PERFORMANCE OF TWO SOYBEANS (*Glycine Max* L. Merr) CULTIVARS IN DIFFERENT WEEDING TIMES UNDER NO TILLAGE

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Abstract: *Weeds are the main problem in soybean production due to their harmful effects and its need to control properly in the right time for effective control and maintain yield. The main objective of this study was to investigate the effect of weeding time on density of weeds and yield of soybean under no tillage system. Five weeding times (2, 4, 6, 8, 10 weeks after sowing) and two soybean cultivars (Sindoro and Slamet) were tested in a randomized complete block design with three replicates. The highest summed dominance ratio (SDR) of weeds was Cynodon dacylon and Cyperus rotundus than other weeds at different time of weeding. Weeding at two weeks after sowing under no tillage gave the higher soybean yield than other weeding time.*

Key words: *Soybean, weeding time, no tillage, SDR, yield*

INTRODUCTION

In Indonesia, soybean is the most important staple food in terms of the source of protein substance with contains of 35 g protein, 18 g fat, 35 g carbohydrate and other nutrition per 100 g dry weight and is also used for industrial food products and for feed where the demand in average is 1.4 – 2.5 ton year^{-1} (SUPRAPTO, 2001). The demand for soybean, as predicted, would increase by 2.92% per year while the domestic production capacity remain low such a low productivity might be the major determinant of the weak comparative and competitive advantages of soybean production in Indonesia (SIREGAR, 2001). The low productivity of soybean due to the main problems of low production capacity of soybean varieties, inadequate tillage systems, fertilizer application and pest, disease and weed management method.

To increase domestic soybean production, Department of Agriculture released some varieties with the high production potency above 2 ton ha^{-1}. There are Slamet and Sindoro (released in 1995), Argomulyo, Argopuro, Kawi and Bromo (released in 1998) (HERMAWAN et al., 1999). Besides using appropriate soybean varieties, tillage method has an important role in soybean production. Tillage disrupts dense soil layers, decreases bulk density, and increase porosity and the number of large water conducting pores (CHAUNDHARY et al., 1985). Objectives of tillage are reduced run off, enhance infiltration, suppress evaporation, and control weeds for water conservation (UNGER et al., 1998; PRIHAR et al., 2000). Clean tillage is applied by farmers to provide the good condition of soil structure for temporary water storage, controlling weeds and also under some conditions suppressing evaporation (UNGER et al., 1998). However, residue-free surface condition produced by clean tillage often aggravates the crusting problem (ALLMARAS et al., 1998; UNGER et al., 1998).

Therefore, introducing no tillage system as being widely promoted aims at enhancing erosion control because it retains nearly all crop residues on the surface and also provides water conservation benefits (UNGER et al., 1998; ROSEGRANT et al., 2002) and also reduces labor and budget (KOBAYASHI et al., 2003).

Both appropriate soybean varieties and tillage method could not help to improve production if pest control is not applied properly especially for weeds. Present of weeds in land production without control could reduce yield production by about 15 – 75% (ARDJASA AND BANGUN, 1985; ABUSTEIT, 1993). To avoid too much reducing in production, farmers are controlling weeds continuously by hoe or hand anytime and this can be costly in labor. Weeds are an attributed of crop production to some extent and of management decisions to a larger extent. One can choose to treat symptoms with short-term, temporary strategies, or choose the design of cropping systems that prevent weed problems. Managing croplands in tune with appropriate design makes for fewer and less-costly weed problems. Weeds are an important variable in crop production, both economically and ecologically. There are numerous reports of cultural practices such as choice of tillage system (GILL AND ARSHAD, 1995; FUENTE et al., 1999), herbicide use and inter row cultivation influencing weed (and weed seed) density and distribution. Previous study has been done by KOBAYASHI et al. (2003) that clarified that continuous no-tillage causes a rapid decrease in the emergence depth of grass weeds. Many seedlings emerge from the soil surface or from a very shallow layer. This result suggests that it is easier to suppress weed emergence in a no-tillage field than in a tilled field.

