Pak. J. Weed Sci. Res. 11(1-2): 55-60, 2005

INTEGRATED WEED MANAGEMENT IN OKRA

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ABSTRACT

Integrated weed management study was carried out at Agronomic Research Area, Faculty of Agriculture, Gomal University Dera Ismail Khan, Pakistan during the summer 2003. Seven treatments viz.black plastic mulch, straw mulch, Stomp 330 EC alone, Stomp 330 EC with hand weeding once, hand weeding once, hand weeding twice and unweeded check. Data were recorded for different growth and yield parameters. Germination of okra was slightly affected by spraying the Stomp 330 EC. Plant height was improved by using all the mulches. Number of leaves were increased in all the treatments except un-weeded plots. Weed density was always lower in plots having mulches and the plots sprayed with Stomp 330EC or hand weeded. Plants survival was affected by any treatment; however the effect was not significant statistically. Pod length and pod diameter were also slightly affected, showing the higher pod length and pod diameter in mulch treated plots. Number of pods and yield were increased by all the weed control measures as compared to un- weeded plots. Both the mulches like black plastic mulch and straw mulch were found helpful in conserving the moisture, controlling weeds and producing higher yield, but were not found to be economical. The findings suggest that spraying Stomp330 EC @ 3 L ha^{-1} as pre-emergence with one hand weeding is the best to control weeds to get higher yield and economic returns.

Key words: Herbicides, *Abelmoschus esculentus*, growth and yield, okra, mulch.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench.) locally known as *Bhindi*, belongs to family Malvaceae. It is one of the prominent summer vegetable crops grown in Pakistan. Okra originated in the Ethiopian region of Africa, but now widely grown in Africa, Asia, Central and South America (George, 1985). During 1993-94, area under cultivation of okra was 1618 hectares with total production of 14131 tons in N.W.F.P. In D.I.Khan the total area under cultivation was 62 hectares with a production of 526 tons (Anonymous, 1994). Okra is the lucrative vegetable used in fresh form as well as canned food and is a common crop of this region with a considerable potential. In U.S.A a significant quantity of Okra is used because of its gummy or the thickening characteristics in the preparation of soups and stews (Kader *et al.* 1985). Being an important vegetable crop the yield is lower as compared to advanced countries. Besides other factors for lower yield, lack of proper weed control is the most important one. Weeds not only reduce the yield of vegetable but also deteriorate the quality of vegetable. There are several methods for controlling weeds i.e. chemical, biological and physical. Rao (1983) observed that a combination of chemical, cultural and manual weed control methods was more effective

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in controlling weeds than their isolated applications, while Jarwar *et al.* (1999) observed that chemical weed control combined with cultural method of weed control was very effective and reduced weed populations and decreased their dry matter.

Recently, weed scientists have started asking profound questions about the environment and many of these questions have ethical implications for the biosphere. Most of these developments have taken place in the developed countries of the world while weed control practices in smallholder agriculture of the developing countries (DCs) have remained unchanged. The fragile nature of agro ecosystem in the DCs requires that appropriate weed management technologies be system-based and ecological in their approach. Technologies that have the best chance of farmer acceptance are those that are developed with farmer participation, tested on farmers' fields, are simple to use, control weeds economically, safe to the environment, and support food production on a sustainable crop yield basis. Examples of on-the-shelf system-based technologies that meet these guide lines include live(living) mulch, slash/mulch, planted fallow, and integrated weed management systems (Okezie, 2000). The present study is, therefore, designed with the objectives, to find out the most effective and economical way of controlling weeds to increase the yield of okra.

MATERIALS AND METHODS

Study on integrated weed management in okra was carried out at Agronomic Research Area, Faculty of Agriculture, Gomal University, D.I.Khan, Pakistan during the summer 2003. The experiment was laid out in Randomized Complete Block Design (RCBD) with seven treatments, three replications and treatment size of 9 m^2. The field was fertilized with the recommended dose of FYM, and optimum doses of NPK at the rate of 100:80:80 kg ha^{-1}, respectively. The seed of cultivar "Posa sawani" was sown on April 3, 2003 on ridges 75cm apart. The data were recorded during the course of studies on % germination, plant height (cm), pod length (cm), pod diameter, weed density m^{-2}, plant survival (%), number of leaves $plant^{-1}$, pod yield (t ha^{-1}), Soil moisture content (%) and cost benefit ratio. The data were analyzed statistically by using the analysis of variance technique (Steel and Torrie, 1980)

