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EVALUATION OF ECONOMIC THRESHOLD LEVEL OF WILD OAT (*Avena fatua* L.) IN WHEAT UNDER SUPER IMPOSED APPLICATION OF FENOXAPROP-P-ETHYL

Muhammad Sarwar Cheema[1] and Muhammad Akhtar

ABSTRACT

Field Studies were conducted at Agronomic Research Station, Bahawalpur, Punjab, Pakistan during the year 2004-05 revealed that Avena fatua L growing in association with wheat caused on an average yield reduction of 4.61, 7.27, 12.51, 17.45 and 21.24 percent in grain yield at weed density of 5, 10, 15, 20 and 25 wild oat plants m^{-2} as compared to weed free (0 weed) check. The various yield components of wheat like fertile tillers m^{-2}, grains $spike^{-1}$ and 1000- grain weight significantly reduced due to weed competition whereas these were significantly increased by the application of Puma Super 75 EW (fenoxaprop–p-ethyl) @ 1L ha^{-1}. Application of Puma Super 75 EW resulted 80-90 percent mortality of wild oats. Economic threshold for Puma Super 75 EW applied @ 1L ha^{-1} as post emergence was calculated to be 13 wild oat plants m^{-2} at a standard crop density of 200 plants m^{-2}.

Key words: Wheat, wild oats, density, competition, economic threshold.

INTRODUCTION

Economic threshold is of practical consideration. Knowledge of critical threshold or ordinary level of weed density that will not cause significant reduction in yield is fundamental for the formulation of proper weed control measures. Economic threshold or critical density is used to determine circumstances in which profit from controlling weeds exceed the cost of doing so. A wide scale acceptance of any weed control practice depends to a large extent on the economic relationship between treatment cost and increased crop yields. Undoubtedly this is also true for the selective control of wild oat (Avena fatua) but very little information is available on the effect of wild oat competition on crop yields.

Bell and Nalewaja (1968) reported on the basis of two years experimentation at Fargo, North Dakota that wild oat densities of 10, 40, 70, 100, 130 and 160 plants m^{-2} resulted in 8.61, 13.17, 23.80, 24.53, 35.12, and 41.42 percent reduction in wheat yield respectively.

Chancellor and Peters (1974) demonstrated that *Avena fatua* depresses wheat yield observably at a population greater than 150 plants m^{-2} affected yield in only three of seven experiments and each case at a population greater than 150 plants m^{-2}. no significant reduction occurred at 20-100 *Avena fatua* plants m^{-2}.

Padro-Del (1977) reported that there was 17 to 30 percent reduction in winter wheat yield at a population density of 9 to 16 *Avena fatua* plants m^{-2}. While with a density of less than 8 plants m^{-2}, reduction in wheat yields were not significant. Kapeluszny (1980) concluded from field trial in Poland that at a weed density of 19 plants m^{-2} of

[1]Agronomic Research Station, Bahawalpur, Punjab, Pakistan

Avena fatua in winter wheat, the use of 6 liters Suffix (benzoylprop ethyl) per hectare proved to be economical.

Carlson *et al.* (1981) studied that wild oat competition in spring wheat over two seasons and established that at a density of 300 plants m^{-2}, wheat yield was reduced by an average of 65 percent as compared with an un-infested crop. However, yield losses from *Avena fatua* competition were reduced with increasing density of spring wheat. The economic threshold for herbicidal application was calculated to be 14 Avena fauta plants m^{-2} at a crop density of 517 plants m^{-2} or 7 *Avena fatua* plants m^{-2} at a crop density of 258 plants m^{-2}.

Jain et al. (1983) observed that only flufen 0.12 to 0.18 kg ha^{-1} pre- em., methoxuron @ 1.5 to 2 kg ha^{-1}, isoproturon @ 1 to 1.5 kg ha^{-1} and terbutryn @ 0.5 to 0.75 kg ha^{-1} decreased dry weight, increased plant height, spike length and stimulated tillering.

It is evident from the above information that although a lot of published information on weed competition in wheat in different agro-ecological zones of the world is available yet very little information is available in this aspect, especially on wild oat in our country. Therefore, present study was conducted to find out the economic threshold level of wild oat for its economic herbicidal use in wheat for the fenoxaprop-p-ethyl herbicide.