The introduction of new tillage practices (reduced, minimum or non-tillage) commonly causes changes in the composition and abundance of weed species present in cropping systems (FROUD-WILLIAMS et al., 1981; GEBHARDT et al., 1985; BALL AND MILLER, 1990). In arable crops such as soybean (ROBINSON et al., 1984; KAPUSTA AND KRAUZ, 1993) and maize (BALL AND MILLER, 1993) weed population shifts were observed when conventional tillage systems were changed to non-tillage. Annual weeds were found at higher densities and perennial weeds at lower densities in conventional than in reduced tillage (STANIFORTH AND WIESE, 1985; FRICK AND THOMAS, 1992).

According the previous studies regarding to tillage systems and crop production affect by weeds, therefore, there is the needs to find out the effective weeding time without interfere the yield. Keeping this in view, the present investigation was carried out to evaluate the combined effect of weeding time and soybean varieties under no tillage on density of weeds and yield of soybean under no tillage.

MATERIALS AND METHODS

This study was conducted during dry season at the Soybean Research Centre, Faculty of Agriculture, Jenderal Soedirman University, Purwokerto, Indonesia. Soil texture was sandy clay loam with friable consistency and pH of 5.5 at 110 m above sea level. During study, the location received an average monthly rainfall of 57 mm and temperature of 30.3 ^{0}C. The topography of the study area is flat with an approximate slope of 0 – 5%.

The experimental design comprised of 5 x 2 factorial combinations of five weeding time viz. 2, 4, 6, 8 and 10 weeks after sowing (was) and two soybean varieties viz. Slamet and Sindoro and arranged in a randomized complete block design with three replicates. The experimental plot was 6 m x 25 m and each plot 6 m^2.

In the no-till (NT) method, glyphosate (state active ingredient) was applied at the rate of 4 L ha^{-1} in 100 L of water to control weeds before planting. Three soybean seeds were dibbled directly on spacing of 20 x 30 cm giving a plant population of 200 stands per plot. Each plot received N, P and K at the rate of 50, 100 and 75 kg ha^{-1} using urea (46% N), triple super phosphate (19.8 % P) and muriate of potash (50% K), respectively as a basal dressing, two weeks after sowing. The seedlings were thinned out to two plants per hill 7 days after emergence. Pest or diseases attack was controlled properly depend on the intensity. Weeds were manually controlled following the treatments

At harvest sum dominance ratio of weeds was determined and weeds biomass was weighed. Also, an area 1 m^2 was demarcated in each plot for the determination of soybean yield components which include weight of 100 seeds, weight of seeds per plant, and number of pod with seeds.

Grains at harvest were collected using ten randomly selected soybean plants from each treatment, and seed dry weight was recorded after oven-drying (LORENS et al. 1987). Yield components, i.e. weight of 100 seeds, weight of seeds per plant and number of pod with seeds were also estimated from the same sample.

All data were analyzed by using Analysis of Variance procedure (STEEL AND TORRIE, 1980). Treatment means were compared using the Duncan's Multiple Range Test when one or interaction among the factors was significant at $p<0.05$.

RESULT

Sum dominance ratio (SDR). Weeding time and cultivars showed a varied distribution of weeds at different time of weeding in soybean plots. SDR of *Cynodon dactylon* and *Cyperus rotundus* were higher than others at different time of weeding in Sindoro and Slamet plots. Thus, SDR each weed was tend decrease following time to 10 weeks after sowing (WAS) and highest at 2 WAS (Table 1).

Weeds biomass. Weeding time had significant ($p > 0.05$) effects on biomass of weeds, but not significant on cultivars and interaction (Table 2). Among cultivar, weeds biomass in Slamet was slight higher than in Sindoro, 224.4 g and 192.2 g, respectively (Table 3). Among the weeding regimes, 2 WAS (47.3 g) was significantly lower ($p < 0.05$) than others, but there was no significant difference between 6,8 and 10 WAS ranged from 254.2 g at 6 WAS to 299.7 g at 10 WAS (Table 3).

