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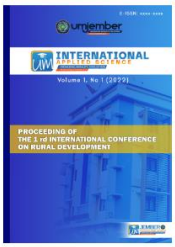

The first International Conference on rural development was held on December 15, 2020 via Zoom Webinar Universitas Muhammadiyah Jember (online) due to the pandemic. ICRD 2020 aims to bring together leading academic and industry researchers, scientists, engineers and practitioners to exchange research and service ideas, methods, results and share the latest experiences, on all theoretical, experimental and applied aspects of the Social and Exact field. ICRD 2020 will provide a unique interdisciplinary and multidisciplinary forum for researchers, practitioners, and educators to present and discuss innovations, trends, practical challenges faced, and smart solutions adopted in the social and exact fields of rural development.

At this conference, there were research and service papers carried out by several researchers from various institutions and universities, which were presented in parallel oral sessions. In addition, the committee also presented four keynote speakers, namely Prof. Drs. ec. Ir. Riyanarto Sarno, M.Sc, Ph.D (Ten November Institute of Technology, Indonesia), Dr. Emy Kholifah R., M.Si (University of Muhammadiyah Jember, Indonesia), Prof. Habibullah Magsi, Ph.D (Sind Agricultural University, Pakistan) and Prof. Dr. Kittisak Jermsittiparsert, (Henan University of Economics and Law, China).

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COMMITTEE

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Effect Of Weeding and Pest Control on Root Dynamics of Soybean (Glycine max (L.) Merril) on Sugarcane-Soybean Intercropping System

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Abstrak: Soybean (Glycine max (L.) Merill) is one of the important commodities in the provision of food, feed, and industrial materials, so it has become a major commodity in international trade. The need for global soybeans increases every year, along with population growth, improvement in per capita income, and the development of a food industry that is made from soybeans. This research was conducted in the experimental garden of the Faculty of Agriculture, Muhammadiyah University, Jember, Jember, East Java, Indonesia. The research was conducted in the form of factorial field experiments. The First Factor is F1: Weed Weeding Frequency, as many as 3 levels, yi: F1: Weeding once (15 hst), F2: Weeding 2 times (15, 30 hst), F3: Weeding 3 times (15, 30, and 45 days after)) and and the second factor is Pest Control by 4 levels: I1 = Chemical Insecticide (Decis 25 EC), I2 = Vegetable Insecticide, I3 = Vegetable Insecticide Soursop Extract, I4 = Vegetable Insecticide of Neem Extract. The treatments above were arranged using a Complete Randomized Block Design (RCBD) which was repeated three times. The results of the study of weed frequency treatment significantly affected the growth of root nodules and the development of the roots of soybean plants. The best weed weeding frequency is weeding three times in one growing season. Treatment of pest control significantly affects the growth of root nodules and the development of the roots of soybean plants. The best pest control is pest control with chemical insecticides. The interaction of weed weeding frequency with pest control significantly influences the growth of root nodules and the root growth of soybean plants. The best interaction in this study is the interaction between the frequency of weeding three times sugar with pest control using chemical insecticides.

Keywords: soybean, intercropping, nodules, roots, weeding, chemical insecticide, natural insecticide.

INTRODUCTION

Soybean (Glycine max (L.) Merill) is one of the important commodities in the provision of food, feed, and industrial materials, so it has become a major commodity in international trade [1], [2], [3] [4], [5]. Total world production for soybeans in 2016 reached 334,894,085 metric ton. The United States is the largest producer, accounting for 35% of world production [6]. The United States (USA) is the largest soybean producing country in the world, the amount of production in 2017 was 119,518,490 tons. While the second place as a soybean producing country is Brazil with a total production of around 114,599,168 tons, while the third is occupied by Argentina with a total production of 54,971,626 tons [6].