Table-1. Detail of treatments used in the experiment

S. No.	Treatments	Weeding methods
1	Black plastic mulch	Black plastic mulch applied to plot before sowing Holes were made to the points of seeds planted
2.	Wheat straw mulch	Wheat straw spread @ 20 kg ha^{-1}
3.	Stomp 330 EC alone	Stomp 330 EC (pendimethaline) sprayed as pre emergence @ 3 L ha^{-1}
4.	Stomp 330 EC + Hand weeding (once)	Sprayed as pre emergence @ 3 L ha^{-1}, while plots were weeded once 40 days after sowing.
5.	Hand weeding (once)	Plots were weeded once 40 days after sowing.
6.	Hand weeding (twice)	Plots were weeded 30 and 44 days after sowing.
7	No weeding (control)	No method of weed control was used

RESULTS AND DISCUSSION

Weed infestation in okra is a serious problem causing considerable reduction in okra yield. Herbicides, hand weeding and mulches are commonly used to control weed population. The results of the study as affected by different treatments are presented as under:

Percent germination

Germination data were collected when almost all of the plants showed germination as given in Table-2. Statistical analysis showed that differences among the treatments were found significant. All the treatments gave similar results except where Stomp 330 EC was sprayed. Germination of okra was slightly affected by spraying the Stomp330 EC. Both of the plots sprayed with Stomp 330 EC showed minimum germination i.e. 89 %. Germination in other plots ranged from 91% to 92%. These findings are supported by Babu *et al.* (1987). They reported that okra germination decreased slightly at the highest rate of herbicide compared with unweeded plots.

Plant height

Data on plant height at maximum growth stage is given in Table-2. Maximum plant height (94.60 cm) was recorded in plots with straw mulch followed by Stomp 330 EC only (91.80 cm), hand weeded twice (85.6 cm), plots weeded once (84.2 cm) and black plastic mulch (83.1 cm), respectively. The minimum plant height was recorded in control plot i.e. 64.13cm. Similar results were reported by Makus *et al.* (1994). They reported that mulch application increased plant height, while reducing weed competition.

Number of leaves plant^{-1}

The data on number of leaves plant^{-1} indicated that all the treatments caused more number of leaves plant^{-1} than the weedy control plot (Table-2). Maximum number of leaves plant^{-1} (9) were recorded in Stomp 330 EC + hand weeded plot followed by Stomp 330 EC alone (8). Since plants in the check plots were smaller, therefore, these plots produced lower number of leaves plant^{-1}, while other plots had increased number of leaves due to lower competition of weeds. The minimum number of leaves plant^{-1}(4) was recorded in control plot. Plants in black plastic mulch, straw mulch, hand weeding once, and hand weeding twice produced same number of leaves plant^{-1} i.e. 5.93.

Weed density m^{-2}

The minimum number of weeds m^{-2} (1.333) was recorded in plots hand weeded twice, while maximum weeds m^{-2} (6.222) were counted in unweeded plots (Table2). Weeds counted in plots with black plastic mulch, straw mulch and Stomp 330 EC + hand weeded once, showed statistically identical number of weeds m^{-2} i.e.2.259, 2.222, and 2.556, respectively. These results are similar to Ramesh and Rao (1993) and Saimbhi *et al.* (1994). They used various herbicides and reported that pendimethaline (Stomp 330 EC) resulted in the greatest weed control.

Percent plant survival

Percent plant survival data is given in Table-3. The data indicated that maximum percent of plant survival (72.50) was obtained in black plastic mulch plot while it was minimum in plot treated with Stomp 330 EC + hand weeded once (52.50%). The overall result regarding plant survival was statistically not significant. The plant survival was slightly affected due to herbicide phytotoxicity, as being reported by Babu *et al* (1987).

Pod size (cm)

Pod size was measured in centimeters. Data recorded for pod length and pod diameter are given in Table-3. Differences among the treatments for pod length and pod diameter were found non significant. However, maximum pod length (6.06cm) was measured in plot with black plastic mulch, while minimum pod length (4.05cm) was recorded in plot with Stomp 330 EC+ hand weeding once. The highest pod diameter of 1.42 cm was recorded in straw mulch and lowest in Stomp 330 EC. Tiwari *et al.* (1985) also reported a similar result that pod yield was increased when herbicide was followed by one hand weeding.

