Short communication

Indian Journal of Weed Science **46**(2): 184–186, 2014

Tillage and weed management for improving productivity and nutrient uptake of soybean

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Received: 12 April 2014; Revised: 23 May 2014

Key words: Grain yield, Raised-bed, Soybean, Weed management, Zero tillage

Soybean [*Glycine max* (L.) Merr.] has emerged as a potential crop and brought about perceptible change in the economy of the farmers in central India. Weeds are a major constraint and their control is essential for successful crop production. Mostly the farmers use pre-emergence herbicides for weed control in soybean but their efficacy is reduced by various climatic and edaphic factors. Hand-weeding is a traditional and effective method of weed control, but untimely continuous rains and unavailability of labour at peak time are main limitations of manual weeding. The only alternative that needs to be explored is the use of post-emergence herbicides. Such herbicides are promising for control of monocotyledonous or dicotyledonous weeds. Further, herbicide mixtures may broaden the window of weed management by broad-spectrum weed control (Bineet *et al.* 2001). An experiment was conducted to study the performance of soybean grown after wheat under varying tillage and weed control practices.

The experiment was conducted during *Kharif* season 2008 at the research farm of Indian Agricultural Research Institute, New Delhi on sandy loam soil, slightly alkaline (pH 7.6), low in organic C (0.38%), and available N (145 kg/ha), medium in available P (9.01 kg/ha) and high in available K (259.4 kg/ha). The treatments included four tillage and crop establishment practices, *viz*. conventional tillage flat-bed, conventional tillage raised-bed, zero tillage flat-bed and zero tillage raised-bed, and six weed management options, *viz*. control, weed free, pendimethalin 0.75 kg/ha as pre-emergence (PE), chlorimuron-ethyl 6 g/ha as post-emergence (POE) at 15 days after sowing (DAS), pendimethalin 0.75 kg/ha as PE + 1 hand weeding (HW) at 25 days after sowing, pendimethalin 0.75 kg/ha as PE + chlorimuron-ethyl 6.0 g/ha as POE at 15 DAS. Thus, 24 treatment combinations were laid out in a thrice replicated split-plot design, keeping tillage and crop establishment in main plots and weed management options in sub-plots. The gross plot size was 16.8 m^2 and net plot was 15 m^2. After the harvest of *Rabi* crop wheat in April, land preparation was done as per treatment and sowing was done on 10 July, 2008 using '*DS 9814*' variety with a seed rate of 80 kg/ha, and a basal dose of 20 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha was applied at the time of sowing in the furrows. The sowing was done at a row to row spacing of 35 cm from with the help of zero-till seed drill in flat-bed and 20 cm on the top of bed with the help of bed planter. The crop was harvested on 23 October, 2008.

Weed growth

Major weed flora were: *Echinochloa colona* (12.7%) among grassy; *Digera arvensis* (10.4%) among broad-leaved; and *Cyperus rotundus* (62.5%) among sedges, beside others. Higher weed count was noticed under ZT due to no soil disturbance and simultaneous germination of weeds along with the crop (Table 1). Although paraquat was sprayed before sowing, which desiccated the foliage of all the previously growing weeds, but some of the over-grown weeds regenerated after two weeks. On other hand, all the weeds growing previously were killed due to tillage operation under CT, and emergence of new weeds was delayed compared with crop seedlings. Lower weed population in the bed-planted crop was due to closer row spacing on the bed. More foliage growth of the bed-planted crop also checked weed population in the furrows. There was significant difference in weed dry weight at 60 DAS due to tillage and crop establishment practices. It was comparatively more under ZT because of no-tilling of the soil compared with 3-4 ploughings given under CT. Although there was greater weed infestation in the furrows initially due to more space and better soil moisture condition, the weeds in furrows also got smothered with ad-

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vancement of crop growth and development of canopy cover. On the other hand, flat-bed crop was sown at uniform spacing (35 cm) provided adequate and uniform inter-row space for the weeds to grow. Several workers reported decrease in weed infestation in furrow-planted compared with flat-sown crop (Behera *et al.* 2005, Mishra and Singh 2009).

