OnLine Journal of Biological Sciences 2 (11): 722-724, 2002
ISSN 1608-4127

Effect of Weed Management Practices on Economic Traits in Wheat

Muhammad Iqbal Marwat, [1]Haji Khalil Ahmad, [2]Haji Himayatullah Khan and [2]Ayyaz Khan
Institute of Development Studies, NWFP Agricultural University, Peshawar, Pakistan
[2]Department of Agronomy, [1]Faculty of Agriculture,
Gomal University, Dera Ismail Khan (D.I. Khan), Pakistan

Abstract: The effect of various management options like herbicide types and varying spacings on economic traits in wheat were studied. The factors included were: three varieties, three types of herbicides - broad-spectrum, broad leaf, grassy leaf herbicide and a control plots following row spacings of 18, 25 and 32 cm. The biological, grain and straw yield, net income and cost benefit ratio were significantly affected by varieties, herbicides and row spacings. Interaction between varieties and row spacings was significant for biological and grain yield and net income. Among varieties Bakhtawar-92 had maximum biological yield, grain yield, straw yield, net income and benefit cost ratio over Ghaznavi-98 and Inqilab-91. In case of herbicide treatment, broad-spectrum herbicides had higher biological yield, grain yield, straw yield, net income and benefit cost ratio over broad leaf, grassy leaf herbicide and weedy check. Within row spacing, 18 cm space had maximum biological yield, grain yield, straw yield, net income and benefit cost ratio over 25 and 32 cm row spacings, respectively. In the interaction of varieties and row spacing, highest had been found in var. Bakhtawar-92 with 18 cm row spacing for biological yield (14.81 t ha^{-1}), grain yield (4.93 t ha^{-1}) and net income (Rs. 37894 t ha^{-1}). It is concluded that for integrated weed management in wheat, variety Bakhtawar-92, broad-spectrum herbicide and 18 cm spacing may be integrated.

Key words: Weed control in wheat, row spacing, net income

Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal crop all over the world with respect to area and production. It is a major source of food for a large section of population of the world and is supplying about 73% of the calories and protein of the average diet (Heyne, 1987). In Pakistan it ranks first among the cereal crops and occupies about 66% of the annual food crop area (Anonymous, 1996). The area in Pakistan under wheat cultivation during 1999-2000 was 8.14 million hectares that produced 18.54 million tons with an average yield of 2.28 tons ha^{-1} (Anonymous, 2001). In NWFP wheat was planted on 0.81 million hectares with a production of 1.07 million tons, producing an average yield of 1.32 tons ha^{-1} during 2000-2001 (Anonymous, 2001). Wheat yield in Pakistan is low as compared to other advanced countries of the world. The wheat potential yield is 6.43 tons ha^{-1} and the achieved is 2.28 tons ha^{-1} while the gap is 4.15 tons or 64.54% (Muhammad, 1984).

Weeds are one of the major problems in crop production. They compete with crop plants for space, light, air, moisture and nutrients. Weeds also increase harvesting costs, require costly cleaning of seeds, reduce water flow in irrigation and drainage channels and increase fire hazards (Arnon, 1972). The control of weeds is a basic requirement and major component of management in most crop production systems (Young *et al.*, 1994; Norris, 1982; Triplett, 1976). Control of weeds has been practiced from time immemorial by manual labor or animal drawn implements. These methods, besides being laborious and tiresome are expensive due to the increased cost of labor, animals and implements (Iqbal, 1994) and as such have stimulated interest in the use of chemical weeds control.

Proper row spacing is one of the most important management factors affecting the agronomic characteristics of wheat. Narrow row spacing produces high leaf area index (LAI), which results in more interception of photo-synthetically active radiation and dry matter accumulation (DMA) [Tollenaar *et al.*, 1992]. Narrow row spacing also has higher leaf photosynthesis and suppresses weed growth compared with wider row spacing (Dwyer *et al.*, 1991).

However, very limited research has been reported in Pakistan especially on the integrated efforts of wheat production. In order to ascertain the integrated use of crop management practices, the present study viz; "effect of weed management practices on economic traits in wheat was conducted in irrigated plains of Ismail Khan (D.I. Khan).

The objectives of this research are to evaluate; I) integrated impact of weed management practices, ii) row spacing and cultivars on wheat production and to assess economics of wheat production with respect to weed management and row spacing.

