EVALUATION AND DEMONSTRATION OF HERBICDES ALONE AND IN MIXTURE FOR MANAGEMENT OF GRASSY AND BROAD LEAF WEEDS IN WHEAT (*Triticum aestivum* L.) IN SARGODHA ZONE PAKISTAN

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ABSTRACT

Wheat is the staple food of Pakistan and elsewhere in the world, which supplies 73% calories and proteins to the nation. The wheat area was sown on an area of 8.973 m ha which produced almost 26.674 million tons in Pakistan during 2016-17. Despite all improved agronomic practices the wheat production is gradually decreasing per unit area due to certain factors. Weeds are the major factor affecting the wheat grain yield. For this reason, a field experiment was designed to evaluate some grass and broadleaf weed killers alone and in combination for the control of narrow and broad leaf weeds in wheat crop in Sargodha zone, Pakistan on the Research area of Adaptive Research farm Sargodha during Rabi 2017-18 using wheat variety Faisalabad-2008. There were six treatments (Harvester @1 L ha^{-1}, clodinofop 350 g ha^{-1}, Buctril Super (bromoxynyl + MCPA) @0.75 L ha^{-1}, Harvester + clodinofop @1 L ha^{-1} + 350 g ha^{-1}, Buctril Super + clodinofop @ 0.75 L ha^{-1} +350 g ha^{-1} and the weedy check). The data revealed that Buctril Super + clodinofop propargyl with only 6 weed plants m^{-2} followed by clodinofop alone and Harvester + clodinofop with 8.38 weeds m^{-2} each. Buctril Super alone outyielded all the treatments by producing the maximum grain yield of wheat (3466.7 kg ha^{-1}). However, it was statistically at par with Harvester by yielding 3266.7 kg ha^{-1}). The lowest statistically significant yield was harvested the weedy check. Herbicide combinations failed to give competitive yields showing the antagonistic response of herbicides in combinations. Hence, single herbicide applications of Buctril Super and Harvester are recommended to achieve bumper harvests of wheat in the target area.

Keywords: Chemical control, grain yield, Pre and Post emergence herbicides, weed control, wheat.

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INTRODUCTION

Wheat (*Triticum aestivum* L.); the most important cereal crop is widely cultivated throughout the world and it is one of the most important staple food around the globe. It is the main staple food of Pakistan as well, followed by rice. Besides it also used in livestock and poultry feeds. Wheat supplies 73 % calories and proteins (Heyne, 1987). About one third of the world protein and calories requirement is supplied by wheat crop (Khan, 2003; Montazeri *et al*., 2005). The total area of wheat during the year 2016-17 in Pakistan was 8.973 m ha which produced almost 26.674 million tons (Anonymous, 2019). In many countries like Pakistan, despite the efforts of government, farmers and good soil and favorable climatic condition, the average per hectare yield of wheat still remains far below potential yield. Weed infestation is among the important factors for low yields (Cheema and Farooq, 2007).

Weeds compete with crops for moisture, nutrition, space, light and other growth factors, which ultimately resulting in quantity and quality loss of the produce (Qasim and Foy, 2001; Gupta, 2004). Thus, consequently weeds cause huge losses to the crop yield which amount to Rs. 115 to 200 billion per annum in Pakistan. Weeds cause losses more to wheat (45%) as compared to insects and diseases combined (Rao, 2000). Infestation losses due to weeds are not only in Pakistan, but it has been recorded all over the world minimizing the yield by 37 to 50% (Waheed *et al.*, 2009).

The problem of weeds becomes bad to worse, when cultivated area is irrigated and cropping intensity is rapidly increasing when traditional method (Dab method) was used and hand weeding is impossible and manual hoeing is time consuming, laborious and energy intensive and only possible on small scale area. In this situation the use of herbicides seems to be the only option which is not only economical but also effective and easiest approach to minimize the weed infestation losses. Hence, chemical method for controlling weeds is most effective, efficient, up-to-date and time saving (Ashiq *et al.*, 2007).

In Pakistan, major weeds of wheat causing huge economic losses are curly dock (*Rumex dentatus* L.), swine cress (*Coronopus didymus* L.), spiny emex (*Emex spinosa* L.), prickly chaff flower (*Achyranthes aspera* L.), littleseed canary grass (*Phalaris minor* Retz.), wild oat (*Avena fatua* L.), yellow sweetclover (*Melilotus indica* L.), fumitory (*Fumaria indica* L.), prostrate knotweed (*Polygonum plebejum* L.) and lambsquarters (*Chenopodium album* L.). Weeds with relatively lesser economic importance include wild medic (*Medicago polymorpha* L.) field bindweed (*Convolvulus arvensis* L.) and *Bromus* spp. (Shamsi and Ahmed, 1984; Khan and Marwat, 2006).

