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AN APPRAISAL OF BENZOIC ACID AND SORGAAB EFFECT ON WEED MANAGEMENT AND WHEAT (*Triticum aestivum* L.) YIELD

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ABSTRACT

A field trial was conducted to evaluate the effect of benzoic acid (an organic compound) and sorghum water extract (Sorgaab) at the Agronomic Research Area, University of Agriculture Faisalabad, during 2010-2011. Experiment was laid out in randomized complete block design (RCBD) with three replications. Benzoic acid and sorgaab were applied as foliar spray, alone and in different combinations at 22 days after sowing of wheat. All the treatments increased wheat yield as compared to control but the combined effect of benzoic acid and sorgaab was more pronounced than their sole effect. The highest grain yield (4.72 t ha^{-1}) was recorded in plots treated with benzoic acid applied @ 6 kg ha^{-1} + sorgaab @ 12 L ha^{-1} (T_8) which was 48% higher than control. Application of benzoic acid significantly affected all agronomic parameters as number of productive tillers per plant, number of grains per spike, 1000-grain weight, grain yield, biological yield as well as harvest index (HI) as compared to control. Significantly less total weed density, weeds fresh weight and dry weight were recorded in plots that were treated with 6 kg ha^{-1} + sorgaab @ 12 L ha^{-1} (T_8).

Keywords: allelopathic crop residues, minor weeds, weed density, yield components.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the staple food in Pakistan and it is the major grain crop of the country as compared to other cereals. It contributes 13.1% to the value added in agriculture and 2.8% to the total GDP. It is cultivated on an area of 9.045 million ha and its average yield is 2585 kg ha^{-1} (Gov. of Pakistan, 2010). In addition to other factors limiting crop yield, weed infestation is one of the important factor causing 20-40 % decrease in wheat yield (Ahmad and Shaikh, 2003). Uncontrolled weeds reduce wheat production by 7.4 million tones (26 % losses in yield) and cause Rs.112 billion per annum monetary losses to the national economy (Mushtaq and Cheema, 2008).

Several weeds infest wheat fields, among these, wild oat (*Avena fatua* L.), canary grass (*Phalaris minor* L.), lambsquarters (*Chenopodium album* L.) are major weeds, while broadleaf dock (*Rumex dentatus* L.), sweet clover (*Melilotus indica* L.) wild medic (*Medicago polymorpha* L.), crow pea (L*athyrus aphaca* L.) and fieldbind weed *(Convolvulus arvensis* L.) are relatively minor (Shamsi and Ahmad, 1984). Weed density, type of weeds, their persistence and crop management practices determine the extent of yield losses (Khaliq *et al*. 2002; Cheema *et al*. 2003a; Irshad and Cheema, 2002). Wheat crop usually suffer from stress created by weeds through competition for water, nutrients (Cheema *et al*. 1997; Cheema *et al*. 2000 Cheema *et al*. 2002), space and sunlight (Anderson *et al*. 1978). Weeds also cause interference by releasing toxic substances into rhizosphere of crop plants (Cheema *et al.* 2003b). Allelopathy offers potential for weed control (Cheema *et al*., 1997) by the production and release of allelochemicals from leaves, flowers, seeds, stems, and roots of living or decomposing plant materials (Weston, 1996; Cheema *et al*. 2008). Thus integrating commercial herbicides in low concentration with allelochemicals can be a promising approach in future for sustainable agriculture and to keep the environment safe.

Present study was designed with the dual objective of assessing the role of benzoic acid and allelochemical in managing weed population as well as their effect on yield of wheat.

MATERIALS AND METHODS

The present study was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during 2010-11. Sorghum (*Sorghum bicolor* L.) was planted in June-July and was harvested at full maturity. Plant material was stored and dried under shade to avoid possible leaching by rain water. The plant material was chopped with electric fodder cutter in 2-cm pieces. Chopped plant material was soaked in distilled water for 24 hours at room temperature (21°C) at a ratio of 1:10 (W/V) and was filtered through 10 and 60 mesh sieve (Cheema *et al*. 2003). For easy handling, these extracts were boiled at 100°C to concentrate up to 20 times. Allopathic water extract and its combination with organic acid were applied at 30 days after sowing. First irrigation was applied 12 days after crop emergence and further irrigation was done at different critical stages i.e. at tillering, booting, anthesis and grain development stages.

Seeds of wheat variety Shafaq-2006 were sown on 18th of November 2010. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications and eight treatments. Treatments included Benzoic Acid at 2 kg ha^{-1}, Benzoic Acid at 4 kg ha^{-1}, Benzoic Acid at 6 kg ha^{-1}, *Sorgaab* Extract at 12 L ha^{-1}, Benzoic Acid at 2 kg ha^{-1} + *Sorgaab* Extract at 12 L ha^{-1}, Benzoic Acid at 4 kg ha^{-1} + *Sorgaab* Extract at 12 L ha^{-1} and Benzoic Acid at 6 kg ha^{-1} + *Sorgaab* Extract at 12 L ha^{-1}. Net plot size was 5 m × 2.5 m. Fertilizer used were urea (46%N), diammonium phosphate (18%N: 46%P_2O_5) and sulphate of potash (50% K_2O). Fertilizer was applied

at 110: 60: 60 N: P: K kg ha^{-1}. The whole phosphorus and potassium and half of nitrogen were applied at the time of sowing and remaining half nitrogen was applied at first irrigation.

STATISTICAL ANALYSIS

Statistical analysis of recorded data was performed by using analysis of variance technique with the help of 'MSTATC' computer software package (Freed and Eisensmith, 1986). Differences among the treatment means were compared using the LSD (Least Significant Difference) test at 5% probability level (Steel and Torrie, 1980).

