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Effects of Sowing Rates and Methods on Weed Control and Yield of Wheat

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Abstract: Effect of different sowing rates revealed that weed densities and biomass were less in pora method as compared to broadcast method. Weed densities and biomass decreased with increase in the seed rate. The highest grain yield (5325.13 kg ha^{-1}) was obtained from seed rate of 175 kg ha^{-1} and proved to be the most economical seed rate. Further results indicated that sowing methods greatly affected number of fertile tillers, number of unfertile tillers, single spike weight, straw yield whereas final plant height and length of spike were non significant. Similarly seed rates also highly significantly affected spike length, straw yield, final plant height, number of fertile tillers, number of unfertile tillers, per spike weight and grain yield.

Key words: Weeds management, seed rates, sowing methods, wheat

Introduction

Wheat (*Triticum aestivum* L.) is the basic component of human diet. It was grown as food crop since times possibly as early as 8000-10000 B.C. It is the basic food of Pakistan and meets the major dietary requirements. The all Pakistan second estimates of wheat crop for 1998-99 released by the Ministry of food and Agriculture place the area and production at 8.312 million hectares and 17.97 million tonnes as compared with 8.355 million hectares and 18.69 million tonnes in the previous season. The area indicates a decline of 0.5% and production shows a decrease of 3.9%. The production target for the 1999-2000 crop has been set at 19.5 million tonnes which is 8.5 percent more than the 17.97 million tonnes produced last year. Besides proposed increase in support price of wheat for the new crop, the government has increased credit limit for the purchase of fertilizer, pesticides and seeds to attain the target. Five high yielding wheat varieties evolved in Baluchistan are expected to raise production in the province (Anonymous, 1999).

Conventional methods of weed control are weather dependent, laborious and costly due to high cost of labour and chemicals. Increased plant population has been used as a tool in weed management in many crops. The use of dense crop population, narrow row width and delayed planting are some of the known management practices which can reduce weed infestation and growth (Miller *et al.*, 1983, Teasdale and Frank, 1983).

Materials and Methods

The experiment was conducted at the Faculty of Agriculture, Gomal University, D.I.Khan during winter 1993-1994. Two sowing methods (pora method and broadcast method) and seven sowing rates were evaluated for their effects on weed infestation and grain yield of wheat. The experiment was laid out in split-plot design having sowing methods in the main plots and sowing rates in the sub-plots. All other procedure was kept constant. Data were statistically analyzed by using the analysis of variance techniques (Steel and Torrie, 1984).

Results and Discussion

Weeds density (m^{-2}) after 30 days: Table 1 shows the comparison of weeds density at 30 days after sowing between pora method and broadcast method. Weeds density recorded in the broadcast method were much highest as compared to pora method. Weed suppression observed due to pora method could be due to the reason that single row cotton drill uprooted the germinated weeds during seeding operation. Secondly it could also be possible that due to better crop stand and growth attained by the wheat plants in the early period because of proper seeding, weeds were suppressed. Khan and Rashid (1989) reported that weeds densities were less in line sowing. With the increased seeding rates there was a gradual decrease in the weed population except S_7. This might be due to that this plot already established some perennial weeds, but pora method also seen to successful here for suppressing the weeds.

The interaction between seeding method and seed rate reveal that weed densities decreased gradually with increasing seed rates either pora or broadcast seeded except S_7. It can be concluded from these results that increased plant population can play a great role in weed management. However S_5 (200 kg ha^{-1}) is an optimum seed rate where weed problem is reduced without any loss in the seed yield.

Weeds density (m^{-2}) at the time of harvest: Weeds densities observed in the pora method at the time of harvest was comparatively less than the broadcast method (Table 2). Further it also revealed that there was decline in weeds plant population as an increase in seed rate. Similar results were also observed in the case of interaction between seeding methods and seed rates. This might be due to decrease in the available light, moisture and nutrients for the weed species, which in this case emerged later than the crop plants. These results confirmed the results of Wilson *et al*. (1980) who reported that when crop stands are reduced weeds growth should be more vigorous as shown in Table 2. The results indicated that maximum number of uniformly distributed wheat plants depressed the growth of weeds plant by producing number of tillers and occupying more space. The tillering nature and fibrous root system of wheat plant might be more efficient in absorbing moisture, nutrients and light as compared to weed plants.