In Pakistan, reduction in wheat yields due to weed infestation has been recorded upto30% (Abbas, 2006). Weeds reduce crop yield not only by competing for necessary growth factors such as water, nutrients, light and space, but also by releasing allelochemicals in the rhizosphere through their roots or other plant parts (Reddy, 2000). Experiments show that weed control by using chemicals gives more grain yield as compare to hand weeding and higher cost benefit ratio (Qazi *et al*., 2002). In the present studies pre and post emergence herbicides alone or in combination were tested to control various weeds in wheat crop

MATERIALS AND METHODS

This study was conducted at Adaptive Research Farm, Sargodha, Pakistan during the year 20017-18. Wheat variety Faisalabad-2008 was planted @ 125 ha^{-1} seed rate. NPK @ 115-85-62 kg ha^{-1} were applied. All phosphorus, potash and one third nitrogen was applied at sowing time, one third nitrogen was applied with the first irrigation and remaining one third was applied with the second irrigation. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications having 15x5 m^2 plot size. The herbicides were

sprayed at 4-6 leaf stage of weeds in moist field, after first irrigation. These herbicides were applied by hand operated knapsack sprayer fixed with T-jet nozzle in a spray volume of 300 liter per hectare. A check plot was kept un-weeded for comparison (Table-1).

Table-1. The Detail of treatments used in the experiment.

Treatments	Trade Name of Herbicides	Common Name of Herbicides	Dose ha^{-1}
T1	Harvester	fluroxypyr + MCPA + clopyralid	1 L
T2	Clodinofop propargyl	Phenoxypropionic acid	350 g
T3	Buctril Super	bromoxinyl + MCPA	0.75 L
T4	Harvester + clodinofop propargyl	fluroxypyr + MCPA + clopyralid + clodinafop propargyl	1 L + 350 g
T5	Buctril Super + clodinofop propargyl	brommoxynil + MCPA + clodinafop propargyl	0.75 L + 350 g
T6	Weedy check	-	-

The weeds under study were naturally occurring in the field. The common weeds observed in wheat field were *Avena fatua* L. (wild oat), *Phalaris minor* Retz. (littleseed canary grass), *Chenopodium album* L. (common lambsquarters), *Vicia sativa* L. (common vetch), *Medicago polymorpha* L. (burclover/common medic) and *Rumex dentatus* L. (broad leaf dock). Data on weed count were recorded before and four weeks after spray of herbicides from one meter square area randomly selected area from each plot and weed mortality percentage was computed. The data on wheat crop was recorded on tillers count m^{-2}, number of grains $spike^{-1}$, 1000-grain weight (g) and grain yield kg ha^{-1} at harvesting.

The data recorded for each parameter was individually subjected to the ANOVA technique (Steel *et al.*, 1997) by using Statistical software Statistix 8.1. Significant means were separated by using LSD test.

RESULTS AND DISCUSSION

Germination (m^{-2})

The ANOVA showed that treatment means were non-significant statistically for germination count m^{-2} (Fig. 1). The data reveal that the maximum germination was observed in T5 (Buctril Super + clodinofop propargyl} followed by T6 (Weedy check) and T4 (Harvester + clodinofop propargyl), respectively (Fig.1).

Number of productive tillers m^{-2}

The ANOVA showed that treatment means were significantly different statistically ($P<0.05$) for the trait under reference. The data in Fig. 1 reveal that the maximum number of productive tillers m^{-2} (200.67 each) were recorded in T5 (Buctril Super + clodinofop propargyl) and T6 (weedy check). Whereas, the lowest number of productive tillers m^{-2} were recorded in T2 (Clodinofop propargyl) and T4 (Harvester + clodinofop propargyl) with 148.67 and 172 tillers m^{-2}, respectively (Fig. 1).