Materials and Methods

The experiment was carried out at the Gomal University, D.I. Khan (Pakistan) for two consecutive seasons (1998-99, 1999-2000) in split-split plot design. The factors included were: three varieties (Bakhtawar-92, Ghaznavi-98, Inqilab-91), three herbicides viz. broad-spectrum herbicide (2,4-D butyle ester: 72% EC + isoproturon 75% WP @ 623 a.i. ha^{-1} and 649 a.i. ha^{-1} respectively), broad leaf herbicide (2,4-D butyle ester: 72% EC @ 711 a.i. ha^{-1}), grassy leaf herbicide (isoproturon 75% WP @ 968 a.i. ha^{-1}) and a control (no herbicide used); following three row spacings 18, 25 and 32 cm. Varieties were allotted to main plots while herbicides to sub-plots with varying row spacings to sub-sub plots. A standard seed rate of 110 kg ha^{-1} was used for all the varieties. A standard dose of 100:60 kg N:P ha^{-1} was also used in the form of urea and di-ammonium phosphate (DAP). Data on individual observations were collected using the following procedure: biological yield was recorded on per plot basis and then converted into tons ha^{-1}. Grain yield was recorded on per plot basis and then converted into tons ha^{-1}. Straw yield (tons ha^{-1}) was calculated by subtracting grain yield from biological yield. Cost of all operations/inputs required to produce wheat ha^{-1} (manual labor, machine labor, animal labor, seed, fertilizers, herbicide, water rates, land rent, etc.) was worked out. Gross income from the main product (grain) and by-product (straw) was also calculated. The net income ha^{-1} was worked out by subtracting production cost from gross income. The formula for benefit cost (BC) ratio was: Gross Income ha^{-1}/production cost ha^{-1}. Analysis of variance was applied to detect whether the effect of treatments for different characters was significant or not. Significant means were subsequently separated by the least significance difference (LSD) using MSTAT-C computer software package.

Results and Discussion

Biological yield (t ha^{-1}): The biological yield was significantly affected by varieties, herbicides and row spaces. Data revealed

Corresponding Author: Muhammad Iqbal Marwat, Institute of Development Studies, NWFP Agricultural University, Peshawar, Pakistan

Table 1: Effect of herbicides, varieties, row spacings and interactions on economic traits of wheat at D.I. Khan

Parameters	Biological yield (t ha^{-1})	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Net income (Rs. ha^{-1})	Benefit cost ratio
Herbicides					
Broad spectrum	14.13a	4.81a	9.35a	35350a	2.57a
Broad leaf	14.09a	4.68b	9.30a	34588a	2.51b
Grassy leaf	13.09b	4.43c	8.65b	31480b	2.41c
Control	11.72c	4.01d	7.69c	26928c	2.26d
Varieties					
Bakhtawar-92	13.83a	4.67a	9.15a	34251a	2.55a
Ghaznavi-98	13.15b	4.41b	8.73b	31582b	2.44b
Inqilab-91	12.79c	4.37b	8.36c	30426b	2.33c
Row spacings (cm)					
Row space-18	14.17a	4.72a	9.41a	35443a	2.57a
Row space-25	13.27b	4.48b	8.75b	32158b	2.45b
Row space-32	12.33c	4.25c	8.09c	28658c	2.30c`
Interaction of varieties with row spacings					
Bakhtawar-92 x row space-18	14.81a	4.93a	-	37894a	-
Ghaznavi-98 x row space-18	14.34b	4.71b	-	35668b	-
Inqilab-91 x row space-18	13.35c	4.52c	-	32768c	-
Bakhtawar-92 x row space-25	14.01b	4.70b	-	34785b	-
Ghaznavi-98 x row space-25	12.88d	4.34de	-	31016d	-
Inqilab-91 x row space-25	12.91d	4.39cd	-	30674d	-
Bakhtawar-92 x row space-32	12.67d	4.36de	-	30075d	-
Ghaznavi-98 x row space-32	12.24e	4.27de	-	28063e	-
Inqilab-91x row space-32	12.09e	4.21ef	-	27837e	-
LSD at alpha 0.01					
Herbicide	0.24	0.10	0.26	1067	0.05
Variety	0.36	0.15	0.28	1454	0.07
Row space	0.30	0.09	0.23	923	0.04
Varieties x row spaces	0.35	0.16	-	1600	-

