	Diameter of the Stem (cm)	Leaf Area Index/ LAI (cm)	Number of Branches	Wet straw weight (gram)	Dry straw weight (gram)
J1	0,49[a]	3,83[a]	4,49[a]	9,78[a]	6,98[b]
J2	0,47[a]	7,47[c]	3,72[a]	6,21[a]	4,87[a]
J3	0,45[a]	6,28[bc]	4,71[a]	10,48[a]	6,11[ab]
J4	0,47[a]	5,89[b]	4,38[a]	6,55[a]	5,38[ab]

Description: Numbers followed by the same letters show results not significantly different from the 5% DMRT test.

According to Lahadassy et al. [10] sufficient energy and nutrients are needed to increase the number and size of cells and to meet plant water requirements to achieve optimal fresh weight, although according to Singh and Reddy [20] the water content of fresh straw does not affect the increase in leaf dry weight.

Dry straw weight can describe the results of a plant's growth process after being dried at 70 ° C and reaching a constant weight [20]. J1 (control) has the highest value of straw dry weight of 6.98 grams while treatment J2 (2 rows of plants interspersed with 1 empty line) has the lowest value of stover dry weight of 4, 87 grams. Different populations between treatments will affect the adequacy of nutrients, water and the ability of plants to intercept sunlight. In accordance with the explanation from Lahadassy et al. [10] this will affect the results of photosynthesis produced and dry straw weight. Singh et al. [19] added that plant concentration is a product of dry straw weight and nutrient concentration divided by total biomass.

Result Variable

According to Sitompul et al. [21] observed the number of pods per plant better than seed weight per plant as a parameter in the selection of soybean offspring at the beginning of the generation. J1 (control) has the highest number of pods per plant as many as 51,77 while treatment J4 (4 rows of plants interspersed with 1 empty row) has the lowest number of pods per plant amounting to 35.10 pieces. According to Harjadi [7] the higher population of plants grows well only at the beginning of growth, while the subsequent growth will decrease further by showing a response to reducing the size of all parts of the plant so that it affects the results.

J1 (control/quadratic) has the highest seed weight per plant of 11.08 grams while treatment J4 (4 rows of plants interspersed with 1 empty row) has the lowest seed weight per plant of 7.74 grams. Different conditions for each treatment were thought to show different responses. The need for sunlight is met according to Liu et al. [13] can improve seed yield. According to Fader and Koller [4] the concentration of CO_2 and the intensity of sunlight affected the growth of soybeans during the seed growth phase.

J1 (control/quadratic) has the highest weight of 100 seeds at 12.25 grams and treatment J4 (4 rows of plants interspersed with 1 empty row) showing the lowest weight of 100 seeds of 11.27 gram. Soybeans have varying seed sizes. This is according to Widiastuti and Latifah [23] due to the difference in the amount of photosynthate in the form of complex compounds

Table 2. the results of observing the results variable

Treatment	Observation Variable			
	Number of Pods	Sample weight (gram)	Weight of 100 Seeds (gram)	Seed yield/plot (gram)
Kontrol	51,77[c]	11,08[c]	12,25[b]	370,32[a]
Jarwo 2:1	42,22[ab]	8,81[ab]	11,59[ab]	351,63[a]
Jarwo 3:1	47,22[bc]	10,14[bc]	11,81[ab]	395,48[a]
Jarwo 4:1	35,10[a]	7,74[a]	11,27[a]	326,87[a]

Description: Numbers followed by the same letters show results not significantly different from the 5% DMRT test.

contained in seeds in the form of carbohydrates, fats, and proteins. Zhang et al. [26] added that environmental factors and genotypes or the interaction of both will affect the weight of seeds.

J3 treatment (3 rows of plants interspersed with 1 empty line) has a yield per plot that tends to be higher at 395.48 grams per plot area (2.86m2) (1.18 ton/ha) and J4 treatment (4 rows of plants interspersed with 1 empty row) showed yields per plot which tended to be lower at 326.87 gram per plot area (2.86m2) (0.97 ton / ha) while for control plants it is 370.32 grams per plot area (2.86m2) (1.10 tons/ha).

J3 treatment on the LAI value variable showed results that were not significantly different from the J2 treatment which had the highest LAI value. According to Misbahulzanah et al. [14] plants will grow and develop well if leaf organs are available in the right amount and size. Widiastuti and Latifah [23] explained that an increase in photosynthesis would increase the amount of carbohydrates produced as food reserves that accumulate in the form of seeds.

CONCLUSION AND SUGGESTIONS

Conclusion

The conclusion of this research activity is the treatment of Jajar Legowo 3:1 did not give a significant difference in the variable growth of control/quadratic system 20 cm x 20 cm but increased the LAI value. Other jajar legowo treatments reduce the yield component number of pods, seed weight per plant, and weight of 100 seeds.

Suggestions

Suggestions that can be submitted based on the results of the research that has been carried out are applying soybean cultivation no-tillage field with a quadratic system of 20 cm x 20 cm.

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