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Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2020 17(1): 424-429. **OPEN ACCESS**

Influence of growth and yield of several hybrid maize varieties planted with distance based on the number of Soybean rows

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This study aims to obtain the adaptation of several hybrid corn varieties planted with spacing based on the number of rows of soybeans. The study design uses Split Plot Design (RPT), as the main plot of maize distance between soybean 5 rows (180 cm) and 7 rows (240cm). Whereas subplots namely hybrid corn varieties consisting of Pioneer 35, Bima 19, JH 27, Bima 2 and Nasa 29, so there are 10 treatment combinations, then repeated 3 times. The results showed that the highest plant in the Pioneer 35 variety was 255.42 cm. the height of the location of the cobs and the ratio of plant height to the height of the location of the cobs in JH 27 varieties were 126.81 cm and 53.34%, respectively. The highest number of seeds per row and number of seeds per cob in the treatment of Nasa Variety 29 were planted with a spacing of 7 rows of soybeans respectively 33.86 and 493.83 seeds. Whereas the highest weight of pipettes per cob in the treatment of Bima 2 varieties was planted 7 rows 174.00 g. The highest 1000 grain weight in the treatment of Bima 19 corn varieties were planted 7 rows of soybeans and Pioneer 35 varieties were planted 5 rows of soybeans weighing 345.33 g. Maize production was significantly affected by varieties based on observations showing that JH 27, Pioneer 35 and Bima 2 varieties were higher than Bima 19 and Nasa 29 varieties.

Keywords: Varieties, Hybrid Corn, Spacing, Intercropping, productivity.

INTRODUCTION

Corn (Zea mays L.) is a multifunctional commodity because it can be used as food, feed ingredients, and industrial raw material sources. As a food, corn plays a strategic role in maintaining food security. According to Suarni and Yasin (2011), corn is an important source of protein for the community. According to Orenstein (2010) that the needs of corn in Indonesia 66% are used as feed, 20% are processed for industrial materials and 14% as food. The target of maize production every year has increased were in 2018 amounted to 26.5 million tons in 2019 to 27.8 million tons of dry shelled (Ministry of Agriculture. 2015).

The use of hybrid corn seeds is one of the steps to increase corn crop yields in terms of productivity, resistance to pests and diseases, responsive to certain nutrients, has good growth ability (Yuwariah, et al. 2017). Adaptive hybrid and composite corn on specific land are very much needed (Sutoro, 2015). If hybrid corn as the main crop is intercropped with soybeans to optimize land productivity, it is necessary to use the hybrid corn genotype that has the best response and the use of soybeans that are resistant to growth and yield (Yuwariah, et al. 2017). Cereal intercropping systems with legumes commonly used by farmers do not always give good results due to the selection of inappropriate varieties (Belel et al.

2014). Intercropping can be carried out between annual crops and annual crops which are mutually beneficial, for example between corn and beans (Marliah et al. 2010).

MATERIALS AND METHODS

This research was conducted in the border area of Sanggau Regency, precisely in Kenaman Village, Sekayam sub-district, Sanggau district In October 2018 - February 2019. The corn seeds used were Variety Pioneer 35, Bima 19, JH 27, Bima 2 and Nasa 29, while the soybean seeds used Dena 1. The land was carried out with perfect tillage, plowed and rotated. Planting maize between rows of 60 cm in rows of 12.5 cm, while the distance of maize is delivered between rows of soybeans as a treatment. Planting corn 2 seeds/planting hole, then covered with manure ± 25-50 g / hole. Fertilizing is done twice, namely the age of 14 days after planting (urea 50 kg / ha, TSP 100 kg / ha and NPK 16-16-16 200 kg / ha), second fertilization at 30 days after planting (100 kg / ha, and NPK 16-16- 16 as much as 250 kg / ha).

This study uses a split-plot design. The main plot is J1 = distance of corn plants between soybean plants 5 rows (180 cm), and J2 = distance of maize plants between soybean plants is 7 rows (240 cm). Subplots are varieties consisting of V1 = Pioneer 35, V2 = Milky 19, V3 = JH 27, V4 = Milky 2 and V5 = NASA 29, so that there are 10 treatment combinations that are repeated 3 times, producing 30 treatment plots. Variables observed in maize were (1) plant height (cm), (2) height of cob location (cm), (3) ratio of plant height to height of cob (cm), (4) length of cob (cm), (5) the circumference of the cobs (cm), (6) the number of seeds per row (seeds), (7) the number of seeds per circumference of cobs (seeds) (8) the weight of seeds per cob (g) (9) the weight of empty cobs (g) (10) weight of 1000 grains (g), and (11) yield of Pipil seeds (t/ha).

