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RESPONSE OF WHEAT TO HERBICIDES APPLICATION AND HAND WEEDING UNDER IRRIGATED AND NON-IRRIGATED CONDITIONS

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ABSTRACT

In irrigated and non-irrigated areas winter weeds like Convolvulus arvensis, Carthamus oxyacantha, Avena fatua, Phalaris minor and Melilotus parviflora, Medicago denticulata and Ammi visnaga etc. are the main causes drastically reducing yield of cereals, especially wheat. An experiment was conducted during 2003-4 to assess the herbicides effects under irrigated and non-irrigated conditions with wheat variety Saleem-2000. Recommended dose of Puma super 75 E.W (0.94 kg ha^{-1}) and Buctril-M 40 E.C (0.70 kg ha^{-1}) was used in the experiment. The experiment was carried out in RCB design with split plot arrangement, with experimental conditions (irrigated and non-irrigated) in main plots, while herbicide treatment (Puma super 75 E.W, Buctril-M 40 E.C, Mixture of Puma super 75 E.W and Buctril-M 40 E.C, hand weeding and control) were kept in the sub plots. The data were recorded on emergence m^{-2}, weed density m^{-2} before spraying, weed density m^{-2} after spraying, plant height, spikes m^{-2}, grains spike^{-1}, 1000 grain weight, grain yield and biological yield. Significantly maximum emergence m^{-2} (115), weed density m^{-2} before spraying (74), weed density m^{-2} after spraying (26), plant height (92 cm), spikes m^{-2} (78), grains spike^{-1} (64.8), 1000 grain weight (44.64 g), grain yield (2795 kg ha^{-1}) and biological yield (5794 kg ha^{-1}) were recorded in irrigated condition. As regards herbicidal applications, minimum weed density m^{-2} after spraying (7) was recorded in hand weeding, while maximum plant height (93 cm), spikes m^{-2} (182) grains spike^{-1} (49.7), 1000 weight (47.80 g), grain yield (3275 kg ha^{-1}) and biological yield (6740 kg ha^{-1}) were recorded in hand weeding. It is concluded that hand weeding and mixture of herbicides Puma super 75 E.W and Buctril-M 40% E.C showed better result in terms of productivity and weed control than both control as well as sole herbicide applications. But due to very high infestation of weeds and more labour cost involvement in hand weeding practices, the mixture of Puma super 75 E.W and Buctril-M 40 E.C is recommended for better performance of wheat in both irrigated as well as non-irrigated conditions.

Key words: Wheat, herbicides, weeds, irrigated and non-irrigated conditions

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INTRODUCTION

Wheat (*Triticum aestivum* L.) is the cereal of choice in most countries of the world. It is a chief source of food for a great deal of population and is known as the king of cereal. In Pakistan it ranks first among the cereal crops and occupies about 66% of the annual food cropped area (Anonymous, 1996). It is the staple food for the people of Pakistan and meets the major dietary requirements, supplies about 73% of the calories and protein of the average diet (Heyne, 1987). A healthy wheat crop is not only a symbol of prosperity but also a source of strength for a nation. A decrease in wheat production severely affects the economy of a country and increases the miseries of the inhabitants. Actual farm yield of the wheat in Pakistan is about 30-35 % of the total potential yield, where as 50% mean yield is realized in wheat leading nations like China and Mexico (Anonymous, 1997). A better progress has been made in increasing per hectare yield of wheat in the country four years ago. This bumper wheat harvest had changed the nation's status from wheat importing to an exporting one, but unfortunately it could not be exported and it was carried over to next year due to which market stayed cluttered. Unfavorable weather conditions during the last growing season conjunctly declined wheat production and this year the country is importing wheat again to meet its domestic needs. One of the prime reasons for the increased yield in the recent past was the introduction of very effective grass specific herbicides Puma super and Topik which were feasible to be used due to increased support price of wheat. Despite the use of adequate amount of chemical fertilizer and modern cultivars, the yield of wheat are still 30-80% lower than the potential yield of wheat crop and have been stagnant for the last many years (Khan, 2001). Weed infestation is an important but less noticed constraint, contributing towards low yield of wheat in Pakistan. It has been estimated that weeds cause 17-25% losses in wheat annually (Shad, 1987) and 17-50% (Anonymous, 1998). Weeds use soil fertility, available moisture, and nutrients and compete for space and light. Annual losses in wheat amount to more than Rs.28 billion at the national level and Rs.2 billion in NWFP (Hassan and Marwat, 2001). The major weeds competitive with wheat crop in NWFP include: *Avena fatua*, *Phalaris minor*, *Cirsium arvense*, *Convolvulus arvensis*, *Ammi visnaga*, *Chenopodium album*, *Carthamus oxycantha* and *Euphorbia helioscopia* (Hassan, *et al.*, 2003)

