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EFFICACY OF DIFFERENT HERBICIDES FOR CONTROLLING WEEDS IN WHEAT CROP-II. WEED DYNAMICS AND HERBICIDES

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ABSTRACT

An experiment was laid out at Malakandher farm of the NWFP Agricultural University, Peshawar to study the efficacy of grass and broadleaf specific or broad spectrum herbicides alone and in mixtures in wheat cv. 'Ghaznavi-98'. The experiment was designed in randomized complete block with 4 replications. The plot size measured 5 x 1.50 m^2. All the recommended production package except the herbicidal treatments were equally adopted for all the experiment. Avena fatua, Poa annua, Medicago denticulata and Rumex crispus were the predominant weeds infesting the experiment. The data were recorded on the mortality (%) of grasses and broadleafs, density (m^{-2}), relative density (%) and frequency (%). The analyses of data showed that mortality of the different weed species significantly varied with the differential treatment. Puma Super[2], Topik and their tank mixtures with the broad leaf killers gave an excellent control of grasses. Isoproturon was moderately effective in controlling grassy weeds and it emerged as very weak on wild oats. The braodleaf killers and their tank mixtures gave a remarkable control of broadleafs. Isoproturon was also equally effective in controlling broadleafs. The weed density was non-significant when recorded 30 Days after spray or at the time of harvesting wheat exhibiting that the herbicides gave a successful season long control of the target weeds. Tank mixing of grass and broadleaf specific herbicides offered a synergistic control of weeds, thus for effective weed management tank mixing of the two categories of herbicides is suggested.

Key words: Wheat, weed control, weed dynamics

INTRODUCTION

Wheat *(Triticum aestivum* L em Thell) is the basic component of human diet. It is the staple food of Pakistan. Wheat plays an important role in the national economy. A decrease in wheat production severely effects the economy of Pakistan and adds into the miseries of the inhabitants. Average yield of wheat in Pakistan does not go beyond 30-35 % of its optimum potential (Sarwar and Nawaz, 1985). Among the factors which adversely influence the crop yield, weed

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infestation is the devastating one. Weeds exert stress onto the cultivated crop through interference, consisting of competition, allelopathy, and parasitism. They compete with cultivated crops for space, light, water, soil nutrients and carbon dioxide. Weeds cause greater losses than either insects or plant diseases. Weeds affect the growth of desired crops species due to the competition, allelopathy, and by providing habitat for other harmful organisms (allelomediation). The major losses in wheat yield at the national level due to weed infestation amount to a grain loss of 1.25 to 2.5 millions tons per year (Ahmad et.al., 1984). However, losses in wheat yield due to weed infestation may be up to 17 - 25 % (Shad , 1987). The annual losses to wheat crop on Pakistan and NWFP in monetary terms amount to Rs.28 and 2 billions, respectively (Pervaiz and Quazi, 1992). Under Indian conditions, weeds have been reported to decrease yield by 15.50 percent and in a serious infestation conditions may lead to a complete failure of crop (Gill and Walia, 1979). Under Iranian environment, 65% loss due to weed infestation in wheat has been evaluated (Mirkamali, 1987). The bumper wheat harvests of 1999-2000 and 2000-2001, which have rendered the nation from wheat importing to an exporting country, are believed in part due to the introduction of effective oat-killers like Puma Super and Topik and increased use of chemical weed control strategy due to anticipated economic gains, needs to be made sustainable.

In Pakistan, during 1999-2000, wheat was grown on an area of 8.30 million ha, with a production of 21 million tons. The area consists of about 6.898 million ha irrigated and 1.332 million ha of un-irrigated land. In NWFP, wheat is grown on an area of about 0.858 million ha. One-third of this area in NWFP is irrigated, while two-third is rainfed (Anonymous, 2000). Control of weeds is a serious problem in Pakistan's agriculture. Conventional methods of weed control are weather-dependent, tedious, laborious, time consuming and costly. Crop mimicry (resemblance) by grassy weeds like wild oats and canary grass complicates the success of manual weed control strategies. Thus, chemical weed control has been proved to be relatively efficient and economical in controlling weeds (Majid *et al*., 1983 and Salarzai *et al*., 1999).

