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Weed Management Practices in Cotton Crop

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Abstract: The field trial was conducted to assess weed management practices in cotton at Students Farm, Sindh Agriculture University, Tandojam, Pakistan. The herbicides applied were: T1 = Dual Gold 960 EC @ 2.0 L ha^{-1} pre-emergence, T2 = Dual Gold 960 EC @ 2.5 L ha^{-1} pre-emergence, T3 = Stomp 330 EC @ 2.5. L ha^{-1} pre-emergence, T4 = Stomp 330 EC @ 3.75 L ha^{-1} pre-emergence, T4 = Hand weeding and T5 = Control. Weed flora after 71 days of sowing competing with experimental cotton were: *Cyperus rotundus* (40.03%), *Portulaca oleraceae* (17.77%), *Cynodon dactylon* (13.70%), *Echinochlor columum* (10.00%), *Convolvulus arvensis* (9.25%), *Digeria arvensis* (3.70%), *Euphorbia hirta* (1.85%), *Cressia cretica* (1.85%) and *Chorchorus depressus* (1.85%). Highest weed density (54.25 m^2) and weed intensity (25.00 m^2) were recorded in weedy (control) fields, while highest weed control percentage (74.07%) was observed in hand weeded plots. Among herbicide treatments, Dual Gold 960 EC @ 2.5 L ha^{-1} pre-emergence produced maximum weed control (56.66 %), followed by Dual Gold 960 EC @ 2.0 L ha^{-1} pre-emergence (36.66 %). Stomp 330 EC @ 3.75 L ha^{-1} pre-emergence resulted 33.33% weed control, while Stomp 330 EC @ 2.5 L ha^{-1} pre-emergence recorded 29.62% weed control. Mean cotton plant height (103.65 cm), monopodial branches (3.06) and sympodial branches (39.00) $plant^{-1}$, productive bolls (32.3) $plant^{-1}$ and seed cotton yield (3942.50 kg ha^{-1}) were maximum in hand weeded plots. Among, herbicidal treatments, Dual Gold 960 EC @ 2.5 L ha^{-1} pre-emergence produced best results with 93.05 cm cotton plant height, 2.66 monopodial branches, 29.0 sympodial branches and 23.20 productive bolls $plant^{-1}$ and seed cotton yield of 2992.50 kg ha^{-1}. It was observed that weed control practices in cotton were more effective in controlling weeds and producing higher seed cotton yield, when integrated efforts which include manual weeding as well as use of herbicides are employed simultaneously. However, Dual Gold 960 EC @ 2.5 L ha^{-1} pre-emergence may be preferred for chemical control of weeds in cotton.

Key words: Weed, cotton, flora, density, control, herbicides, weedicides, growth, yield, *Cyperus rotundus*, *Portulaca oleraceae*, *Cynodon dactylon*, *Echinochlor columum*, *Convolvulus arvensis*, *Digeria arvensis*, *Euphorbia hirta*, *Cressia cretica*, *Chorchorus depressus*

INTRODUCTION

The seed cotton production per unit area is affected by a number of factors including weeds. Weeds infestation is considered one of the major risk factors in cotton production. The weeds compete with main crop for moisture, light, space and all soil and applied nutrients, hence check the crop growth and result in reduced production per unit area (Anonymous, 1999). Most important weeds commonly observed in cotton field include Chulai, Hulhul, Lehli, Bhauphali, Tandla, Lal Dodhak, Hazardani dodak, Kulfa lunak, Dhaincha/Jantar, Itsit, Bishkhapra, Bhakra, Mahabat booti, Ghass, Khabbal ghass, Ledhra, Madhana, Mooti khabbal, Palwan, Phollan ghass, Swanki, Madhani ghass, Boori, Sabz loomar ghass, Bru and Deela (Anonymous, 2003). Managing weeds is critical for successful cotton production. Effective weed control often has been more difficult in cotton than in other row crops such as corn and soybean because cotton grows more slowly early in the season and is less competitive with weeds. Herbicide options are also more limited. However, technological advancements have increased the weed management options in cotton.

The greatest competition usually occurs early in the growing season. Late-season weeds, while not as competitive as early-season weeds, may interfere with insecticide applications and may cause harvesting difficulties. Weed competition at square formation and flower formation stages proved to be more harmful as compared to the weed competition effects at later stages (Farrell *et al*., 2001). Weed management means the careful consideration of all available weed control techniques and subsequent integration of appropriate measures that discourage the development of weeds and keep

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herbicides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment (Farrell *et al*., 2001). Weed management emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. Weed management takes into account all relevant control tactics and methods available locally, evaluating their potential cost effectiveness. It does not, however, consist of any absolute or rigid criteria. Implementation with the farmers, who will adopt those elements which are seen to be practical and add value to their activities (Dumka *et al*., 2004). The present study was therefore carried out to assess the suitable weed management practices on weed intensity, growth and seed cotton yield of cotton.