The control of weeds is a basic requirement and major component of management in the production system (Young *et al.*, 1996). Eradication and destruction of weeds has been practiced by man since long time by manual labour or animal drawn implements but these practices were hard, laborious and expensive due to increasing cost of labour. The growing mechanization of farm operation has even increased chemical weed control. The selection of herbicides, proper time of application and proper dose of herbicides are the important consideration for lucrative return (Fayad *et al*, 1999). Different reports are available on the efficacy of herbicides in wheat (Khan *et al*, 2001) however; recent studies showed that herbicides treatment gave 87.2 to 90.3% weed control with a consequent 19.4 to 20.97% increase in grain yield. The adoption of economical, feasible and effective weed control packages such as herbicides is encouraging in the wheat growing belt of the country. Therefore, instant studies were planned to determine the efficacy of herbicides on weeds both in irrigated as well as non-irrigated conditions.

MATERIALS AND METHODS

In order to study the efficacy of herbicides on wheat variety Saleem-2000 under irrigated and non-irrigated condition, a trial was carried out at Agricultural Research Farm, NWFP Agricultural University, Peshawar during Rabi season 2003-2004. The

experiment was laid out in randomized complete block design with split plot arrangement and four replications. The experimental condition (irrigated and non-irrigated) was assigned to main plot, while herbicidal treatments (Puma super 75 E.W, Buctril-M 40 E.C, Mixture of Puma super 75 E.W and Buctril-M 40 E.C, hand weeding and unweeded control) to sub plots. The subplot size of 15 m^2 was maintained in the experiment. The herbicides were applied to subplot first at three leaf stage and then prior to boot leaf stage both in irrigated as well as in non-irrigated conditions at recommended dose of Puma super 75 E.W (0.94 kg a.i. ha^{-1}) and Buctril-M 40 E.C (0.70 kg a.i. ha^{-1}). Similarly hand weeding was also done at the same stages, whereas Irrigation was applied whenever required in irrigated condition while no irrigation was given to non-irrigated condition. Seedbed was prepared at proper moisture conditions and a basal dose of 120 kg N and 60 kg P_2O_5 ha^{-1} was applied as Urea and SSP, respectively. The data were recorded on: emergence m^{-2}, weed density m^{-2} before spraying, weed density m^{-2} after spraying, plant height, spikes m^{-2}, grains $spike^{-1}$, 1000 grain weight, grain yield and biological yield of wheat. Data were analyzed using analysis of variance appropriate to RCB design. Upon obtaining significant differences, least significant difference (LSD) test was used for comparison among the treatment means (Little and Hills, 1978).

RESULTS AND DISCUSSION

Emergence m^{-2} is an important parameter of any crop and substantially contributes to final yield. Data regarding emergence presented in Table-1 showed significant differences for irrigated and non-irrigated conditions while non-significant differences for herbicides treatments. Maximum wheat emergence m^{-2} (115) was recorded in irrigated condition in comparison to non-irrigated condition (108). The significant results might be due to proper and adequate moisture availability for proper germination and initiation of Phase II of germination of seedling, which may have resulted in proper, uniform and maximum germination. The non-significant effect of herbicides may be due to initially lack of weeds in plot, which may have no effect on germination of seedling or might be due to seeds' capability to germinate into seedling.