Seed dry weight accumulation rate was not affected by weeding time and cultivars (Table 4). Seed dry weight accumulation rate of Slamet and Sindoro were 0.507 and 0.505 mg day^{-1}, respectively. Among weeding regimes, it ranged from 0.505 mg day^{-1}at 8 and 10 WAS to 0.510 mg day^{-1} at 2 WAS, with at 4 and 6 WAS giving a moderate seed dry weight accumulation rate of 0.506 mg day^{-1}.

Yield components. Of the two factors, only weeding time had significant ($p < 0.05$) effect on yield components of number of pods with seeds and weight of seeds per plant (Table 2), while there was no significant ($p < 0.05$) effects on weight of 100 seeds (Table 2). Cultivars had no significant ($p < 0.05$) effects on yield components (Table 2). Number of pods with seeds of Slamet and Sindoro were 3.1 and 2.9, respectively. Weeding time at 2 WAS had the significantly highest number of pods of 3.7 while the lowest of 2.2 was obtained from 10 WAS (Table 4) but insignificantly with 8 WAS (2.8).

Table 1.

Sum dominance ratio (SDR) of weeds on Sindoro and Slamet cultivars plots at different time of weeding under no-till.

Name of weed [1]	Sum dominance ratio (%)									
	Sindoro plot (was)					Slamet plot (was)				
	2	4	6	8	10	2	4	6	8	10
Cynodon dactylon	32.8	18.6	18.9	20.6	12.4	31.5	18.4	13.2	15.6	12.4
Cyperus rotundus	21.6	21.9	18.8	13.7	22.3	20.9	26.8	26.6	18.5	21.5
Ageratum conyzoides	7.7	3.7	3.2	2.9	2.2	7.2	3.9	3.1	2.7	2.5
Axonopus compressus	5.4	0.8	1.6	1.8	1.9	2.2	0.8	0.6	2.0	2.3
Amaranthus spinosus	3.7	3.1	2.3	5.2	2.3	3.8	1.7	2.8	3.2	2.1
Euphorbia hirta	1.0	4.1	10.3	7.1	14.1	2.1	3.6	5.5	5.6	8.1
Others	1.8	1.1	4.9	4.9	5.8	1.3	1.2	4.8	5.4	6.1

1) 1/ Estimated from 5 randomly samples in each plot with the size of 50 cm x 40 cm.

Weight of 100 seeds of Slamet and Sindoro were 9.75 g and 10.3 g respectively. Among weeding time, weight of 100 seeds range from 9.5 g at 6 WAS to 10.3, with 4 WAS having the highest value (Table 4). Weight of seeds per plant of Slamet and Sindoro were 15.4 g and 14.4 g, respectively. Weight of seeds per plants was higher at 2 WAS of 17.9 g and lowest at 10 WAS of 12.0 g.

Table 2.

Analysis of effect of variance weeding time on soybean characters under no-till

Source of variance	Biomass of weeds	Soybean			
		Number of pods	Seed dry weight accumulation rate	100 seeds weight	Seeds dry weight per plant
Varieties (V)	ns	ns	ns	ns	ns
Weeding time (T)	**	**	ns	ns	**
V x T	ns	ns	ns	ns	ns

ns = non significant at *p*<0.05; ** = very significant at *p*<0.01

Table 3.

Biomass of weeds as influenced by weeding time and soybean cultivars under no-till

Treatments	Biomass of weeds (g) [1)]
Cultivar	
Slamet	224.4
Sindoro	192.2
Weeding time	
2 was	47.3 a
4 was	151.2 b
6 was	254.2 c
8 was	294.1 c
10 was	299.7 c

1/ Estimated from 5 randomly samples in each plot with the size of 50 cm x 40 cm. Values sharing similar letters do not differ significantly at *p*<0.05, according to Duncan's multiple range tests.

Table 4.

Seed dry weight accumulation rate, weight of 100 seeds and seeds per plant as influenced by weeding time and soybean cultivars under no-till.

