Nat. Volatiles & Essent. Oils, 2021; 8(4): 15475-15486

NVEO
Natural Volatiles &
Essential Oils

The Effect Of Glutinous Corn Planting Distance On Intercropping Patterns With Peanuts On Yield And Micro-Environment Of Plants

Marwan Hidayat Lussy[1] , Titin Sumarni[2] , Karunia Puji Wicaksono[3]

[1]Postgraduate Program in Agronomy, Faculty of Agriculture, Brawijaya University, Malang, Indonesia

[2,3]Department of Agricultural Cultivation, Faculty of Agriculture, Brawijaya University, Malang, Indonesia

ABSTRACT

Glutinous corn (Waxy corn) Zea mays ceratina L.) is one of the cereal commodities that has the potential as a source of main food ingredients other than rice and soybeans in Indonesia. and land ownership by farmers is decreasing. One alternative is a planting pattern with an intercropping system and determining the right spacing. The purpose of this study was to analyze the effect of different spacing of glutinous corn with a combination of planting rows of peanuts on production yields in an intercropping system. The research was carried out at the Jatimulyo Experimental Garden, Faculty of Agriculture, Universitas Brawijaya, from september to december 2020. The study used a randomized block design with 6 treatments and 4 replications. Data analysis using analysis of variance (ANOVA) and testing using F table 5% level. If there is a significant effect, then it is continued with the Smallest Significant Difference (LSD) test. The results of this study showed that the JT4 treatment (20x105 cm with 3 rows of peanuts) on corn and peanuts gave the best response for all parameters of yield observations, However, in observing the yield of seeds/harvest plots and yields of ton ha^{-1}, then the JT2 treatment (20x85 cm with 2 rows of beans) gave a higher effect on corn plants. This was because the population was higher when the spacing of the plants wascloser. while the lowest conversion results to tons ha^{-1} were obtained in the JT6 treatment (20x125 cm with 4 rows of nuts).

Keyword: Glutinous Corn Planting, Distance, Peanutson Yield , Micro-Environment

Introduction

Along with the increasing population in Indonesia, namely 1.49% per year, This causes the need for food to increase as well. Until now most of the people's food needs still depend on rice. However, rice production has not been able to meet the needs of the community, This is further exacerbated by the increasing percentage of land conversions that productivity and land ownership by farmers decreases. In connection with this problem, then the application of appropriate cultivation techniques and food diversification programs need to be carried out

so that efforts to increase national food sufficiency can be fulfilled (Mardiharini and Jamal 2017).

Glutinous corn (Waxy corn) Zea mays ceratina L) including one of the cereal commodities that have the potential as a source of main food ingredients other than rice and soybeans in Indonesia. This is supported by the nutritional content contained in glutinous corn, namely its protein content (9,11%), fat content (4,97%) crude fiber (3,02%) and carbohydrates (72,81%) which is almost equal to the carbohydrate content of rice which reaches 79% (Suarni & Yasin 2011). However, the average yield potential of pulut corn is still low, which is less than 2 t ha^{-1} (Rouf, Zubair, and Walangadi 2010). When compared with the national corn production which can reach 5-7 t ha^{-1}, even for hybrid varieties can reach 8-13 t ha^{-1}. Thus the strategy applied must refer to efforts to make efficient use of nutrients, water and sunlight, this effort can be approached through setting cropping patterns, namely intercropping (Suminarti 2011)

The intercropping system is one of the business systems of planting more than one type of plant on the same plot of land at the same or slightly different times. (Francis et al. 1986). It has been proven that intercropping is more efficient in increasing system productivity, with more effective use of agricultural land and limited resources because temporal and spatial complement each other (Feike et al. 2012; Hong et al. 2017; Li, Zhang, and Zhang 2013; Yu et al. 2015; Zhang et al. 2014).The advantage of the intercropping systemis determined by how the components of plant growth and the allocation of dry matter to the plant organs are (Ren et al. 2016). Identifying the mechanism of dry matter accumulation among plant organs in intercropping systems aims to further increase the efficiency of resource use and determine the potential for increasing productivity in this system. (Gou et al. 2017).

how much contribution can be obtained in the tumpagsari system to yield gains is largely determined by the combination of intercropping plants and the arrangement of plant spacing to suppress competition as much as possible which can reduce crop yields. Based on these, To find out how the intercropping system is able to increase the growth and yield of cultivated plants, a study was carried out on the effect of spacing on the growth and yield of maize pulut in an intercropping system with peanuts..