that highest biological yield (13.83 t ha^{-1}) was obtained for Bakhtawar-92, followed by Ghaznavi-98 (13.15 t ha^{-1}) and Inqilab-91 (12.79 t ha^{-1}). The herbicidal application indicated that maximum biological yield (14.13 t ha^{-1}) was recorded in plots treated with broad spectrum followed by broad leaf (14.09 t ha^{-1}) herbicide, grassy weeds herbicide (13.09 t ha^{-1}) while minimum yield (11.72 t ha^{-1}) was observed in control plots. The highest biological yield in row spacing was observed in row space of 18 cm (14.17 t ha^{-1}), followed by 25 cm (13.27 t ha^{-1}) and 32 cm (12.33 t ha^{-1}) (Table 1). Maximum biological yield in var. Bakhtawar-92 might be due to maximum number of tillers m^{-2} compared to Ghaznavi-98 and Inqilab-91. Highest biological yield in broad-spectrum herbicide might be due to the fact that weeds were effectively controlled which resulted in maximum number of tillers m^{-2} and thus biological yield. The highest biological yield observed in 18 cm row space could also be attributed to maximum number of tillers m^{-2} in the same treatment. These findings are in agreement with those of Sarir (1998), Kotru *et al.* (1999) and Khan *et al.* (1999). They reported that the application of broad-spectrum herbicide and narrow row spacing had increased the biological yield in wheat.

Grain yield (t ha^{-1}): Grain yield for different varieties, herbicides, row spacing and interaction of varieties with row spacing was significant. The maximum grain yield was recorded in variety Bakhtawar-92 (4.67 t ha^{-1}), broad-spectrum herbicide (4.81 t ha^{-1}) treated plots, row spacing 18 cm (4.72 t ha^{-1}) and interaction of Bakhtawar-92 with 18 cm row spacing (4.93 t ha^{-1}). The lowest grain yield was found in variety Inqilab-91 (4.37 t ha^{-1}), control (4.01 t ha^{-1}) treatment, row spacing 32 cm (4.25 t ha^{-1}) and interaction of variety Inqilab-91 with 18 cm row spacing (4.21 t ha^{-1}) (Table 1).

The maximum grain yield in variety Bakhtawar-92 might be due to maximum number of productive tillers m^{-2} and genetic yield potential as compared to other two varieties. The higher grain yield in broad-spectrum herbicide treated plots correlates with having maximum productive tillers m^{-2} and control of both grassy and broad leaf weeds. These results were in agreement with the findings of Boparai *et al.* (1991), Panwar *et al.* (1995), Prasad and Singh (1995), Prasad and Rafey (1996), Singh and Singh (1996), Azad *et al.* (1997) and Kotru *et al.* (1999). They reported that post-emergence application of 2,4-D + isoproturon was the best treatment combination in reducing dry matter yield of weeds and producing the greatest straw and grain yields (5.93 and 3.96 t ha^{-1}, respectively) compared to 2.74 and 1.66 t ha^{-1} in the un-weeded control.

The maximum grain yield recorded in 18 cm row spacing and interaction of variety Bakhtawar-92 x 18 cm row spacing might be due to fact that the productive tillers m^{-2} were more in variety Bakhtawar-92 and 18 cm row spacing as compared to other two varieties and row spacing. These results were in agreement with the work of Rath *et al.* (1990), Marko (1994), Behera *et al.* (1995), Ercoli and Masoni (1995) and Malik *et al.* (1996). They found that grain yield was highest in 6 and 15 cm row spacing and decreased in wider row spacing.

Straw yield (t ha^{-1}): Statistical analysis of straw yield data revealed that differences among the straw yields of varieties, herbicides and row spaces were significant. Maximum straw yields (9.15 t ha^{-1}) was exhibited by variety Bakhtawar-92, followed by Ghaznavi-98 (8.73 t ha^{-1}) and Inqilab-91 (8.36 t ha^{-1}). The broad-spectrum herbicide was found with highest straw yield (9.35 t ha^{-1}) followed by broad leaf (9.30 t ha^{-1}), grassy leaf (8.65 t ha^{-1}) and control (7.69 t ha^{-1}). In row space, maximum straw yield was observed in 18 cm (9.41 t ha^{-1}) followed by row space 25 cm (8.75 t ha^{-1}) and 32 cm (8.09 t ha^{-1}). Highest straw yield in var. Bakhtawar-92 and broad-spectrum herbicide treated plots might be due to maximum number of tillers m^{-2} as compared to other two varieties and herbicides and control. These findings are in agreement with those of Patel and Upadhyay (1990) and Kotru *et al.* (1999). They reported that post-emergence application of 2,4-D + isoproturon was found to be the best treatment combination in reducing dry matter of weeds and producing the greatest straw and grain yields of 5932 and 3961 kg ha^{-1}, respectively, compared to 2735 and 1657 kg ha^{-1} in the un-weeded control plots. Among row spaces, maximum straw yield might also be due to higher number of tillers m^{-2} in narrow row spaces as compared to wider row space. These result are in agreement with the work of Malik *et al.* (1996), who reported that grain and straw yields were highest at 15 cm row spacing and decreased at wider row spacing.

