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Research Article

Effect of Adjuvant ADPRO SQUAD on the Efficacy of Pyroxsulam in Controlling Weeds in Wheat

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ABSTRACT

Studies were conducted in 2016/2017 and 2017/18 at Holetta research center and farmers' fields to determine the efficacy of adjuvant ADPRO SQUAD on post emergence herbicide Pyroxsulam (Pallas 45-OD) in wheat weeds. There were five treatments which were laid out in a randomized complete block design with three replications. The treatments were comprised of three adjuvant rates (the company recommended 0.225 L ha^{-1}, suboptimal 0.113 L ha^{-1}, optimal 0.34 L ha^{-1}, rate), Pyroxsulam 0.5 L ha^{-1} alone, and untreated check. The crop variety used was Hidasse. The selected area was infested with dominant weed species like, *Setaria pumila, Phalaris paradoxa, Bromus pectinatus, Avena fatua, Snowdenia polictacha, Guzotia scabra, Polygonum nepalense, Galinsoga parviflora, Amaranthus hybridus, Plantago lanceolata, Galium spurium, Medicago polymorpha* and others. The results revealed that application of Pyroxsulam 0.5 L ha^{-1} mixed with ADPRO SQUAD 0.113 L ha^{-1} had a significant ($P<0.05$) effect on broad leaf and grass weeds population followed by the standard check Pyroxsulam 0.5 L ha^{-1} alone. The mean yield data indicated statistically significant difference between treatments. Pyroxsulam 0.5 L ha^{-1} mixed with adjuvant ADPRO SQUAD 0.113 L ha^{-1} gave highest yield (6.6) followed by Pyroxsulam 0.5 L ha^{-1} mixed with adjuvant ADPRO SQUAD 0.225L ha^{-1} (5.4) and the standard check Pyroxsulam 0.5 L ha^{-1} alone (5.3) t ha^{-1} which enhanced grain yield by 19.1% over herbicide alone. The yield harvested from untreated weedy check plot was significantly lower than the rest treatments. As far as plant height and thousand grain weight were concerned insignificant differences were observed between treatments.

Key words: Adjuvants, Pyroxsulam, Weed control, *Triticum aestivum* L

INTRODUCTION

The magnitude of increasing wheat grain yield is an important national goal to face the continuous increasing food needs of Ethiopian people. Wheat production in the country increased from1.2 t ha^{-1} to 2.2 t ha^{-1} (Quilligan *et al*., 2013). This increase was achieved by increasing wheat area and inputs. The yield is still far below the yield level obtained in other wheat growing countries of the world like Germany (7.28 t ha^{-1}), and others (Tagour and GM–EL-METWALLY, 2011). Generally, weeds are a significant threat to wheat production in Ethiopia causing yield losses estimated as high as 70% (Tanner *et al*., 1991; Rao and Nagamani, 2013). Weed can reduce crop yield through competition for moisture, nutrients, sunlight and space. Furthermore, during harvest this reflected on reducing quantity and/or quality and reducing the economic return (Zewdie and Suwanketnikom, 2005). Weed control methods in wheat production remains to be one of the most expensive, time and energy consuming moreover, the availability of adequate labor doesn't warrant timely weeding and least successful means of increasing yield. To produce more wheat with less damage to the environment is very imperative. Presently new methods are used to reduce the amount of herbicides dose. One of these ways is using Adjuvant or additives to increase the efficiency of herbicides. Several researchers have demonstrated that the addition of adjuvants to herbicides alter the formulation so that they more completely and evenly cover plant surfaces thereby keeping the herbicide contact with plant tissues rather than bordering up and rolling off. Other adjuvant increases the formulations penetration through the cuticles wax, cell walls and or stomata openings (Green and Hazen**,** 1998). In some situation an adjuvant may enhance the formulations ability to kill the targeted species without harming other plants; enhance its selectivity (Hess and Foy, 2000). In this way adding an appropriate adjuvant can lower total costs of weed control. With this consideration the trial was conducted to determine the adjuvant ADPRO SQUAD efficiency on performance of herbicide pyroxsulam

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herbicide pyroxsulam (Pallas 45-OD) against commonly problematic annual broad leaf and grass weeds in wheat.

