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Integrated Weed Management Strategies in Wheat Crop

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Abstract

An experiment to study the impact of integrated weed management strategies in wheat was carried out at agronomic research area, faculty of agriculture, Gomal University, Dera Ismail Khan, during the year 2010-2011. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications and ten treatments. The net plot size was kept as 5 m × 2 m (10 m^2). The treatments included single, double and triple hoeing with kasola. 3-hoeing with khurpa, puma super applied at 1st and 2nd irrigation. Sonic, Buctril super, weed control throughout the season and no weeding (check). The results revealed that the application of herbicides and hoeing significantly affected the weed biomass (g m^{-2}), number of tillers (m^{-2}), spike length (cm), 1000-grain weight (g), grain yield (t ha^{-1}), and biological yield (t ha^{-1}). Weed free crop throughout the season it remains on top more than grain and biological yield gave the highest grain yield (6.167 t ha^{-1}) and biological yield (11.42 t ha^{-1}). Among various herbicides, Buctril super recorded maximum grain yield (4.767 t ha^{-1}) and biological yield (9.953 t ha^{-1}). The lowest Cost-Benefit Ratio (0.33) was recorded in Buctril super treatment.

Keywords: Herbicides; Biological yield; Buctril super treatment

Introduction

Wheat (*Triticum aestivum* L.) is the basic component of human diet. It is the most widely grown cereal grain crop in the world, except in the rice-eating regions of Asia. Wheat products are the principal cereal foods of an overwhelming majority of the world inhabitants. It has great adaptability to a wide variety of soil and climatic conditions. It is staple food of the people of Pakistan and serves as backbone in the economy of the country. Among all cereals, wheat is the most preferred food for human being. It is planted to a limited extent as a forage crop for livestock and the straw can be used as fodder for livestock. Globally, it is the most important food grain and ranks second in total production as a cereal crop behind maize, the third being rice [1]. It is reported that 100 g of wheat grain contains 326-335 calories, 11.57-14.0 g water, 9.4-14.0 g protein, 1.2-2.5 g fat, 69.1-75.4 g total carbohydrate, 1.8-2.3 fiber, 1.7 g ash, 36-46 mg calcium, 354-400 mg phosphorus, 3.0-4.3 mg iron, 370-435 mg potassium, 0.43-0.66 mg thiamine, 0.11-0.12 mg riboflavin and 4.3-5.3 mg niacin. Yields of wheat continued to increase, as new land came under cultivation and with improved agricultural husbandry involving the use of fertilizers, threshing machines and reapers and tractor-drawn cultivators.

The yield per unit area obtained in our country is far less than the yield of developed countries of the world. Besides various causes of low grain yield per unit area, presence of weeds is a key factor of reduction in yields. Weeds compete with crop for light, nutrient, water and carbon dioxide.. Moreover, they observed that weeds consume three to four times more nitrogen, potassium and magnesium than weed free crop. Weeds exert stress on the cultivated crop through interference, consisting of competition, allelopathy and parasitism and by providing habitat for other harmful organisms. Weeds not only reduce the yield of crops but also deteriorate the quality of farm produce by contaminating the seed, thereby reducing its market value. The annual losses to wheat crop due to weed infestation in Pakistan and K.P.K. province in monetary terms amount to Rs. 28 billions and Rs. 2 billions, respectively. These enormous figures warrant an efficient control of weeds for lucrative economic returns. The eradication of weeds from the cropped field is, therefore, very essential for obtaining good crop stand and high economic returns.

From the start of settled agriculture upto the middle of the 20th century, the plough and hoe have been the main direct methods of weed control although fire, howing, mowing and smothering have also been applied. Conventional methods of weed control are weather-dependent, tedious, laborious, time consuming and costly. Crop mimicry by grassy weeds like wild oats and canary grass complicates the success of manual weed control strategies. Now weed technology has entered a scientific phase and chemical weed control is being more emphasized in modern agriculture. Chemical weed control is less dependent on weather and hence more practicable for use during the critical period of weed crop competition. The use of chemicals is usually easy, time saving, highly effective and most economical approach to weed control. However, it may not be environmentally safe as manual, mechanical and biological methods of weed control [2].

Integrated Weed Management (IWM) is the careful consideration of all available weed control techniques and subsequent integration of appropriate measures that discourage the development of weed and keep herbicides and other intervention to levels that are economically justified and reduce or minimize risks to human health and the environment. Integrated weed management emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. Integrated weed management takes into account all relevant control tactics and methods available locally, evaluating their potential cost effectiveness. It does not, however, consist of any absolute or rigid criteria. Implementation of IWM lies with farmers, who adopt those elements of IWM, which are seen to be practical and added value to their activities.