RESULTS AND DISCUSSIONS

Weeds density, fresh weight and dry weight

Data regarding the total weed density, fresh weight and dry weight of weeds in wheat, recorded at 60 DAS indicated that all the treatments significantly reduced total weed density, fresh and dry weight of weeds as compared with control. The highest reduction in total weed density (80%), fresh weight (88.3%) and dry weight (90.1%) of weeds were observed in treatment where Benzoic Acid applied @ 6 kg ha^{-1} + Sorgaab Extract (Sorghum water extract) applied @ 12 L ha^{-1} and it was followed by the treatment where Benzoic Acid applied @ 4 kg ha^{-1}+ Sorgaab Extract @ 12 L ha^{-1} were applied, as shown in Table-1. These results are in-line with the work of Rasmussen and Einhellig (1979) who suggested that combination of sorgaab (Sorghum water extract) with organic compounds has inhibitory effect on weeds. The inhibition of fresh and dry weight of weeds by *sorgaab* is in line with the previous findings (Naseem, 1997; Kayouli and Lee, 1993)

Table-1. Effect of benzoic acid and sorghum water extract on total weed density (m^{-2}), fresh weight (g) and dry weight (g) of weeds in what wheat.

Treatments	Total weed density (m^{-2})	Fresh weight (g)	dry weight (g)
T_1 Control	78.33 a	98.77 a	14.22 a
T_2 Benzoic Acid at 2 kg ha^{-1}	54.67 b	56.95 b	11.56 b
T_3 Benzoic Acid at 4 kg ha^{-1}	52.00 b	47.54 bc	11.65 b
T_4 Benzoic Acid at 6 kg ha^{-1}	36.00 c	40.22 cd	8.62 c
T_5 *Sorgaab* Extract at 12 L ha^{-1}	33.00 c	39.48 cd	8.43 c
T_6 Benzoic Acid at 2 kg ha^{-1}+ *Sorgaab* Extract at 12 L ha^{-1}	30.33 c	30.64 d	7.98 c
T_7 Benzoic Acid at 4kg ha^{-1}+ *Sorgaab* Extract at 12 L ha^{-1}	23.33 cd	19.65 e	4.67 d
T_8 Benzoic Acid at 6kg ha^{-1}+ *Sorgaab* Extract at 12 L ha^{-1}	15.67 d	11.48 e	4.10

*Mean values carrying different letters are significantly different from each other's.

YIELD PARAMETERS

The number of productive tillers and number of grain per spike are very important indicators of crop yield. The highest number of productive tillers m^{-2} (364.67), number of grin per spike (50.52), 1000-grain weight (39.88 g), biological yield (11.80 t ha^{-1}), grain yield (4.72 t ha^{-1}) and harvest index (40.02%) were increased in treatment where Benzoic Acid @ 6 kg ha^{-1} + sorgaab (Sorghum water extract) @ 12 L ha^{-1} were applied as shown in Table-2. These results were in line with the findings of Sharif *et al.* 2005 who stated that organic compounds and sorgaab application enhanced number of productive tillers of wheat. From these results it appears that possibly allopathic extracts have some growth regulatory effect on the wheat crop. These findings also support the work of Cheema *et al*. (2003) who reported that grain yield of wheat was increased where crop sorgaab was used with reduced dose organic compounds. Increase in biological yield due to suppressing weeds was also reported by Akhtar *et al*. (1991) and Sarwar (1994). Sadiq (1999) and Khaliq (2002) also found significant effect of sorgaab and organic compounds on harvest index.

Table-2. Effect of benzoic acid and sorghum water extract on number of productive tiller m^{-2}, number of grain $spike^{-1}$, 1000 grain weight (g), Biological yield (t ha^{-1}), grain yield (t ha^{-1}) and harvest index (%) in wheat.

Treatments	No. of productive tiller m^{-2}	No. of grain $spike^{-1}$	1000-grain weight (g)	Biological yield (t ha^{-1})	Grain yield (t ha^{-1})	Harvest index (%)
T_1Control	326.00 c	32.590 f	36.463 e	8.80 f	3.15 d	35.79 b
T_2 Benzoic Acid at 2 kg ha^{-1}	339.33 bc	37.647 e	37.143 d	9.68 e	3.54 c	36.57 b
T_3 Benzoic Acid at 4 kg ha^{-1}	343.00 abc	39.587 de	37.18 d	9.73 de	3.58 c	36.79 d
T_4 Benzoic Acid at 6 kg ha^{-1}	352.00 ab	41.680 d	38.74 cd	10.14 cd	3.68 c	36.29 d
T_5 *Sorgaab* Extract at 12 L ha^{-1}	358.67 a b	44.543 c	38.35 cd	10.53 bc	3.79 bc	35.99 e
T_6 Benzoic Acid at 2 kg ha^{-1}+ *Sorgaab* Extract at 12 L ha^{-1}	359.00 a b	44.840 c	38.45 c	10.55 bc	3.95 b	37.44 c
T_7 Benzoic Acid at 4kg ha^{-1}+ *Sorgaab* Extract at 12 L ha^{-1}	364.33 a	47.433 b	38.55 b	10.85 b	4.05 b	37.85 b
T_8 Benzoic Acid at 6kg ha^{-1}+ *Sorgaab* Extract at 12 L ha^{-1}	364.67 a	50.527 a	39.883 a	11.80 a	4.72 a	40.05 a

Mean values carrying different letters are significantly different from each other's.

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