Chemical control of weeds, aiming at shifting the balance of the agro-ecosystem in favour of cultivated crop has proved to be relatively efficient and economical in controlling the weeds. The efficacy of weedicides, however, depends more upon their formulation in addition to time, methods and rate of application (Majid *et al.,* 1983). Isoproturon, Tribunil, and Nitrofen gave efficient control of weeds and increased number of tillers, grain yield and other yield components of wheat (Borghain *et al*., 1985). Application of Buctril-M decreased broadleaf weed population significantly and increased total number of tillers, number of grains per spike, 1000- grain weight and straw yield (Shah *et al*., 1989; Khan *et al*., 1999; Khan *et al.,* 2001). Randhawa *et al.* (1981); Rastogi *et al*.. 1984 and Iqbal, *et al*., (1987) studied various substituted urea herbicides and found 51-62% decrease in weed population including *Phalaris minor*, with a consequent increased grain yield of upto 3.5 tons ha^{-1}. Iqbal, *et al*., (1987) and Riaz, *et al*., (1988) obtained upto 92% increase in wheat grain yield with the use of different weed killers as a consequence of gain in yield components.

Tank mixing of herbicides is practiced for attaining synergism but, antagonism is also not uncommon in such a mixing. A reduction in absorption and translocation has been reported when grass killers were mixed with the broadleaf killers (Williams, 1984; Deschamps, *et al*., 1990.

Augero-Alverdo and Appleby, 1991; Augero-Alverdo, *et al.*, 1991). The instant studies were undertaken to evaluate the efficacy of different herbicides alone and in mixture on dynamics of weeds in wheat.

MATERIALS AND METHODS

Studies pertaining to the effect of different herbicides alone and in mixture on the dynamics of weeds in the wheat variety 'Ghaznavi-98' were conducted at the Malakandher Farm of N.W.F.P Agricultural University, Peshawar. Experiment was laid out in randomized complete block design with four replications with a plot size of 10 x 1.5 m^2. The herbicidal treatments employed in the studies are detailed in Table 1. Wheat variety Ghaznavi-98 was sown during the 3rd week of November, 1999. Herbicides were sprayed after first irrigation in moist condition at 3-5 leaf stage. After spraying the herbicides, the mortality data were recorded for the broadleaf and grassy weeds separately by a visual rating in the scale from 0 to 100. The zero in the scale showed no effect on weed, while 100 exhibits 100% kill of the weed. The densities and frequencies of the pre-dominant weed species i.e. littleseed canary grass *(Poa annua)*, wild oats *(Avena fatua)*, common medic *(Medicago denticulata)*, curly dock *(Rumex crispus)*, and pimpernel *(Anagallis arvensis)* were taken by using a quadrate of 50 cm^2. Subsequently the data were converted to m^{-2}. The relative density of grass and broadleaf species was recorded separately, where it equals number of plants of the given species divided by total number of plants of all species, expressed as percent.

In this manuscript, the data is reported for the former four weed species. The weed density and frequency were recorded 30 days after spray (DAS) and at the time of harvesting. The data collected were tabulated and the data for individual trait were subjected to ANOVA technique and the significant means were separated by Least Significant Difference Test (Steel and Torrie, 1980) using MSTATC computer software. For the analysis of data for density, relative density and frequency an additional variable i.e. the time of data recording was also included in the analyses.

Table 1. Detail of herbicidal treatments in the herbicide efficacy studies in wheat.

Trade name	Common name	Dose (kg ai ha^{-1})
T1=Logran 64 W.G	Trisulfuron	0.16
T2=Topik 15 W.P	Clodenafop	0.04
T3=Buctril-M 40% E.C	bromoxynil+MCPA	0.70
T4=Puma Super 75 E.W	fenoxaprop-ethyl	0.94
T5=Isoproturon 50 W.P	isoproturon	0.63
T6=2, 4-D Ester 72% E.C	2, 4-D	0.90
T7=Puma Super + Logran	T1 + T4	0.94 + 0.16
T8=Topik + Buctril-M	T2 + T3	0.04 + 0.70
T9=Puma Super + Buctril-M	T3 + T4	0.94 + 0.70
T10=Isoproturon + Buctril-M	T3 + T5	0.63 + 0.70
T11=Puma Super + 2, 4-D	T4 + T6	0.94 + 0.90
Weedy Check	Weedy Check	-------

RESULTS AND DISCUSSION

Weeds Mortality (%): The experiment was infested with broadleaf and grassy weeds. Weed spectrum mainly composed of more than 15 weed species viz. grasses and broadleaf, but predominantly there were two grassy (*Avena fatua* and *Poa annua*) and two broadleafs (*Rumex crispus* and *Medicago denticulata*) species infesting the experiment. Mortality data of grasses exhibit that the treatments involving Puma super and Topik @ 0.94 and 0.04 kg ai ha^{-1}, respectively gave the best control of grassy weeds, whereas the worst control of grasses was obtained when broadleaf herbicides were applied alone (Table 2). Broadleaf weeds were affected significantly in all the treatments except in the grass killers Topik (12.50%) and Puma super (12.50%). While Isoproturon being a broad spectrum herbicide controlled both the grasses (63.75%) and broadleafs (82.50%) effectively (Table 2).

