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Research Article

The effect of tillage systems and dosages of cow manure on weed and soybeans yield (*Glycine max* Merrill)

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Abstract: A field experiment to elucidate the effect of tillage systems and dosages of cow manure on weed and soybeans yield (*Glycine max,* Merrill) was conducted at the Agrotechno Park of the University of Brawijaya in Jatikerto, Malang, from May to July 2017. The experiment used a split-plot design with 3 replications. The main plot was the tillage systems, with 3 levels: T0= No-tillage, T1= Minimum tillage, and T2 = Conventional tillage. The subplot was the dosages of cow manure, with 3 levels: P1= 2.5 t cow manure/ha, P2 = 5 t cow manure/ha, and P3 = 7.5 t cow manure/ha. Results of experiment showed that dry weight of weed was higher at no-tillage systems and at dosages of 7.5 t cow manure/ha. Growth and yield of soybean were lower at no-tillage compared with conventional tillage systems. Application of cow manure with dosages of 5 t/ha and 7.5 t/ha was better than 2.5 t/ha for growth and yield of soybean.

Keywords: *cow manure, soybean, tillage, weed*

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Introduction

Soybean is a protein source for the people of Indonesia and a national food commodity, as much as 67.99% must be imported from abroad (Center for Data and Agricultural Information Systems, 2016). Abdraimova et al. (2014) stated that soybeans are one of the most important economic crops for producing protein and oil and have the capacity to fix nitrogen. Various efforts have been conducted to increase the production of soybeans. Soil tillage systems and application of fertilizers, whether inorganic or organic can increase the production of soybeans. Soil tillage is the essential components of soil management (Vrandecic et al., 2014). Tillage can improve environmental conditions and make them suitable for plant growth (Royyani et al. 2018). Raintung (2010) stated that soil tillage can improve the physical characteristics of soil, such as structure and soil porosity. Nutrient availability is important for plant growth. Gautam and Pathak (2014) stated that organic matter as a source of plant nutrients, directly and indirectly, influence the physical and chemical properties of soil. Prihastuti et al. (2015) stated that the application of organic fertilizer is environmentally safe and cheap, and can produce quality food products, reduce the use of inorganic fertilizer, and be prepared from available materials. Fitriana et al. (2015) stated that the application of manure increases soil fertility. Kristiono and Subandi (2013) stated that a source of nutrients and is relatively widely used by farmers is the cow and chicken manure.

Materials and Methods

The experiment was conducted at the Agrotechno Park of the Faculty of Agriculture, Brawijaya University in Jatikerto Village, Kromengan Sub-District, Malang Regency, from May to July 2017. A split-plot design was used for the experiment with 3 replications. The main plot was the tillage systems, with 3 levels: T0 = No-tillage, T1 = Minimum tillage, and T2 = Conventional tillage The subplot was the dosage of cow manure, with 3

