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Studies on integrated weed management in wheat (*Triticum aestivum* L.)

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The treatments were manual weed control, weedy check (full season), Buctril-M 40 EC @ 1.0 lit ha^{-1}, Close row spacing + Buctril-Super 60 EC @ 625 mL ha^{-1}, Close row spacing + Buctril-Super 60 EC @ 825 mL ha^{-1}, Buctril-M 40 EC @ 1.5 lit ha^{-1}, Normal sowing + Buctril-Super 60 EC @ 625 mL ha^{-1}, and Normal sowing + Buctril-super 60 EC @ 825 mL ha^{-1}. The results revealed that all the growth, yield contributing traits and grain yield were highly significantly affected by integrated weed management. All treatments were found more effective as compare to weedy check (full season). Among chemical amendments of treatments Buctril-M 40 EC @ 1.5 lit ha^{-1} performed better growth, yield contributing traits and recorded highest seed yield (4431.36 kg ha^{-1}). The Buctril-M 40 EC @ 1.5 lit ha^{-1} proved to be the best under Tando Jam Soil Conditions.

Key words: Wheat (*Triticum aestivum.*), weed management, Buctril-M, Buctril-Super, normal sowing, close row spacing

Introduction

Wheat (*Triticum aestivum*) is one of the most important cereal crops of Pakistan and is extensively grown, produced and consumed in the world. Among all cereals, wheat is the most preferred food for human being. Wheat is planted to a limited extent as a forage crop for livestock and the straw can be used as fodder for livestock or as a construction material for roofing thatch (Palmer and John, 2001). Globally, it is the most important food grain and ranks second in total production as a cereal crop behind maize; the third being rice. It is reported that per 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

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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 (Ken, 2004). 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 reaping machines (the combine harvester), tractor-draw cultivators and planters and better varieties. With population growth rates falling, while yields continue to rise, the acreage devoted to wheat may now begin to decline for the first time in modern human history (Vaughan and Judd, 2003).

The yield per unit area obtained in our country is far less than the yield of developed countries of the world. Besides varied causes of this low grain yield per unit area, presence of weeds has also been become a key factor is reduction of yields. Weeds are seriously managed in crop production they not only reduced crop yield but in many cases the quality of farm is also affected. They compete with crop mainly for light, nutrient, water and carbon dioxide. Rao (2000) reported that reduction in crop yield has a direct correlation with weed competition, while Friesen *et al.* (2000) mentioned that herbicides would continue to be a key component in most weed management systems in wheat. Moreover, they observed that weeds consume three to four times more nitrogen, potassium and magnesium than weed free crop.

Olea *et al.* (2003) reported that *Avena* spp., *Bromus* spp, *Promus* spp, *Parietaria debilies, Bowlesia incana, Hybanthus parviflorus* species of weeds in wheat resulted considerable losses on its yield. Wierrma *et al.* (2003) tested a number of herbicides to control weeds in wheat and found that tank mixing defenzoquat with imazamethabenz reduced weeds infestation, while Shao Xiaoming and Wu Wenliang (2003) applied Tribenuron and hand weeding and reported economic thresholds as 20 and 70 plant m^{-2}, respectively. In consideration with the growth dynamics of this weed community, the test weed density to use tribenuron in autumn was determined as 12 plant m^{-2}. An ocular estimate method was recommended for deciding the weeds density in wheat field. Kassai *et al.* (2002) tested a number of wheat varieties for their tolerance against weeds and observed 4 to 18 percent reduction in grain yield.

Integrated weed management (IWM) means the careful consideration of all available weed control techniques and subsequent integration of appropriate measures that discourage the development of weeds and keep herbicides and other interventions to levels that are economically justified and reduce or minimized risks to human health and the environment (Ferrell *et al.*, 2001). 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 task into account all relevant control tactics and methods available locally, evaluating their potential

cost effectiveness. It does not, however, consists of any absolute or rigid criteria. Implementation of IWM lies with farmers, who adopted those elements of IWM, which are seen to be practical and added value to their activities (Dumka *et al.*, 2004). The present study was planned to assess the effect of integrated weed management practices on weed intensity, growth and grain yield of wheat under agro-ecological conditions of Tandojam.

Materials and methods

An experiment was conducted at plant physiology section in the Agriculture Research Institute, Tandojam during Rabi during 2005-2006. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications with the size of 3 m x 6 m^2. The treatments were as follows: T1 = Manual weed control (full season), T2 = Weedy check (full season), T3 = Buctril-M 40 EC @ 1.0 lit ha^{-1}, T4 = Close row spacing + Buctril-Super 60 EC @ 625 ml ha^{-1}, T5 = Close row spacing + Buctril-super 60 EC @ 825 ml ha^{-1}, T6 = Buctril-M 40 EC @ 1.5 lit ha^{-1}, T7 = Normal sowing + Buctril super 60 EC @ 625 ml ha^{-1} and T8 = Normal sowing + Buctril Super 60 EC @ 825 ml ha^{-1}, where EC is emulsifiable concentrates.

