Pak. J. Agri. Sci. Vol. 36 (1-2), 1999

AGRO-CHEMICAL ~ED MANAGEMENT IN WHEAT

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The effect of different seeding densities and agro-chemical weed management practices on weed flora and wheat productivity was determined under field conditions on a sandy-clay loam soil: Seeding densities were 100,125 and 150 kg hat, while weed control treatments comprised Stomp 330 E @3.75 I ha", Dicuran MA 60 WP @ 2.47 kg ha', hand weeding and weedy check. Higher seed density (150 kg ha-') and herbicide application significantly decreased weed population and weed biomass and increased number of fertile tillers m-2 and grain yield of wheat over weedy check. Stomp 330E and Dicuran MA 60 WP with seeding density of 150 kg ha-I gave the maximum net income of Rs. 40282 and 39702 ha-I, respectively.

INTRODUCTION

Among the different constraints responsible for low wheat productivity, weed infestation and poor crop stand are the major ones at present. Weeds are usually more aggressive and strong competitors for water, nutrients, light, etc. with the result that benefits of applied inputs are not fully realized unless it is followed by proper weed control programme. Weeds not only reduce yield and quality of produce but also are hazardous in cultural operation and serve as host for harmful insect pests and disease spreading pathogens. Reduction in wheat grain yield due to weed infestation ranges between 17 and 25 % depending upon weed species and level of infestation (Shad,1987). Taking minimum loss of 17 % as a base, annual yield losses in wheat could go up to 2.43 million tonnes (Ahmad,1992). Reduction in wheat grain yield from 1.3 to 2.1 t ha'. due to presence of weeds was also reported by Miller *et al.(1978).* Besides, appropriate seeding density along with proper weed management may help in increasing wheat yield ha-I to a considerable extent.

Seeding density has direct relationship with weed flora and development of wheat crop in terms of number of tillers, spike length, grains spike-! and grain yield. Seeding below the optimum level may lead to overall poor stand of crop and encourage weed growth. According to Ohlsson (1993),high seeding rate enhances wheat grain yield by 100-250 kg ha". Weed dry matter and wheat grain yield losses are reduced as seed rate is increased (Christensen,1994). Higher seed rate may help in weed control as higher plant density suppresses weeds by overshadowing and enables the crop to out-compete the weeds for different production factors. Besides, weeds can be controlled through chemical and cultural means. Stomp 330 E has been reported to be the best and economical herbicide for weed control in wheat crop (Ahmad *et al.,* 1994). On the contrary, weed mortality was the maximum (67.68 %) where Tribunal was applied and it was followed by Arelan (60.80%), Stomp 330 E (57.57%) and Dicuran MA 60 WP(53.85%) (Basra *et al.,* 1994). However, Prasad (1989) reported that application of 1 kg Chlortoluron ha-! and 1.5 kg Metoxuron ha-! 30 days after wheat sowing was the most effective in decreasing dry biomass of weeds and increasing average grain yield, number of grains spike-', spike length and 1000-grain weight. The present study was designed to determine the combined effect of different seeding densities and agro-chemical weed control measures on weed flora and wheat productivity under the agro-ecological conditions of Faisalabad in an irrigated environment.

MATERIALS AND METHODS

The effect of different seeding densities and agro-chemical weed control measures on weed flora and wheat productivity was investigated under field conditions at the University of Agriculture, Faisalabad during the year 1993-94. Weed control treatments comprised weedy check, hand hoeing (one), Stomp 330E (Pendimethalin) @3.751 ha^{-1} and Dicuran MA 60 WP (Chlortoluron+MCPA) @2.47kg ha'. with seeding densities 100,125 and 150 kg ha". The experiment was laid out in a split plot design with four replications. The net plot size measured 2x6 m. Weed control treatments were randomized in main plots and seeding densities in subplots. Wheat variety "Inqalab-91" was sown in 25 cm spaced single rows on a well prepared sandy-caly loam soil on November 7, 1993. Stomp 330 E was applied as pre-emergence spray two days after sowing the crop. Dicuran MA 60 WP was sprayed at optimum

moisture condition as post-emergence after first irrigation. Hand-weeding was done with "Kasola" after first irrigation. All other agronomic practices for all the experimental units were kept uniform. In all four irrigations (7.5 cm each) were given to the crop in addition to the soaking irrigation "Rauni" of 10 cm. The crop was harvested on April 26, 1994. Observations on weed count m^{-2} after spraylhoeing, dry weed biomass m^{-2}, yield components of wheat were recorded by following the standard procedures. Data collected were analyzed using MSTAT computer programme.

