

Comparative Study of Various Weeding Methods on Cotton Crop under Bed-Furrow Planting Technique in Punjab, Pakistan

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Abstract:

Effective and economic weed control is essential as weeds are the most efficient users of resources due to their different kinds, intensity and fast growth habits. In bed-furrow cotton planting technique, application of irrigation for cotton seed germination, emergence and seedling growth, weeds germinate more in number and grow much faster than cotton. Studies were conducted in two consecutive years (2011 to 2013) to evaluate the effect of different weed control methods on weed intensity, seed cotton yield and its components. Treatments comprised pre-emergence sequence with Dual Gold 960EC (s-metolachlor @ 2.0 lit ha⁻¹), Panida Grande (Pendimethaline 43.5EC @ 2.0 lit ha⁻¹) and post emergence Glyphosate 490G/L @ 4.7 lit ha⁻¹, Dual Gold 960EC + Glyphosate 490G/L, Panida Grande + Glyphosate 490G/L, Mechanical inter-culturing, Manual weeding (thrice), Mechanical inter-culturing + Manual weeding and Untreated check. Treatments were arranged in randomized complete block design with four replications. Cotton cultivar CIM-499 was dibbled manually at experimental area of CCRI, Multan on silt loam soils. Results indicated that all chemical and mechanical weeding methods increased seed cotton yield and its components over untreated whether applied alone or in combination. Anyhow, combination of Panida Grande (pre-emergence) + Glyphosate (post-emergence) and Dual Gold+ Glyphosate gave 113.7% and 120.5% increase in seed cotton yield over untreated respectively. Moreover, combination of mechanical (inter-culturing) + Manual (hand weeding once) gave maximum increase in yield i.e. 126% over untreated. All weeding methods mechanical or chemical gave significantly broad leaves and narrow leave weed control over untreated. Data recorded 60 days after planting showed that combination of pre- and post-emergence weedicide i.e. Panida Grande + Glyphosate gave 92.36 broad & 86.15% narrow leave weeds control and Dual Gold + Glyphosate showed 96.75 broad & 98.28% narrow leave weeds control over untreated. Moreover, Mechanical + Manual weeding (once within plants) at 60 days after planting provided 98.87 broad and 97.59% narrow leaves weed control over untreated, respectively.

Key words: Pre- and post-emergence weedicides, mechanical weeding, bed-furrow, *Gossypium hirsutum*, weed intensity, seed cotton yield.

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Introduction

Agriculture remains the main stay in economy of Pakistan. Share of crop production in agriculture is 37.6% (Anonymous, 2012-13). Cotton production is hampered by many factors like sowing at optimum time, germination, stand establishment, nutrient management and weeds infestation. Weeds affect crop production in a serious way by capturing the growth resources of crop like light, water, nutrients, space etc (Mubeen, et al, 2009).

Weed control is one of the most important factors among agronomic practices. Naturally weeds have some peculiar characters for their existence in the fields. Weed seeds germinate early and their seedling grow faster. They make flowers early and form seeds in abundance and mature earlier than the main crop. They have the remarkable ability to germinate under varied conditions, but peculiarly are season bound and the peak period of germination always takes place in certain season in regular succession, year after year. Due to special character of physiological dormancy, weed seeds do not lose their viability for years even under adverse conditions, so the weed control should be a regular process. Weed control is most difficult when the cotton seedlings are very young and is more beneficial before start of reproductive phase.

Any of the weed control method, effective in one set of conditions may not be effective in other set of conditions (Nadeem, *et al*, 2013). Mechanical method of weed control is very costly. (Muhammad, *et al*, 2009). Hand hoeing is used as a method of weed control especially in line sown crops (Mubeen, *et al*, 2014).

Sudden and abrupt changes in climatic conditions, pose a continuous challenge for the agricultural researchers and farming community. The changes in climate will affect not only the ecology and biology of weeds but also the weed seed bank in the soil. These dynamic changes in the climate demand for continuous efforts to reshape the weed management approaches in an integrated way.