Based on the facts above show that soybean needs dunia increase every year, along with population growth, per capita income improvement,and the development of a food industry made from soybeans. One way to increase soybean production through increased land productivity is by intercropping. Intercropping is planting two or more types of plants which are cultivated together on the same land and time. According to [7],[8], [9], [10], [11], [12],[13], intercropping aimed at utilizing the environment (nutrients, water and sunlight) as well as possible in order to obtain maximum production. Research on soybean intercropping with sugar cane is one of the efforts to help increase food production through crop diversification by utilizing empty space on sugar cane land [14], [15], [16], [17], [18]. The root is an important organ in plants,

especially for absorbing water and nutrients in the growing media. At the time of drought can occur anatomical and physiological changes in taaman especially at the root [19], [20]. Planting is more developed root systems in response to nutrient deficiencies and drought [21], [20]. Soybean plants have taproots that form branch roots that grow sideways (horizontally) not far from the ground surface. If the soil moisture drops, the roots will grow deeper so they can absorb nutrients from the water. . Side growth can reach a distance of 40 cm, with a depth of up to 120 cm [22], [18]. Besides functioning as a place for plants and water and nutrient transport, the roots of the weed plant are also the place where the root nodules are formed [23. The composition of soybean roots in general is very good. Growth of straight taproots into the soil and has many branch roots. At the roots of many branches there are nodules containing batteries Rhizobium japnicum, which have the ability to attach free nitrogen (N2) from the air which is then used to fertilize the soil [24].

Root nodules are formed by Rhizobium when the soybean plants are young, that is, after the form of root hairs on the main root or at the root of the branch. Root nodules formed due to stimulation on the root surface that causes bacteria to enter the root and develop rapidly in it [4], [11]. Root nodules which are a symbiosis between the root and Rhizobium japonicum bacteria function to bind the free nitrogen element [25]. It also can fertilize the soil because it can save the use of NH3 available in the soil and the supply of nitrogen to the soil [20]. Formation of nodules is influenced by the availability of nitrogen in the soil, humidity, sanitation, pH and the presence of Rhizobium. Soybeans to flourish and have a high production requires soil rich in nutrients, loose, and rich in organic matter. Efforts to increase fertility need to add organic matter to the soil that has a high C/ N ratio so that it is difficult to be composed and cause immobilization of nitrogen elements [23], [26]. Besides that, the environmental conditions at the surface of the land greatly determine the growth and development of roots and formation of soybean root nodules. The influence of weeds and pest disorders greatly affects the growth and development of soybean roots [27],[28]. Whe n competition occurs between staple crops (soybeans) and weeds will affect the growth and development of soybean roots [29], [30], [31], [2], likewise if a pest attack causes growth and development of the roots of soybean plants will be disrupted [29], [32], [2]. Results of previous studies on the development and growth of soybean nodules showed the interaction between single plow-rotary plow-rotary plow soil by releasing 60 hours of sugarcane leaves and Humacos fertilizer at a dose of 12 l / ha, growth and development of roots and nodules of soybean roots is better, compared with other treatment combinations [33], and use Burangrang soybean varieties, 90 kg of urea fertilizer and the participation of 500,000 plants per ha for tangible results on the number of effective root nodules when compared to other benefit combinations [34]. Based on the description above, the authors are interested in conducting further research on the dynamics of soybean root (Glycine max (L.) Merril) on weeding and pest control in the cane-soybean intercropping system.