MATERIALS AND METHODS

Studies were carried out at Agronomic Research Station, Bahawalpur, Punjab, Pakistan during 2004-05. The experiment was laid out in split plot design with four replications having a gross plot size of 6x1 8 m^2 and net plot size of 4x1.2m^2, with the objective to establish an economic threshold level of wild oat for the wild oat killer Puma Super which is fenoxaprop-p-ethyl used for controlling annual grasses in wheat crop. A widely cultivated wheat variety Inqlab 91 as a test variety. Wild oat seeds collected from the previous crop were broadcast and incorporated in well prepared seed bed by harrowing in order to ensure its required stand. The trial was fertilized with recommended dose of 150 kg N ha^{-1}, 100 kg P_2O_5 ha^{-1} and 50 kg K_2O ha^{-1}. Half of the nitrogen and full dose of phosphorus and potash were applied at sowing and remaining half of the nitrogen was applied with first irrigation. The employed levels of wild oat density were as under:-

T1 = 0 Wild plants m^{-2} (check)

T2 = 5 wild oat plants m^{-2}.

T3 = 10 wild oat plants m^{-2}

T4 = 15 wild oat plants m^{-2}

T5 = 20 wild oat plants m^{-2}

T6 = 25 wild oat plants m^{-2}

Puma Super @ 1 liter ha^{-1} post-em was sprayed 35-40 days after sowing at 3-4 leaf stage of wheat crop on half of the plots while other half were left as such after maintaining desired level of densities of wild oats to compete with the wheat crop. In weed free plots one hand pulling was also done 25 days after application of herbicidal

spray. All other agronomic practices were kept uniform to all the treatments. Data on yield and yield components were collected and analyzed, by using analysis of variance technique and subsequently LSD test was used for mean separation (Steel and Torrie. 1980).

In working out the economic threshold level for herbicidal use, cost associated with inputs like fertilizer and irrigations required to raise a successful crop were kept constant, while the variable cost associated with treatments such as cost of herbicide and its application charges and enhanced value of the returns were made the basis to derive economic threshold level. The economic benefit of the fenoxaprop-p-ethyl application over various wild oat densities was compared with untreated wild oat densities to ascertain the economic threshold level for herbicidal application.

RESULTS AND DISCUSSION

Economic thresholds are used to determine the level in which profit from controlling weeds exceeds the investment cost. Their use in decision making in weed control has recently received increasing attention. Economic thresholds are influenced by variation in control cost and prices received for crop products. The economic feasibility and efficiency of a herbicides is ultimately determine by its relative profitability. This experiment was carried out by using Puma Super as test product to work out the economic threshold levels of the wild oat. The data pertaining to growth and yield parameters of wheat and wild oat as affected by fenoxaprop-p-ethyl and various densities of wild oat along with statistical interpretations and economic threshold level for herbicidal use are presented and discussed as under:-

Grain yield kg ha^{-1}

Data on grain yield presented in Table-1 revealed that herbicidal application of Puma Super @ 1 L ha^{-1} significantly affected the grain yield. Wild oat densities have significantly affected final grain yield ha^{-1} during the year 2004-05, the weed free check (0 wild oat) gave the highest grain yield, it was followed by 5 wild oat plants m^{-2}. The lowest grain yield was obtained where 25 wild oat plants infested the wheat crop. The rest of wild oat densities were intermediate but were significantly different from each other. The results further led to the conclusion that there was a linear and progressive decrease in grain yield with successive increase in wild oat weed density from 5 to 25 wild oat plants m^{-2}. Reduction in yield by wild oat densities has been reported by Padro-Del (1977) who concluded that there was 17 to 30 percent reduction in winter wheat yield at a population density of 9 to 16 *Avena fatua* plants m^{-2}. While with a density of less than 8 plants m^{-2} reduction in wheat yield was not significant.

Yield components of wheat as affected by herbicide and wild oat densities

Yield components of wheat as affected by the application of herbicide Puma Super 1 L ha^{-1} and wild oat densities of 5, 10, 15, 20 and 25 are presented in Table-2. The yield as well as yield components data viz fertile tillers m^{-2}, grains $spike^{-1}$ and 1000 grain weight were significantly reduced due to wild oats competition whereas these were significantly increased by the application of herbicide however, wild oat density of 5 plants m^{-2} had no significant adverse effect on fertile tillers m^{-2} and 1000-grain weight and beyond that it was significantly affected results are in conformity with Cheema *et al.* (1988).

Table-1. Grain yield reduction percentage as affected by wild oat density and mortality percentage of herbicide during 2004-05.