MATERIALS AND METHODS

The study was carried out to assess the suitable weed management practices on the growth and seed cotton yield of cotton during the year 2005 at Student Farm, Sindh Agriculture University, Tandojam, Pakistan. The experiment was laid out in a four replicated randomized complete block design. For this purpose the piece of land left fallow in off-season, was ploughed up by cross-wise disc plough. After soaking dose, when the land came in condition, the seedbed was prepared by using cultivator (cross-wise) and rotavator. Thereafter, clods were crushed completely by clod crusher followed by planking. The plots were prepared in such a way to discriminate the treatments and replications easily and channels and bunds were prepared to facilitate the irrigation process and further monitoring of the crop against any pest problem. The details of the treatments are furnished as follows:

Treatments

T_1 = Dual Gold at 2 L ha^{-1} at pre-emergence level
T_2 = Dual Gold at 2.5 L ha^{-1} at pre-emergence level
T_3 = Stomp 330 EC at 2.5 L ha^{-1} at pre-emergence level
T_4 = Stomp 330 EC at 3.75 L ha^{-1} at pre-emergence level
T_5 = Hand weeding (intercultutring for full season)
T_6 = Weedy for full season

The sowing was done with the help of single coulter hand drill in lines. Nitrogen was applied in the form of Urea (46%) in three splits. The first dose of nitrogen (1/3 N) was applied at the time of sowing, the second (1/3 N) at the first irrigation and the final (1/3 N) at the time of third irrigation. All Phosphorus in the form of SSP (18% P_2O_5) was applied at the time of sowing. Irrigations were applied as per requirement of crop. The row to row distance of 75 cm and plant to plant distance 30 cm was maintained. The recommended cultural practices were performed in all the subplots. Fifteen plants in each treatment were selected at random for recording the observations of cotton crop. These plants were labeled and numbered separately to avoid any mix-up of sample plants.

Weed flora: All the weed species found in the experimental field were noted and their local names, English names and botanical names were mentioned. The term weed flora refers to all species of weeds recorded during observation.

Weed density, weed intensity and weed control (%)

Weed density (m^2) = Total number of weed in each treatment/Number of replications.

Weed intensity (%) = Weed density/Total number of weed in no weeding x 100.

Weed control (%) = Total number of weeds present-Total number of weeds present in no weedy in each treatment/Total number of weeds present in no weedy x 100.

The data thus collected were subjected to statistical analysis using analysis of variance technique and LSD (Least Significant Test) to discriminate the superiority of treatment means following the procedures of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Weed flora: Weed species found competing with cotton were *Cyperus rotundus* (40.03%), *Portulaca oleraceae* (17.77%), *Cynodon dactylon* (13.70%), *Echinochlor columum* (10.00%), *Convolvulus arvensis* (9.25%), *Digeria arvensis* (3.70%), *Euphorbia hirta* (1.85%), *Cressia cretica* (1.85%) and *Chorchorus depressus* (1.85%). It was noted that *Cyperus rotundus* was highly infesting weed species (40.03%) to cotton crop, while *Portulaca oleraceae* was also considered among highly infesting weed species in cotton at Tandojam (Table 1). Freitas *et al*. (2003) have considered *Cyperus rotundus* as serious weed for cotton, while Economou *et al*. (2005) have reported *Cyperus rotundus*, *Portulaca oleraceae*, *Cynodon dactylon*, *Convolvulus arvensis*, *Euphorbia hirta*, *Cressia cretica* and *Chorchorus depressus* as the most serious weeds of cotton and in present study all the

Table 1: Weed flora in cotton experimental fields

Local name	English name	Botanical name	Infestation % (71 DAS)
Chabbar	Lawn grass	*Cynodon dactylon*	13.70
Kabah	Purple nut sedge	*Cyperus rotundus*	40.03
Naro	Field bind weed	*Convolvulus arvensis*	9.25
Waho	Carpet weed	*Portulaca oleraceae*	17.77
Sawari	Jungle rice	*Echinochlor colunum*	10.0
Lulure	-	*Digeria arvensis*	3.70
Kherol	-	*Euphorbia hirta*	1.85
Oin	Cressa	*Cressia cretuca*	1.85
Mudhari	Wild jute	*Corchorus depressus*	1.85

Table 2: Average weed density m^{2-1} and weed intensity (%) in cotton fields as affected by different weed management practices