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Weeds density (m^{-2}): The analysis of weed density data reveal that weed density was non significant for the two readings i.e. the density recorded 30 DAS and at the time of harvesting wheat in all the major weeds studied except *M.denticulata*, which shows that the herbicides were persistent enough to give the season long control of weed species. The non-significance of *M. denticulata* is attributed to the fact at the time of second data recording the species under reference has already senesced after completing its life cycle. Similarly the interaction of time of data recording with the herbicides was also non significant statistically for all weed species referred herein, which depicts that the residual effect of herbicides was equally effective for all the major weeds studied. The main effects of herbicides were however statistically significant for the species except *P.annua*. Lowest number of *A. fatua* was found in Puma+2,4-D (1.12 m^{-2}) followed by Puma +Logran (1.58 m^{-2}). Maximum number of *A.fatua* plants was recorded in the weedy check (6.50 m^{-2}) [Table 3].

Table 2: Mortality of grasses and broadleafs due to different herbicides applied alone and in mixture

Herbicides	Mortality (%) Grasses	Broadleafs
Logran	5.00 e	97.50a
Topik	85.00ab	12.50b
Buctril-M	0.00 e	90.00a
Puma Super	71.25abc	12.50b
Isoproturon	63.75bcd	82.50a
2,4-D Ester	12.50e	75.00a
Puma+Logran	92.50a	98.75a
Topik+Buctril	82.50abc	87.5a
Puma+Buctril	62.50cd	85.00a
Isoproturon+Buctril	42.50d	100.00a
Puma+2,4-D	78.75abc	91.25a
Weedy check	0.00e	0.00b

The perusal of data in Table 3 further exhibit that none of the herbicides could effectively control *P. annua*. However, its density was numerically lower in Isoproturon treated plots (42.5 m^{-2} and highest count was recorded from 2.4-D (83 m^{-2}) and weedy check (80.50 m^{-2}). *M. denticulata* was controlled effectively in the treatment Puma +Logran (4.90 m^{-2}) which was statistically comparable with the Logran, Isoproturon, 2,4-D and their mixture with grass specific herbicides except Puma + 2.4-D . Astonishingly Buctril-M emerged weaker on *M. denticulata* as its density was statistically comparable even with the weedy check (Table 3). The density of *R. crispus* was statistically significant among the herbicidal treatments. Isoproturon and its mixture with Buctril-M significantly controlled the *R. crispus* as the lowest number was recorded for these herbicides (Table 3). The highest number (21.88 m^{-2}) was recorded in the weedy check. These findings are in a great analogy with the work reported by Riaz et. (1988), Iqbal *et al.*, (1987), Majid et al. (1983), Khan et al. (1999), and Khan et al. (2001), who obtained varying degree of control of different weed species with the different herbicides. These findings however, differ from the work reported by Augero-Alverdo and Appleby (1991), Aguero-Alverdo *et al.*. (1991). Deschamps et al. (1990) and Williams (1984) who reported the antagonistic effect of broadleaf and grass killers when used in mixture. Whereas, our findings reveal either no effect or slightly synergistic response in different combinations of grassy and broadleaf killers.

Weeds relative density (%): The ANOVA depicted statistical differences for data recording time and herbicides for *R. crispus* only. Whereas, no differences for recording time. herbicide and their interaction existed for remaining sources. Among the grasses, the highest density was of *P. annua*. None of the herbicides could give an adequate control of this species (Table 3). For *A. fatua*, although non-significant statistically, the Isproturon ailed to give any control of the species under reference (Table 4). Grass killers (Topik and Puma Super) and their tank mixing with the broadleaf killers gave a good control. Similarly among the broadleafs, the conventional broadleaf killers 2.4-D and Buctril-M could not exhibit their efficacy for the control of *M. denticulata*. For *R. crispus*, the broadleaf killers and broad spectrum alongwith their mixtures with the grass killers furnished an effective control (Table 4). The highest relative density was recorded in the weedy check and the grassy herbicides alone application. These findings are in a great conformity with the work reported by Iqbal *et al.* (1987), Majid *et al.* (1983). Khan *et al.*, (1999).