RESULTS AND DISCUSSION

Components of Growth and Production of Corn Plants

Based on the results of a variety of analysis showed that there was an interaction between the distance of corn plants based on the number of soybean rows with some hybrid corn varieties on the length of the cob, number of seeds per row of cob, number of seeds per cob, weight of empty cob, weight shells per cob and 1000 weights (Table 1).

The data on the length of the cobs in Table 1 shows that the Bima 19, Bima 2 and Nasa 29 varieties with the spacing of corn between 5-7 rows (180-240 cm) have the same length of corncobs. The length of the cobs is strongly influenced by genetic factors and the environment around the plants, the two factors are interrelated where the length of the cobs is influenced by genetic factors, while the ability of plants to produce genetic character is influenced by environmental factors (Haryati and Permadi, 2014).

Data on the number of seeds per row in Table 1 above shows that the Pioneer 35 and Nasa 29 corn varieties planted between soybean plants with a distance of 5-7 rows (180-240 cm) have a higher number of seeds per row than other varieties.

In Table 1 above shows that the highest number of corn seeds per cob in the treatment of Nasa 29 corn varieties planted with 7 rows of soybean spacing (493.83 seeds). While the fewest number of seeds in Bima 2 corn varieties with the spacing of 5 rows of soybeans (347.5 seeds). The number of seeds per cob is influenced by the length and size of the cobs, as well as the size of the seeds, this can be seen in the variety of Nasa 29 which is planted with spacing of 7 rows of soybeans has a high number of seeds, while the weight of 1000 items is 285 g. According to Aribawa (2012) that the long character of cob shows the density of seeds formed and is closely related to the number of seeds per cob.

Data on the empty weight of corn cobs in Table 1 above shows that JH 27 varieties planted with soybean spacing 7 rows (240 cm) are higher (26.93 g), but not significantly different from Bima 19 maize varieties planted with 5-7 rows spaced soybeans and Pioneer 35 and Bima 2 varieties planted with spacing of 5 rows of soybeans. Table 1 above shows that the highest corn shell weight per cob in the treatment of Bima 2 corn varieties planted with spacing of 7 rows of soybeans (174.00 g), while the lowest corn shell weight per cob on the treatment of Bima 2 corn varieties planted with spacing 5 rows of soybeans (112.83 g). According to Noviana and Ishaq (2011) that the weight of seeds per cob affects the yield of corn.

The 1000 grain weight data in Table 1 shows that Pioneer 35 corn varieties planted with 5 rows of soybean spacing (180 cm) and Bima 19 varieties with 7 rows of soybean spacing (240 cm) had the highest 1000 grain weights of 345.33 gr.

Table 1. Average length of cob, number of seeds per row, number of seeds per cob, weight of empty cobs, weight of pipettes per cob and Weight of 1000 grains.

Treatment	Variables Observations					
	Cob length (cm)	Number of seeds per row (seed)	Number of seeds per cob (seed)	Empty cob weight (g)	Pipil weights per cob (g)	1000 weights (g)
Five Rows Soybean + Var Pioneer	14.00 bc	30.83 abcd	415.33 bc	24.13 abc	138.83 b	345.33 a
Five Rows of Soybeans + Var Bima 19	14.50 abc	27.17 de	389.67 c	25.46 ab	120.00 d	307.33 abc
Five Lines of Soybeans + Var JH 27Five Lines Soybeans + Var JH 27	14.64 abc	28.33 cde	389.56 c	24.71 abc	130.11 c	328.00 ab
Five + Bima Var 2	14.65 abc	26.56 e	347.5 d	24.44 abc	112.83 e	300.00 abc
Five Lines Soybean + Var Nasa 29	16.06 a	33.22 ab	440.44 b	20.19 df	140.78 b	305.33 abc
Seven Soybeans + Var Pioneer	15.47 abc	32.00 abc	429.78 b	21.53 cdf	121.94 d	264.00 c
Seven Lines of Soybeans + Milky Var 19	14.97 abc	27.00 e	396.89 cd	24.79 abc	139.28 b	345.33 a
Seven Lines of Soybeans + Var JH 27	13.56 c	29.06 bcde	382.33 bc	26.93 a	134.78 bc	333.33 ab
Seven Lines of Soy + Var Bima 2	15.06 abc	28.83 cde	450.11 c	17.90 f	174.00 a	266.67 c
Seven Lines of Soybean s + Var Nasa 29	15.99 ab	33.86 a	493.83 a	22.81 bcd	139.06 b	285.33 bc