Materials and Methods

An experiment, titled, "Integrated weed management strategies in wheat" was carried out at Agronomic Research Area, Faculty of Agriculture, Gomal University Dera Ismail Khan, Pakistan during winter season 2010-2011. The experiment was laid out in a randomized complete block design with ten treatments and three replications. The net plot size was kept 5 m × 2 m (10 m^2). Wheat variety Hashim-8 was sown on a well prepared seedbed with single row hand drill. Seed rate was used as 100 kg ha^{-1}. Urea, Diammonium Phosphate (DAP) and Sulphate of Potash (SOP) 150 kg N, 120 kg P_2O_5 and 60 kg K_2O ha^{-1} was applied respectively. Full dose of phosphorus, potash and half dose of nitrogen were applied at seedbed preparation while the rest of nitrogen was applied at the time of first irrigation. All other cultural practices were kept uniform for all treatments. Fresh weed biomass (g m^{-2}), Dry weed biomass (g m^{-2}), Days to 50% heading, plant height (cm) , Number of tillers (m^{-2}), Spike length (cm), Number of grains ($spike^{-1}$), 1000- grain weight (g), grain yield (t ha^{-1}), Biological yield (t ha^{-1}), harvest index (%) and Cost Benefit Ratio (CBR) the data collected were subjected to analysis of variance techniques and differences among between individual means of each parameter were performed by using MSTATC package [3].

Results and Discussion

Weed infestation in wheat has become a serious problem resulting considerable reduction in wheat yield. Herbicides and manual weeding are commonly used to reduce weed infestation. The results pertaining to yield components and yield as influenced by the application of various herbicides and manual weeding are presented and discussed in this chapter.

Fresh weed biomass (g m^{-2}) after 60 days of sowing

The broadleaved weeds predominantly germinated in the field were convolvulus *arvensis* (filed bind weed), *Chenopodium album* (Lamb's quarters), *Medicoago denticulata* (Bur Colver), *Melitotus indica* (White melilot), *Rumex dentatus* (Prickly dock) and *Angalis arvensis* (pimpernel). Among narrow leaved weeds, *Avena fatua* (Wild oat) and *phalaris minor* (Canary grass) were dominant in the experimental area. The data taken 60 days after sowing regarding Fresh Weed Biomass (FWB) is illustrated in Table 1 and its ANOVA is given in appendix I.

The data shows that (FWB) was significantly affected by different weed management practices. From the table, it is indicated that the maximum Fresh Weed Biomass (FWB) of (109 g m^{-2}) was recorded in T5 (Control) while the rest of other treatments T1 (One hoeing with kasola), T2 (Two hoeing with kasola), T7 (sonic), T9 (3-Hoeing with kasola) and T6 (3-hoeing with khurpa) have visible differences but statistically these treatments were at par with T5.

The lowest (FWB) (97.88 g m^{-2}) was observed in T4 (Weed free) but was at par with the remaining two treatments T10 and T3 [4]. The highest (FWB) in T5 (control) was due to the presence of abundant weeds in this treatment as no weed control measure was adopted while the lowest (FWB) was recorded in T4 (weed free) where weeding was done from time to time to eradicate weeds. Herbicides proved effective in decreasing weed (FWB). However the efficiency of herbicides was different in controlling weeds. The application of Puma Super and Buctril Super effectively controlled weeds population resulting in lower FWB.

Weed management strategies	FWB (g m-2) 60 days	DWB (g m-2) 60 days	Days to (gm-2) 50% heading	Plant height (cm)	Number of tillers (m-2)
One hoeing with Kasola	108.8	17.83	17.83	108	380
Two hoeing with Kasola	108.6	17.72	17.72	109.1	396
Puma Super (after 1st irrigation)	100.6	16.39	16.39	110.5	410

Table 1: Fresh weed biomass (gm-2) after 60 days of sowing, dry weed biomass (gm2) after 60 days of sowing, days to 50% heading, fresh weight biomass (gm-2) after 120 days of sowing, Dry weight biomass (gm-2) 120 days after sowing, plant height (cm), number of tillers (m-2) as affected by different weed management strategies.

Dry weed biomass (g m^{-2}) after 60 days of sowing

The data regarding dry weed biomass 60 days after sowing is presented in Table-1 and its Analysis of variance is given in Appendix II. The data revealed that Dry Weed Biomass (DWB) was significantly affected by various weed management strategies. The highest dry weed weight (18.65 g m-2) was recorded in weedy check treatment (T5) followed by T1, T2, T9, T8 and T6 which were statistically similar. The lowest dry weed biomass (14.29 g m-2) was observed in T4 (weed free) which was statistically at par to T3 and T10. The results showed that different weed management strategies effectively controlled weeds growth and decreased (DWB). As no control measure was done in control (T5) which resulted the highest (DWB) while lowest (DWB) was recorded in treatment (T4) where continuous eradication of weeds was carried out. Likewise herbicides also proved effective in reducing weeds density. Buctril Super was the most promising herbicide as lower dry weed biomass was observed in this treatment (T10). This might be due to the fact that broadleaved weeds were dominant in the experimental fields which were killed by this weedicide.

