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The Growth of Two Cultivars Mung Bean under different Sweet Corn Shelter Density in Sandy Soil Coastal Area

Dwi Astutik,* Prapto Yudhono, Sriyanto Waluyo
Department of Agronomy, Faculty of Agriculture, Universitas Gadjah Mada
Jln. Flora no. 1, Bulaksumur, Sleman, Yogyakarta 55281, Indonesia
***Corresponding email: dwhyastutik@yahoo.co.id**

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ABSTRACT

The experiment had been conducted from August to November 2016 at Samas sandy soil coastal area. The research aimed to determine growth response of mung bean sheltered by various density of sweet corn on coastal sandy soil. The experiment used the nested design with two factors with three replications.The first factor was density of sweet corn as shelter consisting of without shelter (S_0), planting space of 15 × 40 cm (S_1), and planting space of 30 × 40 cm (S_2). The second factor was mung bean cultivars compiled of Vima 1 (V_1) and Purworejo local cultivar (V_2). The data of soil temperature, soil moisture content at the depth of 10 and 20 cm, soil salt content at 10 and 20 cm depth, leaf fresh and dry weight, root fresh and dry wieght, plant fresh and dry weight were collected. The effect of shelter density was on the leaves dry weight at 6 week after planting (WAP), meanwhile the mung bean cultivars influenced the soil moisture at 10 and 20 cm depth; leaves fresh weight, leaves dry weight, root fresh weight, and plant dry weight at 4 WAP. Vima 1 resulted in significantly higher compared to Purworejo local cultivar on soil moisture content in 10 and 20 cm, leaves fresh and dry weight, root fresh weight, plant fresh and dry weight at 4 WAP. There was interaction between sweet corn shelter density and mung bean cultivar on soil salt content at 10 cm (2 WAP), 20 cm (6 WAP), plant fresh weight at 4 and 6 WAP, and plant dry weight at 6 WAP. The best growth of mung bean was observed under higher level density shelter with 15 × 40 cm square planting space due to the deeper soil layer and lower salt content.

Keywords: Biomass, Land Condition, Mung Bean, Shelter

INTRODUCTION

Mung bean is used for many traditional food, snack, cake and beverage, as well as consumed as vegetable. The increase of mung bean demand was due to the increasing of populations. Therefore, it is necessary to increase the production of mung beans by expanding the harvest area.

Coastal sandy land is one of the sub-optimal area that has long been used as agricultural land in Yogyakarta. The land is shallow and easy soil management because most of the domination of sand. The land must be improved the fertility and the microclimate for appropriate agriculture land. The specific microclimate in coastal sandy land comprises daytime temperatures ranging around 41–42°C (Auditya *et al*., 2015) and strong winds from the sea area carrying salt particles (Parwata *et al.*, 2014). The crop needs a shelter to control hight temperature, wind speed, and salinity.

Shelter is used to protect the main crops by creating microclimate conditions that suitable for the growth and development of the main crops (Oliet *et al*., 2007). Shelter is used as shade plants such as for coffee plantations (Evizal *et al*, 2012) and tea plantations (Widayat and Rayati, 2011), windbreaking plants such as pine in coastal land (Widodo, 2015), barrier plants for pest control (Inayati and Marwoto, 2011; Aji *et al*., 2015).

In this study, the shelter used was sweet corn plants. Sweet corn has plant height of 60–150 cm, higher than mung beans. The sweet corn plant is expected to be wind breaker. Sweet corn is a valuable horticultural crop. The sweet corn were expected to create the better microclimate that suitable for mung bean. The research aimed to determine growth response of mung bean sheltered by various density of sweet corn on coastal sandy soil.

MATERIALS AND METHODS

This research had been conducted in Samas coastal sandy land, Bantul Regency, since August to November 2016. The experiment was arranged in the nested design consisting of 2 factors with three replications. The first factor was the density of sweet corn plant as shelter, which consisted of three levels i.e. without shelter, planting space of 30 × 40 cm (Shelter 30 cm), and planting space of 15 × 40 cm (Shelter 15 cm) . The second factor was cultivar which consisted of Vima 1 (V_1) and Purworejo's local mung bean cultivar (V_2). The observation was conducted on the soil conditons and the biomass of the mung beans. The data of soil conditions comprising soil temperature, soil moisture content at 10 and 20 cm depth, and salt content at 10 and 20 cm depth were collected by using Electrical Conductivity (EC) method. Plant biomass included the fresh and dry weight of the leaves, roots, and plant.

The data observed were analyzed variance with SAS 9.0 and the least significant difference (LSD) test at alpha 5%.

RESULT AND DISCUSSION

Based on the analysis of variance (Table 1), the shelter density is not affect on the soil temperature, soil moisture content at 10 cm and 20 cm depth and soil salinity at 10 cm and 20 cm depth. The shelter was less effective in lowering the wind speed and inadequate to shade the mung bean area.