Weed density m^{-2} is an important component of crop husbandry, which should be taken into account, because it substantially contributes in determining final yield. Data regarding weed density before spraying presented in Table-1 showed significant differences for irrigated and non-irrigated condition while non-significant differences for herbicides treatments. Maximum weed density m^{-2} (74) was recorded in irrigated treatment while 69 for non-irrigated treatment. The significant results might be due to proper and adequate availability of water for proper germination and development of weeds in their respective plot. The non-significant effect of herbicides treatment and hand weeding may be due to not practicing the control measure of weeds.

Data regarding weed density m^{-2} after control measures are reported in Table-2 Meditation of the data showed significant differences for irrigated and non-irrigated condition as well as for herbicidal treatments. Higher weed density m^{-2} (26) was recorded in irrigated condition in comparison to non-irrigated condition (23). Significantly higher number of weeds in irrigated condition might be due to preceding greater number of weeds, proper as well as adequate water availability for proper germination and development of weed plants in the respective plots. Similarly minimum number (7) of weeds was recorded in hand weeded plots followed by plots sprayed with mixture of Buctril-M and Puma super whereas maximum number of weeds (77) was recorded in unweeded control plots. The significantly minimum number of weeds in plots treated with herbicides or hand weeding might be due the eradication of weeds either due to pulling

out with hand or due to the phytotoxic effects of herbicides on weeds. These results are in line with Hashim *et al.*, (2002) and Hassan *et al.* (2003) who reported maximum weeds in unweeded control plots.

Plant stature affects crop in several ways and has a direct positive effect on biological yield. Plant height data presented in Table-2 revealed that irrigated and non-irrigated conditions as well as herbicide treatments have significant effects on plant height. Higher plant height (92 cm) was recorded in irrigated condition as compared to 83 cm recorded in non-irrigated condition. This significant effect might be due to proper moisture condition necessary for a successful crop raising. Similarly maximum plant height (93 cm) was recorded in hand weeded plots followed by plots sprayed with Puma super and Buctril. These significant increments in plant height may be due to lesser competition of weeds with crop for nutrients, light, space, water and gases.

Statistical analysis of the data regarding spikes m^{-2} shown in Table-3, revealed that number of spikes were significantly affected by irrigation and non-irrigation condition and herbicide treatments. Maximum number of spikes m^{-2} (178) were recorded in irrigated plots as compared to 155 spikes m^{-2} in non-irrigated plots. These might be due to adequate moisture availability at critical stages of crop development. Similarly maximum number of spike m^{-2} (179 each) were recorded in hand weeded plots and the plots sprayed with Puma super and Buctril mixture, whereas minimum number of spikes m^{-2} (137) were recorded in unweeded control plots. The eradication of weeds either by hand pulling or due to phytotoxic effects of herbicides might have led to maximum number of spikes m^{-2} in hand weeded and sprayed plots. The control of weeds has direct impact on number of spikes m^{-2} and increased with decrease in weed density. These results are in line with Khalil *et al* (1999) who reported that post emergence herbicides have increased number of spike m^{-2} in wheat crop.

Data regarding grains $spike^{-1}$ showed that irrigation and non-irrigation condition and herbicides treatments had significantly affected on grains $spike^{-1}$ (Table-3). More grains $spike^{-1}$ (46.8) were recorded in irrigated plots while 39.9 grains $spike^{-1}$ was recorded in non-irrigated condition. This might be due to the great influence of water availability at critical stages of plant growth, which have substantially increased number of grains $spike^{-1}$. Similarly maximum number of grains $spike^{-1}$ (49.7) was recorded in hand weeded plots, followed by (49.2) in plots sprayed with Puma super and Buctril mixture whereas minimum (35.3) grains $spike^{-1}$ were recorded in unweeded control plots. This might be due to elimination of weeds in hand weeded and herbicides applied plots which might have resulted in more free space, nutrient availability and light capturing capability of plots which leading to higher number of grains $spike^{-1}$. These results are in line with Khan *et al.*, (2002) and Tunio *et al.*, (2004) who reported more grains $spike^{-1}$ in plots treated with herbicides.