Yield (ton ha $^{-1}$)

Total yield (ton ha^{-1}) for all the treatments is given in Table-3. Differences among the treatments tested were found statistically significant. The highest yield of 7.03 ton ha was recorded in the plot that was hand weeded twice during the season, but was at par with the plot treated with Stomp 330 EC alone (6.58 ton ha^{-1}), Stomp 330 EC + hand weeded once (6.68 ton ha^{-1}) and hand weeding once (6.49 ton ha^{-1}), respectively. Straw mulch also produced better results giving 6.01 t yield ha^{-1}. Plots with black plastic mulch gave 5.55 t ha^{-1} yield. Unweeded plots gave the lowest yield (4.16 ton ha^{-1}) being significantly different from all other treated plots. These findings are supported by Sandhu *et al.*, 1991 who treated okra cv. Pusa sawani with herbicide along with hand weeding and reported that there were complete control of weeds and the yield of okra was the highest.

Soil moisture content (%)

Data on soil moisture content is given in Table-3. Data on soil moisture content was recorded to see the effect of mulches on moisture conservation. The results showed that black plastic mulch conserved maximum moisture (13.33%), while minimum moisture was found in plots with hand weeding twice. The rest of the treatments were almost identical in moisture conservation .The present findings are in conformity with that of Saikia *et al.* (1997), who reported that black plastic mulch was effective to keep the moisture level higher in the soil than bare soil.

Cost benefit ratio

The results showed that Stomp 330 EC + hand weeding once gave the highest CBR (1: 17.44) while black plastic mulch and wheat straw mulch produced negative results giving CBR of 1:0.60 and 1:0.56, respectively (Table-4). Mulches, although, controlled the weeds but applying mulches, was not economical and expenses went higher than the net income received. Gogoi *et al.* (1997) achieved similar results in studying the effects of herbicides, either alone or in combination with hand weeding once. They reported that herbicide combined with hand weeding once resulted in better control of weeds than a single herbicide treatment, resulting in the maximum cost benefit ratio.

CONCLUSION

From the experiment it is concluded that black plastic and straw mulches control the weeds but is expensive when compared with other treatments. Spraying Stomp 330 EC+ hand weeding once and hand weeding twice were found to be economical.

Table-2. Effect of weed control measures on germination, plant height, leaves plant^{-1} of okra and weed population

Treatments	% Germination	Plant height (cm)	Number of leaves plant^{-1}	Weed density m^{-2}
Black plastic mulch	92.00 a	83.4 a	5.93 c	2.259 d
Straw mulch	91.00 a	94.6 a	5.93 c	2.222 d
Stomp 330 EC+ one hand weeding	89.00 b	91.8 a	9.00 a	2.556 cd
Stomp 330 EC (alone)	89.00b	82.6 a	8.00 b	2.703 c
Hand weeding once	92.00 a	84.2 a	5.77 c	3.186 b
Hand weeding twice	92.00 a	85.6 a	5.93 c	1.333 e
Control (No weeding)	91.00 a	64.13 b	4.00 d	6.222 a
$LSD_{0.}$	1.2485	17.2642	1.1355	0.3513

Means followed by different letters are significantly different at 5% level of probability

Table-3. Effect of weed control measures on plant survival, pod size and yield of okra.

Treatments	% Plant survival	Pod length (cm)	Pod diameter (cm)	Yield (ton ha^{-1})	% Soil moisture content
Black plastic mulch	72.50 ^{NS}	6.06^{NS}	1.33 ^{NS}	5.55 c	13.33 a
Straw mulch	60.83	6.03	1.42	6.01 bc	8.89 b
Stomp 330 EC+ one hand weeding	52.50	4.74	1.13	6.68 ab	6.50 c
Stomp 330 EC	60.00	4.05	0.93	6.58 ab	6.60 c
Hand weeding once	65.00	5.33	1.24	6.49 ab	6.70 c
Hand weeding twice	64.17	5.04	1.19	7.03 a	6.50 c
Control	69.17	5.53	1.30	4.16 d	6.82 c
$LSD_{0.05}$	---	---	---	0.89	0.35

* Means followed by different letters are significantly different at 5% level of probability

Table-4. Effect of weed control measures on cost benefit ratio of okra.

Treatments	Cost(Rs.ha^{-1})	Profit (Rs. ha^{-1})	Net Profit (Rs. ha^{-1})	CBR
Black plastic mulch	22,000.00	55,500.00	33,500.00	1 :0.63
Straw mulch	33,000.00	60,100.00	27,100.00	1 : 0.56
Stomp 330 EC + one hand weeding	5000.00	66,800.00	64,412.00	1 : 17.44
Stomp 330 EC	1388.00	65,800.00	61,800.00	1 : 5.04
Hand weeding once	3703.00	64,900.00	61,197.00	1 : 6.29
Hand weeding twice	7406.00	70,300.00	62,894.00	1 : 3.88

Note: The rate of okra was considered Rs.10 kg^{-1}

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