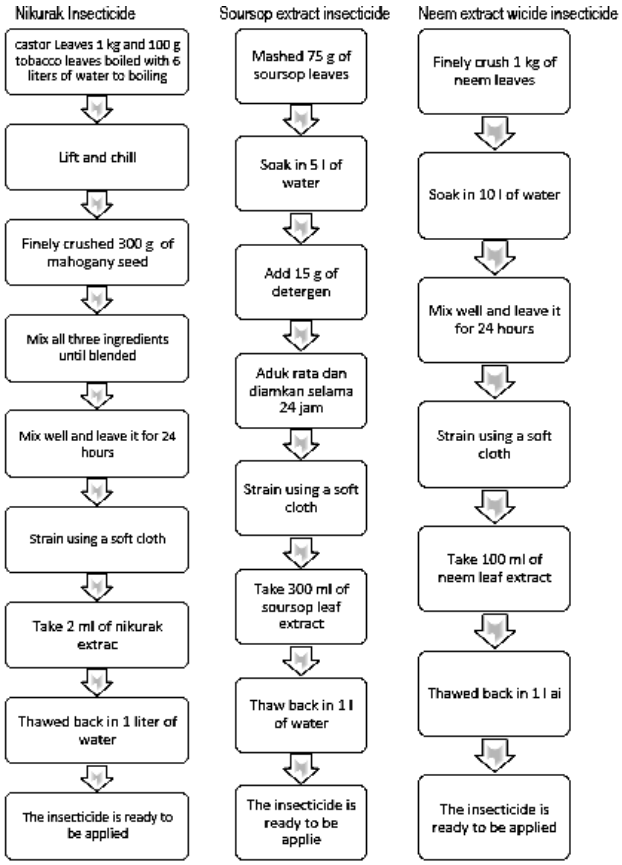
METHOD

Experimental site

This research was conducted in the experimental garden of the Faculty of Agriculture, Muhammadiyah University, Jember, Jember, East Java, Indonesia, in the rainy season, with a height of 89 meters above sea level, from January to June 2020 in sandy loam soil with a pH of 6.4. Average rainfall in the range from January to June 2020 is 467,167 mm month-1, and daily temperatures range from 31 - 33oC.

Experimental design

The research was conducted in the form of factorial field experiments. The First Factor is Weed Weeding Frequency, 3 levels, yi: F1: Weeding 1 time (15 hst), F2: Weeding 2 times (15, 30 hst), F3: Weeding 3 times (15, 30, and 45 hst)) and and the second factor is 4 levels of Pest Control: I1 = Chemical Insecticide (Decis 25 EC), I2 = Vegetable Insecticide, I3 = Vegetable Insecticide Soursop Extract, I4 = Vegetable Insecticide Mimba Extract. The treatments above were arranged using a Complete Randomized Block Design (RCBD) which was repeated three times. The best cultivation technology from the results of previous studies was used in this study, where the best cultivation technology in the first year, namely a) Spacing of 10 x 20 cm, b) varieties of Burarang soybeans, and c) fertilization. 90 kg Urea ha-1, 150 kg TSP ha-1 and 100 kg KCl ha-1 as well as the selected cultivation technology that is resistant to the second, namely a) single plow-rotary plow-rotary plow processing, b) disposal of cane leaves 60 days after planting, and c) applying organic fertilizer Humakos 12 l ha-1. Manufacturing of Nikurak Vegetable Insecticide, Soursop extract insecticide, and neem extract insecticide can be seen in the chart for making vegetable insecticide in Appendix 1.



Appendix 1. Chart for Making Plant-based Insecticides

Statistical Analysis

Data collected in the analysis of variance (ANOVA), and the average test for weeding weed treatment was compared using the DMRT test at 5% level, while the average test for pest control and the average test of the interaction of the two treatments were compared using the test Orthogonal contrast at 5% level.

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Research Implementation

The initial stage of conducting the experiment is to provide seeds and tillage. The selected seeds are normal, healthy, intact and have high variety purity. Soybean seeds used are Burarang varieties. Soil management includes clearing land from weeds and crop residues, then processed with single plow-rotary plow-rotary plow and made a 4 x 2 m plot. The distance between treatment plots is 2 dead plates while between blocks is 1 m.

Soybean seed planting is carried out in conjunction with sugar cane planting. Before soybean seeds are planted, Rhizobium japonicum is inoculated with a dose of 10 g inoculant kg seed-1. Soybean planting holes are made by drilling as deep as 3-5 cm with a spacing of 20 x 10 cm. Each planting hole is planted with 3-5 seeds which are then covered with loose soil. Thinning or replanting is done when the plant is visited 10-15 hours by selecting 2 plants per hole to continue to be maintained. Planting of sugarcane is done by making holes 10-15 cm deep, each hole contains three sections of sugarcane that have buds, spacing between rows of 100 cm, and spacing of rows in rows of 15 cm. After the sugar cane seeds are inserted into the planting hole, then covered with soil again.

