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Effect of Post-Emergence Herbicides on the Growth and Yield of Up-Land Cotton

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Abstract: An experiment was laid out at Students Farm, Sindh Agriculture University, Tandojam, Pakistan. Cotton variety Shahbaz-95 was treated with weed control treatments (Stomp-330 EC at 3 L ha^{-1}, Stomp-330 EC at 4 L ha^{-1}, Stomp-330 EC at 5 L ha^{-1}, Fusilade at 3 L ha^{-1}, Fusilade at 4 L ha^{-1}, hand weeding and untreated check). Among the twelve weed species observed in the cotton field *Trianthema portulacastrum* (29.56%), *Cyperus rotundus* (17.24%), *Portulaea oleracea* (14.78%) and *Digerea arvensis* (10.47%) were the dominant weeds, while other weed species were in trace. Weed population recorded before herbicide application ranged between 63.71 - 65.13 m^{-2}. Hand weeding and application of Stomp-330 EC at 5 L ha^{-1} reduced weed density significantly (92.40 and 91.59%) over other weed control measures, which in turn resulted taller plants (158.50 and 155.60 cm), exhibited more fruiting branches (14.09 and 13.50 $plant^{-1}$), higher productive bolls (82.39 and 80.78 $plant^{-1}$) and maximum seed cotton yield (2121.75 and 1957.50 kg ha^{-1}).

Key words: Cotton, herbicides, weeds, stomp, weeding, bolls, branches, yield

INTRODUCTION

Cotton is an important crop which contributes major portion in the national economy. This crop suffers losses due to presence of un-wanted plants called weeds. Weeds not only compete with the crop for nutrients, moisture, light, heat energy and space but, also harbor insects and disease organism (Anderson, 1983), thus, reducing the growth and yield of cotton due to weed competition (Papamichail *et al*., 2002). In addition weeds exert stress to the cultivated crops through their allelopathic and parasitism effect and the crop be kept free from weeds in critical stages to prevent crop yield loss (Knezevic *et al*., 2002). Weeds consume 5 to 6 times nitrogen, 5 to 12 times phosphorus and 2 to 5 times potash more than cotton crop at the early growth stages and thus reduces seed cotton yield from 54 to 85% (Jain *et al*., 1981). Shad (1987) reported that cotton, being a crop of irrigated areas, is severely infested by almost all types of kharif weeds. Among 10 most important weeds commonly observed in Pakistan, *Cynodon dactylon* L. is a serious threat to our National Agriculture after *Trianthema portulacastrum* L. while, *Dactyloctenium aegyptium* L. is the fourth major weed causing yield losses to the crops. Thus, the chemical control measures are the need to control the weed (Ansari *et al*., 2003). Now a day, development of herbicides has played significant role for the successful cotton production. However, Gill *et al*. (1985) reported that herbicide is an economic proportion when labor is problem or in abnormal weather when fields are not accessible for mechanical weeding. The corresponding increase in wages, more farmers expected to increase labor productivity and reduce labor intensity by improving agricultural production conditions and are not always successful or cost-effective (Ngouajio *et al*., 1997). As a result, chemical weed control became more important and attractive to farmers (Zhang and Huang, 1999).

The chemical weed control suppresses the weeds at early stage of cotton and enables the cotton plant to grow vigorously. Tunio (2000) observed that weeds may be minimized in their population and losses through better weed control methods. Brar *et al*. (1998) reported that the weed control treatments, which resulted in a significant reduction in weed number as compared to control. Hayee *et al*. (1983) observed that chemical and cultural weed control measures were effective in minimizing weeds in cotton crop. They reported that hand weeding and chemical weed control methods lead to best control methods for obtaining highest yields in cotton crop. Ehsanullah and Cheema (1995) observed that the hand weeding produced highest seed cotton yield over weedy check. Seed cotton yield is also increased by herbicidal application. Tunio *et al*. (2003) reported that the application of herbicides Dual Gold 960 EC and Stomp

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455 g L^{-1} CS, as pre-emergence spray was effective weed control method for cotton along with hand weeding. In china, more than 200 species of weeds infested main crop fields among which approximately 30 species are major weeds causing great crop yield losses. About 35.8 million hectares of crop fields are heavily infested by weeds and the annual reduction of crop yields is 12.3-16.5% (weighted average). Along with rural economic development, approximately 50% of the main crop fields undergo herbicide application. Chemical weed control has changed cultural practices to save weeding labor in rice, wheat, maize, soybeans and cotton. At the same time, continuous use of the same herbicides has caused weed shift problems and weed resistance to herbicides. Consequently, integrated weed management in main crops should be practiced for future damages by weeds (Zhang, 2003). Askew *et al.* (2002) conducted field trial and reported that weeds were controlled and yield was increased by the application of herbicides at different levels. The pre-sowing and pre-emergence herbicides are not effective against all weeds, whereas, post-emergence herbicides can control weeds but it needs proper time and skill. The combination of pre and post emergence herbicides are required to be integrated for effective weed control and increased in seed cotton yield. Ali *et al.* (2005) reported that maximum increase of 199.4% in seed cotton yield was obtained with Stomp 330E in combination with inter-culturing plus hand weeding while Round-up 490 g L^{-1} at the rate of 4.7 L ha^{-1} with 188.9% increase over untreated check. Stomp 330E in combination with inter-culturing + hand weeding gave 90% Broad Leaf Weeds (BLW) and 89% Narrow Leaf or grassy Weeds (NLW) control, respectively, while Round-up 490 g L^{-1} in combination with inter-culturing + hand weeding provided 93% control of BLW and 80% of NLW over untreated check.