RESULTS AND DISCUSSION

Weed Flora: Common weed flora in this study comprised *Phalaris minor Retz* (Dumbi Siti), *Rumex dentatus* (Jangli Palik), *Coronopus didymus* (Jangli Haloon) and *Medicago denticulate* (Maina).

Total Number of Weeds m^{-2} **15 Days Mter SpraylHoeing :** There was a progressive decrease in number of weeds m^{-2} with successive increase in seeding density from 100 to 150 kg ha-I(Table 1). The highest number (95) of weed plants m^{-2} was recorded in plots where crop was seeded @ 100 kg ha^{-1} against the lowest (77 plants m^{-2}) in the crop seeded @ 150 kg hat. Similar results were reported by Afzal (1989) and Nayyar *et al.(l994).* However, Marwat *et al.(1989)* and Teich *et al.(1993)* found that weed population showed negative response to seeding rates. Although there were non-significant differences among hand-hoeing and two herbicidal treatments yet weed population drastically decreased compared to weedy check. Number of weed plants m^{-2} in herbicidal treatments varied from 13.4 to 31.2 against the maximum of 288.4 in weedy check. These results suggest that all weed control treatments were equally effective in controlling the weeds. These results are similar to those of Ahmad *et al.(1985).* Interaction between the two factors was also significant. The minimum number of weeds (8.8 m^{-2}) was recorded in plots treated with Stomp 330 E and seeded @ 150 kg ha-i compared with the maximum (309.5 m^{-2}) in weedy check seeded @ 100 kg hat which in turn was at par with weedy check seeded @ 150 kg ha^{-1} showing an average of 228.4 weeds m^{-2}.

Dry Weed Biomass m^{-2} **80 Days** After **Sowing:** There were significant differences in dry weed biomass m^{-2} among the three seed rates (Table 1). Crop seeded @ 150 kg ha! although gave significantly less dry weed biomass than crop seeded @ 100 kg ha-! but was at par with the crop seeded @ 125 kg ha-I. These results are in agreement with those of Christens en (1994). As regards weed control treatments, both hoeing and chemical weed control treatments drastically reduced dry weed biomass compared to weedy check. Although all the three weed control treatments did not significantly differ from one another yet chemical weed control caused 11.5% more reduction in dry weed biomass compared to hand-hoeing. Interactive effect of seeding density and weed control treatments on weed biomass was also significant. The lowest dry-weed biomass (0.40 g m^{-2}) was recorded in plots treated with Dicuran MA 60. WP and seeded@ 150 kg ha! which was, however, at par with several other interactions. The highest dry weed biomass (21.18 g m^{-2}) was recorded in untreated (weedy check) plots seeded @100 kg hai.

Number of Fertile Tillers m^{-2} : Final yield of wheat is mainly determined by number of fertile tillers per unit area at harvest. All the three seeding densities differed significantly from one another in fertile tillers m^{-2} (Table 1). There was a significant increase in number of fertile tillers m^{-2} with successive increase in seeding rate from 100 to 150 kg ha^{-1}. Crop seeded @ 150 kg ha-t produced the maximum number of fertile tillers (453 m^{-2}) against the minimum of 385 m^{-2} in crop seeded @100 kg ha-t. Similar results were reported by Teich *et al.(1993).* On the contrary, various weed control treatments had no significant effect on number of fertile tillers which ranged between 400 and 427 m^{-2}. Interaction of seeding density and weed control treatments was significant. The maximum number of fertile tillers(468 m^{-2}) was recorded in plots treated with Dicuran MA 60 WP and seeded @ 150 kg hai, which was, however, statistically at par with those treated with either Stomp 330 E or hand-hoed and seeded @ 150 kg ha-t. The lowest number of productive tillers (375 m^{-2}) was recorded in control plots seeded @100 kg ha-t.

Number of Grains Spike-h Number of grains spike'! is an important yield component and has a direct bearing on the wheat yield haX'I'able 2). There were non-significant differences among the different seeding densities. However, number of grains spike'! varied from 62.2 to 64.0. By contrast, differences among weed control treatments were significant. Although hand-hoed crop produced significantly higher number of grains spiket than weedy check but was at par with that treated

Table 1. Weed population/biomass and yield components of wheat as affected by seeding density and weed control treatments