Fertilization is done after finishing the making of the experimental plot with 90 kg Urea / ha fertilizer, 150 kg TSP ha-1 and 100 kg KCl ha-1 and Humakos organic fertilizer 12 l ha-1. Pest control is carried out using 4 chemical insecticides and vegetable insecticides as follows: 1) Chemical insecticide decis 25 EC with a dose of 2 ml l-1 water, 2) Vegetable insecticide with a dose of 2 ml ml l-1 water, 3) Vegetable insecticide soursop extract, with a dose of 300 ml ml l-1 water and 4) Insecticide vegetable extract of neem with a dose of 100 ml ml l-1 water. Weeding is carried out mechanically by pulling out weeds that are growing using hands or sickles. Weeding is carried out in 3 treatments as follows: 1. The first weeding is carried out at 15 DAP, 2. The second weeding is done at 15 DAP; 30 HST, and 3. The third weeding is done at 15 DAP; 30 hst; 45 hst. Soybean harvesting is done when the plant has shown the following characteristics: hard pods and yellowish brown, seeds filled with full, smooth and hard skin, and leaves 60% are falling at the age of 85-90 HST. .

Observation of the root dynamic component of soybean plants was carried out on sample plants. The root components which are sealed are as follows: 1). Total number of nodules, i.e. by counting all the root nodules that are formed, the calculation is done when the plants are flowering and when the plants are harvested. 2). the number of effective root nodules, i.e. by counting all effective root nodules that are formed, the calculation is done when the plants are in flower and when the plants are harvested, 3). Total root nodule weight (g), that is by weighing dried root nodules, the calculation is done when the plants are flowering and when the plants are harvested, 4). Effective root nodule dry weight (g), that is by weighing the dried root nodules effectively, calculations are performed when the plants are flowering and when the plants are harvested, 5). Root length (cm), i.e. by measuring from the base of the stem to the longest root, the calculation is performed on harvested plants, 6). Root dry weight (g), by weighing all roots after drying, the calculations are performed on harvested plants

RESULTS AND DISCUSSION

Total Number of Nodules of Soybean plants

Observation data on the frequency of weed weeding, pest control, and the interaction of both of them on the total number of root nodules of soybean plants at flowering showed a significantly different effect, while the total number of root nodules of soybean plants at harvest showed not significant effect.

DMRT analysis results of 5% (Table 1), the effect of weed weeding frequency treatment (F) shows that weeding with three times the frequency (F3) shows the highest total number of nodules (77.55), this result is significantly different from other treatments. While the effect of pest control treatment shows that pest control using chemical insecticides (I1), showing the highest number of root nodules (74.60), these results are significantly different from organic insecticides (Vegetable insecticide (I2), Vegetable insecticide soursop extract (I3)), and neem extract (I4), while the interaction between weed weeding frequency and pest control, treatment with weeding frequency three times using Nikurak vegetable insecticide (F3I2), shows the highest number of weed roots (29.20), these results were not significantly different from the frequency of weeding twice using Chemical insecticide (F2I1), and weeding frequency three times using Chemical insecticide (F3I1), but were significantly different from other treatment interactions.

Table 1. Average Total Number Of Nodules Of Soybean Plants In Weed Weeding (F) Frequency, Pest Control And Interaction Between Weed Weeding Frequency And Pest Control

Weeding Frequency (F)	Average TNN **	Interaction (FI)	Average TNN **
F1	63.80 a	F1I1	21.27 c
F2	72,70 b	F1I2	18,60 d
F3	77.55 c	F1I3	22.47 c
Pest Control (I)	Average TNN **	F1I4	22.73 c
		F2I1	26,73 ab
		F2I2	24.93 bc
I1	74,60 a	F2I3	22.87 c
I2	72.73 b	F2I4	22,40 c
I3	68.20 c	F3I1	26,60 ab
I4	69.57 c	F3I2	29,20 a
		F3I3	22.87 c
		F3I4	24.73 bc

Note: numbers shown with the same letters in the same column show no significant difference in DMRT 5%.

***: TNN: Total Number of Nodules*

Efective Number Of Nodules Of Soybean Plant

Observation data on the frequency of weed weeding, on the number of effective nodules at flowering and at harvest, showed significant differences, while the pest control treatment, and the interaction between weeding frequency and pest control, on the number of effective soybean nodules at flowering and at harvest, showed not significant effect.