Treatments	Weed density (m^2)	Weed intensity (%)	Weed control (m^2)
T1 = Dual Gold 960 EC @ 2.0 L ha^{-1} at pre-emergence	32.5	14.97	36.66
T2 = Dual Gold 960 EC @ 2.5 L ha^{-1} at pre-emergence	28.75	13.24	56.66
T3 = Stomp 330 EC @ 2.5 L ha^{-1} at pre-emergence	41.25	19.00	29.62
T4 = Stomp 330 EC @ 3.75 L ha^{-1} at pre-emergence	38.25	17.62	33.33
T5 = Hand weeding (interculturing for full season)	21.75	10.02	74.07
T6 = Weedy for full season	54.25	25.00	-

above weeds were recording infesting cotton crop at Tandojam. Furthermore, Shaikh *et al.* (2005) also observed above weeds in Punjab province infesting cotton crop.

Weed density (m^2) and weed intensity (%): Highest weed density of 54.25 weeds m^2 was recorded from the plots left un-weeded, while the lowest weed density (21.75 m^2) was recorded under hand weeding. Among treatments where herbicides were applied for weed control, Dual Gold 960 EC @ 2.5 L ha^{-1} at pre-emergence. treated plots had lowest weed density of 28.75 m^2, followed by Dual Gold 960 EC @ 2.0 L ha^{-1} at pre-emergence with weed density of 32.5 m^2. The weed density in plots received pre emergence application of Stomp 330 EC @ 3.75 L ha^{-1} was 38.25 m^2, while weed density increased to 41.25 m^2 when Stomp 330 EC was applied at reduced rate of 2.5 L ha^{-1} (Table 2).

Maximum weed intensity of 25.00% was recorded under weedy (control) plots, while the lowest (10.02%) in the plots where weeds were removed manually. Weed intensity in plots treated with pre-emergence application of Dual Gold 960 EC @ 2.5 L ha^{-1} was 13.24%, weed intensity increased to 14.97% with decreased dosage in Dual Gold. Likewise, it was observed that weed intensity was increased with herbicidal application at reduced dosage and intensity decreased by increasing the rate of herbicide application (Table 2). Similar results have also been reported by Askew and Wilcut (2002) who have reported that weed density and intensity percentage was higher in no weeding, while interculturing or hand weeding resulted in significantly reduced weed density and intensity percentage in cotton crop.

Weed control (%): Hand weeding produced maximum control of weeds (74.07%), followed by herbicidal application with Dual Gold 960 EC @ 2.5 L ha^{-1} with 56.66% weed control, followed by 36.66 and 33.33% weed control percentage recorded under herbicidal applications with Dual Gold 960 EC @ 2.0 L ha^{-1} and Stomp 330 EC @ 3.75 L ha^{-1}, while the lowest weed control percentage of 29.62 was recorded in plots treated with Stomp 330 EC @ 2.50 L ha^{-1} (Table 2). The integrated weed management system has proved to be more economical and effective and the farmers must not depend on any one method of weed control, because only chemical control would be uneconomical and even inefficient when other methods are not employed as integral parts of weed management system. In the present study, it was observed that hand weeding resulted in highest weed control when compared with those plots where herbicides were applied. Earlier researchers have also reported similar results and Hadizadeh *et al.*, (2002) advocated hand weeding for economical weed control in cotton, while Pagar *et al.* (1995) recorded 94.76% weed control by manual weeding and herbicide application also proved beneficial after interculturing.

Plant height (cm): In the present study, maximum increase (55.28%) in plant height over weedy (control) was recorded by removing the weeds manually (hand weeding), followed by weeding through Dual Gold 960 EC @ 2.5 L ha^{-1} and 2.0 L ha^{-1}, where the plant height was increased by 39.40 and 27.71% over weedy control, respectively. Similarly, herbicidal application with Stomp 330 EC @ 3.75 L ha^{-1} and @ 2.50 L ha^{-1} increased plant height by 20.59 and 12.65%, respectively over control (Table 3). Similar results have also been reported by Bacchi *et al.* (1998) who concluded that cotton plants were tallest in hand weeded plots as compared to weedy check and in plots where herbicides were used.

