Indian Journal of Agronomy **45** (1) : 97–102 (March 2000)

Contingent crop planning in winter season under mid-hill sub-humid agro-climate of Himachal Pradesh

VINOD SHARMA AND D. R. THAKUR

Regional Research Station, Himachal Pradesh Krishi Vishvavidyalaya. Bajaura 175 125

Received : December 1998

ABSTRACT

In an experiment conducted during 1995–96 to 1996–97 to determine ideal agronomic conditions for late-sown crops. Argentine rape 'Sheetal' showed the highest total productivity in terms of wheat-equivalent yield during both the seasons. Wheat [*Triticum aestivum* L. emend. Fiori & Paol.] 'HPW 42' and argentine rape 'Sheetal' were more remunerative than other crops or varieties. Based on pooled analysis, wheat 'HPW 42' gave 18.03 and 185.64% higher net return over wheat 'HS 295' and lentil 'HPLC 8431' respectively. The increased due to argentine rape was 16.17 and 181.15 per cent respectively. The effect of seed rate was not significant. The increase in nitrogen level by 25% over recommended dose increased the productivity as well as monetary returns over the recommended nitrogen. Based on pooled analysis, increased nitrogen level (25% over recommended) gave 7.52 and 20.22% higher net return than recommended and 25% lower than recommended N levels respectively.

Key words : Contingent crop planning, Winter season, Wheat, Argentine Rape, Lentil, Seed rate, Nitrogen

Wheat (*Triticum aestivum* L. emend. Fiori & Paol.) is the main winter-season crop grown under mid-hill sub-humid conditions of Himachal Pradesh. First fortnight of November is the optimum sowing time to realize maximum benefits. But normal weekly rainfall data (average of 1973–1992) at Bajaura indicate that sowing period of winter crops experiences severe moisture stress, since scanty rainfall (1.9–11.8 mm/week) is received right from meteorological weeks 40 to 51 (1 October–23 December) with very high variability. Data (average values of 1973–92) regarding monthly rainfall at Bajaura show that October, November and December receive the minimum rainfall with minimum rainy days as well as minimum mean rainfall as percentage of the year. It shows that during optimum sowing time of winter crops there are chances of drought conditions; as a result, sowing cannot be done under rainfed conditions. Therefore crop cultivars or crops that will perform better under late–sown rainfed conditions are to be indentified, because more than 80% of cultivated area is rainfed in the state. Enhanced and stabilized productivity from rainfed areas is possible through adoption of improved varieties (Paroda and Rai, 1991) and balanced fertilizers. Therefore to harness the natural resources for sustainable production under aberrant weather conditions, the present investigation was carried out with the objective to find out suitable crop/variety, optimum seed rate and balanced fertilizer doses when the crop is sown very late during winter season under mid–hill subhumid conditions of Himachal Pradesh.

MATERIALS AND METHODS

The field experiment was conducted during winter (*rabi*) seasons of 1995–96 and 1996–97 at Himachal Pradesh Krishi Vishvavidyalaya, Regional Research Station, Bajaura, situated 31°8N, 76°E and at an altitude of 1,090 m above mean sea level in split–plot design. The 24 treatment combinations comprised four crops/ varieties and two seed rates in main plots, and three levels of nitrogen is subplots, with three replications. The treatment details are given in Table 1. The soil was sandy loam, near–neutral in reaction (pH 6.7) and medium in organic carbon (0.45%). The fertility of the soil was low in available nitrogen (254 kg/ha), and medium in available P (17.0 kg/ha) and K (226 kg/ha). The crops were sown on 8 January 1996 and 7 January 1997, by using seed rate and nitrogen levels as per treatments, whereas P and K were applied as recommended for different crops. In cereals and oilseeds N was applied in two equal splits as basal and at 35 days after sowing, whereas in pulse crop whole of the N was applied basal, and P and K were applied basal to all the crops. Recommended seed rates were 100, 6 and 30 kg/ha for wheat, argentine rape and lentil respectively, whereas the recommended fertilizer doses were 80:40:40, 120:60:40 and 10:40:0 kg $N:P_2O_5:K_2O$/ha for wheat, argentine rape and lentil respectively. The crops were harvested between 27 May to 8 June during both the seasons. A rainfall of 485.6 mm and 469.5 mm was received during crop period (January to May) in 1996 and 1997 respectively, whereas the mean monthly maximum and minimum temperatures varied from 15.1 to 29.2°C, and 0.7 to 12.0°C during 1996, and 16.1 to 28.6°C and –0.5 to 11.2°C during 1997 respectively. Analysis of variance was performed as per standard procedures (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of crops/cultivars