DMRT analysis results of 5% (Table 2), the effect of weed weeding (F) frequency, weeding with three times frequency (F3) showed the highest number of effective root nodules at flowering (26,20), this result was significantly different from other treatments and at harvest the most effective nodules were found in the treatment of weeding frequency three times (F3) (8.35), but these results were only significantly different from the treatment of the frequency of weeding once (F1).

Table 2. Average Number Of Effective Soybean Roots Of Soybean Plants In Weed Weeding Frequency Treatment (F)

Weeding Frequency (F	Effective number of nodules of soybean plants	
	When flowering (fruit)	At harvest (fruit)
F1	19,20 a	7.50 a
F2	23,40 b	8.25 b
F3	26.20 c	8.35 b

Note: numbers shown with the same letters in the same column show no significant difference in DMRT 5%.

Total Weight of Nidules Of Soybean Plants

Observation data on the frequency of weed weeding treatment, the total weight of nodules at the time of flowering showed a significant difference, while at harvest it showed no real effect. The treatment of pest control on the total weight of nodules at flowering showed no significant, while at harvest showed a significant difference. The interaction between weeding frequency and pest control, on the total weight of the soybean nodules at flowering and at harvest, shows not significant effect.

DMRT analysis results of 5% (Table 3), the effect of weed weeding (F) frequency, weeding with three times frequency (F3) shows the heaviest total root nodule weight at flowering (4.65), this result is significantly different from sugar weeding treatment the other, while the effect of pest control treatment (I) shows that pest control with chemical insecticide (I1) shows the weight of the heaviest total root nodules at harvest (3.57), these results are significantly different from other pest control treatments.

Table 3. Average Weight Of Total Root Bintil Soybean Plants In Weed Weed (F) Frequency Treatment And Pest Control (I)

Weeding Frequency (F)	Total root nodule weight when flowering (g)	Pest Control (I)	Total root nodule weight at harvest (g)
F1	3.80 a	I1	3,57 a
F2	4.04 b	I2	3.43 b
F3	4.65 c	I3	3.46 b
		I4	3.46 b

Note: numbers shown with the same letters in the same column show no significant difference in DMRT 5%.

Dry Weight of Soybean Root Nudules

Observation data on the frequency of weed weeding treatment, on the dry weight of nodules on effective roots when flowering showed a significant difference, while at harvest it showed no real effect. The treatment of pest control on the effective weight of the nodules at the time of flowering showed no real effect, while at harvest it showed a significant difference. The interaction between weeding frequency and pest control, on the effective weight of nodules on soybean plants at flowering and at harvest, shows not significant effect.

The results of DMRT analysis of 5% (Table 4), the effect of weeding weed frequency (F), weeding with three times frequency (F3) showed the heaviest effective weight of dry nodules at flowering (3.88), this result was significantly different from weeding treatment other weeds, while the effect of pest control treatment (I) shows that pest control by chemical insecticide (I1) shows the dry weight of the nodules

effectively the heaviest at harvest (0.84), these results are significantly different from other pest control treatments.

Table 4 Effective Weight Of Root Bintil Effective Soybean Plants In Weed Weed (F) Frequency Treatment And Pest (I)

Weeding Frequency (F)	The dry weight of nodules is effective when flowering (g)	Pest Control (I)	The dry weight of nodules is effective at harvest (g)
F1	3.16 a	I1	.84 a
F2	3.45 b	I2	0.69 c
F3	3.88 c	I3	0.75 b
		I4	0.74 b

Note: numbers shown with the same letters in the same column show no significant difference in DMRT 5%.

Root Length of Soybean Plants

Observation data of weed frequency, weed control, pest control, and the interaction of both of them on the root length of soybean plants showed a significantly different effect.

DMRT analysis results of 5% (Table 5), the effect of weed weeding frequency treatment (F) shows that weeding with one-time frequency (F1) shows the longest root length (95,35), these results are significantly different from other treatments. While the effect of pest control treatment shows that pest control using chemical insecticide (I1), showing the length of rooted roots (94.44), these results are significantly different from organic insecticides (Vegetable Insecticides (I2), Vegetable Insecticide Soursop Extract (I3) , and vegetable extracts of neem extract (I4), while the interaction between weed weeding frequency and pest control, treatment with weeding frequency twice using chemical insecticide (F1I1), shows the longest root length (34,60).