levels: P1= 2.5 t cow manure/ha, P2 = 5 t cow manure/ha, and P3 = 7.5 t cow manure/ha. The land was prepared by cutting the weeds that grew in the experimental field using a mower, which was conducted 2 weeks before tillage. After land preparation, experimental plots were created at a size of 3.3 m x 1.5 m; the distance between plots is 50 cm and the distance between replications is 1 m. In the no-tillage plots (NT), the land was not tilled at all, but weeds were cleared using a mower during land preparation, and then cleared a second time one week after the land preparation. In the minimum-tillage plots (MT), soil tillage was performed once by digging the soil to a depth of approximately 5-7 cm, one week after land preparation. In the conventional-tillage plots (CT), soil tillage was performed twice. The first tillage was conducted one week after land preparation by digging the soil to a depth of approximately 10-15 cm. Next, the second soil tillage was performed 3 days before planting by digging the soil until it became loose. Application of cow manure at dosages of 2.5 t/ha, 5 t/ha and 7.5 t/ha was performed one week before planting by spreading the manure above ground level. Planting was done one week after tillage treatment for no-tillage, minimum tillage, and conventional tillage. Soybean seeds of the Grobogan variety were planted, 3 seeds per hole, to a depth of 3-5 cm with a plant spacing of 30 x 20 cm, and the planting hole was covered with soil. Thinning was done one week after planting by leaving one plant per hole. In addition, inorganic fertilizer as 25 kg/ha of urea fertilizer, 50 kg/ha of KCl fertilizer, and 50 kg/ha of SP36 was also given. Urea fertilizer was given twice, ½ dose at planting time and the remaining ½ dose at the time the plants aged 21 days after planting (DAP). Meanwhile, SP36 and KCl fertilizers were given at the beginning of planting, around the soybean crop. Weeding was done twice mechanically by using a hoe at 21 and 35 DAP. Observations consist of weed dry weight; plant height;dry weight of plants; leaf area at 21, 35, 49, 63, and 77 days after planting; total seed weight per plot; weight of 100 seeds; and plant yield. Analysis of variance (F test) at 5% level was used for analysis obtained data and continued with the LSD test at 5% level to find out differences among treatments.

Results and Discussion

Total dry weight of weeds

Results from Table 1 showed that the treatments of tillage systems and dosages of cow manure had a significant effect on total weed dry weight. The total dry weight of weeds observed at 21 and 63 days after planting was not significantly different between no-tillage and minimum tillage but was significantly higher compared to conventional tillage. Observed at 77 days after planting, total weed weight for no-tillage was significantly higher compared to minimum and conventional tillage. For dosages of cow manure treatment, observed at 21, 63, and 77 days after planting, dry weight of weeds at a dosage of 2.5 t cow manure/ha was lower and not significantly different with a dosage of 5 t/ha. Weed dry weight was significantly higher with a dosage of 7.5 t cow manure/ha. Mayadewi (2007) stated that the application of manure causes an increase in the growth of weeds.

Table 1. Average total dry weight of weeds as affected by tillage system and dosages of cow manure at various observations.

Treatment	**Average of total dry weight of weeds (g/0.25 m^2) at various observations**				
	21 DAP	**35 DAP**	**49 DAP**	**63 DAP**	**77 DAP**
Tillage systems					
No tillage	50.56 a	12.72	12.50	46.62 a	79.17 a
Minimum tillage	41.71 ab	12.57	12.41	42.38ab	67.29 b
Conventional tillage	34.01 b	14.22	11.53	37.57 b	64.86 b
LSD 5%	10.54	NS	NS	7.46	5.61
CV %	11.09	10.76	6.98	7.80	4.98
Dosage of cow manure					
2.5 t/ha	36.77 a	12.56	11.80	39.95 a	64.38 a
5 t/ha	39.76 ab	13.98	11.87	41.67 ab	68.59 ab
7.5 t/ha	49.18 b	12.96	12.76	44.94b	77.83 b
LSD 5%	9.62	NS	NS	4.94	10.78
CV %	12.91	8.67	5.83	6.58	8.61

Note: Numbers followed by the same letter within the same column show no significant difference based on the 5% LSD test. CV = Coefficient of variance,. DAP= Days After Planting, NS = Not significant

Plant growth

Plant height

The results showed that treatments of tillage systems and dosages of cow manure had a significant effect on plant height (Table 2). For the treatment of tillage, plant height observed at 49 DAP increased by 13.67% and 15.74% with minimum tillage and conventional tillage compared to no-tillage. The research of Solyati and Kusuma (2017) on green beans showed that minimum tillage with the application of straw mulch increased yield compared to no-tillage. For dosages of cow manure, observed at 21, 35, and 49 days after planting (DAP), plant height with a dosage of 2.5 t cow manure/ha was not significantly different with a dosage of 5 t/ha. However, plant height increased by 22.04%, 19.07%, and 17.63% for a dosage of 7.5 t cow manure/ha. At 63 DAP, plant height with a dosage of 2.5 t/ha was significantly lower and increased by 8.88% and 16.41% for dosages of 5 t/ha and 7.5 t cow manure/ha, respectively.