MATERIALS AND METHODS

The tools needed in the research are: (LAM) Leaf Area Meters type LI-3100, calipers, ovens, measuring instruments(meters), rulers, stationery, analytical scales, hand tractors, tillage tools, tugal, digital cameras, and lux meters. The materials needed in this study include corn seeds, peanut seeds, chicken manure, NPK and Furadan 3G.

This study is a non-factorial treatment study using a Completely Randomized Block Design (RCBD) consists of 6 treatments including; JT1: Corn Planting Distance 75x20cm and 2 rows of peanuts (66.666 Corn population ha^{-1}), JT2: Corn Planting Distance 85x20 cm and 2 rows of peanuts (58.823 Corn population ha^{-1}), JT3: Corn Planting Distance 95x20 cm and 3 rows of peanuts (52.631 Corn population ha^{-1}), JT4: Corn Planting Distance 105x20 cm and 3 rows of peanuts (47.619 Corn population ha^{-1}), JT5: Corn Planting Distance 115x20 cm and 4 rows of peanuts (43.478 Corn population ha^{-1}), JT6: Corn Planting Distance 125x20 cm and 4 rows of peanuts (40.000 Corn population ha^{-1}) repeated 4 times so that the total experimental units were 24 units.

Observations were made at harvest time of 95 days after planting. Observation of maize yields were cob weight with cob, cob weight without cob, cob diameter, cob length, seed weight per plant, weight of 100 seeds, grain yield t ha^{-1}, then peanuts, namely the total number of pods, the number of filled pods, the weight of the filled pods, the weight of the seeds, the weight of 100 seeds, the yield of seeds t ha^{-1} and observations of the efficiency of solar energy conversion. Analysis of the data using analysis of variance and testing using F arithmetic if there is a significant effect then proceed with the LSD test at the 5% level

Observation of Glutinous Corn

The weight of the cob/plant, the weight of the cob without the cob/plant, the length of the cob and the diameter of the cob

The results of the analysis of variance showed that the treatment of corn spacing in the intercropping system with a combination of peanut planting rows gave a significant effect on the observed variables of harvesting, cob weight and cob, cob weight without cob and cob length., but on the observation of the diameter of the cob does not appear to have a significant effect. The average weight of cob with cob, weight of cob without cob, length of cob and diameter of cob based on the effect of treatment is presented in Table 1.

Table 1. Average yield of cob weight + cob weight, cob weight - cob length and cob diameter of white corn plants with maize spacing treatment in an intercropping system with a combination of peanut planting rows at the age of 95 days after planting.

Treatment	weight of cobs with cob/plant(g)		cob weight without kelobot/plant (g)		cob length(cm)		barn diameter(cm)
JT1	185,19	a	147,47	a	13,84	a	38,73
JT2	225,76	ab	187,63	ab	15,52	bc	39,03
JT3	190,14	a	148,47	a	14,45	ab	42,02
JT4	243,39	b	210,28	b	16,52	c	42,44
JT5	186,77	a	170,29	ab	14,75	ab	45,55
JT6	192,12	a	166,48	ab	14,51	ab	46,37
LSD 0,5%	40,70		45,20		1,63		NS
CV	11,47		15,12		6,27		10,64

Note: Numbers accompanied by the same letter in the same column show no significant difference based on the LSD test at the 5% level. Weight of cobs with cob/plant

Table 1 showed that for the observation of cob weight with cob weight the best value was obtained in the JT4 treatment with a value of 243,39 g when compared with treatment JT1, JT3, JT5 and JT6 but not different from the treatment JT2 of 225.76. Treatment use JT4 giving an increase in cob weight with a tan of 58.20 g (31,42%) when compared with JT1 treatment with the lowest value of 185.19 g. These results are in accordance with the research Herlina (2011) which shows that with close spacing, the competition will be higher in the uptake of

nutrients, water, CO2 and light so that the organic matter accumulated in the weight of the cobs is lower.