Table 5. Average Root Length Of Soybean Plants In Weed Weeding (F) Frequency, Pest Control And Interaction Between Weed Weeding Frequency And Pest Control

Weeding Frequency (F)	Average RLSP ** (cm)	Interaction (FI)	Average RLSP ** (cm)
F1	95,35 a	F1I1	33,00 ab
F2	90.88 b	F1I2	32,00 ab
F3	84.00 c	F1I3	29.47 bc
Pest Control (I)	Average RLSP ** (cm)	F1I4	32,67 ab
		F2I1	34,60 a
I1	94.44 a	F2I2	30.17 b
I2	91.17 b	F2I3	26.53 c
I3	88.87 c	F2I4	29.86 b
I4	85.87 d	F3I1	26.80 c
		F3I2	29.00 bc
		F3I3	32.87 ab
		F3I4	23.33 d

*Note: numbers shown with the same letters in the same column show no significant difference in DMRT 5%. ** RLSP: Root Length of Soybean Plants*

Dry Weight of Soybean Roots

Observation data on the weed frequency of weeding, the dry weight of the roots of soybean plants showed a significant difference, while the treatment of pest control, and the interaction between weeding frequency and pest control, on the dry roots of soybean plants showed not significant effect.

DMRT analysis results of 5% (Table 6), the effect of weed weeding (F) frequency, weeding with three times frequency (F3) shows the dry weight of the heaviest soybean plant roots (131), these results are significantly different from weed weeding treatment the other, 0.84), this result is significantly different from other pest control treatments.

Table 6. Average Dry Weight Of Soybean Roots In Weed Weed Frequency (F) Treatment

Weeding Frequency (F)	Dry root weight of soybean plants (g)
F1	96 a
F2	112 b
F3	131 c

Note: numbers shown with the same letters in the same column show no significant difference in DMRT 5%.

Discussion

Weed Frequency Weeding

The frequency of weed control three times in the soybean sugar cane intercropping system has a positive impact on the total number of soybean root nodules, the number of effective soybean nodules, the total weight of soybean nodules, dry berattots of soybean plants, soybean root roots display and dry weight the roots of soybean plants when compared to the frequency of weeding once and twice. This is because the control of weeds three times in one planting season in the soybean intercropping system causes a symbiotic process between the roots of soybean plants with Rhizobium japnicum bacteria better when compared to the frequency of weed control once and twice. A symbiotic process occurs between the roots of soybean plants with the bacterium Rhizobium japnicum better causing the process of forming nodules on soybean plants more. The root nodules are formed due to stimulation on the root surface which causes bacteria to enter the roots and develop rapidly in them [4], [19]. Root nodules which are a symbiosis between the root and the bacterium Rhizobium japonicum function to bind the free nitrogen element [25], [22].

Weeds that grow with plants can reduce the quality and quantity of crop yields because weeds become competitors in taking nutrients, water and light and become hosts for pests and diseases [35], [16]. This causes disruption of weeds to the main crop regarding competition, the growth factors become small so that in the next generative phase, the formation of pods and seeds becomes higher than plants that are not weeded at that time. [36], 37]. Furthermore [11], [31] stated that the presence of weeds in large quantities and densities during growth and development will cause loss total results. Proper weeding time, even if done only once or twice and thrice, will produce production that is not significantly different from weed-free treatment during plant growth [27], [28], 37] added that a significant decrease in crop yield occurs when weeds are allowed to grow from the second week to the fourth week and that time can be called a critical period due to weeds. The amount of competition depends on the duration of the competition and the competitive power of each plant that is intercropped. To minimize competition for sunlight, a way is needed so that maximum results in intercropping can be achieved. will produce production that is not significantly different from weed free treatment during plant growth.