Days to 50% heading

Analysis of variance indicated that different weed management strategies significantly affected days to 50% heading of wheat crop. Data presented in Table 1 showed that maximum days to heading (108.0) was recorded in T5 (weedy check) while minimum days to 50% heading (86.00) was found in T1. However, it is clear from the data that all the weed management practices significantly reduced the days to 50% heading as compared to control treatment (T5), indicating that wheat crop was in competition with weeds for sunlight and gained more time to bear flowers. However combining these practices and integrating them with herbicides use can result in long term and more cost-effective weed management [5].

Plant height

Data relating to plant height at maturity as affected by different weed management practices are presented in Table-1 and appendix-VI. The results revealed that plant height was significantly increased by different herbicides application and hand weeding. The maximum plant height of (121.0 Cm) was recorded in T4 (weed free) which differed significantly from all other treatments. It was followed by T6 and T9 with plant height of (118.5 cm) and (117.5 cm) respectively. The highest plant height in weed free and 3-hoeings treatments suggest that weeds in these treatments were eliminated and crop plants were safe from weeds competition for nutrients, light and space. Moreover, hoeing improved soil condition and made soil environment conducive for plant growth. The minimum plant height (106.6 cm) was observed in T5 (control) that differed significantly from all other weed management practices. Among herbicides treatments, the maximum plant height of (113.9 cm) was recorded in Buctril Super (T10) followed by Puma Super at 2nd irrigation (111.5 cm) while the minimum plant of (109.2 cm) was observed in Sonic applied treatment (T7) indicating that Buctril Super effectively controlled weeds density and promoted plant growth due to lesser weeds competition with crop plants for light, space and nutrients.

Number of tillers

The data regarding the number of tillers (m^{-2}) as affected by various weed management strategies are presented in Table-1. Analysis of variance table showed that number of tillers (m^{-2}) was affected significantly by different weed management strategies. Weedicides application and manual weeding resulted more tillers than weedy check (control). The maximum number of tillers m-2 (492) were produced in T4 (weed free) followed by T6 (3-hoeing with khurpa) giving (482.7 tillers m-2) and both treatments were statistically alike. The minimum tillers m^{-2} (273.3) was observed in weedy check (T5). Among herbicidal treatments Buctril Super application proved the best regarding production of tillers m^{-2} (422.0) followed by Sonic and Puma Super producing (410 tillers m^{-2}).The maximum number of tillers m^{-2} produced in plants growing in weed free and 3-hoeing with khurpa plots may be due to eradication of weeds and availability of nutrients to plants while the minimum number of tillers in plants growing in weedy check plot might be due to lesser availability of nutrients to crop plants in the presence of weeds.

Spike length

The analysis of variance table given in Appendix VIII revealed that different weed management strategies significantly increased the spike length of wheat. The maximum spike length of (12.22 cm) was noticed in T4 (weed free) followed by T6 (3-hoeing with khurpa) with spike length of (11.82 cm) and both treatments were significantly similar. T9 (3-hoeing with kasola ranked third with respect to spike length (11.25 cm) and was significantly superior to all other treatments except T4 and T6. The minimum spike length (6.810 cm) was found in T5 (weedy check) which differed significantly from all other treatments. Application of Buctril Super (T10) proved superior to other herbicides followed by Puma Super at 2nd irrigation (T8) and Puma Super at 1st irrigation (T3). The T10 was statistically at par with T8 while T8 in turn was significantly akin to T3. Application of Sonic (T7) was least effective in increasing spike length than Buctril Super and Puma Super. The maximum spike length in weed free and 3-hoeing treatments might be due to effective weeds eradication and improvement of soil environment conducive for crop plants to receive nutrients. Herbicides application enhanced spike length due to killing of weeds and consequently more nutrients were available for wheat plants. The results suggest that all weed management practices whether mechanical or chemical enhanced spike length.

