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IMPACT OF PHYSICAL AND CHEMICAL WEED CONTROL ON WHEAT YIELD AND YIELD COMPONENTS

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ABSTRACT

Field experiment was conducted at Research Farm, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan during Rabi 2007-08 to study the effect of herbicides and tillage on weeds and wheat. The experiment was carried out in randomized complete block design with split plot arrangement replicated four times. The treatments included in the experiment were 3 tillage depths viz. shallow tillage (5-7.5 cm with one cultivator and rotavator), medium tillage (10 cm with 2 cultivator and rotavator), and deep tillage (20-25 cm with disk plough, cultivator and rotavator) assigned to main plots, while five weed control treatments i.e. 2,4-D amine @ 1 L ha^{-1}, Topik 15 WP @ 0.09 kg a.i ha^{-1}, 2,4-D + Topik (clodinafop), hand weeding thrice (at 20, 35 and 50 days after sowing) and untreated weedy check (control) were assigned to subplots. Data were recorded on weed density m^{-2}, fertile tillers m^{-2}, spike length (cm), grains $spike^{-1}$, 1000 grains weight (g) and grain yield (t ha^{-1}). Tillage and herbicides significantly affected yield and yield components of wheat. Deep tillage produced highest yield and yield components followed by medium tillage and shallow tillage. Hand weeding performed better regarding yield and yield components closely followed by 2,4-D + Topik. Deep tillage in combination with either hand weeding or mixture of 2,4-D + Topik is recommended for effective weed management and enhanced grain yield of wheat.

Key words: Wheat, weed, tillage, herbicides, yield

INTRODUCTION

Wheat is an important food crop grown on an area of 8.5 million ha producing 21 m tones with an average yield of 2.5 tons ha^{-1} (MINFAL, 2008). Wheat yield is affected by several biotic and abiotic factors; however, weed is one of the most limiting factors which affect both quality as well as quantity of wheat. Weed control with the sole use of herbicides is possible and in practice in developing countries. However, recently many concerns are the serious issues of the globe. Herbicide associated problems

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are now under discussion. Thus there is a dire need of reducing herbicide dose and incorporation of other methods of weed control. Tillage practiced in sufficient depth not only controls weeds but also break plough pan and prompt decomposition of crop residues, which accelerate soil microbial activities and enhance soil fertility. Deep tillage has significant role in enhancing wheat yield, however, economic feasibility should be thoroughly monitored (Hussain and Munir, 1986). In contrast shallow tillage practices face severe weeds problem, difficulty in management of previous crop residues, lower mineralization rate and lower soil fertility, which contribute to lower wheat yield and yield components of wheat (Zentner *et al*. 2002). The present experiment was therefore designed to know the impact of tillage depth and various weed control treatments including herbicides and hand weeding on wheat yield and yield components in irrigated conditions of Dera Ismail Khan, Pakistan.

MATERIALS AND METHODS

Field experiment was conducted at Agronomic Research Farm, Faculty of Agriculture, Gomal University, D.I. Khan during 2007-08. Seed of improved wheat (*Triticum aestivum* L.) variety "Nasir-2000" at seed rate of 120 kg ha^{-1} was planted in rows 30 cm apart in the first week of November, 2007. The experiment was laid out in randomized complete block design with split plot arrangement replicated four times with subplot size of 5x3 m^2. The treatments used were shallow tillage (5-7.5 cm with one cultivator and rotavator), medium tillage (10 cm with 2 cultivator and rotavator), and deep tillage (20-25 cm with disk plough, cultivator and rotavator) as main plots, while five weed control treatments viz. 2,4-D amine @ 1 L ha^{-1}, Topik 15 WP @ 0.09 kg a.i ha^{-1}, 2,4-D + Topik (clodinafop), hand weeding thrice (at 20, 35 and 50 days after sowing) and untreated weedy check (control) as subplots. Recommended dose of fertilizer (120:60:30, NPK kg ha^{-1}) and five irrigations with one month interval were given uniformly to all the treatments during the course of experiment. Data were recorded on weed density m^{-2}, fertile tillers m^{-2}, spike length (cm), grains $spike^{-1}$, 1000 grains weight (g) and grain yield (t ha^{-1}). The data were statistically analyzed using analysis of variance and least significant difference (LSD) test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Weed density m^{-2}