Weed management practices brought about significant effect on weed growth. Presumably, the highest weed count was under unweeded control, which was decreased by more than half due to different treatments at all the stages of growth. Pre-emergence application of pendimethalin provided effective control of all species from early stages. Further, HW and post-emergence application of chlorimuron-ethyl at 15 DAS checked the emergence of the second flush of weeds. Both of these treatments, *i.e.* pendimethalin + HW and pendimethalin + chlorimuron-ethyl were equally effective and resulted in near weed-free conditions throughout. The minor weeds emerging late in season did not cause significant adverse effect on crop growth. Pre-emergence application of pendimethalin, followed by post-emergence chlorimuron ethyl was however slightly inferior to pendimethalin + HW. Application of pendimethalin or chlorimuron-ethyl alone was not much effective to control the weeds at initial stage and/or second flash in soybean, respectively.

Pendimethalin is the most popular herbicide for weed management in most crops including soybean. It is widely recommended for weed control without any adverse effect on crop growth. Therefore, pre-emergence application of pendimethalin provided complete elimination of grassy weeds and most of the broad-leaved species. Second flush of the weeds was checked by HW or application of chlorimuron-ethyl at 15 DAS. Thereafter, there was no weed emergence due to development of adequate canopy cover, which suppressed late emerged weeds. These results indicate that post-emergence application of chlorimuron-ethyl was as good as HW in reducing weed count (Behera *et al*. 2005, Jadhav and Gadade 2012).

Seed and stover yield

Seed yield was significantly influenced by the treatments of tillage and crop establishment but the differences in stover yield were not significant (Table 1). Seed yield was the highest under CT–raised-bed, which was on par with CT-flat and ZT-raised bed. The lowest seed yield was under ZT-flat-bed, which was significantly lower than CT-raised-bed. Weed management treatments brought about large increases in crop productivity, when weeds were controlled effectively by chemical and cultural means. Favourable environment was created within the crop canopy, which led to higher growth and yield attributes, and thereby yield performance. Two weed control practices, *viz.* pendimethalin + HW and pendimethalin + chlorimuron-ethyl resulted in almost similar weed control; thus gave equal seed and stover yield, which was significantly higher than unweeded control. The mean increase in seed yield under these treatments was 39.1%. The loss of seed yield in unweeded control was 38.3%. Mishra and Singh (2009) also found a similar response with the application of 1.0 kg/ha of pendimethalin + hand weeding at 20-30 DAS.

Table 1. Weed growth at 60 days after sowing, and yield of soybean as influenced by tillage and crop establishment, and weed management practices

Treatment	Weed count (no./m^2)	Weed dry weight (g/m^2)	Seed yield (t/ha)	Stover yield (t/ha)
Tillage and crop establishment				
CT – raised-bed	6.13 (39.1)	5.93 (44.5)	2.17	5.36
CT – flat-bed	5.49 (31.9)	5.62 (39.6)	2.31	5.28
ZT – raised-bed	6.11 (38.9)	9.23 (104.0)	1.72	3.96
ZT – flat-bed	5.83 (35.9)	7.41 (69.2)	2.20	4.85
LSD (P=0.05)	0.27	0.37	0.20	NS
Weed management				
Pendimethalin 0.75 kg/ha	6.09 (37.0)	7.30 (58.8)	2.15	4.83
Chlorimuron-ethyl 6 g/ha	6.73 (45.0)	9.69 (97.8)	1.97	4.62
Pendimethalin 0.75 kg/ha + 1 HW	5.03 (25.0)	3.12 (9.5)	2.18	5.01
Pendimethalin 0.75 kg/ha + chlorimuron-ethyl 6 g/ha	6.04 (36.2)	7.35 (61.5)	2.00	4.40
Control	8.02 (64.0)	12.2 (151.9)	1.84	4.51
Weed free	3.44 (11.5)	2.56 (6.6)	2.47	5.56
LSD (P=0.05)	0.27	0.26	0.15	0.65