Cob weight without kelobot/plant

The results of the analysis of diversity showed that the spacing of maize pulut in an intercropping system with peanuts had a significant effect on the observed weight of cobs and cobs, which are presented in Table

1. Observation of cob weight without cob the best value was obtained in the JT4 treatment of 210.28 g when compared with the treatment of JT1 and JT3 with each value of 147,47 g and 148,47 g but not significantly different from the JT2, JT5 and JT6 treatments, the use of JT1 and JT3 treatments resulted in a decrease in the weight of the cobs without shells, respectively by 62,81 g (29,87%) and 61,82g (29,39%) when compared with JT4. The increase in cob weight is influenced by the effectiveness of the photosynthesis process and the translocation of photosynthate to the cob (Somputan, 2014). Ukonze et al. (2016) that the high cob weight yield was caused bythe number of seeds on each measured cob.

Cob Length

The results of the analysis of diversity showed that the distance treatment of maize pulut in an intercropping system with peanuts had a significant effect on the observation of cob length, which is presented in Table 1. Observation of the best cob length was obtained in the JT4 treatment of 16.52 cm when compared to theJT1, JT3, JT5 and JT6 treatments but did not differ from the JT2 treatment of 15,52 cm.

Seed/plant weight, 100 seed weight and seed weight t ha^{-1}. Observation average seed/plant weight, 100 seed weight and seed weight t ha^{-1}

The results of the analysis of variance showed that the treatment of corn spacing in the intercropping system with a combination of peanut planting rows gave a significant effect on the observation variable of seed/plant weight harvest, weight of 100 seeds and seed weight t ha^{-1}. Observation average seed/plant weight, 100 seed weight and seed weight t ha^{-1} based on the effect of treatment is presented in Table 2.

Table 2. Average yield of seed weight/plant, seed weight/harvest plot, weight of 100 seeds and seed yield of t ha^{-1} maize rice plants with maize spacing treatment in an intercropping system with a combination of peanut planting rows at age 95 days after planting.

Treatment	Seed/plant weight		Seed weight/ harvest plot (g)		Weight 100 seeds/plant (g)		Seed weight t ha^{-1}	
JT1	103,60	a	547,14	b	26,32	a	4,66	a
JT2	121,12	b	706,41	c	29,32	ab	7,71	b
JT3	104,91	a	489,65	b	26,46	a	4,89	a
JT4	123,20	b	562,01	b	32,09	b	6,73	b
JT5	118,21	b	349,28	a	27,38	a	3,84	a
JT6	112,97	ab	314,84	a	26,73	a	3,61	a
LSD 5%	11,46		73,02		3,07		1,53	

CV	13,51	12,49	15,29	13,31

Note: Numbers accompanied by the same letter in the same column show no significant difference based on the LSD test at the 5% level.

Weight of seeds/plant of glutinous corn Table 2 above shows that for the
observation of seed/plant weight the best value was obtained in the JT2, JT4, and JT5 treatments with each value of 121,12; 123,20and 118, 21 g when compared with JT1 and JT3 treatments but not significantly different from JT6 treatment with a value of 112.97 g, the use of JT1 treatment reduced the value of seed/plant weight by 19,60 g (15,91%) when compared with the JT4 treatment. This is due to the determination of the correct spacing resulting in planting can take advantage of the availability of nutrients, especially potassium properly so as to increase the enlargement of the cobs and increase the weight of seeds per plant. (Subiksa and Made 2011).