Net income and benefit cost ratio: The net income and benefit cost ratio were significantly affected by varieties, herbicides and row spaces. Interaction between varieties and row spaces for net income were significant while maximum net income and benefit cost ratio (Rs. 34251 ha^{-1} and 2.55) were computed in variety Bakhtawar-92, followed by Ghaznavi-98 (Rs. 31582 ha^{-1} and 2.44), while minimum (Rs. 30426 ha^{-1} and 2.33) was observed for variety Inqilab-91, respectively. Among herbicides highest net income and benefit cost ratio was of broad-spectrum (Rs. 35350 ha^{-1} and 2.57), followed by broad leaf (Rs. 34588 ha^{-1} and 2.51), grassy leaf (31480 and 2.41) and control (Rs. 26928 ha^{-1} and 2.26) treatment (Table I). Maximum net income and benefit cost ratio of 18 cm row space (Rs. 35443 ha^{-1} and 2.57), followed by 25 cm (Rs. 32158 ha^{-1} and 2.45) and 32 cm (Rs. 28658 ha^{-1} and 2.30) row space (Table 1). In the interaction of varieties with row spacing, the highest net income was recorded from the interaction of variety Bakhtawar-92 with 18 cm row space (Rs. 37894 ha^{-1}), followed by Ghaznavi-98 x the same row space (Rs. 35668 ha^{-1}) and Inqilab-91 with row space 32 cm (Rs. 32768 ha^{-1}) (Table 1). The maximum net income and benefit cost ratio recorded in variety Bakhtawar-92 might be attributed to its genetical potential for high yielding by having more productive tillers m^{-2} as compared to other two varieties. The application of broad-spectrum herbicides controlled weeds, which increased grain and straw yield and ultimately maximized net income. The 18 cm row space had higher productive tillers m^{-2} and thus gave higher grain and straw yield accruing ultimately maximum net income and benefit cost ratio. Highest net income from the interaction of variety Bakhtawar-92 with 18 cm row space might be a good combination, which increased net income and benefit cost ratio. These findings are in agreement with those of Sumkova (1956), Marko (1994), Pattanaik *et al.* (1996), Singh and Singh (1996) and Kotru *et al.* (1999). They reported that post-emergence application of 2,4-D + isoproturon and closer unidirectional sowing + integrated weed management resulted in the highest net returns of Rs. 7122 ha^{-1} and benefit: cost ratio of 2.37. The narrow-rowed sowing increased yield and was found more economical.

Biological yield ha^{-1}, straw yield ha^{-1}, grain yield, net income ha^{-1} and benefit cost ratio were affected by different varieties, herbicides and row spacings. Variety Bakhtawar-92 gave highest net return compared to Ghaznavi-98 and Inqilab-91. The application of broad-spectrum herbicide (2,4-D + isoproturon) was economical among herbicides followed by row spacing 18 cm.

References

Anonymous, 1996. Agricultural Statistics of Pakistan, Government of Pakistan, Ministry of Food, Agriculture and Cooperative, Food and Agriculture Division (Planning Unit), Islamabad, Pakistan.

Anonymous, 2001. Agriculture Statistics of NWFP, Agriculture Extension Department, Government of NWFP, Peshawar, Pakistan.

Anonymous, 2001. Economic Survey of Pakistan, Government of Pakistan, Finance Division, Economic Advisor's Wing, Islamabad, Pakistan.

Arnon, I., 1972. Crop Production in Dry Regions. Leonard Hill Book, London.

Azad, B.S., H. Singh and H. Singh, 1997. Effect of weed control measures and nitrogen on productivity of wheat (*Triticum aestivum*). Indian J. Agron., 42: 98-103.

Behera, A.K., 1995. Effect of seed rate, row spacing and fertilizer on wheat (*Triticum aestivum*). Indian J. Agron., 40: 510-511.

Boparai, B.S., H.S. Dhaliwal and D. Singh, 1991. Chemical control of small canary grass (*Phalaris minor*) and broad-leaf weeds in wheat (*Triticum aestivum*). Indian J. Agron., 36: 198-201.