Treatments	Number of weeds after spray	Dry weed biomass (g m-2)	Number of fertile tillers m-2
Weed control treatments			
Weedy check	288.4 a	17.0 a	400 NS
Hand-hoeing	31.2 (88) b	2.8 b	419
Stomp 330 E	13.4 (95) b	0.9 b	427
Dicuran MA 60 WP	13.9 (94) b	0.7 b	423
Seeding rates (kg ha-1)			
100	95.0 (48) a	6.9 a	385 c
125	88.2 (53) b	4.9 b	414 b
150	77.0 (60) c	4.2 b	453 a
Interaction			
100+weedy check	309.5 a	21.2 a	375 e
125+weedy check	293.0 b	15.9 b	404 be
150+weedy check	262.8 c	14.0 c	421 b
100+ hand-hoeing	26.3 (91) d	3.9 de	388 cde
125+ hand-hoeing	32.5 (89) d	2.5 ef	412 bcd
150+ hand-hoeing	24.8 (91) de	1.8 f	456 a
100+ Stomp 330 E	18.0 (94) ef	1.3 f	395 bcde
125+ Stomp 330 E	13.5 (95) ef	0.8 f	420 bc
150+ Stomp 330 E	8.8 (97) f	0.6 f	466 a
100+ Dicuran MA 60 WP	16.3 (95) ef	1.1 f	383 de
125+ Dicuran MA 60 WP	13.8 (85) ef	0.7 f	418 be
150+ Dicuran MA 60 WP	11.8 (96) f	0.4 f	468 a

Any two means in a column not sharing a letter differ significantly at 0.05 P; NS= Non-significant.

with Stomp 330 E or Dicuran MA 60 WP. The difference between weedy check and Dicuran MA 60 WP treated plots was also significant. These differences could be attributed to varying degree of competition among weeds and wheat plants under various treatments. Interaction between seeding density and weed control treatments was, however, non-significant.

lOOO-Grain Weight: Grain weight is also an important yield component of wheat. Various seeding densities have significant effect on 1000-grain weight (Table 2). Crop seeded @ 125 kg ha-1 produced significantly higher 1000-grain weight than that seeded @ 100 or 150 kg ha-1. This difference was due to more number of mother tillers m-2 in thickly-seeded plots than those in thinly-seeded ones which ultimately produced heavier grains. Marwat *et al.(1989)* also reported significant effect of seeding density on lOOO-grain weight. By contrast, the various weed control treatments had no significant effect on lOOO-grain weight which ranged between 41.8 and 45.1 g. Interaction of seeding density and weed control treatments was also non-significant.

Grain Yield: Grain yield of wheat is a function of the interplay of various yield components. Data on grain yield indicated that various seeding densities had significant effect on grain yield ha-1 (Table 2).

Table 2. Grain yield, yield components and harvest index of wheat as affected by seeding density and weed control treatments

Treatments	Number of grains spike^{-1}	1000-Grain weight (g)	Grain yield (t ha^{-1})	Harvest index (%)
Weed control treatments				
Weedy check	60,3 b	45.1 NS	4.2 c	38.6 c
Hand-hoeing	64.9 a	43.2	5.9 b	39.3 be
Stomp 330 E	64,2 a	41,8	6.1 a	39.6 b
Dicuran MA 60 WP	62.5 ab	44.1	6.1 a	40.9 a
Seeding rates (kg ha-t)				
100	62.2 NS	42,4 b	5,4 c	39.1 NS
125	64.0	44.9 a	5.6 b	39.5
150	62.8	43.3 b	5.8 a	40.2
Interaction				
100+weedy check	64,4 NS	42.9 NS	4.0 f	37.8 NS
125+weedy check	60,3	49.3	4.2 ef	38.6
150+weedy check	59,3	43.1	4.5 e	39.3
100+ hand-hoeing	64,9	48.9	5.8 d	38.8
125+ hand-hoeing	66,4	43.9	6.0 bed	39.7
150+ hand-hoeing	63.6	43.7	6.2 abc	39.5
100+ Stomp 330 E	62.5	42.3	5.9 bed	38.6
125+ Stomp 330 E	64,4	41,9	6.1 bed	39.0
150+ Stomp 330 E	65.8	41,2	6,4 a	40.9
100+ Dicuran MA 60 WP	59.7	42.5	5.9 cd	40.9
125+ Dicuran MA 60 WP .	65.2	44.6	6.1 bed	40.7
150+ Dicuran MA 60 WP	62.5	45.1	6.3 ab	40.9

Any two means in a column not sharing a letter differ significantly at 0.05 P; NS = Non significant.