Table 2. Average plant height as affected by tillage and dosages of cow manure at various observations.

Treatment	Average plant height (cm) at various observations			
	21 DAP	35 DAP	49 DAP	63 DAP
Tillage system				
No tillage	16.18	32.00	36.58 a	43.42
Minimum tillage	14.32	33.31	41.58 b	45.24
Conventional tillage	15.17	34.76	42.34 b	47.54
LSD 5%	NS	NS	3.84	NS
CV %	16.01	12.32	4.22	6.25
Dosage of cow manure				
2.5 t/ha	14.02 a	31.31 a	37.33 a	41.87 a
5 t/ha	14.53 ab	31.48 a	39.26 ab	45.59 b
7.5 t/ha	17.11 b	37.28 b	43.91 b	48.74 c
LSD 5%	2.81	5.45	6.12	2.98
CV %	10.41	9.17	8.59	3.69

Notes: No significant difference based on the 5% LSD test for numbers followed by the same letter within the same column. CV = Coefficient of variance. DAP = Days After Planting, NS = Not significant.

Dry weight of plants

The results showed that tillage systems significantly affected the dry weight of plants 49 DAP. Dosages of cow manure also affected the dry weight of plants at 35 and 49 DAP (Table 3). For tillage systems observed at 49 DAP, the dry weight of plants significantly higher for minimum tillage compare with no-tillage, while it significantly increased by 39.16%. For dosages of cow manure as observed at 35 and 49 DAP, there were not significantly different between the dosage of 2.5 t cow manure/ha and the dosage of 5 t cow manure/ha for the dry weight of the plant. Soybean dry weight increased by 31.49% at 35 DAP and 23.02% at 49 DAP with a dosage of 7.5 t cow manure/ha compared to a dosage of 2.5 t cow manure/ha. Kuntyastuty and Muzaiyanah (2017) stated that the application of organic cow manure can replace inorganic fertilizers and increase yields of cowpea and soybeans in acidic soil.

Leaf area

The results showed that tillage systems significantly affected the leaf area of the plant at 21, 49, and 63 DAP. Meanwhile, dosages of cow manure at 21 and 63 DAP (Table 4). At 21 DAP, leaf area with no-tillage system was significantly lower compared to that of the minimum and conventional tillage. The leaf area increased by 68.62% and 117.05% with minimum and conventional tillage respectively compared to no-tillage. At 49 and 63 DAP, the leaf area of plants were not significantly different between no-tillage and minimum tillage, and leaf area of plants significantly increased by 40.57% and 83.64% with conventional tillage. A study conducted by Sebayang and Rifai (2018) showed that leaf area of soybean at conventional tillage was better than that of the minimum and no-tillage. At 21 and 63 DAP, leaf area was not significantly different between dosage of 2.5 t cow manure/ha and a dosage of 5 t cow manure/ha. Leaf area increased by 26.53% and 36.66% for a dosage of 7.5 t cow manure/ha compared to a dosage of 2.5 t cow manure/ha.

Plant yield

The results showed that tillage systems significantly affected the total seed weight per plot

and plant yield. Dosages of cow manure had significant effects on total seed weight, weight of 100 seeds, and plant yield/ha (Table 5). For tillage systems, total seed weight of soybeans per plot and plant yield/ha with no-tillage was lower and did not significantly different with minimum tillage and with conventional tillage increased by 22.91% and 23.26%. The research by Pradoto et al. (2017) showed that minimum tillage was significantly different from no-tillage for soybean harvest yield but was not significantly different from conventional tillage. For dosages of cow manure, total seed weight per plot, weight of 100 seeds, and plant yield/ha were significantly lower for the dosage of 2.5 t cow manure/ha compared to the dosages of 5 t cow manure/ha and 7.5 t cow manure/ha. Application of cow manure at dosages of 5 t/ha and 7.5 t/ha did not significantly affect the plant yield/ha of soybeans. The study by Sudarsono et al. (2013) showed that the growth and yield of soybeans increased by the application of 7.5 t cow manure/ha.