Seed weight/ plot of glutinous corn harvest

Based on the analysis of the diversity of the maize spacing treatment in the intercropping system with peanuts, it has a very significant effect on the observation of seed weight/harvest plot, which is presented in Table 2, where the JT2 treatment gives the highest effect with an average value of 706,41 g compared to all treatments, maize grain yield is related to the number of seeds per area which depends on the number of plants per area, the number of cobs per plant and the number of seeds per cob. (Sangoi et al. 2002)

The weight of 100 corn kernels

Based on the analysis of the diversity of observations of the weight of 100 seeds, the highest value was obtained in the JT4 treatment of 32.09 g, significantly different from the JT1, JT3, JT5 and JT6 treatments but not significantly different from the JT2 treatment of 29.32. This is because at a spacing that is too tight, the leaves of the plant will tend to shade the lower leaves of each plant in the absorption of sunlight, thus affecting the yield of seeds. (Susanti and Barunawati 2019) that corn production cannot be separated from the plant leaf area for the photosynthesis process, the assimilate produced by the photosynthesis

Peanuts

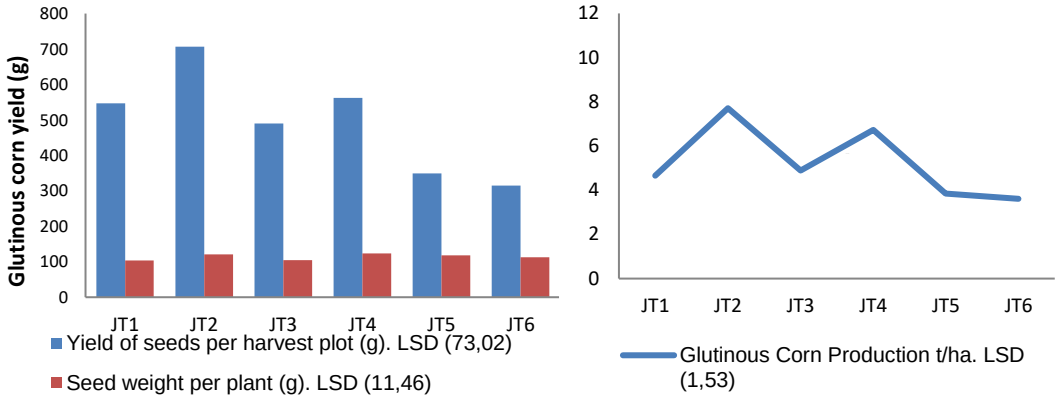
total number of pods/plant, number of filled pods/plant and weight of filled pod/peanut plant.

The results of analysis of variance showed that the distance treatment of maize in an intercropping system with a combination of planting rows of peanuts had process in the leaves is stored as sinks, growth and food reserves (seeds).

Seed weight t ha^{-1} maize pulut

Based on the analysis of diversity presented in table 2, it shows that the results of the seed weight variable t ha-1 of the best pulut corn were obtained in the JT2 and JT4 treatments with each value equal to 7,71 and6,73 t ha^{-1} and significantly different with all treatments. This is because the close spacing will increase the number of plant populations on the unit of land area, on the contrary, if the spacing is too wide, it will reduce the number of plant populations,

so that it will affect the decrease in yield, this is in accordance with the results of the study. (Zhang et al. 2020) on the intercropping pattern of corn and peanuts with a higher population level of corn plants gives the best effect on production yields per unit area of land. Observation of the harvest at the age of 95 days after planting shown in Figure 2 can be seen that the highest yield on the observation of seed/plant weight seen in the JT4 treatment shows the effect of treatment on plant quality, but when viewed in terms of quantity the effect of spacing treatment on maize production pulut then the JT2 treatment has the highest effect on both the observation of the yield of seeds/harvest plots and the yield t ha^{-1}



Picture 1. histogram of mean seed weight/plant, seed weight/harvest plot and yield of t ha^{-1} maize crop due to maize spacing treatment in an intercropping system with combination of peanut planting rows

Information: (JT) spacing treatment not significant

a significant effect on the observed variables for harvesting the total number of pods/plant, the number of filled pods/plant and the weight of filled pods/plant. The average observation of the total number of pods/plant, the number of filled pods/plant and the weight of filled pods/plant based on the effect of treatment are presented in Table 3.

