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Artikel

THE RESPONSE OF SOME YARDLONG BEAN *(Vigna unguiculata subsp. Sesquipedalis)* ACCESIONS TO *Bradyrhizobium* INOCULATION

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ABSTRACT

Yardlong bean (*Vigna Unguiculata* subsp. *Sesquipedalis*) is very potential commodity to be developed in Indonesia and *Rhizobium* has played an important role to increase pod production through free nitrogen fixation. *Bradyrhizobium* is a species of *Rhizobium* that is commonly found in *vigna*. The purpose of this study was to determine the response of twenty accessions of yardlong beans to *Bradyrhizobium* inoculation and determine effective accessions with *Bradyrhizobium* inoculation. This research was conducted at AIC-UGM from March to July 2019. The planting material was 20 accessions of yardlong beans from AIC-UGM collection using seed inoculation methods. The result after inoculation of *Bradyrhizobium* treatment showed that the innoculation enhances plant height, number of leaves, root volume, root area, root length, root fresh weight, root dry weight, pod fresh weight, number of pods, number of effective root nodules, amount of root nodules and accelerate the age of flowering and harvest age in most accessions. Considering its response to the *Bradyrhizobium* inoculation, accessions of yardlong bean that have the potential to be developed for superior varieties are FBKP 143, FBKP 146, FBKP 147, FBKP 150, FBKP 152, FBKP 161 and FBKP 162.

Keyword: inoculation, rhizobium, Yardlongbean

INTRODUCTION

Yardlong bean (Vigna Unguiculata L.) is one of the vegetable commodities that is very potential to be developed because it has quite high economic value. Cultivation method especially nutrient fulfillment has an important role in increasing the productivity of yardlong bean. Nitrogen is a macronutrient for plants, but this element is quickly lost in the soil either through volatilization/evaporation, nitrification, denitrification or drifting (washed) with water, and erosion (Ashari, 2006). Generally, plants absorb nitrogen from the soil, but legumes can fix nitrogen from the air through symbiosis with *Rhizobium* bacteria. Infection with *Rhizobium* will result nodulation. Certain *Rhizobium* species is generally effective with only one legume species or in each legume cultivar (Surtiningsih et al., 2009). *Bradyrhizobium* is a nitrogen-fixing bacterium in symbiosis with plants of the genus vigna including yardlong beans (Swift and Bignell, 2001).

Inoculation of legumes provides a considerable opportunity to increase the yield of these beans both in quality and quantity, as well as in reducing the use of artificial fertilizers (Singleton and Taveres, 1986). The initial effort to assemble the national superior cultivars

of yardlong beans is to gather genetic resources for selected plant species. Individuals or plant populations with special morphological characteristics are important to support plant breeding programs, so evaluating the response of accession of yardlong beans to *Bradyrhizobium* infection as an effort to support the concept of sustainable agriculture is feasible.

MATERIALS AND METHODS

The research was conducted at Agrotechnology Innovation Centre of Universitas Gadjah Mada (AIC-UGM) in Kalitirto, Berbah, Sleman, Yogyakarta on March-June 2019. Research material was 20 yardlong bean accessions which was collection accessions of AIC-UGM. In this research, split-plot model was used to divide control and inoculation treatments with treatment as main plot and accessions as subplot. Plants planted with row system whereas every row contains 15 plants of each yardlong bean accessions. The method of this research was to compare the growth and production between yardlong bean accessions on control and inoculation treatment. Inoculation treatment is given by seed inoculation method with dosage 14 g *Bradyrhizobium* for 1 kg seeds.

The observed variables include component of nodules (number of nodule and number of effective nodules) and root components (root fresh weight, root dry weight, root length, root area). The data then analyzed by variance analysis and further test with Scott Knott.