Pest Control

Chemical pest control in the soybean cane intercropping system has a positive impact on the total number of soybean root nodules, total weight of soybean root nodules, dry weight of soybean root nodules, and display of plant roots when compared with pest control Vegetable insecticide, Insecticide soursop vegetable extract (I3), and vegetable extracts of neem extract. This is because chemical insecticides have a more effective and faster active ingredient in controlling pests that attack plants, when compared to the active ingredients contained by plant-based insecticides. Controlled population and pest infestation on intercropping of soybean sugar cane cause the growth of roots of soybean plants to develop properly as well as the symbiosis process between the roots of soybean plants with the bacterium Rhizobium japonicum to bind free nitrogen runs well, so that the formation of root nodules on soybean plants more. The root nodules are formed due to stimulation on the root surface which causes bacteria to enter the root and develop rapidly in it [4], [19]. Root nodules which are a symbiosis between the root and the bacterium Rhizobium japonicum function to bind the free nitrogen element [25], [22]. Results of previous studies tcereals and legumes are efficient planting systems, for example, increasing nitrogen fixation, increasing biodiversity, increasing and stabilizing yields, increasing resource use and reducing damage caused by diseases and pests[38], 39], 40], [41].

Weed Weedding Interaction with Pest Control

Interaction between weeding three times with chemical insecticide in the intercropping system Soybean Sugar Cane has a positive impact on the total number of soybean root nodules, the number of effective soybean nodules, the total weight of soybean nodules, dried beratt nodules of soybean plants, soybean root root display and the dry weight of the roots of soybean plants when compared with the frequency of weeding weeding with other pest control. It is suspected that the two treatments can work together in providing an optimal growing environment for the growth and development of soybean plant roots, as well as providing a good environment for the symbiosis process between soybean plant roots with Rhizobium japonicum bacteria, to bind free nitrogen in the air,

Soil temperature around plant roots influences plant growth, the number and dry weight of soybean nodules and the effectiveness of rhizobium tethering N from the atmosphere. The optimum temperature around plant roots for soybean plant growth and nodulation by rhizobium is 25o C. In the tropics, including Indonesia, soil temperatures range from 25-30oC. Thus, these conditions are conducive to the growth of soybean plants and symbiosis with rhizobium. Rooting temperatures higher than 28oC have been reported to reduce nodulation by rhizobium and the effectiveness of the enzyme nitrogenase in inhibiting N and growth of soybean plants. Furthermore [42], [36], stated suggest that nodulation will decrease significantly at temperatures over 30oC. In certain areas in Indonesia, especially in eastern Indonesia, the temperature around the roots may be more than 30o C. In areas that have relatively high daily temperatures, rhizobium undergoes natural selection so that it develops adaptive and effective rhizobium strains under high temperature conditions during the day. Rhizobium strains commonly found in areas with low temperatures are generally found in small amounts in areas that have relatively high temperatures [43], [44].

Rhizobium cells are mostly composed of water, so soil moisture is a vital factor for the growth and development of rhizobium in the soil. However, the condition of excess water is not favorable. Increasing soil moisture, such as flooding or inundation for planting lowland rice, can reduce the density of rhizobium cells [45], [2]. Rhizobium is an aerobic microbe, it requires oxygen. In flooded conditions, the soil lacks

oxygen because the air space in the soil is filled with water. Oxygen is also needed by the nitrogenase enzyme in the N2 fixation process from the atmosphere. Thus the optimum benefit from symbiosis with rhizobium will be obtained if soybeans are planted under aerobic conditions, sufficient oxygen [46], [47].

.CONCLUSION

The frequency of weed weeding in the intercropping system of soybean sugar cane affects the growth of soybean root nodules, and also affects the development and growth of soybean plant roots. The best weed weeding frequency in this study is weeding three times in one growing season. Pest control in soybean intercropping cropping systems affects the growth of soybean root nodules, and also affects the development and growth of soybean plant roots. The best pest control in this study is pest control with chemical insecticides. Interaction of weed frequency weeding with pest control in soybean intercropping cropping system influences the growth of soybean root nodules, and also influences the development and growth of soybean root. The best interaction in this study is the interaction between the frequency of weeding three times sugar with pest control using chemical insecticides..

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