Treatments	Wild oat density m^{-2}	Wheat grain yield kg ha^{-1}	Yield reduction (% of check)	Morality (%)
No Herbicide	0 (Check)	4125	-	-
	5	3935	4.61	-
	10	3825	7.27	-
	15	3609	12.51	-
	20	3405	17.45	-
	25	3249	21.24	-
Herbicide applied	0 (Check)	4240	-	100
	5	4075	3.89	80
	10	4000	5.67	80
	15	3948	6.89	90
	20	3917	7.62	90
	25	3890	8.25	85

Table-2. Yield components of wheat as affected by herbicide application and wild oat density during 2004-05

Treatments	Fertile tillers (m^{-2})		Grains spike $^{-1}$		1000-Grain weight (g)	
Wild oat density (m^{-2})	Herbicide Applied (H1)	Herbicide not applied (H0)	Herbicide Applied (H1)	Herbicide not applied (H0)	Herbicide Applied (H1)	Herbicide not applied (H0)
0 (check)	325 a	316 b	46 a	46 a	40.99 a	41.17 a
5	319 ab	302 c	45 abc	43 c	40.71 ab	40.68 ab
10	315 b	296 c	44 bc	40 d	40.23 b	40.03 c
15	312 b	290 cd	44 bc	39 d	39.88 c	39.47 d
20	308 bc	285 cd	43 c	37 d	39.18 d	39.09 d
25	296 c	276 d	44 bc	34 e	38.84 d	38.18 e
$LSD_{0.05}$	8		1.26		0.37	

Means not sharing a letter differ significantly by LSD test at 5% probability level.

Wild oats biomass kg ha^{-1}

Weed biomass reflects the growth potential of the weed and is a better indicator of its competitive ability with the crop plants. The data presented in Table-3 revealed that there were highly significantly differences among the herbicidal treated and herbicide non-treated treatments. Successive increase in wild oat density resulted in progressive and significant increase in weed biomass. The interaction between the herbicide Puma Super and wild oat weed density was significant. Puma Super @ 1 L ha^{-1} post emergence treated densities showed a significant reduction in their biomass as compared to not treated wild oat densities.

Economic threshold level of wild oat for herbicidal use

The economic feasibility and productive efficiency of a herbicide is ultimately determined by its relative profitability. The detail of partial budget incurred on variable weed control practices and net

Table-3. Wild oat biomass (kg ha^{-1}) as affected by herbicidal application and wild oat densities during 2004-05

wild oat density (m^{-2})	Herbicide applied (H1)	Herbicide not applied (H0)
5	13.1h	223.1 e
10	30.8 gh	366.3 d
15	50.3 fg	535.2 c
20	56.8 fg	628.4 b
25	68.2 f	887.5 a
$LSD_{0.05}$	34.2	

Means not sharing a letter differ significantly by LSD test at 5% probability level.

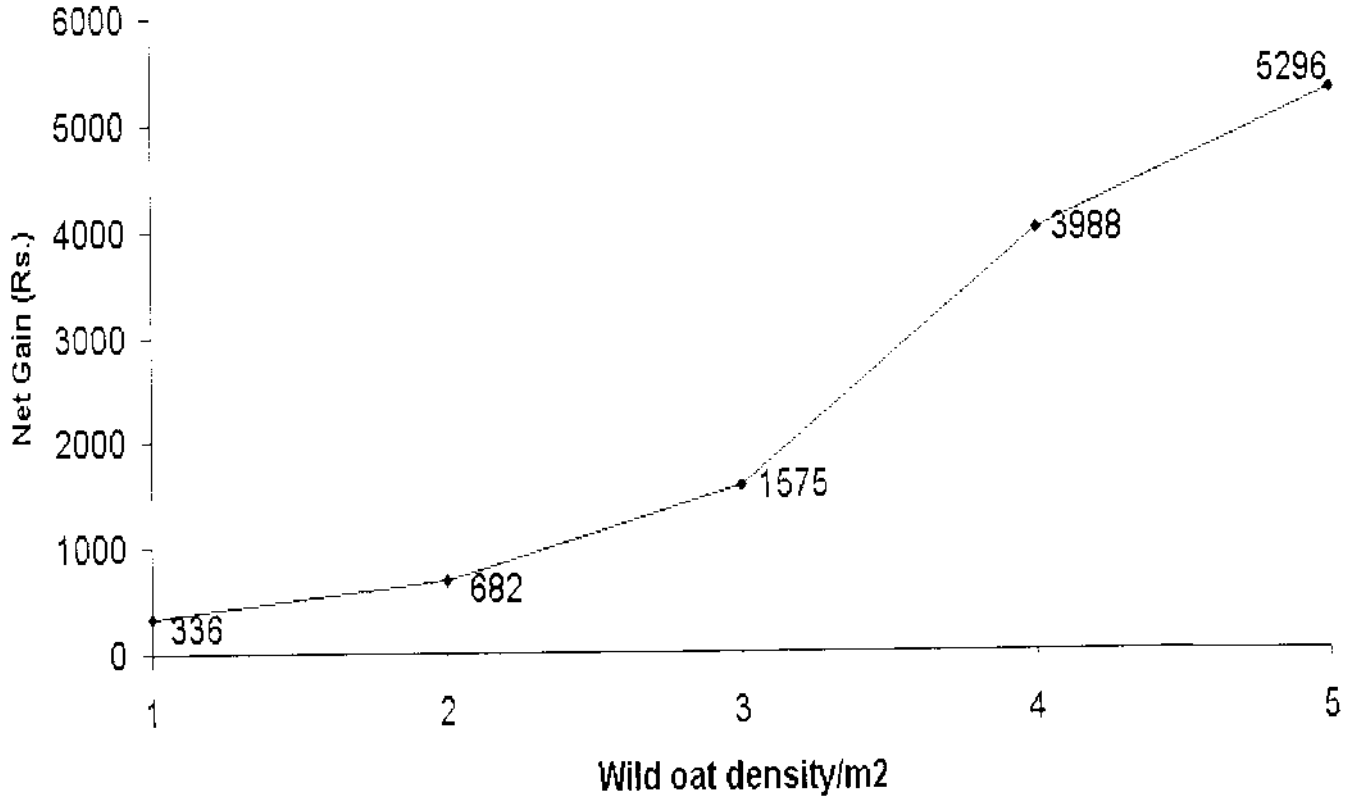
benefit is given in Table-4. In working out the economic threshold level for wild oat densities viz: 5, 10, 15, 20 and 25 plants were allowed to compete with the standard wheat density (200 plats m^{-2}). Their field prices were calculated on the prevailing market rates in the area. In another set of treatments the same densities ere treated with a wild oat herbicide Puma Super @ 1 L ha^{-1} as post em. Its mortality rate ranged between 80 to 90 percent. In calculating the economic threshold the cost incurred on herbicide and its applications were deducted from the income and net benefits were worked out. Then from these net incomes the income received without the application of herbicide for respective wild oat density were deducted and net gain of herbicidal application for different wild oat densities were determined (Table-4). These net gains were plotted against the difference wild oat densities in Fig.1 while the cost of herbicidal application was superimposed, the point at which cost and net gains for different density i.e. 13 wild oat plants m^{-2} for Puma Super 1 L ha^{-1} post em. was the economic threshold level. These results are agreement with those of Padro-Del (1977) reported that there was 17 to 30 percent reduction in winter wheat yield at a population density of 9 to 16 *Avena fatua* plants m^{-2}. While with a density of less than 8 plants m^{-2}, reduction in wheat yield was not significant. Kapeluszny (1980) concluded from field trial in Poland that at a weed density of 19 plants of *Avena fatua* m^{-2} in winter wheat, use of 6.0 L ha^{-1} Suffix (benzol –prop-ethyl) proved to be economical.