Table 3. Density (m^{-2}) of different grassy and broadleafd weeds in wheat

Herbicides	Grasses		Broadleafs	
	A. fatua	*P. annua*	*M. denticulata*	*R. crispus*
Logran	3.25bcd	10.62def	3.62	3.75cd
Topik	2.96bcd	14.71cdef	7.83	10.50bc
Buctril-M	3.21bcd	17.08cde	11.2	5.25cd
Puma Super	3.62bc	18.58cde	8.44	16.25ab
Isoproturon	3.37bcd	3.16f	4.90	1.75d
2.4-D Ester	3.96b	31.34ab	7.92	6.87cd
Puma+Logran	1.58cd	8.41ef	2.58	3.37cd
Topik+Buctril	2.96bcd	17.00cde	5.33	4.12cd
Puma+Buctril	2.37bcd	20.45bcd	6.33	5.37cd
Isoproturon+	2.96bcd	8.16ef	4.16	2.25d
Buctril	1.12d	23.37abc	8.95	3.25cd
Puma+2,4-D	6.50a	34.04a	11.8	21.88a
Weedy check	----	-----	-----	-----

Weeds frequency (%): The analysis of data exhibit the time of recording frequency was only significant statistically for *R. crispus* and *M. denticulata*, which depicts that for these two species some variation occurred in frequency over time, but the variability among the herbicides and the interaction was non-significant statistically for these species. The frequency of *A. fatua* was significant statistically due to different herbicidal treatments, whereas the interaction was non-significant statistically for the same species. The significantly lowest frequency of *Avena fatua* was recorded in Puma super +2,4-D (20.75%). The maximum frequency (100%) was recorded in weedy check, which however was statistically at par with some broad leaf killers (Table 5). Statistically non-significant, but the lowest frequency of *P. annua* was recorded in the treatment Isoproturon (50%), while the highest in 2,4-D (95.87%) followed by the weedy check (92.50%) [Table 5]. For *M. denticulata*, the lowest frequency was recorded in Puma +Logran (29.12%) and the highest in weedy check and 2,4-D (Table 5). The frequency of *R.. crispus* was the lowest in the treatment Isoproturon (16.62%). Whereas, the maximum frequency was recorded in Puma Super which was almost numerically at par with the weedy check (Table 5).

Table 4: Relative Density (%) of different grassy and broadleaf weeds in wheat

Herbicides	Grasses		Broadleafs	
	A.fatua	*P.annua*	*M.denticulata*	*R.crispus*
Logran	36.87	69.37	23.75	29.62abc
Topik	12.13	61.12	24.25	23.37cd
Buctril-M	16.13	71.25	39.75	9.50cd
Puma Super	23.25	76.75	26.25	45.25ab
Isoproturon	45.00	42.50	18.62	3.12d
2,4-D Ester	17.00	83.00	40.87	22.12cd
Puma+Logran	27.25	72.75	18.87	25.37cd
Topik+Buctril	20.63	73.62	26.37	15.75bc
Puma+Buctril	14.75	82.12	35.37	24.35cd
Isoproturon+	35.50	64.50	21.62	22.12c
Buctril	4.75	82.37	37.25	13.25cd
Puma+2,4-D	20.37	80.50	24.57	47.25a
Weedy check	----	-----	-----	-----

Table 5: Frequency (%) of different grasses and broadleafs in wheat

Herbicides	Grasses		Broadleafs	
	A.fatua	*P.annua*	*M.denticulate*	*R.crispus*
Logran	62.50 bcd	91.62	37.50	45.87
Topik	45.87 de	62.50	70.75	58.37
Buctril-M	58.37 bcd	87.50	75.00	33.37
Puma Super	87.62 ab	83.25	66.62	100.0
Isoproturon	50.12 cde	50.00	37.37	16.62
2,4-D	83.37 abc	95.87	83.25	49.87
Puma+Logran	41.75 de	79.25	29.12	41.62
Topik+Buctril	50.00 cde	75.50	45.87	62.62
Puma+Buctril	75.00 abcd	83.25	66.62	41.62
Isoproturon+	66.62 abcd	62.50	45.75	41.62
Buctril	20.75 e	83.37	66.62	41.62
Puma+2,4-D	100.0 a	92.50	83.25	95.87
Weedy check	-----	-----	-----	-----

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