There was a significant increase in grain yield ha! with each increase in seeding rate from 100 to 150 kg ha-'. The highest grain yield of 5.8 t ha-! was obtained from crop seeded @ 150 kg ha'! against 5.6 and 5,4 t ha! from crop seeded @ 125 and 100 kg hat, respectively. Crop seeded @ 150 and 125 kg ha-ı produced 8.1% and 3.5 % more grain, respectively than that seeded @ 100 kg ha-'. Higher grain yield was attributed to greater number of fertile tillers m-2 in thickly-seeded crop. Increase in grain yield with higher seed rate was also reported by Marwat *et al.(1989)* and Teich *et al.(1993).* Although crop treated with Stomp 330 E resulted in significantly greater grain yield ha! than weedy check and hand-hoed crop but was equal to that treated with Dicuran MA 60 WP. Difference between hand-hoed crop and weedy check was also significant. Hand-hoed plots and those treated with Stomp 330 E .and Dicuran MA 60 WP gave 41.70, 45.5 and 43.8 % higher yield, respectively, than weedy check. High yield from Stomp 330 E and Dicuran MA 60 WP treated crop was attributed to comparatively less weed-crop competition, which by increasing grains spike! ultimately led to the maximum grain yield ha-'. These results are in conformity with those of Ahmad *et* al.(1994).Interaction between seeding density and herbicides was also significant. Crop treated with Stomp 330 E and seeded @ 150 kg ha-! gave the highest grain yield of 6,4 t ha'! but was at par with Dicuran MA 60 WP or hand-hoed crop seeded @ 150 kg ha", which yielded 6.3 and 6.2 t ha-', respectively.

Harvest Index: Seeding density had no significant effect on harvest index which varied from 39.1 to 40.2 % (Table 2),These results differ from those of Kovac (1978) who reported that harvest index

Table 3. Partial budget analysis of different weed control treatments

	WC1+S1	WC1+S2	WC1+S3	WC2+S1	WC2+S2	WC2+S3	WC3+S1	WC3+S2	WC3+S3	WC4+S1	WC4+S2	WC4+S3
1. Grain yield (t ha^{-1})	4.01	4.19	4.46	5.79	6.01	6.15	5.89	6.08	6.46	5.88	6.04	6.28
2. Net grain yield(t ha^{-1})	3.36	3.52	3.76	4.96	5.16	5.28	5.05	5.22	5.55	5.04	5.19	5.40
3. Grain yield value (Rs.)	20160.00	21120.00	22560.00	29760.00	30960.00	31680.00	30300.00	31320.00	33300.00	30240.00	31140.00	32400.00
4. Straw yield (t ha^{-1})	6.61	6.67	6.89.00	8.87	9.15	9.42.00	9.09	9.25	9.28	8.47	8.82.00	9.06
5. Straw yield value (Rs.)	6610.00	667.00	6890.00	8870.00	9150.00	9420.00	9090.00	9250.00	9280.00	8470.00	8820.00	9060.00
6. Gross income (Rs.)	26770.00	27790.00	29450.00	38630.00	40110.00	41100.00	39390.00	40570.00	42580.00	38710.00	39960.00	41460.00
7. Variable weed control cost												
a. Labour for hoeing	-	-	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
b. Cost of herbicide	-	-	-	-	-	-	1838.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
c. Labour charges for herbicide application	-	-	-	-	-	-	100.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
d. Rent of spray	-	-	-	-	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
e. Cost of additional seed rate	-	[illegible]	[illegible]	-	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]
Total cost that varied (a to e)	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net benefit (Rs.)	26770.00	27640.00	29150.00	37330.00	38660.00	[illegible]	37392.00	38422.00	40282.00	37252.00	38352.00	39702.00

Price of wheat grain = Rs. 6/ kg
Price of wheat straw = Rs. 1/ kg
Stomp 330 E = Rs. 490/litre
S1 = 100kg ha^{-1}
S2 = 125 kg ha^{-1}
S3 = 150 kg ha^{-1}

Dicuran MA 60 WP = Rs. 525/kg
Labour charges for spray = 1 man/day/ha @ Rs. 100/man
Manual weeding = 13 men/ha @ Rs. 100/man/day (as labour charges)
WC1 = weedy check
WC2 = hand-hoeing (one)
WC3 = Stomp 330 E @ 3.75 l ha^{-1}
WC4 = Dicuran MA 60 WP @ 2.47 kg ha^{-1}

decreased with increasing seeding rate. On the contrary, harvest index was significantly affected by different weed control treatments. The highest harvest index of 40.9 % was obtained from plots treated with Dicuran MA 60 WP. Interaction between both the factors was, however, non-significant.

Economic Analysis: Partial budget analysis of different weed control treatments is given in Table 3. All the combinations of weed control treatments and seeding densities gave considerably higher net income than the combinations of weedy check and seeding densities. Among these combinations, the highest net income of Rs.40282 ha! was obtained from crop treated with Stomp 330 E and seeded @ 150 kg ha'· followed closely by crop treated with Dicuran MA 60 WP and seeded @ 150 kg ha! (Rs.39702 ha-') while the remaining treatment combinations resulted in less income. Similar results have been reported by Ahmad *et al. (1994).*

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