Land was prepared by two plowing and followed by land leveling to achieve fine seedbed. However more emphasis was given to the precisely leveling of land preparation bunds and channels around the field were manually made. The seed of wheat variety T.D-1 was sown by single coulter hand drill. The spaced between row to row in normal was 22.5 cm, while in the close spacing. The row-to-row spacing was measured 16 cm, the crop was sown on during the month of November 2005-2006. The manual weed control (full season) was made in T_1. The rest of the treatments were done by herbicidal application. The herbicides were used as selective and systematic one and were applied after first irrigation. Before spraying, herbicides were thoroughly mixed with water in separate container to get proper uniformity. Crop management practices such as fertilizers application, irrigation etc were carried out according to the standard recommended practice for wheat crop. Weed densities of different weed species were recorded after 45 days of sowing. Weed density was counted throughout all the plots separately and calculated by following formula:

$$\text{Weed density } m^2 = \frac{\text{Total number of particular weed species}}{\text{Total number of treatments}}$$

The weed control percentage was recorded before and after application of treatments and calculated by following formula:

$$\text{Weed control \%} = \frac{\text{WBA-WAA}}{\text{BA}} \times 100$$

Whereas: WBA = weeds before application and WAA = weeds after applications.

The plant height (cm) was recorded randomly at three-selected plants from each treatment at the time of wheat maturity/harvest. The number of tillers was recorded from three selected plants at the time of harvesting. The numbers of spickelets were recorded from three selected plants randomly from different treatments at the time of harvesting of crop. The grains weight plant^{-1} (g) was recorded from three selected plants randomly from different treatments at the time of harvest. The seed index was recorded by counting and weighting 1000 seeds from different treatments after threshing of crop. The grain yield (kg ha^{-1}) was calculated on each plot. The collected data kg ha^{-1} was subjected to statistical analysis using analysis of variance technique and LSD to determine the superiority of treatment means by following Gomez and Gomez (1984).

Results and discussion

The results on weed density m^{-2} (Table 1) revealed that weed density m^{-2} of weed species in present experiment indicated that Naro, *Convolvuslus arvensis* had maximum (14.69) weed density m^{-2} as compared to other weed species. Jhill, *Chenopodium album* stood on second position by showing 13.59 and Jhangli Javi, *Avena futa* was found with minimum (1.49) weed density m^{-2}.

The data on weed control is presented in Table 2. The results showed that Buctril-M 40 EC @ 1.5 lit ha^{-1} was most effective as compared to all other herbicides applications at post emergence. The maximum percentage of weed control (92.79) was recorded in T_6 Buctril-M 40 EC @ 1.5 lit ha^{-1} followed by T_1 Manual weed control (full season) was 92.09 percent. While the minimum weed control was recorded in T_2 Weedy check for full season.

The mean plant height of wheat, as affected by integrated weed management, is presented in Table 3. The results showed that maximum plants height (74.79 cm) were recorded under the T_5 close row spacing + Buctril-super 60 EC @ 825 ml ha^{-1} followed by T_4 close row spacing + Buctril-super 60 EC @ 625 ml ha^{-1} (73.88 cm). Where as minimum plant height (68.83 cm) was recorded under T_2 weedy check for full season. The present results were comparable with the findings of Jamro *et al.* (2000), who reported that herbicides were more effective to control weeds better them hand weeding.

Table 1. Weed density m^{-2}.

Weed name	Weed density m^{-2}
Fat-hen (Jhil) = *Chenopodium album*	13.59
Bindweed (Naro) = *Convolvulus arvensis*	14.69
Toothed dock (Palak) = *Rumex dentatus*	9.34
Sweet clover (Singh) = *Melilotus alba*	4.37
Nut grass tuber (Kabah) = *Cyperus rotandus*	2.46
Pimpernel (Bili boti) = *Anagallis arvensis*	6.77
Canary grass (Dhanaki) = *Phalaris minor*	1.52
Wild Oat (Jhangli javi) = *Avena futa*	1.49
Bermuda grass (Chabbar) = *Cynodon dactylon*	3.06

The results revealed that maximum number of tillers $plant^{-1}$ (7.83) were recorded under the T_6 Buctril-M 40 EC @ 1.5 lit ha^{-1} followed by T_1 Manual weed control for full season (7.74). Where as minimum number of tillers $plant^{-1}$ (4.49) was recorded under T_2 Weedy check (full season) as seen in Table 3.

Table 2. Weed control.