Monopodial branches $plant^{-1}$: There was an increase of 54.54% in monopodial branches over weedy (control)

Table 3: Cotton plant characters as affected by weed management practices

Treatments	Plant height (cm)	Monopodial branches plant^{-1}	Sympodial branches plant^{-1}	Productive bolls plant^{-1}	Seed cotton yield kg (ha^{-1})
T1 = Dual Gold 960 EC @ 2.0 L ha^{-1} at pre-emergence	85.25bc	2.34b	27.30b	21.25b	2565.0b
T2 = Dual Gold 960 EC @ 2.5 L ha^{-1} at pre-emergence	93.05ab	2.66ab	29.00b	23.20ab	2992.50ab
T3 = Stomp 330 EC @ 2.5 L ha^{-1} at pre-emergence	75.2cd	2.32b	25.8b	21.00b	2018.70b
T4 = Stomp 330 EC @ 3.75 L ha^{-1} at pre-emergence	80.5bcd	2.46ab	26.35b	22.10ab	2137.50b
T5 = Hand weeding (interculturing for full season)	103.65a	3.06a	39.00a	32.30a	3942.50a
T6 = Weedy for fullseason	66.75d	1.98b	20.95b	16.25b	1790.00b
SE ±	71.77	0.144	21.116	29.711	322.95
LSD(5%)	12.36	0.516	6.706	7.955	889.30
LSD(1%)	16.75	0.697	9.088	10.078	1205.0

Mean values with same letter(s) are not significantly different

under hand weeding, followed by weeding through Dual Gold 960 EC @ 2.5 L ha^{-1} and Stomp 330 EC @ 2.5 L ha^{-1}, where the monopodial branches was increased by 34.34 and 24.24% over weedy (control), respectively. Similarly, herbicidal application with Dual Gold 960 EC @ 2.0 L ha^{-1} and Stomp 330 EC @ 3.75 L ha^{-1} increased monopodial branches by 18.18 and 17.17%, respectively over control (Table 3). The results reported by Turkhede *et al.* (2002) are in concurrence with the present study, who were of the experience that branches per plant were higher in plots where weeds were removed manually, followed by chemical control (herbicides).

Sympodial branches plant^{-1}: An increase of 86.15% in sympodial branches under hand weeding, followed by weeding through Dual Gold 960 EC @ 2.5 L ha^{-1} and Dual Gold 960 EC @ 2.0 L ha^{-1}, where the number of sympodial branches was increased by 38.42 and 30.30% over control, respectively. Likewise, herbicidal application with Stomp 330 EC @ 3.75 L ha^{-1} and Stomp 330 EC @ 2.50 L ha^{-1} increased the number of sympodial branches by 25.77 and 23.15%, respectively over weedy (check) (Table 3). These results have been in accordance with those of Turkhede *et al.* (2002) and Giri *et al.* (1998) who reported that branches per plant in cotton were lowest in weedy plots and in interculturing or manually weeded plots, the plants had more number of branches. However, different herbicides had varied effects in suppressing the weeds in cotton.

Number of productive bolls plant^{-1}: The maximum increase (98.76%) in productive bolls over weedy (control) was observed in case of weed removal by hand weeding, followed by weeding through pre-emergence application of Dual Gold 960 EC @ 2.5 L ha^{-1} and Stomp 330 EC @ 2.5 L ha^{-1}, where the productive bolls was increased by 42.76 and 36.00% over control, respectively (Table 3). Similar results have also been reported by Turkhede *et al.* (2002) who were of the experience that bolls per plant were higher under weeded plots and in weedy plots boll number was decreased considerably.

Seed cotton yield (kg ha^{-1}): The seed cotton yield per hectare was significantly higher in plots where hand weeding was carried out, while the yields were relatively lower when the weeding was carried out by using different herbicides. However, lowest yields were recorded under control plots where, no weeding was done and the crop was left unweeded (Table 3). A number of researchers have supported by findings of the present investigation, such as Hadizadeh *et al.* (2002), Pagar *et al.* (1995), Giri *et al.* (1998), Turkhede *et al.* (2002) and Askew and Wilcut (2002) who all had consolidated experience that hand weeding/manual weeding and interculturing practices in cotton proved to be most effective in controlling weeds, they also have advocated the integrated weed management approach in cotton with the opinion that if a weed control practice fails in controlling weeds, another practice of the IWM system will serve the purpose.

CONCLUSIONS

The weed species found competing with cotton were: *Cyperus rotundus* (40.03%), *Portulaca oleraceae* (17.77%), *Cynodon dactylon* (13.70%), *Echinochlor columum* (10.00%), *Convolvulus arvensis* (9.25%), *Digeria arvensis* (3.70%), *Euphorbia hirta* (1.85%), *Cressia cretica* (1.85%) and *Chorchorus depressus* (1.85%). It was concluded that weed control practices in cotton were more effective when integrated efforts which include manual weeding as well as use of herbicides are employed simultaneously. However, pre-emergence application of Dual Gold 960 EC @ 2.5 L ha^{-1} may be preferred for chemical control of weeds in cotton.

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