There was no significant of the soil temperature, and the salt content at 10 cm depth at 4 WAP, 6 WAP, and at 20 cm in depth at 2 WAP and 4 WAP between the cultivar. However, the soil moisture content of Vima 1 cultivar plot was higher than Purworejo local cultivar at 10 and 20 cm in depth. Vima 1 cultivars had a dense canopy causing lower light interception which can decrease the evaporation. The rate of evaporation is closely related to the moisture savings, the lower the evaporation the higher moisture content (Sudyastuti and Setyawan, 2007). According to Yusuf *et al*. (2015) the availability of water in the soil will facilitate the process of photosynthesis, by accelerating the translocation of photosynthate supporting the growth of plants.

There was an interaction between shelter density and cultivar on soil salt content at 10 cm (2 WAP) and at 20 cm (6 WAP) (Table 2). Purworejo local cultivar without shelter, Vima 1 under shelter with 30 cm planting space, and Vima 1 under shelter with 15 cm planting space had higher soil salt content level at 10 cm depth compared to other treatment combinations when mung bean plants were at 2 WAP. While salt content of 20 cm 6 WAP, combination of treatment of 30 cm shell of Purworejo local cultivars and Vima 1 cultivar shelters have lower salinity than other combinations treatment. Decrease in soil salt level is influenced by the presence of shelter. The 2 WAP green bean plant is very vulnerable if there is high salt either on the leaf surface or in the soil. Salt levels in the soil will greatly affect the plant. Excess of the salt can cause salinity to the soil. Rice yield and beans in post-tsunami Aceh due to increased soil electric cunductivity (Rachman *et al.*, 2008).

Based on analysis of variance in Table, 3 shelter density treatments did not significantly affect leaves fresh weight at 2, 4, and 6 WAP. Both cultivar had different leaves fresh weight at 4 WAP but not at 2 and 6 WAP. Mung beans at 4 WAP had a greater leaves fresh weight compared to Purworejo local cultivar. Each cultivar has different genetic factors which will affect the morphology of plants according

Table 1. Soil temperature (^oC) and moisture content (%) of mung bean and salt content (ppm) plot under different shelter density and cultivar

Treatments	Soil temperature	Soil moisture content		Soil salt content 10 cm		Soil salt content 20 cm	
		10 cm	20 cm	4 WAP	6 WAP	2 WAP	4 WAP
Shelter							
Without Shelter	34.26a	4.15a	3.23a	5.99a	13.50a	11.50a	5.34a
Shelter 30 cm	34.10a	4.89a	3.44a	6.67a	10.83a	13.83a	4.99a
Shelter 15 cm	34.40a	5.37a	3.96a	6.83a	11.34a	5.00 a	3.99a
Cultivar							
Vima 1	34.42a	5.65a	4.03a	6.22a	11.67a	11.11a	4.22a
Local Purworejo	34.08a	3.96b	3.06b	6.78a	12.11a	9.11a	5.34a
Average	34.25	4.80	3.45	6.61	11.89	27.83	32.99
CV (%)	1.22	19.23	22.8	38.45	41.45	27.83	29.18
Interaction	-	-	-	-	-	-	-

Remarks: The numbers in the column in each factor with same letter showed no significant difference by Duncan's 5%

Table 2. Soil salt content (ppm) of mung bean plot under different shelter density and cultivars

Treatments		Soil salt content 10 cm 2 WAP	Soil salt content 20 cm 6 WAP
Without shelter	Vima 1	7.000 bc	9.000 ab
	Local Purworejo	27.333 a	7.000 ab
Shelter 30 cm	Vima 1	22.667ab	13.667 a
	Local Purworejo	6.333 c	4.667 b
Shelter 15 cm	Vima 1	12.000 abc	6.667 b
	Local Purworejo	4.667 c	9.000 ab
Average		13.333	8.333
CV (%)		35.18	10.198

Remarks: The numbers with same letters in the same column and/or rows showed no significant difference by Duncan's 5%

Table 3. Leaves fresh and dry weight (g) of different mung bean cultivars under different shelter density

Treatments	Leaves fresh weight			Leaves dry weight		
	2 WAP	4 WAP	6 WAP	2 WAP	4 WAP	6 WAP
Shelter						
Without shelter	2.105a	6.178a	15.693a	0.289a	0.747a	0.889b
Shelter 30 cm	2.549a	7.157a	15.562a	0.369a	0.718a	1.145ab
Shelter 15 cm	2.480a	6.551a	16.114a	0.331a	0.735a	1.333a
Cultivar						
Vima 1	2.513a	8.309a	14.442a	0.347a	0.924a	0.963b
Local Purworejo	2.243a	4.948b	17.137a	0.313a	0.543b	1.315a
Average	2.322	6.628	14.184	0.329	0.733	1.139
CV (%)	26.79	8.93	27.20	15.60	18.38	25.60
Interaction	-	-	-	-	-	-

Remarks: The numbers in the column in each factor with same letter showed no significant difference by Duncan's 5%

to the growth phase.