Thousand-grain weight is a major contributor to the final grain yield. The data regarding thousand grain weight are presented in Table-4. A reference to the data revealed that irrigation and non-irrigation condition and herbicides had significantly affected thousand-grain weight. Higher 1000-grain weight (44.64 g) was recorded in irrigated plots while 37.30 g grain weight was recorded in non-irrigated condition. This might be due to the great influence of water availability at critical stages of plant that have substantially increased thousand-grain weight. Similarly maximum thousand-grain weight (47.8 g) was recorded in hand weeded plots, followed by 47.19 g in the plots sprayed with Puma super and Buctril-M mixture whereas, the minimum (32.41 g) grain weight was recorded in unweeded control plots. This might be due to the removal of weeds in hand weeded and herbicide treated plots resulting in more free space, nutrient availability and

light capturing capability of plants leading to maximum thousand grain weight. These results are in line with Qureshi *et al.*, (2002) and Hassan *et al.* (2003), who reported more grain weight in plots applied with herbicides.

Biological yield is a major contributor to the economic output of any crop and it depends upon species, growing season and various other factors. Significantly higher biological yield (5794 kg ha^{-1}) was recorded for irrigated plots as compared to 4358 kg ha^{-1} produced in non-irrigated condition (Table-5). It might probably be due to the availability of sufficient amount of water at critical stages of crop which may have resulted in more biological yield. Similarly improved biological yield (6740 kg ha^{-1}) was recorded in hand weeded plots, followed by 6384 kg ha^{-1} in plots sprayed with Puma super and Buctril-M mixture while minimum (3434 kg ha^{-1}) biological yield was recorded in unweeded control plots. These significant increments in biological yield might be attributed to the effective weed control in these treatments and consequently wheat crop has efficiently utilized all the available resources. These results agree with the findings of Khan *et al.*, (2003).

Grain yield is the ultimate target of all the crops and depends upon various factors such as soil status, environmental factor and plant genetic makeup. Significantly higher grain yield (2795 kg ha^{-1}) was recorded for irrigated plots and 2051 kg ha^{-1} for non-irrigated condition (Table-5), this might be probably due availability of sufficient amount of water at critical stages of crop growth which may have resulted in maximum grain yield. Similarly improved grain yield (3275 kg ha^{-1}) was recorded in hand weeded plots, followed by (3094 kg ha^{-1}) in plots sprayed with Puma super and Buctril-M mixture while minimum (1575 kg ha^{-1}) grain yield was recorded in unweeded control plots. The significant increment in grain yield might be attributed to the effective weed control in these treatments and consequently wheat crop efficiently utilized all the available resources. These results are in line with Awan *et al.*, (1990) and Tunio *et al.*, (2004) who reported more grain yield in plots applied with herbicides.

CONCLUSION AND RECOMMENDATION

From the preceding results it is concluded that weed have a direct effect on wheat performance and weed drastically decreased wheat yield. Both hand weeding and herbicidal treatments result in better control of weeds but due to high cost of labour it is recommended that mixture of Puma super and Buctril-M may be used at recommended rate for better performance of wheat in agro-climatic conditions of Peshawar.