Biomass of weeds (g) at harvest: Maximum biomass of weeds were recorded by broadcast method x 100 kg ha^{-1} seed rate while minimum biomass were produced in 250 kg ha^{-1} seed rate x pora method as shown in Table 3. These results clearly show decline in the weed biomass as the seed rate increased. More wheat plant population has reduced the weed biomass. At the time of harvesting of crop, more weeds already matured only grass weeds continued to flourish when wheat crop harvested. Evidently seeding mechanically (Pora method) contribute significantly towards weeds management. Khan and Rashid (1989) also reported that weed biomass were less in mechanical line seeding as compared to broadcast method. Weed biomass decreased with an increase in the seed rate. Such reduction is not possible in low seed rate with wide spaced row crop where weed grows luxuriantly in the interspaced as well as in the crop rows. If the crop stand is thin or lacks vigour, weeds flourish well.

Plant height (cm): It can be seen from the data given in Table 4 that sowing rates have highly significant effect on plant height. The highest plant height of 91.7 cm was obtained in plot where a seed rate of 250 kg ha^{-1} was applied and sown by broadcasting than that of other rates. It was due to plant competition on the motto of survival for fittest.

Minimum plant height 79.07 cm was noted in treatment S_1 M_1. Regarding sowing methods, broadcast method produced

Table 1: Weeds density (m^{-2}) after 30 days of germination in wheat field

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
pora	18.50	18.25	15.0	17.50	17.50	15.00	17.50	17.03B
Broadcast	27.25	28.00	25.50	25.75	22.50	26.25	25.50	25.80A
Mean	22.98 B	23.13 A	20.25 E	21.63 C	20.00 G	20.63 F	21.50 CD	

Means not sharing a letter in common differ significantly at 1% level of probability

Table 2: Weeds density (m^{-2}) at time of harvest in wheat field

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	91.25	88.50	76.50	63.50	64.50	63.00	61.50	72.68B
Broadcast	111.75	90.50	83.50	71.00	79.50	63.50	54.00	79.11A
Mean	101.50 A	89.50 B	80.00 C	67.25 E	72.00 D	63.25F	57.75G	

Means not sharing a letter in common differ significantly at 1% level of probability

Table 3: Biomass (g) of weeds at time of harvest in wheat field.

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	30.00	28.50	25.13	24.40	21.25	18.55	15.78	23.37B
Broadcast	47.75	40.25	33.63	28.15	23.30	20.33	18.85	30.32A
Mean	38.88 A	34.38 B	29.38 C	26.27 D	22.27 E	19.44 F	17.31 G	

Means not sharing a letter in common differ significantly at 1% level of probability.

Table 4: Final plant height (cm) of wheat variety Pak-81 as affected by sowing methods and seed rates

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	79.07	83.82	84.67	85.30	85.70	85.82	91.00	85.05
Broadcast	79.87	80.51	80.90	84.22	84.87	89.51	91.70	84.51
Mean	79.47 C	82.17 BC	82.79 BC	84.75 BC	85.29 BC	87.67 A	91.35 A	

Means not sharing a letter in common differ significantly at 1% level of probability

Table 5: Number of unfertile tillers (m^{-2}) of wheat variety Pak-81 as affected by sowing methods and seed rates

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	9.50	30.50	29.00	36.50	55.00	67.00	102.50	47.14 A
Broadcast	2.50	4.25	5.0	9.25	14.00	15.75	18.25	9.86 B
Mean	6.00 F	17.38 E	17.00 E	22.88 D	34.50 C	41.38 B	60.38 A	

Means not sharing a letter in common differ significantly at 1% level of probability

Table 6: Number of fertile tillers (m^{-2}) of wheat variety Pak -81 as affected by sowing methods and rates.