According to Table 3, shelter density treatment had an effect on leaves dry weight at 6 WAP while at 2 and 4 WAP, it was contrary. The highest leaves dry weight at 6 WAP was observed in mung bean plants under shelter with both 30 and 15 cm spacing. It was probably because the shelter could increase the plant dry weight. Shelter served as a barrier to salt particles carried by wind from the sea. Soil salinity will decrease mung bean plant growth (Hayat *et al*., 2010) and crown weight (Mensah and Ihenyen 2009). According to Taufiq and Purwaningrahayu (2013), the salt tolerance of mung beans was different among genotypes. Dry weights of mung beans were different among cultivars in the flowering phase (Taufiq and Purwaningrahayu, 2013). The leaves dry weight of Purworejo local cultivar increased from 4 WAP to 6 WAP and was higher compared to Vima 1.

Based on Table 4, the density of shelter had no significant effect on root fresh and dry weight at 2, 4 and 6 WAP. Both cultivar had significant difference on root fresh weight at 4 WAP but not at 2 and 6 WAP. Vima 1 had a higher root fresh weight than Purworejo local cultivar did. It was assumed that each plant had genetic diversity characterized by differences in plant shape, plant growth, leaves, flowers, fruits, seeds and genotypic characteristics, as well as the ability to grow well under certain environmental conditions. The dry matter production process varies depending on the genotype, environmental conditions, and undertaken cultivation techniques (Gurmu *et al*., 2009). The root dry weight was not different between cultivars at 2, 4 and 6 WAP.

Table 5 showed the analysis results of the plant fresh weight and dry weight at 2 and 4 WAP. Shelter density treatment had no effect on all those parameters. This indicated that the shelter had no effect on the formation of plant biomass. Plant biomass are

Table 4. Root fresh and dry weight (g) of different mung bean cultivars under different shelter density

Treatments	Root fresh weight			Root dry weight		
	2 WAP	4 WAP	6 WAP	2 WAP	4 WAP	6 WAP
Shelter						
Without shelter	0.727a	1.575a	3.224a	0.092 a	0.251 a	0.536 a
Shelter 30 cm	0.972a	1.474a	3.033a	0.081 a	0.288 a	0.539 a
Shelter 15 cm	0.831a	1.695a	3.314a	0.079 a	0.275 a	0.585 a
Cultivar						
Vima 1	0.917a	1.913a	3.383a	0.091 a	0.309 a	0.530 a
Lokal Purworejo	0.769a	1.249b	3.239a	0.078 a	0.234 a	0.576 a
Average	0.084	1.581	3.313	0.084	0.271	0.553
CV	17.67	21.94	18.77	28.07	13.19	21.126
Interaction	-	-	-	-	-	-

Remarks: The numbers in the column in each factor with same letter showed no significant difference by Duncan's 5%

Table 5. Plant fresh and dry weight (g) of different mung bean cultivars under different shelter density

Treatment	Plant fresh weight		Plant dry weight	
	2 WAP	4 WAP	2 WAP	4 WAP
Shelter				
Without shelter	2.338a	12.236a	0.523a	1.676a
Shelter 30 cm	2.611a	13.652a	0.598a	1.814a
Shelter 15 cm	2.693a	13.419a	0.544a	1.973a
Cultivar				
Vima 1	2.739a	15.903a	0.573a	2.218a
Lokal Purworejo	2.355a	10.302b	0.537a	1.424b
Average	2.547	13.102	0.554	1.825
CV	26.27	8.76	17.4	12.44
Interaction	-	-	-	-

Remarks: The numbers in the column in each factor with same letter showed no significant difference by Duncan's 5%

formed from the result of plant photosynthesis and translocation of the source and sink (Greer, 2017). The dry weight of mung bean plants was significantly different between cultivars at 4 WAP. Vima 1 had a higher plant dry weight than Purworejo local cultivar did. This is allegedly because 4 WAP is the peak of maximum growth of mung beans plants. According to research conducted by Sadeghipour (2009), the biomass of mung bean plants was different among cultivars.

Table 6 showed the interaction between shelter density and cultivar on plant fresh weight and dry weight at 6 WAP. Almost all treatment combinations had high plant fresh weight at 6 WAP except cultivar Vima 1 without shelter. The lowest plant dry weight at 6 WAP was observed in cultivar Vima 1 without shelter and under shelter with 30 cm planting space. Shelter with 15 cm planting space resulted in higher plant dry weight compared the other treatments.

CONCLUSIONS

Sweet corn as crop shelter increased the dry weight of mung beans biomass. Vima 1 had higher

Table 6. Plant fresh and dry weight (g) of different mung bean cultivars under different shelter density

Treatments		Plant fresh weight 6 WAP	Plant dry weight 6 WAP
Without shelter	Vima 1	21.16 b	2,341 c
	Lokal Purworejo	34.07 ab	3,977 ab
Shelter 30 cm	Vima 1	31.25 ab	3,206 bc
	Lokal Purworejo	33.02 ab	4,108 ab
Shelter 15 cm	Vima 1	62.70 a	4,022 ab
	Lokal Purworejo	35.35 ab	4,678 a
Average		36.679	3.722
CV (%)		23.441	20.45

Remarks: The numbers in the column with same letter showed no significant difference by Duncan's 5%

soil moisture content, resulting in the higher roots, leaves fresh, dry weight, root fresh weight, and plant dry weigh at 4 WAP compared to Purworejo local cultivar. The growth of Mung bean under shelter was better than without shelter.

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