Table-1. **Emergence m^{-2} and Weed infestation before spraying in wheat as affected by herbicides and hand weeding**

Herbicides	Emergence m^{-2}			Weed infestation before spraying		
	Irrigated	Non-irrigated	Mean	Irrigated	Non-irrigated	Mean
Unweeded Control	114	108	111	73	69	71
Hand weeding	115	108	111	74	69	71
Puma super	115	108	111	74	68	71
Buctril-M	116	109	112	75	69	72
Puma super + Buctril	116	108	112	74	68	71
Mean	115 a	108 b		74 a	69 b	
$LSD_{0.05}$						
Herbicides		NS			NS	
H X I		NS			NS	

Mean followed by same letter(s) in the same category are not significantly different at P≤0.05 using LSD test.

Table-2. **Weed infestation after spraying and Plant height (cm) of wheat as affected by herbicides and hand weeding.**

Herbicides	Weed infestation after spraying			Plant height (cm)		
	Irrigated	Non-irrigated	Mean	Irrigated	Non-irrigated	Mean
Unweeded Control	82 a	72 b	77 a	85 d	77 e	81 c
Hand weeding	8 e	7 e	7 c	100 a	85 bcd	93 a
Puma super	18 c	17 cd	17 b	89 bc	85 cd	87 b
Buctril-M	17 cd	15 d	16 b	89 b	83 d	86 b
Puma super + Buctril-M	8 e	7 e	8 c	99 a	86 bcd	92a
Mean	26	23		92 a	83 b	
$LSD_{0.05}$						
Herbicides		1.478			2.773	
H X I		2.09			3.922	

Mean followed by same letter(s) in the same category are not significantly different at P≤0.05 using LSD test.

Table-3. Spikes m^{-2} and Grains $spike^{-1}$ of wheat as affected by herbicides and hand weeding

Herbicide	Spikes m^{-2}			Grains $spike^{-1}$		
	Irrigated	Non-irrigated	Mean	Irrigated	Non-irrigated	Mean
Unweeded Control	133 f	141 e	137 d	38.3	46.2	[illegible]
Hand weeding	[illegible] a	167 c	182 a	53.2	46.2	[illegible] a
[illegible]	[illegible] b	152 d	[illegible]	44.[illegible]	38.2	[illegible]
[illegible]	[illegible]	148 d	164 c	44.[illegible]	37.[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	17[illegible] a	52 [illegible]	45.7	[illegible]
[illegible]	176 a	156 b		46.8 a	[illegible] b	
[illegible]		4.23			[illegible]	
[illegible]		5.98			NS	

Means followed by same letter(s) in the same category are not significantly different at [illegible] using LSD test.

Table-4 1000 grain weight (g) of wheat as affected by herbicides and hand weeding

Herbicide	1000 grain weight (g)		
	Irrigated	Non-irrigated	Mean
[illegible]	36.19	28.63	[illegible]
[illegible]	51.55	44.07	[illegible]
[illegible]	42.08	35.57	[illegible]
[illegible]	41.69	34.7	[illegible]
[illegible]	50.74	43.55	47.1[illegible] a
[illegible]	44.64 a	37.30 b	
[illegible]		0.964	
[illegible]		NS	

[illegible] same letter(s) in the same category are not significantly different at [illegible] 5% [illegible]

Table- 5. **Biological yield and Grain yield (kg ha^{-1}) of wheat as affected by herbicides and hand weeding**

Herbicides	Biological yield (kg ha^{-1})			Grain yield (kg ha^{-1})		
	Irrigated	Non-irrigated	Mean	Irrigated	Non-irrigated	Mean
Unweeded Control	4006	2861	3434 c	1869	1281	1575 d
Hand weeding	7474	6007	6740 a	3654	2897	3275 a
Puma super	5330	3677	4504 b	2567	1703	2135 c
Buctril-M	5179	3457	4318 b	2482	1588	2035 c
Puma super + Buctril-M	6979	5790	6384 a	3403	2785	3094 b
Mean	5794 a	4358 b		2795 a	2051 b	
$LSD_{0.05}$						
Herbicides		375.8			172.3	
H X I		NS			NS	

Mean followed by same letter(s) in the same category are not significantly different at P≤0.05 using LSD test.

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