RESULTS AND DISCUSSION

1. Root Infection

Based on root sampling, it can be concluded that root nodules form 9-12 days after planting. Table 1. shows that the percentage of effective root nodules in the *Bradyrhizobium* inoculation treatment was greater than without inoculation/control. The *Rhizobium* inoculation treatment will result in more active nodules in carrying out nitrogen fixation. Inoculated plants can form root nodules faster and obtain a greater supply of nitrogen (Prakoso and Dart, 1995). Effective nodule is large in size and has a bright red color on the inside. Red pigment is leghemoglobin which shows active nitrogen retention (Suryantini, 2013).

Table 1. Percentage of effective nodules at 4 weeks after planting

Accessions	Inoculation		Control	
	Number of nodules	Percentage of effective nodules	Number of nodules	Percentage of effective nodules
137	58	17	40	25
138	70	50	70	21
140	70	57	40	30
142	32	47	30	33
143	67	48	40	35
144	75	40	30	37
145	70	43	38	39
146	40	50	40	23
147	47	53	30	37
148	45	44	20	25
150	45	47	35	60
152	25	40	20	40
156	20	40	60	40
157	30	43	40	33
160	40	50	30	40
161	35	29	45	16
162	60	55	30	27
163	38	39	30	20
164	45	87	25	48
165	50	60	35	20

Based on the results in table 2., *Bradyrhizobium* inoculation could effectively increase root volume in most accessions of yardlong beans compared to control. The number of nodules also increased in some accessions. Seed or soil inoculation can form *Rhizobium* strain populations that are effective enough for colonization and infection in the rooting area (Gardner et al.,1991). In plant growth, increased size (volume or length) due to cell division and enlargement can be stimulated by *Bradyrhizobium* inoculation.

Table 2. Number of nodule and root volume of yardlong bean at harvest

Accessions	Number of Nodule				Root Volume			
	Inoculation		Control		Inoculation		Control	
137	16.33	b	16.33	a	17.00	c	17.00	a
138	30.00	a	30.33	a	33.33	b	36.00	a
140	36.33	a	23.67	a	34.00	b	23.33	a
142	34.67	a	18.33	a	24.33	c	22.33	a
143	16.33	b	17.33	a	16.00	c	24.33	a
144	20.00	b	18.33	a	17.67	c	20.67	a
145	42.67	a	17.67	a	24.00	c	25.00	a
146	19.33	b	17.67	a	27.67	b	28.33	a
147	18.00	b	16.33	a	14.33	c	21.67	a
148	16.67	b	19.33	a	39.33	b	26.67	a
150	35.67	a	27.67	a	74.33	a	29.67	a
152	19.67	b	24.67	a	28.33	b	20.33	a
156	17.00	b	29.00	a	41.67	b	21.33	a
157	20.67	b	17.33	a	29.33	b	23.67	a
160	16.67	b	17.33	a	13.67	c	15.00	a
161	17.67	b	18.33	a	25.00	c	20.33	a
162	18.67	b	23.00	a	19.33	c	16.00	a
163	15.67	b	18.33	a	21.67	c	23.33	a
164	16.67	b	23.33	a	35.67	b	20.33	a
165	15.33	b	19.33	a	16.66667	c	14.33	a
CV (a)	21.7% ᵀ				10.60% ᵀ			
(b)	14.5% ᵀ				21.00% ᵀ			

Numbers followed by the same alphabet in the same column, are not significantly different at 5 %

Based on the results in table 3., *Bradyrhizobium* inoculation could effectively increase root area and length in most accessions of yardlong beans

compared to control. Root elongation is caused by growth-promoting hormones such as IAA (Indolasetic Acid) produced by *Rhizobium*. The longer root causes the wider surface area of the root so that it can absorb water and nutrients more optimally (Yusran, 2008).