Description: The number accompanied by the same letter in the same column means that it is not significantly different according to the 5% LSD test.

The results of Pratiwi's (2012) study, intercropping of maize and soybean showed that the wider distance of corn had a weight of 1000 grains higher.

The results of the analysis of variance on plant height, the height of the location of the cobs and the ratio between the height of the plants and the height of the location of corncobs did not have an interaction between the treatment of distance between corns based on the number of soybean rows with some hybrid corn varieties. In each treatment showed that corn varieties significantly affected plant height, the height of the location of the cobs and the ratio of plant height to the location of the cobs. While the distance between corn plants based on the number of 5-7 rows of soybeans did not significantly affect the treatment of plant height, the height of the location of cobs and the ratio of plant height to height of location of cobs (Table 2).

In Table 2 above shows that the highest plants in the treatment of Pioneer 35 varieties (255.42 cm) but not different from the Bima 2 varieties (242.64 cm), JH 27 (239.72 cm) and NASA 29 (236.05 cm). While the spacing of several varieties of corn with 5-7 rows of soybean rows did not occur in differences in plant height of 231.58 cm and 248.64 cm respectively. In general, 5 maize varieties showed a fairly high growth response, this might be due to the fact that soybeans can tether nitrogen from the air, so that nitrogen needs are met. The difference in plant height in each variety shows a difference in growth vigor, the higher the plant the more efficient it is in utilizing sunlight, which will be able to produce more photosynthates for vegetative and generative growth (Vivianthi, 2012).

The height data on the location of the cobs in Table 2 above shows that the highest variety is JH 27 (126.81 cm) and is not significantly different from the Bima 2 variety (120.63 cm). While the spacing of several varieties of corn with the number of soybean rows 5 and 7 rows there was no difference in the height of the location of the cobs of 118.42 cm and 118.08 cm respectively. The height of the cobs is related to the process of pollinating plants, where female flowers close to male flowers have a greater chance to be pollinated (Rembang, 2010).

In Table 2 above shows that the ratio of plant height to the highest location of ear cobs in the treatment of JH 27 varieties (53.34 cm) but not different from Bima 19 varieties (51.26 cm) and

Bima 2 (49.06 cm). While the spacing of several varieties of corn with the number of soybean rows 5 and 7 rows there was no difference in the ratio of plant height to the height of the location of the cobs of 51.59 cm and 47.67 cm, respectively.

The results of the analysis of variance on the circumference of the cob, the number of seeds per circumference of the cob, moisture content and production there were no interactions between the treatment of distance between corns based on the number of soybean rows with some hybrid corn varieties. Each treatment showed that corn varieties significantly affected the circumference of cobs, the number of seeds per circumference of cobs, moisture content, and production. While the distance between maize plants based on 5-7 soybean rows did not significantly influence the treatment of cob circumference, a number of seeds per cob circumference, moisture content and production (Table 3).

Table 2. Average height of plants, height of cob location and ratio of plant height to height of cob location due to the effect of the treatment of hybrid maize varieties with spacing of soybean rows.

Variety Treatment	Variables Observation		
	Plant height (cm)	Height location cob (cm)	Height Ratio vs. Cob (%)
Variety of Pioneer 35	255.42 a	113.54 b	44.72 c
Bima Variety 19	264.72 b	115.28 b	51.26 ab
Variety JH 27	239.72 ab	126.81 a	53.34 a
Variety of Milky 2	242.64 ab	120.63 ab	49.78 ab
Nasa Variety 29	236.05 ab	115.00 b	49.06 b
Treatment of the Number of Soybean Rows			
Soybean 5 Lines	231,58 a	118,42 a	51,59 a
Soybean 7 Lines	248,64 a	118,08 a	47,67 a

Description: The number accompanied by the same letter in the same column means that it is not significantly different according to the LSD test 5% .