*Square root transformed values ($\sqrt{x + 0.5}$), original values are in parentheses

Table 2. Effect of tillage and crop establishment, and weed management options on N, P and K uptake (kg/ha) of soybean

Treatment	N		P		K	
	Grain	Stover	Grain	Stover	Grain	Stover
Tillage and crop establishment						
CT – raised-bed	100.1	83.5	12.3	10.2	34.2	95.5
CT – flat-bed	108.1	85.5	13.0	10.5	36.3	96.6
ZT – raised-bed	80.1	80.4	12.5	9.6	34.6	70.8
ZT – flat-bed	103.2	62.1	9.8	7.7	27.2	88.6
LSD (P=0.05)	11.4	NS	1.20	NS	3.78	NS
Weed management						
Pendimethalin 0.75 kg/ha	100.1	77.0	12.5	9.4	34.1	88.1
Chlorimuron-ethyl 6 g/ha	92.5	76.0	11.2	8.7	31.1	84.8
Pendimethalin 0.75 kg/ha + 1HW	101.1	79.7	12.2	9.7	34.1	89.7
Pendimethalin 0.75 kg/ha + chlorimuron-ethyl 6 g/ha	93.3	70.2	11.2	8.3	31.5	78.6
Control	85.8	73.5	10.4	9.2	29.0	83.5
Weed free	115.1	90.7	13.9	11.6	38.8	102.5
LSD (P=0.05)	14.2	NS	1.85	NS	4.46	12.03

Nutrient concentration and uptake

Concentration of N, P and K in seed and stover of soybean was not influenced due to tillage and weed management (data not given). However, the uptake of nutrients was significantly different under tillage and weed management practices (Table 2). The uptake increased due to higher biomass production under different treatments. The nutrient uptake was the highest under CT-raised-bed, while the lowest value was observed under ZT-flat-bed. These results indicate that better crop growth following reduced weed infestation under CT and raised-bed condition provided adequate supply of nutrients to the crop plants, leading to higher nutrient uptake. Weed management practices caused large and significant differences in nutrient uptake. The uptake of N and K was maximum under pendimethalin + HW, which was significantly more than pendimethalin + chlorimuron-ethyl. However, all the five weed control treatments were significantly superior to unweeded control. The decrease in uptake of N, P and K under unweeded control was to extent of 30.2-37.0%. These variations were evident from the fact that the weeds removed large quantity of nutrients under unweeded control, while under other weed management treatments, the nutrients available in soil were effectively utilized by crop plants for growth and development.

SUMMARY

In this study the population and dry matter of weeds was significantly more under under ZT than CT. Seed yield of soybean was the highest under CT–raised-bed, followed by ZT-raised-bed, CT–flat-bed and ZT-flat-bed. Application of pendimethalin + HW and pendimethalin + chlorimuron-ethyl resulted in almost similar weed control efficiency and gave equal seed yield. Uptake of N, P and K by grain was maximum under pendimethalin + HW, which was significantly more than rest of treatments. It was concluded that soybean can be grown under permanent raised-bed with pre- and post-emergence herbicides for realizing higher productivity.

REFERENCES

Behera UK, Singh U and Singh YV. 2005. Influence of weed control method on productivity of rainfed soybean (*Glycine max*) in Vertisols of central India. *Indian Journal of Agronomy* **50**(3): 221-224.

Bineet M, Anda G and Mohamed TA. 2001. Herbicide mixture in agriculture: a review, pp. 236. In: *Proceedings of Biennial Conference*, Indian Society of Weed Science, held at Bangalore.

Jadhav AS and Gadade GD. 2012. Evaluation of post-emergence herbicides in soybean. *Indian Journal of Weed Science* **44**(4): 259-260.

Mishra JS and Singh VP. 2009. Weed dynamics and productivity of soybean (*Glycine max*)-based cropping systems as influenced by tillage and weed management. *Indian Journal of Agronomy* **54**(1): 29-35.