Table 3. Root area and root length of Yardlong bean at harvest

Accessions	Root Area		Root Length	
	Inoculation	Control	Inoculation	Control
137	4326.72 b	3679.57 b	856.74 a	555.39 b
138	7460.49 a	7378.62 a	1125.09 a	1539.92 a
140	8426.37 a	5550.40 a	1198.35 a	574.58 b
142	5996.65 a	7049.36 a	1125.75 a	1743.97 a
143	2776.31 b	4770.70 a	367.84 a	1376.80 a
144	7636.84 a	5374.81 a	1196.37 a	954.98 b
145	5648.11 b	3566.39 b	862.47 a	456.82 b
146	4021.59 b	4016.41 b	839.98 a	620.21 b
147	4366.78 b	4983.82 a	849.44 a	605.61 b
148	7358.52 a	4129.90 b	1484.45 a	931.68 b
150	8860.89 a	6281.07 a	1374.36 a	1103.96 b
152	6899.89 a	3040.67 b	826.70 a	534.61 b
156	6695.03 a	6927.76 a	1227.83 a	1636.17 a
157	6604.53 a	5732.87 a	1189.73 a	741.93 b
160	3466.28 b	3144.75 b	676.40 a	599.64 b
161	5223.54 b	3781.37 b	1033.79 a	769.31 b
162	4849.80 b	5626.35 a	963.97 a	1074.85 b
163	4811.12 b	5296.55 a	717.32 a	752.99 b
164	6557.55 a	4231.72 b	902.70 a	738.44 b
165	2922.68 b	1998.89 b	561.99 a	544.32 b
CV(a)	8.70% ᵀ		30.10% ᵀ	
(b)	13.50% ᵀ		26.00% ᵀ	

Numbers followed by the same alphabet in the same column, are not significantly different at 5 %

Fresh weight is greatly influenced by the absorption of water by plants. *Rhizobium* plays an active role in increasing plant growth through nitrogen retention, increasing water availability and nutrient uptake. Dry weight is biomass that is produced from photosynthesis during the life of the plant. The higher the dry weight, the better photosynthesis runs. *Bradyrhizobium* inoculation can increase the rate of photosynthesis and water absorption so that it can increase the fresh weight and dry weight of plants (Nalawde & Bhalerav, 2015). Based on the results in table 4., *Bradyrhizobium* inoculation could effectively increase the fresh weight and dry weight of roots in most accessions of yardlong beans compared to controls.

Table 4. Root fresh weight and root dry weight of yardlong bean at harvest

Accessions	Root Fresh Weight		Root Dry Weight	
	Inoculation	Control	Inoculation	Control
137	23.55 c	15.85 a	8.81 c	7.01 a
138	33.61 c	34.63 a	9.18 c	9.43 a
140	40.53 b	22.87 a	12.60 b	8.00 a
142	35.56 b	24.63 a	8.33 c	9.10 a
143	21.51 c	17.66 a	6.19 c	7.13 a
144	23.41 c	12.93 a	8.28 c	6.63 a
145	45.73 b	10.91 a	9.40 c	5.42 a
146	37.75 b	22.39 a	9.51 c	6.94 a
147	19.50 c	22.03 a	6.45 c	6.77 a
148	54.98 a	20.16 a	11.16 b	6.67 a
150	62.41 a	23.18 a	15.98 a	7.45 a
152	37.48 b	15.52 a	7.48 c	4.24 a
156	54.76 a	17.86 a	15.23 a	7.23 a
157	26.59 c	22.48 a	9.05 c	7.55 a
160	15.12 c	17.10 a	4.86 c	5.05 a
161	30.40 c	20.12 a	7.89 c	6.63 a
162	22.13 c	17.92 a	7.57 c	6.68 a
163	27.41 c	18.59 a	9.00 c	6.25 a
164	42.88 b	14.44 a	12.44 b	5.75 a
165	15.24 c	15.23 a	4.90 c	2.94 a
CV(a)	14.7% ᵀ		10.8% ᵀ	
(b)	16.9% ᵀ		13.8% ᵀ	

Numbers followed by the same alphabet in the same column, are not significantly different at 5 %

CONCLUSION

From the research, it can be concluded that twenty accessions of yardlong beans have mixed responses. *Bradyrhizobium* inoculation treatment increased root volume, root area, root length, root fresh weight, root dry weight in most accessions. In some accessions, the *Bradyrhizobium* inoculation treatment increased number of nodules, accessions of yardlong beans that are responsive to *Bradyrhizobium* inoculation, namely accessions 143, 146, 147, 150, 152, 161 and 162.

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