Table 3. Average number of pods/plant, number of filled pods/plant and weight of pods/plants of peanuts with distance treatment of glutinous corn in intercropping system with combination of rows of peanuts aged 95 days after planting.

Treatment	Total of pods/ plant((g)		Total of pods contents /plant (g)		Stuffed pods weight /plant (g)	
JT1	15,31	a	9,41	ab	19,70	ab
JT2	20,73	bc	13,16	c	26,67	c
JT3	14,80	a	8,64	a	19,49	a
JT4	21,06	c	13,51	c	27,61	c
JT5	17,16	ab	8,96	ab	25,25	bc
JT6	15,51	a	10,02	b	25,80	c
LSD 5%	3,72		1,24		5,63	
CV	12,25		13,75		13,43	

Note: Numbers accompanied by the same letter in the same column show no significant difference based on the LSD test at the 5% level; (DAP) = day after planting. Total of pods/ plant Table 3 above shows that in the observation variable the number of total pods/plants the highest average value was obtained in the JT4 treatment of 21.06 when compared to the JT1, JT3, JT5 and JT6 treatments but not significantly different from the JT2 treatment with a value of 20, 73. Total of pods contents /plant Based on the analysis of variance in the observation of the number of filled pods/plants, the best value was obtained in the JT2 and JT4 treatments with values of 13.16 and 13.51 respectively compared to all treatments, the smallest value was obtained in the JT3 treatment of 8.64.

Stuffed pods weight / plant

The results of the analysis of diversity showed that the weight of the filled pods/plants treated with JT2, JT4 and JT6 gave the best effect with each value of 26.67g; 27.61 g and 25.80 g were compared with the JT1 and JT3 treatments, but not significantly different from the JT5 treatment at 25.25 g. High pod weight was supported by a large number of pods because the number of pods and the number of filled pods were positively correlated with the weight of filled pods. (Sundari et al., 2016). Seed weight/ ton, Seed weight/ harvest plot, Weight 100 seeds and Seed weight t ha^{-1} peanut plant

The results of analysis of variance showed that the treatment of maize spacing in the intercropping system with a combination of peanut planting rows gave a significant effect on the observed variables of harvesting, seed weight/plant, seed weight/harvest plot, weight of 100 seeds and weight of seed t ha^{-1}. The mean observations of seed weight/tan, seed weight/harvest plot, weight of 100 seeds and weight of seed t ha^{-1} based on the effect of treatment are presented in Table 4.

Table 4. Average seed weight/plant, seed weight/harvest plot, weight of 100 seeds and weight of seed t ha^{-1} of maize rice with maize spacing treatment in intercropping system at harvest 95 days after planting.

Treatment	Seed/Plant Weight (g)		Seed Weight/ harvest plot (g)		weight 100 seeds (g)		Seed yield t ha^{-1}	
JT1	10,44	a	187,92	a	34,79	a	1,36	a
JT2	17,00	c	306,00	cd	39,27	ab	2,22	c
JT3	11,14	a	200,43	a	35,37	ab	1,45	ab
JT4	17,84	c	321,17	d	39,64	b	2,33	c
JT5	14,36	b	258,48	b	34,81	a	1,87	abc
JT6	14,96	b	269,19	bc	35,11	ab	1,95	bc
LSD 5%	3,04		37,18		4,64		0,55	
CV	12,24		12,24		7,30		16,89	

Note: Numbers accompanied by the same letter in the same column show no significant difference based on the LSD test at the 5% level; days after planting;

Seed Weight/ Peanut Plant

The table above shows that in the observation variable of seed weight/peanut plant the best average value was obtained in the JT2 and JT4 treatments with a value of 17.00 and 17.84 g, respectively, compared to all treatments, while the lowest value was obtained in the JT1 treatment. of 10.44 g.