In cotton production, the broadleaf weeds are a significant problem (McCloskey *et al.*, 1998). Traditionally, weeds emerging with cotton have been difficult to control; however, the commercialization of herbicide resistant cotton varieties provided growers with selective herbicides that could be topically applied to control broadleaf weeds. Previously, measures were taken to control the weeds, but the introduction of new herbicides must be explored to achieve best results. Looking the economic importance of cotton as source of foreign earnings, the investigations were carried to increase the weed cotton productivity through weed control measures.

MATERIALS AND METHODS

A field experiment was conducted to determine the effect of post emergence herbicides on the growth and yield of cotton at Students Farm, Sindh Agriculture University, Tandojam, Pakistan during Kharif, 2005. The suitable seed bed was prepared for seed germination and root penetration. Homogenous seed of a standard commercial cotton variety Shahbaz-95 was drilled in rows 75 cm apart in a four replicated randomized complete-block design. The description of various treatments is as under:

T_1 = Stomp-330 EC at 3 L ha^{-1}
T_2 = Stomp-330 EC at 4 L ha^{-1}
T_3 = Stomp-330 EC at 5 L ha^{-1}
T_4 = Fusilade at 3 L ha^{-1}
T_5 = Fusilade at 4 L ha^{-1}
T_6 = Hand weeding for full season
T_7 = Untreated check (control)

The thinning for proper plant distance was performed before first irrigation. NP fertilizers were applied as per the recommendations of Agronomy Department. Herbicidal spray as post emergence was applied 4 weeks after sowing of crop to all treatments except untreated/control. Data on various weed and crop parameters were compiled and statistically analyzed using Fihser's analysis of variance technique and the Least Significant Difference (LSD) test at $p \leq 0.05$ for comparing the treatment means to determine their efficacy for different parameters (Steel and Torrie, 1980).

RESULTS

Weed population density (m^{-2}) before treatment: About twelve weed species appeared in the cotton field. Among them, *Trianthema portulacastrum* was the dominant specie (29.56%), followed by *Cyperus rotundus* (17.24%) and *Portulaca oleracea* (14.78%), while other weed species were less in number and ranged between 1.23 to 10.47%, respectively (Table 1).

Weed count (m^{-2}) before weed management: The population of weeds recorded m^{-2} before treatment

Table 1: Species, population density (m^{-2}) and density percentage of weeds observed in cotton field

Species names	Local name	Population density (m^2)	Density (%)
Cynodon dactylon	Chabbar	4.00	4.93
Cyperus rotundus	Kabbah	14.00	17.24
Echinochloa colona	Sawari	2.00	2.46
Trianthema portulacastrum	Waho	24.00	29.46
Convolvulus arvensis	Naro	2.00	2.46
Portulaca oleracea	Lunak	12.00	14.78
Cleome viscose	Kinibooti	2.00	2.46
Phyllanthus niruri	Hazardani	2.00	2.46
Tribulus terrestris	Bhurt	4.00	4.93
Amaranthus viridis	Chalooro	1.20	1.48
Verbacum thapsus	Gidergah	1.00	1.23
Desmostachya bipinnata	Dabh	3.00	3.69

Table 2: Weed and crop traits as affected by various weed control methods

Treatments	Weed population (before application) (m^{-2})	Weed population (after 30 days of application) (m^{-2})	Weed reduction (after 30 days of application) (%)	Plant height (cm)	Sympodial branches $plant^{-1}$	Productive bolls $plant^{-1}$	Seed cotton yield (kg ha^{-1})
Stomp-330 EC at 3 L ha^{-1}	65.130	14.4413^{b}	77.680^{d}	148.960^{b}	10.440^{b}	72.080^{c}	1765.500^{c}
Stomp-330 EC at 4 L ha^{-1}	64.100	10.4300^{cd}	83.900^{bc}	150.190^{b}	11.020^{b}	77.540^{b}	1930.000^{b}
Stomp-330 EC at 5 L ha^{-1}	64.300	5.5100^{e}	91.590^{a}	155.600^{a}	13.500^{a}	80.780^{a}	1957.500^{ab}
Fusilade at 3 L ha^{-1}	63.710	11.6800^{c}	81.990^{c}	143.330^{d}	9.650^{b}	63.750^{d}	1754.000^{c}
Fusilade at 4 L ha^{-1}	65.000	8.9000^{d}	86.250^{b}	146.780^{c}	9.860^{b}	70.010^{c}	1913.750^{b}
Hand weeding	54.200	3.5600^{e}	92.400^{a}	158.500^{a}	14.090^{a}	82.390^{a}	2121.750^{a}
Untreated check	64.180	64.8300^{a}	-	126.000^{e}	5.350^{c}	14.350^{e}	786.500^{d}
SE	1.290	0.9430	1.290	1.391	0.575	1.790	78.214
LSD (5%)	-	1.9800	2.350	2.921	1.590	3.759	164.250
LSD (1%)	-	2.7150	3.266	1.006	2.181	5.155	225.257