Number of grains

The potential of spike is measured in terms of its number of grains that is an important yield component. Data regarding number of grains spike-1 are given in Table-2 and Appendix IX. Significant variation existed in number of grains spike-1 due to different manual and chemical weed control measures. The maximum number of grains (73.00) were recorded in T4 (weed free) followed by T6 (3-hoeing with khurpa), T10 (Buctril Super), T9 (3-hoeing with kasola) and T8 (Puma Super at 2nd irrigation) with (72.33, 72.00) and (71.33 grains spike-1) respectively. However, all the four treatments were statistically at par. Similarly T8 was also statistically similar to T3 (Puma Super at 1st irrigation) producing (68.00 grains $spike^{-1}$). The minimum number of grains spike-1 (49.00) was recorded in T5 (weedy check). Among various herbicides, application of Buctril Super produced highest number of grains spike-1 followed Puma Super at 2nd irrigation and 1st irrigation and Sonic. The maximum number of grains spike-1 in wed free and 3-hoeing with khurpa as well as kasola treatments may be due to eradication of weeds and provision of greater amount of nutrients which produced larger spikes. Herbicides application also proved better for producing greater number of grain spike-1 due to elimination of weeds.

Grain yield

The data concerning grain yield of wheat as affected by integrated weed management strategies are given in Table-2. The analysis of variance and comparison of treatment means showed that all the treatments produced significantly higher grain yield than weedy check. The maximum grain yield of (6.167 t ha^{-1}) was produced by T4 (weed free) that differed significantly from all other treatments. It was followed by T6 (3-hoeing with khurpa) and T9 (3-hoeing with kasola) with grain yields of (5.757 t ha^{-1}) and (5.733 t ha^{-1}) respectively. However, both treatments produced significantly similar grain yields. Likewise T10 (4.767 t ha^{-1}), T8 (4.727 t ha^{-1}) and T2 (4.767 t ha^{-1}) were also statistically akin with respect to grain yield. The minimum grain yield of (2.877 t ha^{-1}) was recorded in T5 (weedy check). Amongst different weed management strategies weeding through out season (T4: weed free) and three hoeing with khurpa as well as kasola resulted greater grain yields as compared to herbicides application. Among herbicides, Buctril Super proved superior to Puma Super and Sonic. Buctril Super (T10) and Puma Super at 2nd irrigation (T8) produced statistically similar grain yields whereas Puma Super at 1st irrigation (T3) and Sonic (T7) were also statistically at par in grain yield. The higher grain yields achieved from weed free and 3-hoeing with khurpa as well as kasola might be due to eradication of weeds and creating conducive soil condition for nutrients availability to crop plants. Herbicides application also eliminated weeds and reduced weeds competition for nutrients, light and space.

Cost-benefit ratio

The financial feasibility of adapting appropriate weed management strategies was determined by economics of weed management practices and calculating cost-benefit analysis. Manual weeding like 3-hoeing with khurpa, 3-hoeing with kasola and weed free treatments also proved economical with lower CBR as compared to weedy check (T5). The maximum CBR (0.58) was recorded in T5. The data suggest that investing in weed management practices is a financially viable option at current costs and production prices and the most economical weed management strategy is application of Buctril Super. Although the higher grain and biological yields were obtained in manual weed control practices yet the cost incurred in those treatments were higher which resulted in higher CBR as compared to herbicides application.

Conclusion

The use of different weed management strategies decreased weed density per unit area and increased wheat yield. Weed free treatment gave maximum grain and biological yield (t ha^{-1}) of wheat than other treatments. Among different herbicides Buctril super gave the highest grain yield (t ha^{-1}). Though, both chemical and manual weed control methods gave excellent control of weeds but chemical control was found to be the most easiest, time saving and highly effective. The lowest CBR was recorded with application of Buctril super. Although the weeds free treatment T5 produced the best results regarding grain yield but due to high cost of labour. Its seems difficult to be adopted by the farmers on large scale. Hence, on small scale it is the best option.

References

1. Ahmad S, Khan SM, Allah EFA, Alqarawi AA, Hashem A, et al. (2003) Weed species composition and distribution pattern in the maize crop under the influence of edaphic factors and farming practices: A case study from Mardan, Pakistan. Saudi J Biol Sci 23: 741-748.
2. Dumka D, Bednarz CW, Maw BW (2004) Delayed initiation of fruiting as a mechanism of improved drought avoidance in wheat. Crop Sci 44: 528-534.
3. Varshney S, Hayat S, Alyemeni MN, Ahmad A (2012) Effects of herbicide applications in wheat fields. Plant Signal Behav 7: 570-575.
4. Savary S, Srivastava RK, Singh HM, Elazegui FA (1997) A characterization of rice pests and quantification of yield losses in the rice-wheat system of India. Crop Prot 16: 387-398.
5. Savary S, Willocquet L, Elazegui FA, Castilla NP, Teng PS, et al. (2000) Rice pest constraints in tropical Asia: Quantification of yield losses due to rice pests in a range of production situations. Plant Dis 84: 357-369.