Table 3. Average total dry weight of plants as affected by tillage systems and dosages of cow manure at various observations.

Treatment	**Average dry weight of plants (g) at various observations**			
	21 DAP	**35 DAP**	**49 DAP**	**63 DAP**
Tillage system				
No tillage	0.95	3.59	8.76 a	12.00
Minimum tillage	1.00	4.10	12.19 b	12.93
Conventional tillage	1.02	4.85	10.76 ab	13.58
LSD 5%	NS	NS	2.50	NS
CV %	7.10	17.72	10.42	7.32
Dosage of cow manure				
2.5 t/ha	0.96	3.62 a	9.77 a	12.34
5 t/ha	0.84	4.16 ab	9.91 a	12.37
7.5 t/ha	1.15	4.76 b	12.02 b	13.79
LSD 5%	NS	0.81	1.70	NS
CV %	18.26	10.84	9.05	8.35

Notes: Numbers followed by the same letter within the same column show no significant difference based on the 5% LSD test. CV = Coefficient of variance, DAP = Days After Planting, NS = Not significant

Table 4. Average leaf area as affected by tillage systems and dosages of cow manure at various observations.

Treatment	**Average leaf area (cm) at various observations**			
	21 DAP	**35 DAP**	**49 DAP**	**63 DAP**
Tillage system				
No tillage	42.41 a	185.67	330.49 a	136.75 a
Minimum tillage	71.51 b	209.65	399.98 ab	207.36 ab
Conventional tillage	92.05 c	232.33	464.56 b	251.13 b
LSD 5%	16.10	NS	86.84	77.65
CV %	10.34	14.40	9.60	17.24
Dosage of cow manure				
2.5 t/ha	63.51 a	203.34	377.46	166.65 a
5 t/ha	62.10 a	195.29	409.22	200.84 ab
7.5 t/ha	80.36 b	229.01	408.35	227.74 b
LSD 5%	14.99	NS	NS	55.24
CV %	12.27	14.63	16.71	15.64

Notes: No significant difference based on the 5% LSD test for numbers followed by the same letter within the same column. CV = Coefficient of variance, DAP = Days After Planting, NS = Not significant

Table 5. Averages of total seed weight, 100-seed weight and plant yield as affected by tillage systems and dosages of cow manure.

Treatment	Total seed weight (g/plot)	100 seed weight (g)	Plant yield (t/ha)
Tillage system			
No tillage	64.10 a	19.18	1.29 a
Minimum tillage	74.81 b	21.32	1.51 ab
Conventional tillage	78.79 b	21.79	1.59 b
LSD 5%	10.73	NS	0.23
CV %	6.51	9.65	6.52
Dosage of cow manure			
2.5 t/ha	61.41 a	19.27 a	1.24 a
5 t/ha	75.82 b	20.82 ab	1.53 b
7.5 t/ha	80.47 b	22.20 b	1.63 b
LSD 5%	11.99	2.19	0.24
CV %	9.28	5.93	9.35

Notes: Numbers followed by the same letter within the same column have no significant difference based on 5% LSD test. CV = Coefficient of variance. NS = Not significant

Conclusion

The dry weight of weeds was higher at no-tillage compared to minimum and conventional tillage systems. Dosages of 7.5 t cow manure/ha, dry weight of weed were higher. Growth and yield of soybeans were lower with no-tillage systems compared to conventional tillage. Soybean growth and yield were higher at 7.5 t cow manure/ha and at 5 t cow manure/ha, and significantly lower with 2.5 t cow manure/ha.

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