Seed Weight/ Peanut Harvest Plot

Table 4 above shows that the observation of seed weight/harvest plots has the highest value obtained in the JT4 treatment of 321.17 g when compared with the JT1, JT3, JT5 and JT6 treatments, but not different from the JT2 treatment with a value of 306.00 g, the results the lowest in this observation was obtained in the JT1 treatment of 187.92

Weight of 100 Peanut Seeds

The results of the analysis of diversity showed that the weight of 100 seeds the highest value was obtained in the JT4 treatment of 39.64 g when compared to the JT1 and JT5 treatments with values of 34.79

and 34.81 g, but not significantly different from the JT2, JT3 and JT3 treatments. JT6. The use of JT1 and JT5 treatments resulted in a decrease in the weight of 100 peanuts by 4.85 g (12.23%) and 4.83 (12.19%) when
compared to the JT4 treatment.

Seed Yield t ha^{-1} Peanut

The results of the observation of the seed weight variable t ha^{-1} showed that the spacing of JT2 and JT4 treatments produced the best average seed weight t ha^{-1} of 2.22 and 2.33 t ha^{-1} and was significantly different from the treatment of JT1, and JT3 but not significantly different from the JT5 and JT6 treatments. The average seed weight t ha^{-1} produced by JT2 and JT4 treatments with values of 2.22 t ha^{-1} and 2.33 t ha^{-1}, respectively, showed an increase in seed weight per hectare sequentially by 0, 86 (63.24%) and 0.97 (71.32%) when compared with the JT1 treatment with a value of 1.36 t ha^{-1}.

Observation of the harvest of peanuts aged 95 days after planting as shown in Figure 2 shows that the JT4 treatment gave the highest yields on all variables observed for harvesting pod weight/plant, seed weight/plant and yield t ha^{-1} t ha^{-1}. So it can be concluded that the JT4 treatment with three rows of peanut intercrops can give optimum results.

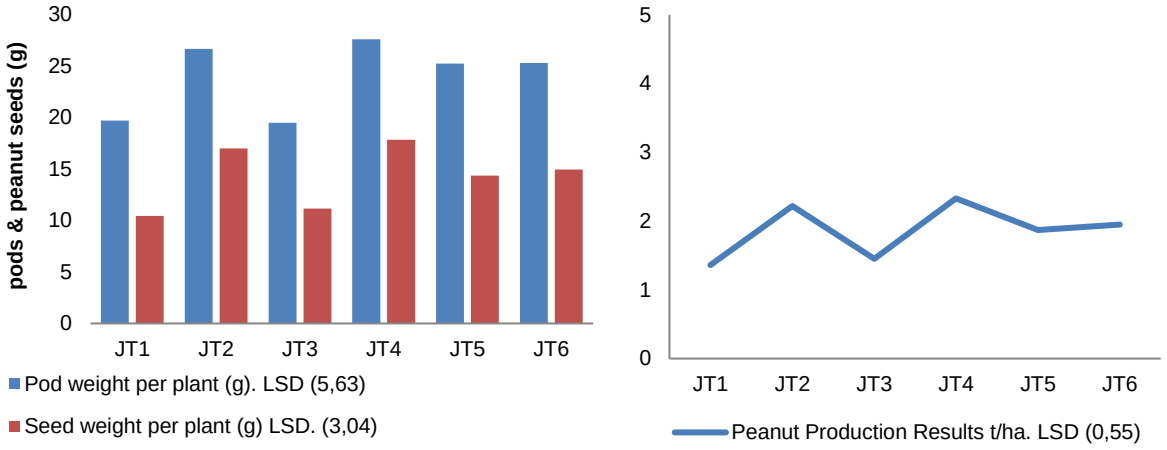


Figure 2. Histogram of mean pod weight/tan, seed weight/tan and yield of t ha^{-1} peanut plantdue to corn spacing treatment in intercropping system
Information: (JT) spacing treatment not significant

Plant Micro Environment

the efficiency of solar energy conversion(ECE)

The results of analysis of variance showed that the distance treatment of maize in an intercropping system with a combination of planting rows of peanuts had a significant effect on the observed variables of solar energy conversion efficiency (ECE) on maize and peanuts. The mean of observing the efficiency of solar energy conversion (ECE) on corn and peanut plants based on the effect of treatment is presented in table 19. Solar energy (ECE) on corn and peanut plants based on the effect of treatment is presented in table 5.