Data in Table 1 for both the seasons and on pooled analysis show that argentine rape 'Sheetal' gave significantly highest wheat-equivalent yield (WEY), followed by wheat 'HPW 42' and 'HS 295'. Similar trend was observed in gross return (Rs/ha) and net return (Rs/ha) during 1995–96. The highest WEY of argentine rape may be ascribed to its higher market price than of wheat. On the contrary, though lentil also had very good market price, but when grown in first week of January it showed a tendency to yield lower than other crops and proved relatively unsuitable for late–sown conditions. But during 1996–97 and based on pooled analysis, wheat 'HPW 42' and argentine rape 'Sheetal' remained statistically on a par with each other, gave significantly highest gross return and net return, followed by wheat 'HS '295'. However, during 1996–97 wheat 'HPW 42' was significantly superior to argentine rape in influencing the net return. Its better performance may be attributed to well–distributed rainfall, particularly during. April and gave mean sunshine hours during the growing season. In spite of having highest WEY, argentine rape was on a par with wheat 'HPW 42' in gross and net return, because of valuable straw of wheat in comparison to valueless straw of argentine rape. Singh *et al* (1997a) also reported that wheat gave highest average gross monetary return among different winter crops. Superiority of wheat among other winter crops except sunflower under late–sown rainfed conditions in low hills-submontane zone of Himachal Pradesh has already been reported by Sharma and Chakor (1995).

Effect of seed rate

The effect of seed rate on WEY, gross

Table 1. Effect of treatments on wheat–equivalent yield, gross return and net return

Treatment	Wheat–equivalent yield (q/ha)			Gross return (Rs/ha)			Net return (Rs/ha)		
	1995–96	1996–97	Pooled	1995–96	1996–97	Pooled	1995–96	1996–97	Pooled
Crop/Cultivar									
Wheat 'HPW 42'	35.76	41.09	38.43	23,070	28,376	25,723	17,907	23,209	20,558
Wheat 'HS 295'	30.79	33.10	31.95	20,964	24,428	22,696	15,797	19,039	17,418
Argentine rape 'Sheetal'	55.09	59.58	57.32	24,770	26,777	25,774	19,231	21,238	20,235
Lentil 'HPLC 8431'	24.78	15.39	20.09	13,725	8,743	11,234	9,688	4,706	7,197
CD (P=0.05)	0.98	3.45	2.54	482	1,844	1,348	482	1,842	1,347
Seed rate									
Recommended	36.33	37.48	36.91	20,426	22,029	21,228	15,496	17,097	16,296
30% higher than recommended	36.38	37.10	36.98	20,838	22,133	21,486	15,816	16,999	16,407
CD (P=0.05)	NS	NS	NS	341	NS	NS	NS	NS	NS
N level									
Recommended	37.09	37.54	37.32	20,831	22,161	21,496	15,856	17,183	16,519
25% higher than recommended	40.70	39.00	39.85	22,762	23,145	22,953	17,654	17,870	17,762
25% lower than recommended	31.99	35.33	33.66	18,304	20,937	19,621	13,458	16,091	14,774
CD (P=0.05)	0.76	1.51	1.20	356	780	607	356	726	573

and net returns was not significant, However, during 1995–96, 30% higher seed rate than recommended gave significantly higher gross return over recommended seed rate, which may be attributed to higher straw yield. But it could not compensate the cost of higher seed rate and hence the effect on net return was not significant. Behera (1995) reported that seed rates of 100 and 125 kg/ha were at par in influencing the grain yield of wheat. The grain yield of wheat was not influenced by the different levels of seed rate (100, 125 and 150 kg/ha) in all the three years of study (Srivastava *et al.*, 1996).