Values followed by similar letter(s) do not differ significantly at 5% level

was more or less same in all the treatments and ranged between 63.71 to 65.13 m^2. There was no significant difference among the treatments (Table 2).

Weed population (m^{-2}) after treatments: Hand weeding resulted in low population of weeds (3.56 m^{-2}) or application of Stamp at high dose (5 L ha^{-1}) also showed similar performance when compared to hand weeding. However, the population of weeds was maximum (64.83 m^2) in plot where no weeding was done (Table 2).

Weed reduction (%): Weeds eradicated manually or application of Stamp-330 EC at 5 L ha^{-1} proved equally efficient in reducing weed density (92.40 and 91.59%), whereas, low rate of Fusilade (4 L ha^{-1}) and Stamp-330 EC (5 L ha^{-1}) were found less effective in reducing weed density (Table 2).

Plant height (cm): The results revealed that all weed management treatments produced taller plants of cotton when compared to untreated check. Hand weeding and application of Stamp-330 EC at 5 L ha^{-1} both produced equally maximum plant height (158.50 and 155.60 cm). The untreated plots resulted in poor plant height (126.00 cm).

Productive bolls $plant^{-1}$: Hand weeding and application of Stomp 330 EC at 5 L ha^{-1} were non-significant treatments which exhibited equally maximum number of productive bolls (82.39 and 80.78 $plant^{-1}$). However, poor numbers of productive bolls (14.35 $plant^{-1}$) were recorded in case of untreated check (14.35 $plant^{-1}$).

Seed cotton yield (kg ha^{-1}): All weed control treatments improved yield as compared to untreated check. Comparatively hand weeding and application of Stomp-330 EC at 5 L ha^{-1} recorded significantly maximum seed cotton yield (2121.75 and 1957 kg ha^{-1}, respectively) (Table 2).

DISCUSSION

Dependence on traditional agricultural and manual measures for crop weed control without herbicide application is most labor intensive and impractical in modern agricultural production. Elimination of weeds from crop fields by adopting various effective agricultural measures and maintaining favorable ecological conditions integrated with chemical weed control is the most effective measure (Zhang, 2003). In our country, interculturing is normal practice to eradicate the weeds but, this practice is not applicable during rainy season due to wet condition in the soil which do not permit the mechanical weeding, under such circumstances the chemical control measures are the alternate to control the weeds (Ansari *et al*., 2003).

The results of this research indicates that about 12 weed species appeared in the cotton field, among them *Trianthema portulacastrum*, *Cyperus rotundus*, *Portulaea oleracea* and *Diugera arvensis* were the major weeds. In Sindh, most of the cotton fields are severely predominated by the weeds and average population can go upto 65 m^{-2}. The application of post-emergence herbicides (Stomp 30 EC) and Fusilade 5 and 4 L ha^{-1}, respectively exhibited maximum reduction of weeds which was same when compared to hand weeding. These treatments in the study significantly enhanced better weed control results which in turn produced taller plants, more fruiting branches, higher number of productive bolls and seed cotton yield. Similar results had been reported by Nobrega *et al.* (1998). Rout and Satapathy (1998), Hiremath and Rao (2001), Panwar *et al.* (2001), Askew *et al.* (2002) and Ali *et al.* (2005) suggested the integrated use of various methods of weed control could enhance cotton productivity by controlling the weeds. Further, Duggan *et al.* (2004) also supported the findings of this study that application of Stomp-330 EC or Roundup against weeds produced more bolls and seed cotton yield. Bukun (2004) reported that herbicide

(pre or post emergence) should be used to eliminate weeds from 1-2 weeks post crop emergence up to 11-12 weeks. Such an approach would keep yield loss level below 5%. Sivakumar and Subbian (2002) reported that different weed control treatments gave 40-60% more yield with 29-53% higher net monetary returns. Raskar and Bhoj (2002) observed that seed cotton yield increased by two hand weeding. However, Nadanassababady and Kandassamy (2002) reported that weed free treatments gave the highest N, P and K uptake in cotton.

CONCLUSION

All the herbicide treatments controlled the weeds. Hand weeding and application of Stomp-330 EC at 5 L ha^{-1} were more effective in controlling the weeds which resulted better growth and seed cotton yield.

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