Statistical analysis of the data showed that weed density m^{-2} was significantly affected by tillage (T) herbicides (H) and T x H interaction (Table-1). Maximum weed density m^{-2} (41) was recorded in shallow tillage (ST), while minimum weed density m^{-2} (16) was recorded in deep

tillage (DT). The least number of weeds recorded in deep tillage was also reported by other researchers (Sharma *et al.* 2004; Khattak *et al.* 2005; Hussain and Munir, 1986; Khan *et al.* 1986; Khan *et al.* 1990; Rathore *et al*. 1985). They reported that shallow produced maximum weed density and deep tillage was the most appropriate tillage to eliminate weeds and increase wheat yield compared to ST. These results are also in line with that of Conns (1987) who reported that DT significantly affected both grassy and broadleaf weeds compared to ST. In case of weed control treatments, hand weeding was the best where lowest number of weeds m^{-2} (4) were recorded, which was statistically at par with 2,4-D + Topik (7). Maximum weed density m^{-2} (58) was recorded in control plot (weedy check) closely followed by 2,4-D (40). 2,4-D + Topik effectively controlled weeds and ranked next to hand weeding in controlling diverse flora of weeds. In T x H interaction, DT performed better compared to ST and MT in all weed control treatments. However, weed density was lowest in all the three tillage methods where hand weeding was applied followed by 2,4-D + Topik (Khan *et al.* 2005). Although hand weeding is difficult yet it could be recommended for many farmers in our country. Many farmers practice hand weeding for the purpose to collect fodder for their animals. However weeding is done at anthesis of wheat therefore the objectives of weed control are not achieved.

Table-1. Effect of tillage (T) and herbicides (H) on weed density m^{-2} in wheat

Herbicides	Tillage			Means
	Shallow tillage	Medium tillage	Deep tillage	
2, 4-D	55.8	46.2	18.3	40.1
Topik	47.9	30.2	26.9	35.0
2, 4-D+Topik	7.9	9.2	4.1	7.1
Hand weeding	1.9	8.0	2.0	4.0
Control	91.0	56.9	27.1	58.3
Means	40.9	30.1	15.7	

$LSD_{0.05}$ for T =0.202, H=0.13, T x H=0.22

Number of fertile tillers m^{-2}

Fertile tillers m^{-2} was significantly affected by tillage, herbicides and tillage x herbicides interaction (Table-2). Higher number of tillers m^{-2} (266) were recorded in deep tillage, while lower tillers m^{-2} (240) were recorded in shallow tillage. The data further revealed that hand weeding showed highest number of fertile tillers m^{-2} (268.1) followed by 2,4-D + Topik (258.8), while control plot recorded lowest fertile tillers m^{-2} (231.1). The higher fertile tillers in hand weeding and 2,4-D + Topik treated plots may be attributed to effective weed control and allocation of more resources to

crop plants compared to weeds (Cheema and Akhtar, 2005). In T X H interaction, DT superceded ST and MT by producing higher fertile tillers in all weed control treatments, which may be ascribed to higher weed control efficiency, higher mineralization and higher moisture conservation in deep tillage compared to shallow tillage or medium tillage (Khan *et al.* 2005).

Table-2. Effect of tillage and herbicides on number of fertile tillers m^{-2} in wheat

Herbicides	Tillage			Means
	Shallow tillage	Medium tillage	Deep tillage	
2, 4-D	241	247	251	246.1
Topik	243	247	259	249.4
2, 4-D+Topik	244	251	282	258.8
Hand weeding	256	262	287	268.1
Control	219	225	250	231.1
Means	240	246	266	

$LSD_{0.05}$ for T =0.33, H=0.34, T x H=0.59

Spike length (cm)

Statistical analysis of the data showed that tillage, herbicide and tillage x herbicide interaction significantly affected spike length of wheat (Table-3). Lengthy spike (10.5 cm) was recorded in DT, while shorter spike length (9.8 cm) was recorded in ST. Hand weeding had the highest spike length (10.9 cm) followed by 2,4-D + Topic, while control plot produced lowest spike length (9.3) due to higher weed infestation. In TxH interaction, DT in combination with hand weeding or 2,4-D + Topik was more effective against weeds and produced higher spike length compared to ST/MT (Khattak *et al*. 2005; Khan *et al*. 2005).