Table 5. Average Solar Energy Efficiency (ECE) on maize and peanuts with maize spacing treatment in an intercropping system with a combination of peanut planting rows.

Treatment	the efficiency of solar energy conversion ECE (%)			
	Glutinous Corn		Peanuts	
JT1	4,15	a	2,02	a
JT2	5,09	bc	2,57	ab
JT3	4,25	a	2,05	a
JT4	5,42	c	3,12	c
JT5	4,97	bc	2,41	ab
JT6	4,99	b	2,71	b
LSD 5%	0,39		0,31	
CV	14,86		16,30	

Note: Numbers accompanied by the same letter in the same column show no significant difference based on the LSD test at the 5% level; days after planting;

Table 5 above shows that the distance treatment of maize pulut with a combination of peanut planting rows has a significant effect on the efficiency of solar energy conversion (EKE) for the two intercropped plant commodities. The JT4 treatment gave the best effect on observing the solar energy efficiency of corn plants with a value of 5.42% when compared to the JT1, JT3 and JT6 treatments, but did not differ from the JT2 and JT5 treatments by 5.09% and 4.97%, respectively. Similar to the observation of peanut plants

where the JT4 treatment gave the best effect on the efficiency of solar energy conversion (ECE) of 3.12% and significantly different from all treatments, the smallest value in this observation was seen in the JT1 treatment of1.02%. This is because corn is a plant group that grows well in full solar radiation (heliophytes) so that the results of energy conversion efficiency are higher than peanuts, the low efficiency of solar energy conversion is caused by various factors including the cultivation system and the determination of improper planting distances so that plants are not optimal in utilizing the intensity of sunlight (Chandrasekaran, Annadurai, and Somasundaram 2010)

CONCLUSION

Treatment of plant spacing that is too close or too wide can not give the best effect on the yield of intercropped maize and groundnut. The highest maize yield was obtained in the JT2 treatment (20x85 cm +2 rows of peanut interlunation) of 7.71 t ha^{-1}, and the highest peanut yield was obtained in the JT4 treatment (20x105 cm +3 rows of peanut interlunation) with a value of 2.33 t ha^{-1}. Higher production yields per unit area of land were obtained in the JT2 treatment (20x85 cm +2 rows of peanut intercrops) with maize yields of 7.71 t $ha^{-1}$and peanut yields of 2.22 t ha-1 so that the total yield of the unit area of land is 9.93 t ha^{-1}.

REFERENCES

Chandrasekaran, B., K. Annadurai, and E. Somasundaram. 2010. A Textbook ofAgronomy. New Age International Limited.

Feike, Til, Reiner Doluschitz, Qing Chen,Simone Graeff-Hönninger, and Wilhelm Claupein. 2012. "How to Overcome the Slow Death of Intercropping in the North China Plain." Sustainability 4(10):2550–65.

Francis, Charles, Alice Jones, Kent Crookston, Kyle Wittler, and Sondra Goodman. 1986. "Strip Cropping Corn and Grain Legumes: A Review." American Journal of Alternative Agriculture 1(4):159–64.

Gou, Fang, Wen Yin, Yu Hong, Wopke vander Werf, Qiang Chai, Nico Heerink,and Martin K. van Ittersum. 2017. "On Yield Gaps and Yield Gains in Intercropping: Opportunities for Increasing Grain Production in Northwest China." Agricultural Systems 151:96–105.

Hong, Yu, Nico Heerink, Shuqin Jin, Paul Berentsen, Lizhen Zhang, and Wopke van der Werf. 2017. "Intercropping and Agroforestry inChina–Current State and Trends."Agriculture, Ecosystems & Environment 244:52–61.