Burns, W., 1944. The technological possibilities of increasing crop yields. J. Am. Soc. Agron., 85: 132-154.

Dwyer, L.M., M. Tollenaar and D.W. Stewart, 1991. Changes in plant density dependence of leaf photosynthesis of maize (*Zea mays L.*) hybrids, 1959 to 1988. Can. J. Plant Sci., 71: 1-11.

Ercoli, L. and A. Masoni, 1995. Effects of row spacing and orientation on yield and yield components of winter wheat. agricultural Mediterranean, 125: 215-221.

Heyne, E.G., 1987. Wheat and wheat improvement. 2nd Edition. Madison, Wisconsin, USA.

Iqbal, S., 1994. Screening of different herbicides for controlling weeds in wheat crop. M.Sc. (Hons) Thesis, Faculty of Agriculture Gomal University, Dera Ismail Khan, Pakistan.

Khan, M.A., M. Zahoor, I. Ahmad, G. Hassan and M.S. Baloch, 1999. Efficacy of different herbicides for controlling broad leaf weeds in wheat. Pak. J. Biol. Sci., 2: 732-34.

Kotru, R., B.S. Azad and H. Singh, 1999. Chemical control of weeds in wheat (*Triticum aestivum* L.). Environ. Ecol., 17: 646-649.

Malik, M.A., M.H. Rasheed and A. Razzaq, 1996. Row spacing study in two wheat varieties under rainfed conditions. Sarhad J. Agric., 12: 31-36.

Marko, F., 1994. Effects of row spacing and seeding rates on grain yield and properties of winter wheat, Rostlinna-Vyroba, 40: 431-438.

Muhammad, A., 1984. Approaches to the transfer of crop production technology in developing countries. Consultancy Report for U.N. Development Programme and U.N. Food and Agriculture Organization.

Norris, R.F., 1982. Interactions between weeds and other pest in the agro-ecosystem, In: Hatfield J.L. and I.J. Thomson (Ed.) Proc. Conf. on Biometeorology in Integrated Pest Management, Univ. of California, Davis, CA. Academic Press, NY., pp: 343-406.

Panwar, R.S., S.S. Rathi and R.K. Malik, 1995. Effect of isoproturon and 2, 4-D combination on weed control in wheat. Haryana Agric. Univ. J. Res., 25: 101-105.

Prasad, K. and R.S. Singh, 1995. Influence of weed and nitrogen management on weed growth, nutrient uptake and yield of wheat (*Triticum aestivum*). Indian J. Agric. Sci., 65: 117-122.

Prasad, K. and A. Rafey, 1996. Effect of nitrogen and weed control on weeds, nitrogen uptake and crop productivity of wheat. Madras Agric. J., 83: 430-432.

Patel, H.C. and P.N. Upadhyay, 1990. Integrated weed management in irrigated wheat. J. Weed Sci., 22: 89-91.

Pattanaik, A., B.D. Behera and S.C. Panda, 1996. Effect of seeding geometry and weed management on weed growth, nutrient uptake and economics of wheat cultivation. The Environ. Ecol., 14: 631-635.

Rath, R., R.B.L. Bhardwaj and K.N. Ahuja, 1990. Effect of sowing methods and herbicide application on population, dry matter production and nutrient uptake by weeds and yield of wheat. Ann. Agric. Res., 11: 115-160.

Sarir, A.J., 1998. Effect of different levels of pre and post-emergence herbicides application on wheat planted at various row spaces. M.Sc. thesis, Department of Agronomy, Faculty of Crop Production Sciences, NWFP Agricultural University, Peshawar, Pakistan, pp: 41.

Singh, G. and O.P. Singh, 1996. Response of late sown wheat (*Triticum aestivum*) to seeding methods and weed control measures in flood prone areas. Indian J. Agron., 41: 237-242.

Sumkova, M., 1956. Narrow rowed sowing of wheat as a mean of increasing the crop yield. Russian J. Agric. Sci., 4: 125-157.

Tollenaar, M., M. Dwyer and D.W. Stewart, 1992. Ear and kernel formation in maize hybrids representing three decades of yield improvement in Ontario. Crop Sci., 32: 432-438.

Triplett, G.B. Jr., 1976. Management of weeds in reduced tillage system. Bull Entomol. Soc. Am., 22: 298-299.

Young, F.J.L., A.G. Ogg, Jr., R.I. Papendick, D.C. Thill and J.R. Alldredge, 1994. Tillage and weed management affects winter wheat yield in an integrated pest management system. Agron. J., 86: 147-154.