Effect of nitrogen levels

Data on WEY, gross and net returns for both the seasons and for pooled analysis show that increase in nitrogen level by 25 per cent over the recommended level gave significantly highest WEY, gross return and net return, followed by recommended dose of nitrogen (Table 1). However, during

Table 2. Interaction effect of crops/varieties, seed rates and nitrogen levels on wheat–equivalent yield (q/ha)

Crop/variety and seed rate	Nitrogen level					
	Recommended		25% higher than recommended		25% lower than recommended	
	1995–96	1996–97	1995–96	1996–97	1995–96	1996–97
Wheat 'HPW 42' with recommended seed rate	35.56	40.13	37.85	45.84	33.19	38.81
Wheat 'HPW 42' with 30% higher seed rate	33.95	41.35	37.18	41.65	34.81	38.76
Wheat 'HS 295' with recommended seed rate	31.08	33.63	31.78	33.74	29.61	33.51
Wheat 'HS 295' with 30% higher seed rate	30.84	32.95	31.35	33.40	30.06	31.39
Argentine rape 'Sheetal' with recommended seed rate	54.40	61.52	64.87	63.47	42.72	53.37
Argentine rape 'Sheetal' with 30% higher seed rate	56.55	58.71	64.73	62.27	47.01	58.12
Lentil 'HPLC 8431' with recommended seed rate	26.80	15.90	29.15	15.60	18.92	14.27
Lentil 'HPLC 8431' with 30% higher seed rate	25.53	16.16	28.65	16.00	19.62	14.39

	CD (P=0.05)	
	1995–96	*1996–97*
For two nitrogen means at same level of crop/variety and seed rate	2.16	4.27
For two crops/varieties and seed rate means at same or different levels of nitrogen	2.24	5.99

1996–97, 25 per cent increased nitrogen level over recommended level and the recommended nitrogen level were statistically at par in influencing the WEY and net return. This increase in WEY and monetary benefits due to increase in nitrogen level may be attributed to increase in growth and yield attributes in the respective crops. Singh *et al.* (1997a) also reported that application of 100% of the recommended nitrogen gave significantly higher yield as well as remarkably higher energy output of all the winter crops (wheat, barley, argentine rape, Indian mustard, field pea and winter maize) over reduced level, i.e. 75% of the recommended N. On the basis of pooled data optimum dose of nitrogen was found to be 113.17 kg/ha for wheat under late-sown condition (Singh *et al.*, 1997b). Dwivedi *et al.* (1997) have reported increase in lentil yield up to 20 kg N/ha. Similarly, Singh *et al.* (1994) also reported increase in lentil yield up to 20 kg N/ha and positive response in yield of Indian mustard with each increment in fertilizer level. Each such increment in fertilizer level (0–120 kg N/ha + 0–45 P_2O_5/ha) increased the seed yield of Indian mustard significantly under late/sown condition (Singh *et al.*, 1996).

Interaction effect of crop/variety, seed rate and nitrogen levels

The experimental evidence indicated significant interaction between crops/ varieties, seed rates and nitrogen levels, and this response varied between the years. In general, yields were higher in 1996–97 due to higher mean sunshine hours during the crop-growth season and good amount of well-distributed rainfall particularly during April, the month in which maximum crop growth is gained. Yield of lentil was much less during 1996–97 due to rainfall at flowering stage.