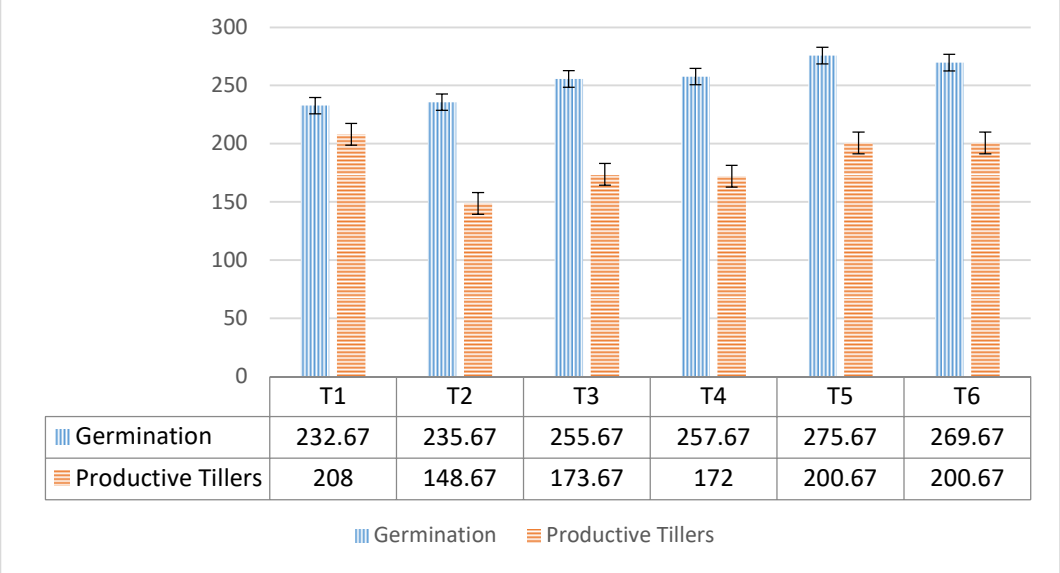


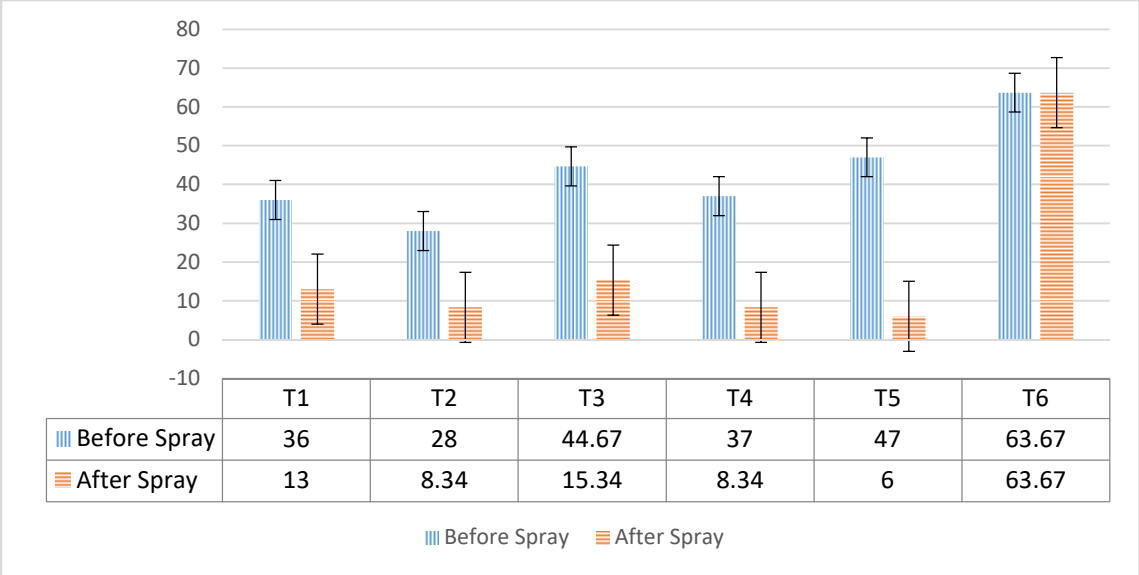
Fig. 1. Mean of Germination Count (m^{-2}) and Number of Productive Tillers (m^{-2}) observed in wheat during Rabi 2017-18.

Number of weeds m^{-2} before application

Although there has been a general spread in the weed count data prior to the application of treatments, ANOVA revealed non-significant differences among the treatments (P>0.05). The data in Fig. 2 exhibit that the maximum weeds (63.67) were counted in T6 (weedy check) followed by T5 (Buctril Super + clodinofop propargyl) and T3 (Buctril Super), respectively at a density of 47 and 44.67 weeds m^{-2} (Fig. 2).

Number of weeds m^{-2} after application

The ANOVA showed that the treatment means were significantly different for weeds count m^{-2} after spray (P<0.05). The data in Fig. 2 reveal that the minimum number of weeds (6 m^{-2}) were recorded in the herbicide mixture T5 (Buctril Super + clodinofop propargyl) with only 6 weed plants followed by T2 (Clodinofop alone) and T4 (Harvester + clodinofop) with 8.38 weeds m^{-2} each. Still statistically significant (P<0.05) from the weedy check were T1 (Harvester) and T3 Buctril Super (bromoxynil + MCPA) with 13 and 15.34 weeds m^{-2}, respectively (Fig. 2). Statistically the highest number of weeds (63.37 m^{-2}) were recorded in T6 (weedy check) as compared to the all other treatments studied.