Li, Long, Lizhen Zhang, and Fusuo Zhang. 2013. "Crop Mixtures and theMechanisms of Overyielding."

Mardiharini, Maesti, and Erizal Jamal. 2017. "Reformasi Kebijakan Penyuluhan Pertanian Menuju Transformasi Pembangunan Pertanian Jangka Panjang." Diakses Pada Http://Www.Litbang. Pertanian. Go. Id/Buku/Reformasikebijakan-

Menuju/BAB-IV-6. Pdf.

Ren, Yuanyuan, Jiajia Liu, Zhiliang Wang, and Suiqi Zhang. 2016. "Planting Density and Sowing Proportions of Maize–Soybean Intercrops Affected Competitive Interactions and Water- Use Efficiencies on the Loess Plateau, China." European Journal of Agronomy 72:70–79.

Rouf, Ari Abdul, Annas Zubair, and Dahlan Walangadi. 2010. "Pengkajian Pemurnian Benih Jagung Pulut Di Provinsi Gorontalo." Prosiding Pekan Serealia Nasional. Hal 117–21.

Sangoi, L., MA Gracietti, C. Rampazzo, and P. Bianchetti. 2002. "Response of Brazilian Maize Hybrids from Different Eras to Changes in PlantDensity." Field Crops Research 79(1):39–51.

Suarni & Yasin, M. 2011. "Corn as a Functional Food Source." Journal ofFood Crop Science and Technology6(1):41–56.

Subiksa, I. Gusti Made, and Gusti Made. 2011. "Pengaruh Jarak Tanam Dan Jenis Pupuk Terhadap Pertumbuhan,Produksi Silase Dan Biji Pipilan Jagung Hibrida Pada Inceptisols Dramaga." Bogor: Badan Penelitian Dan Pengembangan Pertanian.

Suminarti, NE. 2011. "Teknik Budidaya Tanaman Talas (Colocasia Esculenta (L) Schott Var." Antiquorum Pada Kondisi Kering Dan Basah. Disertasi.Program Pasca Sarjana, Fakultas Pertanian, Universitas Brawijaya.

Sundari, Titik, Novita Nugrahaeni, and Gatut Wahyu Anggoro Susanto. 2016. "Interaksi Genotipe x Lingkungan Dan Stabilitas Hasil Biji Kedelai Toleran Naungan." Jurnal Agronomi Indonesia (Indonesian Journal of Agronomy) 44(1):16–25.

Susanti, Mia Maya, and Nunun Barunawati. 2019. "Pengaruh Jarak Tanam Dan Jenis Bahan Organik Terhadap Produksi Kubis Bunga (Brassica Oleracea Var. Botrytis L.)." Jurnal Produksi Tanaman 6(9).

Ukonze, Juliana Adimonye, Victor Ojorka Akor, and Uchenna Marbeln Ndubuaku. 2016. "Comparative Analysis of Three Different Spacing on the Performance and Yield of Late Maize Cultivation in Etche Local Government Area of Rivers State, Nigeria." African Journal of Agricultural Research 11(13):1187–

Yu, Yang, Tjeerd-Jan Stomph, David Makowski, and Wopke van der Werf. 2015. "Temporal Niche DifferentiationIncreases the Land Equivalent Ratio of Annual Intercrops: A Meta- Analysis." Field Crops Research 184:133–44.

Zhang, Dongsheng, Lizhen Zhang, Jianguo Liu, Shuo Han, Qi Wang, Jochem Evers, Jun Liu, Wopke Van der Werf,and Long Li. 2014. "Plant Density Affects Light Interception and Yield in Cotton Grown as Companion Crop in Young Jujube Plantations." Field Crops Research 169:132–39.

Zhang, Dongsheng, Zhanxiang Sun, Liangshan Feng, Wei Bai, Ning Yang,Zhe Zhang, Guijuan Du, Chen Feng, Qian Cai, and Qi Wang. 2020. “Maize Plant Density Affects Yield, Growth and Source-Sink Relationship of Crops in Maize/Peanut Intercropping.” Field Crops Research257:107926.