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	374.50	327.25	401.00	445.25	326.75	375.75	278.50	361.28 A
Broadcast	288.50	370.25	344.75	878.00	229.75	230.75	324.25	309.39 B
Mean	331.5 D	384.8 C	372.9 B	411.6 A	278.0 F	303.4 E	301.4 E	

Means not sharing a letter in common differ significantly at 1% level of probability.

Table 7: Spike weight (g) of wheat variety Pak-81 as affected by sowing methods and seed rates

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	2.40	2.43	2.37	3.00	2.31	2.09	2.37	2.42 A
Broadcast	2.30	2.21	2.24	3.05	2.39	1.99	2.04	2.32 B
Mean	2.36 B	2.32 B	2.31 B	3.02 AB	2.35 B	2.04 B	2.20 B	

Means not sharing a letter in common differ significantly at 1% level of probability

Table 8: Per spike length (cm) of wheat variety Pak-81 as affected by sowing methods and seed rates

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	9.41	10.01	10.28	11.48	10.87	8.73	7.46	9.75
Broadcast	9.39	8.86	9.40	10.46	9.89	8.28	8.14	9.20
Mean	9.40 C	9.44 C	9.84 BC	10.97 A	10.8 AB	8.50 D	7.80 D	

Means not sharing a letter in common differ significantly at 1% level of probability

Table 9 : Straw yield (kg ha^{-1}) of wheat variety Pak-81 as affected by sowing methods and seed rates

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	6760.50	6643.00	8498.00	8406.00	8430.25	9777.50	8564.50	8154.20
Broadcast	4559.25	5663.00	6069.00	6777.25	6697.50	7881.50	8251.00	6556.90
Mean	5660.00 C	6153.00 C	7284.00 B	7592.00 B	7564.00 B	8830.00 A	8408.00 A	

Means not sharing a letter in common differ significantly at 1% level of probability

Table 10: Grain yield (kg ha^{-1}) of wheat variety Pak-81 as affected by sowing methods seed rates

	Seed rates (kg ha^{-1})							
Methods	100	125	150	175	200	225	250	Mean
Pora	4452.5	5306.5	5318.0	5520.8	4973.3	4452.5	3900.3	4854.8A
Broadcast	3170.0	4556.5	4785.3	5069.5	5122.8	3602.8	3918.3	43176.9B
Mean	3811.3 B	3931.5 B	5051.3 A	5325.3 A	5048.0 A	4027.6 B	3909.3 B	

Means not sharing a letter in common differ significantly at 1% level of probability

comparatively taller plant. Method of sowing and seed rate interaction had no significant effect in plant height. Greater height in denser population may ascribed to the fact that method of sowing and low seed rates caused greater tillering which resulting in small stature plant. Competition for light can be an other reason for this. These findings are in agreement with that of Ali and Shah (1983), who studied the effect of 70, 90, 110, 130, 150 kg seeds ha^{-1} on the yield and other characters of wheat variety Pak-81. They concluded that plant height increased with increase in the rate of seeding to 150 kg ha^{-1}.

Number of unfertile tillers (m^{-2}): Table 5, indicated that the number of unfertile tillers m^{-2} as affected by methods of sowing, seed rates and there interaction are highly significant. More unfertile tillers were also recorded in pora method than in broadcast method. The number of unfertile tillers m^{-2} ranged between. It is evident from the Table 5 that the greatest number (60.38) of unfertile tillers are found in the highest seed rates of 250 kg ha^{-1} (S_7) and the least number is in S_1. Seed rates of 125 kg ha^{-1} and 150 kg ha^{-1} interaction between sowing methods and seed rates was also highly significant. The increased number of unfertile tillers m^{-2} recorded in pora method may be attributed to denser stand in plots.