Table- 4. Economic analysis of different wild oat densities controlled / not controlled by Puma-super.

Items	H0 = No Herbicide applied Wild oat density						H1 = Herbicides applied Wild oat density					
	Weed free	5	10	15	20	25	Weed free + herbicide	5	10	15	20	25
Grain: Experimental yield (kg ha^{-1})	4125	3935	3825	3609	3405	3249	4240	4075	4000	3948	3917	3890
Farmer yield (Adjusted after paying harvesting charges @ 250 kg ha^{-1} and 10% threshing charges) Grains (Rs.)	3462 5 34625	3291.5 32915	3192.5 31925	3064.5 30645	2814.5 28145	2674.1 26741	3566 35660	3417.5 34175	3350 33500	3303.2 33032	3275.3 32753	3251 32510
Straw yield (Rs. ha^{-1})	4363	3292	3193	3065	2815	2674	3566	3418	3350	3303	3275	3251
Field price (Rs).	38088	36207	35118	33710	30990	29415	39226	37593	36850	36335	36028	35761
Variable weed control cost.	2600	-	-	-	-	-	1300	-	-	-	-	-
(i) Labour for 2-hoeings	-	-	-	-	-	-	800	800	800	800	800	800
(ii) Herbicide	-	-	-	-	-	-	200	200	200	200	200	200
(iii) Labour for spraying (2men/ha)	-	-	-	-	-	-	50	50	50	50	50	50
(iv) Rent of sprayer												
Total variable cost	2600	-	-	-	-	-	2350	1050	1050	1050	1050	1050
Net benefit (Rs)	35488	36207	35118	33710	30990	29415	36876	36543	35800	35285	34978	34711
Net gain over respective treatment (H1-H0) (Rs.)							1388	336	682	1575	3988	5296

Prevailing market price of herbicide Puma Super (fenoxaprop-p-ethyl 75EW =Rs.800 L^{-1}).
Labour charges for spray= 2 man day =Rs 200, manual hoeing =13Men day ha^{-1} herbicide applied =1 Lit/ ha=Rs 800/ha
1man day =Rs100, Price of wheat grain =Rs 10 kg^{-1}. Straw cost =Rs. 100/quintal.

Fig.1 Economic Threshold level for Fenoxaprop-p-ethyl in wheat under varying wild oat densities during Rabi 2004-05



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