Treatments	Weed density m^{-2} WBA	Weed density m^{-2} WAA	Weed control percentage
T1=Manual weed control (full season)	63.25	5.00	92.09
T2=Weedy check (full season)	52.25	59.50	-12.79
T3=Buctril-M 40 EC @ 1.0 lit ha^{-1}	54.50	5.00	90.82
T4=Close row spacing + Buctril-super 60 EC @ 625 ml ha^{-1}.	59.00	6.50	88.98
T5=Close row spacing + Buctril-super 60 EC @ 825 ml ha^{-1}.	59.75	6.00	89.95
T6=Bustril-M 40 EC @ 1.5 lit ha^{-1}	55.50	4.00	92.79
T7=Normal sowing + Buctril-Super 60 EC @ 625 ml ha^{-1}.	56.00	8.50	84.82
T8=Normal sowing + Buctril-Super 60 EC @ 825 ml ha^{-1}.	58.00	7.50	87.06

The observation presented in Table 3, showed that the maximum number of spikelets / $plant^{-1}$ (153.35) was recorded in T_6 (Buctril-M 40 EC @ 1.5 liter) followed by T_1 Manual weed control for full season (147.24). While the minimum number of spikelets $plant^{-1}$ (62.99) was recorded in T_2 weedy chick (full season).

The results indicated that maximum grain weight of $plants^{-1}$ (19.31g) was recorded under the T_6 Buctril-M 40 EC @ 1.5 lit ha^{-1} followed by T_1 Manual weed control for full season (18.08 g). Where as minimum grain weight $plant^{-1}$ (8.52 g) was recorded under T_2 Weedy check (full season). The results are considered with the findings of Jalis and Noor (1980) and Sarwar *et al.* (1988)

who reported that herbicides were observed better than hand weeding that produced maximum grains in spikes.

The results presented in Table 3 revealed that maximum seed index (1000 grains weight) 42.12g was recorded under the T_6 Buctril-M 40 EC @ 1.5 lit ha^{-1} followed by T_1 Manual weed control for full season 41.11 g. Where as minimum seed index (1,000 grains weight) 37.77 g was recorded under T_2 Weedy check (full season). The mean of grain yield kg ha^{-1} of wheat as affected by integrated weed management were presented in Table 3. The results indicated that maximum grain yield (4,431.36 kg ha^{-1}) was recorded under the T_6 Buctril-M 40 EC @ 1.5 lit ha^{-1} followed by T_1 Manual weed control for full season (4,282.98 kg ha^{-1}). Where as minimum grain yield (3,793.82 kg ha^{-1}) was recorded under T_2 Weedy check (full season).

It is concluded from this study that the chemical and mechanical weed control are suitable to gain higher yield in wheat, whereas Buctril-M 40 EC @ 1.5 lit ha^{-1} proved to the best under Tandojam soil conditions.

The results revealed that all the growth, yield contributing to the traits and seed yield of wheat was highly significantly affected by weed control treatments. It is demonstrated that all the growth and yield components were higher under weed control treatments. Maximum grain yield i.e. 4,431.36 kg ha^{-1} was recorded under Buctril-M 40 EC @ 1.5 ml lit ha^{-1} and minimum grain yield 3,793.82 kg ha^{-1} was recorded under weedy check (full season). Therefore, the used of Buctril-M 40 EC @ 1.5 lit ha^{-1} may recommended as post emergence herbicides in wheat to get maximum reduction of weeds and higher yields.

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Table 3. Mean plant height cm, Number of tiller plant^{-1}, Number of spikelets plant^{-1}, Grain weight plant^{-1} (g), Seed index (1000-grain weight g), Grain yield (kg ha^{-1}) of wheat as affected by integrated weed management.

Treatments	Plant height (cm)	Number of tillers plant^{-1}	Number of spikelets plant^{-1}	Grain weight plant^{-1} (g)	Seed index (1000 grain weight g)	Grain yield kg ha^{-1}
T1= Manual weed control (full season)	72.77abc	7.74b	147.24b	18.08b	41.11b	4282.98b
T2= Weedy check (full season)	68.83e	4.49f	62.99f	8.52f	37.77f	3793.82f
T3= Buctril-M 40 EC @ 1.0 lit ha^{-1}	71.98bcd	7.58ab	137.66ab	17.54ab	40.23ab	4177.86bc
T4= Close row spacing + Buctril-super 60 EC @ 625 ml ha^{-1}.	73.88ab	5.83de	87.5de	12.87de	38.56de	3951.90de
T5= Close row spacing + Buctril-super 60 EC @ 825 ml ha^{-1}.	74.79a	6.58cd	98.75cd	13.50cd	39.28cd	4056.25cd
T6= Bustril-M 40 EC @ 1.5 lit ha^{-1}	72.53abc	7.83a	153.35a	19.31a	42.12a	4431.36a
T7= Normal sowing + Buctril-super 60 EC @ 625 ml ha^{-1}.	69.56de	6.74ef	108.99ef	15.27ef	39.72ef	3895.83ef
T8= Normal sowing + Buctril-super 60 EC @ 825 ml ha^{-1}.	70.88cde	6.83de	111.74de	15.65de	40.01de	3939.80de
S.E	0.8296	0.5235	3.774	6.352	3.639	45.68
CV	2.31	7.578	6.65	8.60	9.10	2.25
LSD 1%	3.32	0.9210	15.11	25.424	14.56	182.926
LSD 5%	2.44	0.7311	11.10	18.68	10.70	134.4