Treatments	Seed dry weight accumulation rate (mg day^{-1})	Number of pods with seeds (n)	Weight of 100 seeds (g)	Weight of seeds per plant (g)
Cultivar				
Slamet	0.507	3.1	9.75	15.4
Sindoro	0.505	2.9	10.3	14.4
Weeding time				
2 was	0.510	3.7 a	10.1	17.9 a
4 was	0.506	3.1 b	10.3	15.8 ab
6 was	0.506	3.1 b	9.5	15.2 b
8 was	0.505	2.8 c	10.1	13.7 bc
10 was	0.505	2.2 c	10.0	12.0 c

1/ Estimated from 5 randomly samples in each plot with the size of 50 cm x 40 cm.
Values sharing similar letters do not differ significantly at *p*<0.05, according to Duncan's multiple range tests.

DISCUSSION

The two factors, weeding time and cultivar was resulted the variation of weeds composition (Table 1). However, *Cynodon dactylon* and *Cyperus rotundus* had the higher SDR than others at different time of weeding in both cultivars. This is showed that both weeds had higher capacity on covering the area to compete with other weeds. *Cynodon dactylon* and *Cyperus rotundus* are the perennial weeds and have a difficulty to control and a greater competitor with other weeds (SASTROUTOMO, 1990). Perennial weeds prosper in less-disturbed and more stable environment (SULLIVAN, 2001) and increased annually (Kobayasi et al., 2004). This result is consistent with the previous studies (FROUD-WILLLIAMS et al., 1981; KOBAYASI et al., 2003).

Another study was reported that the weed spectrum changed rapidly under no tillage (TUESCA et al., 2001) and grass population increased (WRUNCLE AND ARNOLD, 1985; TUESCA et al., 2001). As the story of land which cultivated under tillage systems continuously in every season was resulted the vary composition of weeds. STANIFORTH AND WIESE (1985) and FRICK AND THOMAS (1992) were reported that annual weeds were found at higher densities and perennial at lower densities in conventional than in reduced tillage. The fact showed in this study that perennial weeds were dominance compared to others.

Biomass of weeds increased during the growth period and drastically increased start at 4 WAS. At 2 WAS the weed biomass was low and without weeding, the weeds grew rapidly about six fold of total biomass at 10 WAS (Table 3). This was the fact that without controlling the growth of weeds is faster. Weeds are well adapted to succeed in highly unstable and unpredictable environments. They put much of their life cycle into producing seeds for the next generation (SULLIVAN, 2001).

The growth of weeds had no significantly different effect on seed dry weight accumulation rate under different time of weeding and cultivar. Differences in soybean yielding ability had the same rate of accumulation of seed dry weight (HIDAJAT, 1985) due to yield differences were related to variations in the duration of the filling period (AHAD, 1989). In this case of study was similar that, there was insignificantly effect among cultivar on seed dry weight accumulation rate. But, that effect influenced on number of pods with seeds, weight of 100 seeds and seeds per plant (Table 4).

Weeding time had a significantly effect on number of pods with seeds and weight of seeds per plant. This is an indication even no different on seed dry weight accumulation rate but present of weeds was detrimental effect. In plots where weeding time was done at 10 WAS had the lowest on number of pods with seeds and weight of seeds per plant (Table 4). Due to the higher density of weeds at 10 WAS caused the competition with soybean and this decreased dry matter accumulation on seeds. On the other hand, at 2 WAS weeding reduced competition in soybean which resulted into greater dry matter accumulation without hard competition and gain the highest yield.

Even there was insignificantly different on seed dry weight accumulation rate because of weeds but there was affect on yield and yield components (Table 4). The increasing of weed population directly increasing weed biomass (Table 4) and it adverse affect on yield. DONOVAN et al. (1983) reported that unfavourable environment condition during seed growth and development in the field can reduce yield. It is the fact that availability of weed in a given duration of growth affect on yield and the yield reduction would be higher under long period of uncontrolled weeds. To ensure optimum in soybean production, the period of weed free was required at least six weeks after planting (ABUSTEIT, 1993).

CONCLUSION

This study revealed that perennial weeds of *Cynodon dacylon* and *Cyperus rotundus* had dominancy in growing area than others due to the favourable condition under no-till cropping system. Even there was insignificantly effect on dry weight accumulation rate but because of the higher composition of weeds in area by which impact on decreasing the number of pods and seeds, and weight of seeds per plant.

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