Number of Fertile tillers (m^{-2}): The effect of seed rates and sowing methods on the number of fertile tillers of wheat recorded is presented in the Table 6, which indicated that sowing methods seed rates and their interaction had highly significant effect on fertile tillers. Pora method of sowing gave more fertile tiller m^{-2} as compared to that of broadcast method.

A seed rate of 175 kg ha^{-1} and pora method ($S_1 M_1$) produced maximum average number of fertile tillers m^{-2} followed by $S_5 M_2$. $S_2 M_6$, produced minimum average number of fertile tillers m^{-2}. The interaction between methods and seed rates were also found to be highly significant.

Increased number of fertile tillers in pora method could be ascribed to proportionate distribution of seed and better start as compared to the broadcast method. A seed rate of 175 kg ha^{-1} gave maximum number of fertile tillers as compared to both lower and higher seed rates. Similar findings were reported by Barriga and Pihan (1980), Markovic (1983), Hazar and Ceylon (1985) and Sadiq and Lalah (1986). They noted that by increasing sowing rate increased the number of fertile tillers.

Spike weight (g): The spike is very important part of wheat plant because it is portion which bears the wheat grains " the stuff of life " and make up the grain yield. An intensive study of this aspect of the wheat plant was made and the data obtained were tabulated in the Table 7. The data presented in table showed the effect of sowing methods on the spike weight was significant and that of sowing rates were highly significant, whereas their interactions have no significant effect on the spike weight.

Table 7 indicates maximum mean weight of 3.02 g is given by S_4 whereas minimum mean spike weight 2.04 g is in S_1. Regarding methods of sowing, the maximum mean weight of 2.42 g given by broadcast and minimum weight of 2.40 g by pora method. There was very little difference and none of them shows superiority over the other.

Length of wheat spike (cm): The data presented in Table 8 showed the effect of length on wheat spike due to seed rates was highly significant and the sowing methods effect and their interactions showed non-significant results.

Table 8 indicated that the longest spike 11.48 cm was given by S_4, whereas that with minimum length of 7.46 cm was given by S_7 which may be attributed by over population and lodging of wheat crop. Similar results by Hazar and Ceylon (1985) who observed that increasing seed rates decreased ear length.

Straw yield (kg ha^{-1}): The analysis of variance of data pertaining to straw yield of wheat ha^{-1} presented in Table 9 which would indicate that methods of sowing and seed rates highly significantly affected straw yield. Whereas interaction no effect on the straw yield of wheat variety Pak-81. The highest mean of straw yield was given by pora method, whereas the least straw yield was obtained with broadcast sowing method Maximum straw yield was recorded in treatment S6 M1 (225 kg seeds ha^{-1}, pora method) and minimum straw yield was found in S1 M2 (100 kg seeds ha^{-1} broadcast method). Higher straw yield in pora method may be sowing to greater densities of wheat per unit area. Similar findings were reported by Ali and Shah (1983), Abd-El-Gawad *et al*. (1980), Latif and Tuhamy (1986), Prasad (1995) and Marwat *et al.* (1989) who observed that increasing seeding rates increased straw yield ha^{-1}.

Grain yield (kg ha^{-1}): The grain yield kg ha^{-1} is a function of the integrated effect of the yield components which were influenced differently by growing conditions. The data presented in Table 10 showed that sowing methods and seed rates had highly significant effects whereas their interactions showed non significant effects. The highest mean grains yield of 4856.62 kg ha^{-1} was noted in pora method and the least grain yield of 4317.86 kg ha^{-1} was found in broadcast method of sowing. There were little differences in grain yield as affected by pora and broadcast methods of sowing. It is evident from the table that the highest grain yield was in $S_4 M_1$ and the lowest grain yield was in $S_1 M_1$.

Decreased grain yield ha^{-1} with an increase in seed rates may be attributed to lodging of crop and shriveled grains, such findings have also been reported by Ciha (1983) that increase rate about 200 kg ha^{-1} had not significantly affected the grain yield.

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