Information about the species of weeds, dominant species and their intensity can help a farmer to plan an appropriate management programme to minimize weed interference in cotton crop and then to use the best tools available for weed management. The important weeds present in core area of cotton, South Punjab, Pakistan are given below:

S.No.	Scientific Name	English Name	Local Name
Broad Leaf Weeds			
1	Amaranthus blitum	Pigweed-Amaranth	Chulai
2	Convolvulus arvensis	Field bind weed	Lehli - Rewari
3	Cucumis trigonus	Chito melon	Chibbar
4	Datura stramonium	Jimson weed	Datura
5	Digera arvensis	Digera	Tandla
6	Portulaca oleracea	Common purslane	Kulfa
7	Solonum carolinense	Horse nettle	Mako
8	Solonum nigrum	Black nightshade	Mako
9	Trianthema monogyna	Horse purslane	Itsit

12	<i>Euphorbia prostrata</i>	Petty spurge	Dhodak
13	<i>Amaranthus viridis</i>	Green amaranth	Chulai
14	<i>Euphorbia hirta</i>	Red spurge	Lal Dhodak
Narrow Leaf Weeds and Sedges			
15	<i>Cynodon dactylon</i>	Bermuda, Couch, Lawn & grass	Khabbal,
16	<i>Dactyloctenium aegyptium</i>	Crow foot grass	Madhana ghass
17	<i>Echinochloa colonum</i>	Jungle rice	Swanki
18	<i>Echinochloa crusgalli</i>	Barnyard grass	Dhiddan
19	<i>Eleusine indica</i>	Goose grass, Wiregrass, Silver grass	Madhani
20	<i>Sorghum halepense</i>	Johnson grass	Baroo
21	<i>Setaria viridis</i>	Green foxtail	Loomar ghass
22	<i>Cyperus rotundus</i>	Purple nut sedge	Deela
23	<i>Cyperus esculentus</i>	Yellow nut sedge	Motha

Combined application of pre and post emergence weedicides offer great potential for effective weed control. Mechanical weeding in integration with manual weed control can give the farmer a flexible eco friendly and time saving approach for reducing the crop damage by weeds. Therefore a need was felt to develop a rational, sustainable, effective integrated weed management system in cotton fields under agro-ecological conditions of Multan, Punjab (Pakistan).

Material and Methods:

Field experiments were conducted at the Agronomic Research Area of Central Cotton Research Institute, Multan during 2011-12 and subsequently repeated in 2012-13. The cotton cultivar CIM-599 was planted during 2nd week of May on silt loam soil. The experiment was laid out in randomized complete block design with four replications. The bed-furrows were made on well prepared soil with 75 cm apart rows from each other by tractor driven implement. Bed shaper was used to properly shape the beds for dibbling cotton seed at proper place. Cotton seeds were dibbled at 22.5 cm plant to plant distance within the rows. Irrigation was applied after dibbling. Thinning was done 25 days after sowing. Both pre-emergence weedicides Dual Gold 960EC (*S.Metolachlor* @ 2.0 lit ha⁻¹) and Panida Grande (*Pendimethaline* 43.5EC @ 2.0 lit ha⁻¹) were sprayed after planting within 24 hours on moist soil with knapsack hand sprayer. The post emergence weedicide Glyphosate 490G/L @ 4.7 lit ha⁻¹ was sprayed 35 days after sowing in specific treatments as protective spray by using shield with spray nozzle. Mechanical weeding alone was done at 25, 40 and 55 days after sowing during crop season 2011 and 2012. Manual weeding was done on proper workable field condition at 23, 38, 54 days after planting in their respective plots during both years Manual weeding (once) in combination with mechanical weeding was done within plants at 55 days after sowing during cropping seasons. The data were statistically analyzed by using the Fisher's analysis of variance techniques and least significant difference test at 5% probability level applied to compare the significance of the treatments

Results and Discussion:

In Table 1, Data revealed that all the mechanical and chemical weed control methods alone and in combination significantly increased the bolls per plant and seed cotton yield while boll weight tended to increased but the differences were non-significant. Application of Panida Grande 43.5EC and Dual Gold 960EC as pre-emergence and Glyphosate 490 G/L as post-emergence alone produced 73.6, 84.4 and 72.1% more seed cotton yield over check, respectively. Whereas pre and post-emergence weedicides Panida Grande 43.5EC and Dual Gold 960EC in combination with Glyphosate 490 G/L gave 113.7 and 120.5% increase in seed cotton yield over un-treated. While, mechanical weeding, manual weeding alone and in combination gave 63.3, 88.6 and 126% increase in seed cotton yield over control respectively. Panwar, *et al.* (2000), Mahar, *et al* (2007), Patil, *et al.* (2007) and Kumar, *et al.* (2007) reported similar result.

Data showed in Table 2 indicated that all the mechanical and chemical weed control methods alone and in combination gave significant weed control over untreated. Dry weight of weeds 30 Days after sowing, Panida Grande 43.5EC as Pre-emergence alone resulted in 64.7 and 73.3% broad and narrow leaf weeds control over untreated, respectively. Dual Gold 960EC resulted in 83.3 and 86.8% broad and narrow leaf weeds control over check. Mechanical weeding resulted in 78.9% broad and 86.9% narrow leaf weeds control over untreated. Manual weeding resulted in 80.3% and 98.2% broad and narrow leaf weeds control over untreated respectively. Interactive effect of mechanical weeding plus manual weeding resulted in 71.5% and 88% broad and narrow leaf weeds control, respectively.

Dry weight of weeds (g m^{-2}) presented in Table 3 showed that the weed intensity 60 Days after sowing indicated that Glyphosate 490 G/L (post-emergence) alone resulted in 89.4% and 81.0% broad and narrow leaf weeds control. However, Glyphosate 490 G/L in combination with Panida Grande 43.5EC resulted in 92.4% and 86.2% broad and narrow leaf weeds control while in combination with Dual Gold 960EC gave 96.8% and 98.3% broad and narrow leaf weeds control over untreated.

Mechanical weeding alone resulted in 76.7% broad and 84.9% narrow leaf weed control over check. Manual weeding alone resulted in 86.3% and 96.4% broad and narrow leaf weeds control over check. Mechanical weeding in combination with manual weeding gave 98.9% and 97.6% broad and narrow leaf weeds control over check, respectively. These results are supported by Kumar *et al.* (2006), Nikam, *et al* (2007) and Mohammad *et al* (2009) who reported that with the application of weedicides weed intensity decreased.

Table-1: Seed cotton yield and its components as influenced by different chemical and mechanical weeding methods.

Treatments	Bolls plant ⁻¹	Boll weight (g)	Seed cotton yield (kg/ha)	% increase over untreated
Panida Grande 43.5 EC @2.0 L/ha	26	3.00	2615	73.6
Dual Gold 960 EC@ 2.0 L/ha	28	3.05	2777	84.4
Glyphosate 490 G/L @4.7 L/ha	26	3.01	2592	72.1
Panida Grande 43.5 EC @2.0 L/ha+ Glyphosate 490 G/L @4.7 L/ha	31	3.13	3219	113.7
Dual Gold 960 EC@ 2.0 L/ha+ Glyphosate 490 G/L @4.7 L/ha	33	3.15	3320	120.5
Mechanical weeding	24	3.00	2459	63.3
Manual weeding	29	3.05	2841	88.6
Mechanical weeding + Manual weeding	34	3.15	3404	126.0
Control	14	2.97	1506	--
LSD 5%	340.375	NS	5.84489	--

Table-2: Dry weed biomass (g/m²) as influenced by different chemical and mechanical weeding methods (30 days after planting).