	T1	T2	T3	T4	T5	T6
Before Spray	36	28	44.67	37	47	63.67
After Spray	13	8.34	15.34	8.34	6	63.67

Fig. 2. Mean of weeds Count (m^{-2}) before spray and after spray observed on Wheat crop During Rabi 2017-18.

Grain yield kg ha^{-1}

The grain yield data in Fig. 3 show that by using herbicides against weeds at a proper time gives better yield as compared to control. The maximum grain yield of wheat (3466.7 kg ha^{-1}) was harvested by applying T3 Buctril Super alone (bromoxinyl + MCPA) which was statistically at par with T1 (Harvester 3266.7 kg ha^{-1}). These treatments were followed by T2 (clodinofop propargyl alone) with 3000 kg ha^{-1}, which in turn was statistically at par with T5 (Buctril Super + clodinofop propargyl) and T4 (Harvester + clodinafop propargyl) producing 2900 and 2766 kg ha^{-1}, respectively. While the minimum yield of wheat was only 2066.7 kg ha^{-1} being harvested from the weedy check (Fig. 3).

In is concluded from the above data that the herbicides are an effective tool in increasing the grain yield of wheat. The herbicidal application of Buctril Super and Harvester alone proved to be the excellent treatments in the instant studies. Our data further reveals that herbicide mixtures did not emerge as synergistic in increasing the grain yield of wheat, hence alone formulations of the tested herbicides may be applied commercially for harvesting optimum yields of wheat.

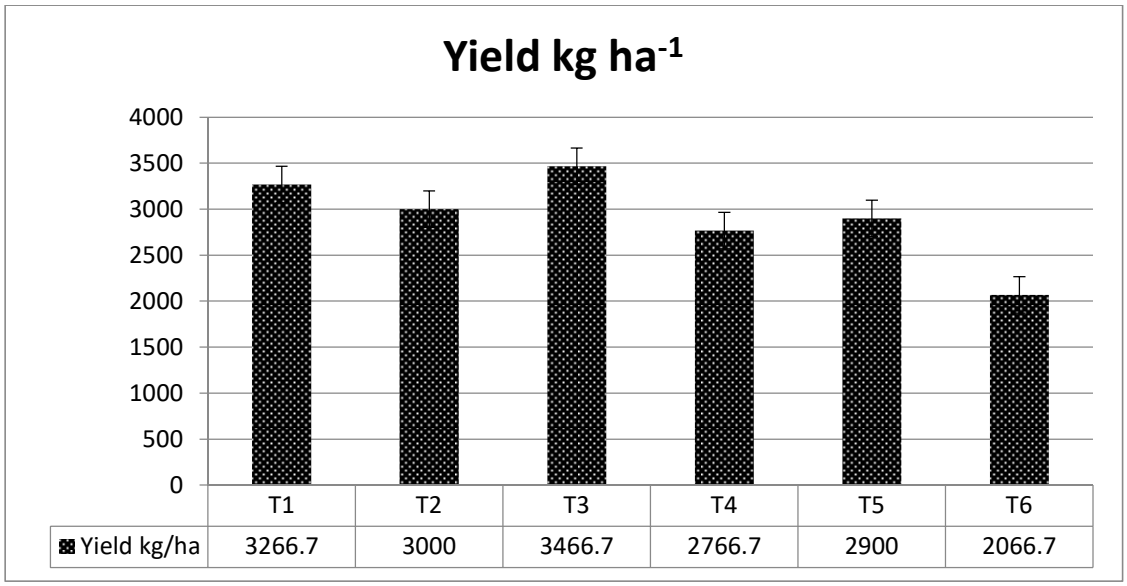


Fig. 3. Mean of yield kg ha^{-1} observed on Wheat crop During Rabi 2017-18.

The findings of our study are widely corroborated by the previous work that the use of herbicides at proper time boosts the grain yield due to increase in spike length, grains per spike and spike bearing tillers and grain weight (Malik *et al*., 1998; Madafiglio *et al*., 2006). Walia *et al*. (2001) conclude that application of metribuzin and atrazine alone or in combination significantly reduced the weeds density and biomass of weed species. Alvi *et al.* (2004) and Hassan *et al*. (2005) reported that isoproturon, Affinity and Sencor provided good control against weeds and resulted in increased grain yield.

Our results are also in agreement with Bharat and Kachroo (2007) who reported that Isoproturon significantly reduced the density *Rumex dentatus* in their studies. Moreover, our findings are also corroborated with the previous work of Pandey and Dwivedi (2007), Abbas *et al*. (2009), and Chachar *et al*. (2009), who also found that chemical weed control gave minimum dry weed weight of weeds per unit area and maximum weed control. Their studies show that by using proper herbicides at appropriate time against weeds gave the maximum yield.

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