Table 3. Average ear circumference, number of seeds per ear circumference, moisture content and maize yield due to the effect of corn varieties treatment with the distance of soybean rows .

Variety Treatment	Variables Observation			
	Cob circumference (cm)	Number of seeds per cob Circumference (seed)	Moisture content (%)	Tonnes per Hectare production
Variety of Pioneer 35	14.25 b	13.56 ab	18.68 ab	4,273 a
Bima Variety 19	15.49 a	14.44 a	17.85 ab	3,505 c
Variety JH 27	15.42 a	13.28 b	19.18 a	4,356 a
Variety of Milky 2	14.45 a	14.28 ab	17.72 b	4,088 a
Nasa Variety 29	14.42 a	13.86 ab	18.62 ab	3,885 b
Treatment of the Number of Soybean Rows				
Soybean 5 Lines	14,69 a	13,51 a	18,63 a	3,859 a
Soybean 7 Lines	14,92 a	14,26 a	18,19 a	4,183 a

Description: Figures accompanied by the same letters in the same column means are not significantly different according to 5% LSD test.

The data on the circumference of corn cobs in Table 3 below shows that the varieties of Bima 19, JH 27, Bima 2 and Nasa 29 have the same length of the circumference of the cob. While the planting distance of some hybrid corn varieties with the number of soybean rows 5 and 7 rows there was no difference in the length of the circumference of

the cob 14.69 cm and 14.92 cm respectively.

Table 3 above shows that the highest number of corn seeds per cob circumference in the treatment of Bima 19 corn varieties (14.44 seeds) but not different from Bima 2 corn varieties (14.28 seeds), NASA 29 (13.86 seeds) and Pioneer 35 (13.56 seeds). While the spacing of several varieties of corn with the number of soybean rows 5 and 7 rows there was no difference in the number of seeds per cob circumference of 13.51 cm and 14.26 seeds respectively.

The water content data in Table 3 above shows that JH variety 27 (19.18%) but not significantly different from Pioneer 35 varieties (18.68%), NASA 29 (18.62%) and Bima 19 (17.85%) . While the spacing of several varieties of corn with the number of soybean rows 5 and 7 rows there was no difference in the content of water content respectively 18.63 cm and 18.19 cm.

Production yield data based on corn chips in Table 3 above shows that JH 27, Pioneer 35 and Bima 2 varieties did not show differences between varieties of production of 4,356 t / ha, 4,273 t / ha and 4,088 t / ha. While the spacing of several varieties of maize with the number of soybean rows 5 and 7 rows there was no difference in the production yield of 3.859 t / ha and 4.183 t / ha respectively. The length of the cobs and the weight of corncobs are closely related to the yield of dried corn seeds (Pesireron and Senewe. 2011). Amir and Nappu (2013) added that the yield stability of a variety is positively correlated between the number of rows and the dry grain yield and must also be supported by inter-row seed density, row length and seed size.

The development of varieties that have adaptability in accordance with the environment is carried out with the introduction of new high yielding varieties (Subekti *et al.,* 2009). The ability of a variety will provide higher production if the environment is growing optimally (Saidah *et al.,* 2015). The development of varieties that have adaptability in accordance with the environment is carried out with the introduction of new high yielding varieties (Subekti *et al.,* 2009). The use of varieties that must be considered the ability to adapt to agroecosystem conditions (Fahmi and Sujitno, 2015).

CONCLUSION

Hybrid corn of JH 27 variety significantly influences the height of ear cobs and the ratio of plant height to ear cobs height compared to other varieties.

Nasa 29 variety planted with 7 rows of soybean spacing has the number of seeds per row and the number of seeds per cob significantly influences compared to other treatments.

JH 27 hybrid corn varieties increased significantly in Nasa 29 and Bima 19 varieties by 10.81% and 19.54%.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

ACKNOWLEGEMENT

Thanks to the friends of the researchers whose names are listed in this article. The results of this study are dedicated to the development of science.

AUTHOR CONTRIBUTIONS

S, AM, and HMCS design and conduct research, data collection, data analysis and also manuscript writing. LL designs and conducts research, reviewing manuscripts and submit manuscripts. All authors read and approved the final version

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