Treatments	Dry Weight (g/m ²)		%age Weed Control	
	Broad Leaved	Narrow Leaved	Broad Leaved	Narrow Leaved
Panida Grande 43.5 EC @2.0 L/ha	38.35	24.63	64.69	73.33
Dual Gold 960 EC@ 2.0 L/ha	18.12	12.20	83.32	86.79
Mechanical weeding	22.9	12.11	78.92	86.9
Manual weeding	21.14	1.64	80.30	98.22
Control	108.62	92.35	-----	-----
LSD 5%	4.00281	3.514444	-----	-----

Table-3: Dry weed biomass (g/m²) as influenced by different chemical and mechanical weeding methods (60 days after planting).

Treatments	Dry Weight (g/m ²)		%age Weed Control	
	Broad Leaved	Narrow Leaved	Broad Leaved	Narrow Leaved
Panida Grande 43.5 EC @2.0 L/ha	180.31	92.04	35.91	26.21
Dual Gold 960 EC@ 2.0 L/ha	150.70	44.72	46.43	64.15
Glyphosate 490 G/L @4.7 L/ha	29.92	23.69	89.36	81.00
Panida Grande 43.5EC+Glyphosate 490G/L	21.50	17.27	92.36	86.15
Dual Gold 960 EC + Glyphosate 490G/L	9.13	2.15	96.75	98.28
Mechanical weeding	65.5	18.86	76.72	84.88
Manual weeding	38.5	4.50	86.32	96.39
Mechanical weeding + Manual weeding	3.19	3.0	98.87	97.59
Control	281.33	124.74	-----	-----
LSD 5%	2.60706	3.04748	-----	-----

Table: 4 Economics of weeding methods

Treatment	Yield (kg ha ⁻¹)	Income (PRs. ha ⁻¹)	Increase in yield over control (kg ha ⁻¹)	Values of increased seed cotton (PRs. ha ⁻¹)	Input cost of variable factors (PRs. ha ⁻¹)	Net profit over control (PRs. ha ⁻¹)	Benefit Cost Ratio (BCR)
Panida Grande 43.5 EC @ 2.0 L/ha	2615	205931	1109	87334	1500	85834	1.57
Dual Gold 960 EC @ 2.00 L/ha	2777	218689	1271	100091	2325	97766	1.42
Glyphosate 490 G/L @ 4.7 L/ha	2592	204120	1086	85523	2585	82938	1.32
Panida Grande 43.5+ Glyphosate 490 G/L	3219	253496	1713	134899	4085	130814	1.32
Dual Gold 960 EC + Glyphosate 490 G/L	3320	261450	1814	142853	4910	137943	1.28
Mechanical weeding	2459	193646	953	75049	1800	73249	1.41
Manual weeding	2841	223729	1335	105131	5700	99431	1.17
Mechanical weeding+ Manual weeding	3404	268065	1898	149468	3700	145768	1.39
Control	1506	118598	-	-	-	-	-

Basis of calculation

1. Seed cotton price = Rs.3150/40 kg
2. Panida Grande 43.5EC = Rs. 750/L
3. Dual Gold 960EC = Rs. 930/800 ml
4. Glyphosate 490G/L = Rs.550/L
5. Mechanical weeding = Rs.600/weeding
6. Manual weeding = Rs.1900/weeding

On overall average basis, combination of pre- and post application of weedicides gave 608 kg ha⁻¹ more seed cotton yield than average yield of application of weedicide alone, while combination of mechanical weeding with once manual weeding gave 754 kg ha⁻¹ more seed cotton yield than average yield of mechanical and manual weeding alone.

Among all the application methods, (Table-4) Benefit Cost Ratio (BCR) tabulated showed that application of pre-emergence weedicide remained more economical as compared to all other application of post-emergence weedicides alone as well as in combination and mechanical/manual alone as well as in combination. Yet, mechanical weeding was also economical than manual weeding.

But, keeping in view the interest of farmer's community, application of pre emergence weedicide is more beneficial than all other experienced weeding methods. On the other hand, combination of mechanical + manual weeding and combination of pre- and post-emergence weedicides application is better than all other methods in the best interest of national economy on the basis of production.

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