Data in Table 2 reveal that during 1995–96, the year with less mean sunshine hours during crop growth and less rainfall during April, 25% higher than recommended nitrogen application gave significantly highest WEY, followed by recommended nitrogen application in argentine rape 'Sheetal' and lentil 'HPLC 8431' at both the seed rates and in wheat 'HPW 42' at recommended seed rate. But wheat 'HS 295' at both the seed rates and 'HPW 42' at higher seed rate gave stastistically equal WEY at 25% higher than recommended and the recommended nitrogen levels. During 1996–97 almost all the crops at both the seed rates did not show difference in WEY due to nitrogen levels with few exceptions. Application of 25% higher than the recommended nitrogen gave significantly highest WEY in wheat 'HPW 42' at the recommended seed rate, whereas in argentine rape 'Sheetal' recommended seed rate 25% higher than the recommended and the recommended nitrogen levels remaining statistically at par were significantly superior to 25% lower than the recommended nitrogen. During 1996–97 the good amount of rainfall during maximum crop/growth period (April) and high mean sunshine hours might have resulted in vigorous root growth, enabling the crops to extract nutrients from wider area, and hence the nitrogen levels did not affect the WEY.

Argentine rape 'Sheetal' at both the seed rates gave significantly highest WEY, followed by wheat 'HPW 42' at both the seed rates and wheat 'HS 295' at both the seed rates at all the nitrogen levels during both the years. However, during 1995–96, at 25% lower than recommended nitrogen, argentine rape 'Sheetal' at 30% higher than the recommended seed rate, gave significantly higher WEY than recommended seed rate, whereas in all the other cases seed rates did not influence the WEY significantly.

Thus it can be inferred that when sowing of winter crops is delayed up to first week of January, either wheat 'HPW 42' or argentine rape 'Sheetal' should be raised under mid-hill condition of Himachal Pradesh and nitrogen level should be increased by 25% over the recommended dose of the respective crops to earn more profits.

REFERENCES

Behera, A.K. 1995. Effect of seed rate, row spacing and fertilizer on wheat *(Triticum aestivum). Indian Journal of Agronomy* **40** (3) : 510–511.

Dwivedi, D.K., Singh, H., Dubey, J. and Sah, A.K. 1997. Response of lentil *(Lens culinaris)* to fertility and seed rates as *paira* crop under rainfed lowland condition in north/eastern Bihar. *Indian Journal of Agronomy* **42** (3) : 488–489.

Gomez, G.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research*, pp. 680. (2nd edition). John Willey & Sons, New York, USA.

Paroda, R.S. and Rai, M. 1991. Varietal approach for minimizing risk in rainfed agriculture. Paper presented at the *International Conference on 'Minimizing Risks in Rainfed Agriculture'*, held during 6–9 April 1991 at New Delhi.

Sharma, V. and Chakor, I.S. 1995. Relative performance of late/sown, rainfed winter crops as influenced by sowing dates. *Indian Journal of Agronomy* **40** (2) : 303–304.

Singh, I., Saini, S.L. and Singh, R.C. 1996. Effect of row spacing and fertilizer level on late/sown Indian mustard *(Brassica juncea)* cultivars. *Indian Journal of Agronomy* **41** (1) : 166–167.

Singh, N., Dass, M. and Sodhi, K.S. 1997a. Performance and economics of different winter crops grown after pigeonpea *(Cajanus cajan)* under irrigated conditions. *Indian Journal of Agronomy* **42** (1) : 42–45.

Singh, V.P.N., Singh, S.C. and Uttam, S.K. 1997b. Response of wheat *(Triticum aestivum)* varieties to nitrogen under late-sown condition. *Indian Journal of Agronomy* **42** (2) : 282–284.

Singh, Y., Gaur, N.S. and Singh, D. 1984. Response of Indian mustard *(Brassica juncea)* and lentil *(Lens culinaris)* to nitrogen, phosphorus and potassium in western Uttar Pradesh. *Indian Journal of Agronomy* **39** (4) : 668–689.

Srivastava, U.S.L., Ram, P. and Prakash, O. 1996. Response of wheat *(Triticum aestivum)* to row spacing, seed rate and fertilizer. *Indian Journal of Agronomy* **41** (4) : 558–561.