Table-3. Effect of tillage and herbicides on spike length (cm)

Herbicides	Tillage			Mean
	Shallow tillage	Medium tillage	Deep tillage	
2, 4-D	9.9	10.0	10.3	10.1
Topik	10.1	10.3	10.4	10.3
2, 4-D+Topik	10.1	10.6	10.9	10.5
Hand weeding	10.7	10.7	11.2	10.9
Control	8.2	9.8	10.0	9.3
Mean	9.8	10.3	10.5	

$LSD_{0.05}$ for T =0.10, H=0.05, T x H=0.08

Number of grains spike^{-1}

Number of grains spike^{-1} was significantly affected by T, H, and T x H interaction (Table-4). More number of grains spike^{-1} (62.75) was observed in deep tillage while lower grains spike^{-1} (57.75) was recorded in shallow tillage. Hand weeding produced highest number of grains spike^{-1} (62.42), while control plot produced lowest number of grains spike^{-1} (58.00). Deep tillage x hand weeding produced highest number of grains spike^{-1} (65.75) among all other interactions. ST was inferior at all levels of weed control treatments than medium tillage and deep tillage probably due to higher weed infestation and higher competition among weeds and crop plants (Khan *et al*. 2005).

Table-4. Effect of tillage and herbicides on grains spike^{-1} in wheat

Herbicides	Tillage			Means
	Shallow tillage	Medium tillage	Deep tillage	
2, 4-D	57.75	57.75	61.75	59.08
Topik	57.75	58.75	61.75	59.42
2, 4-D+Topik	57.75	60.75	63.75	60.75
Hand weeding	58.75	62.75	65.75	62.42
Control	56.75	56.5	60.75	58.00
Means	57.75	59.30	62.75	

$LSD_{0.05}$ for T =0.19, H=0.21, T x H=0.35

1000 grains weight (g)

Tillage, herbicides and tillage x herbicides interaction did not influence 1000 grains weight significantly (Table-5). However, favorable effect of tillage showed highest 1000 grains weight (45 g) in deep tillage. Similarly, hand weeding produced heavier 1000 grain weight (45 g), while control plot produced lowest 1000 grain weight (42 g). All other weed control treatments gave similar values regarding 1000 grain weight as reported by Ozpinar (2006) and Khan *et al*. (2005).

Table-5. Effect of tillage and herbicides on 1000 grains weight (g)

Herbicides	Tillage			Means
	Shallow tillage	Medium tillage	Deep tillage	
2, 4-D	44	44	44	44
Topik	44	44	44	44
2, 4-D+Topik	44	44	46	44
Hand weeding	44	46	47	45
Control	39	43	44	42
Means	43	44	45	

Grain yield (t ha^{-1})

Grain yield (t ha^{-1}) was significantly affected by tillage, herbicides and tillage x herbicide interaction (Table-6). Deep tillage produced maximum grain yield (3.2 t ha^{-1}), while shallow tillage produced minimum grain yield (2.8 t ha^{-1}). Hand weeding produced highest yield followed by 2,4-D + Topik, while weedy check produced lowest grain yield (2.5 t ha^{-1}). In tillage x herbicide interaction, deep tillage was superior at all levels of weed control treatments compared to shallow tillage and medium tillage, however, highest grain yield (3.7 t ha^{-1}) was achieved in deep tillage x hand weeding plots. These results are in line with the data reported by other researchers (Hussain and Munir, 1986; Khan *et al*. 1986; Khan *et al*. 1990; Khan *et al.* 2005).

Table-6. Effect of tillage and herbicides on grain yield (tha^{-1}) in wheat

Herbicides	Tillage			Means
	Shallow tillage	Medium tillage	Deep tillage	
2, 4-D	2.6	2.7	3.0	2.7
Topik	2.8	3.0	3.1	2.9
2, 4-D+Topik	3.1	3.2	3.5	3.2
Hand weeding	3.3	3.5	3.7	3.5
Control	2.3	2.4	2.8	2.5
Means	2.8	2.9	3.2	

$LSD_{0.05}$ for T =0.024, H=0.04, T x H=0.06

CONCLUSION

Deep tillage in combination with either hand weeding or mixture of 2,4-D + Topik is recommended for effective weed management and enhanced grain yield of wheat in rice-wheat cropping system.

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