MATERIALS AND METHODS

Description of the study area

The experiment was conducted at Holetta Research centers and farmers' fields during the main cropping season of 2016/17 and 2017/ 2018. In both locations, the average monthly mean minimum temperature during the crop growing season are 6.4 0^c and 11.5 0^c the corresponding average monthly mean maximum temperature are 21.3 0^c and 23.8 0^c with total rainfall of 924.5 and 580mm, respectively. Both locations had been under conventional management practices of plowing, disking and harrowing for last many years.

Treatments, experimental design and procedure

The experiment consisted of five treatments in three sites (HRC and on two different farmers' fields). The trial was laid out in a randomized complete block design (RCBD) with three replications for each site in a plot size of 4m x $5m^2$.

Treatment code	Detail
T1	Pyroxsulam 0.5 L ha^{-1} + ADPRO SQUAD 0.225 L ha-1
T2	Pyroxsulam 0.5 L ha^{-1} + ADPRO SQUAD 0.113 Lha-1
T3	Pyroxsulam 0.5 L ha^{-1} + ADPRO SQUAD 0.34 L ha-1
T4	Pyroxsulam 0.5 L ha^{-1} (standard check)
T5	Un weeded check.

The wheat variety used was Kekeba the experimental fields were ploughed twice using tractor mounted plough on research centers and oxen ploughed in farmer's fields finally the field plots were leveled manually. Planting was done by drilling the seeds at 20 cm wide rows at a recommended rate of seeds and fertilizer in furrows half at planting and the rest half at tillering. Herbicides were applied as post emergence 25-30 days after crop emergence (three to four leaf stage of the crop) using a manual knapsack sprayer with a water volume of 200 L ha^{-1} rate for each plot.

Data collection and analysis

All the necessary agronomic data were collected as per guideline (crop emergence, tillering, flowering, harvesting, weed density by species, general and individual weed control score, phytotoxicity score, plant height, 1000 grain weight, yield and yield components etc.) were recorded. For each treatment of individual sites farmers' opinion were assessed through informal interaction between researchers and the respective host farmers. Finally, all Data were subjected to analysis of variance following a procedure appropriate to the design of the experiment using SAS statistical software. The treatment means that were significantly different at 5% levels of significance were separated using Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The results showed that there was no crop injury due to Pyroxsulam 0.5 L ha^{-1} + ADPRO SQUAD and the rate of application but, severe toxicity was observed on most grass and broad-leaved weeds (Figure 3). This research had a general agreement with the report of Jursík *et al.* (2016). They reported that efficacy of the herbicide pyroxsulam was increased by the application of adjuvant**.** The maximum weed control efficiency on the target grasses and broadleaved weeds was attained from application of the herbicide Pyroxsulam 0.5 Lha^{-1} rate and the adjuvant ADPRO SQUAD 0.113 Lha^{-1} at all testing locations (Figure 1, 2). This study was supported by the findings of Brathuhn and Petersen, (2014) which described that the adjuvant improved the herbicidal efficacy. Efficacy ratings on individual weed species were also achieved better result than the standard check Pyroxsulam 0.5 L ha^{-1} alone. The Plant height result showed that the maximum height attained from Pyroxsulam 0.5 Lha^{-1} with thank mix of ADPRO SQUAD 0.113 L ha^{-1} treated plot (104.1cm) which was significantly higher than all treatments. Significantly higher number of spikes (565.9 m^{-2}) resulted from Pyroxsulam 0.5 Lha^{-1} and the adjuvant ADPRO SQUAD 0.113 L ha^{-1} followed by the standard check (502.7m^{-2}). The significantly higher length (7.4 cm) of spikes was recorded from Pyroxsulam 0.5 Lha^{-1} and the adjuvant ADPRO SQUAD 0.113 Lha^{-1} than other treatments. Thousand grain weight showed significant ($p \leq 0.05$) difference among treatments. The mean yield data revealed that there was statistically significant difference between treatments. Pyroxsulam 0.5 L ha^{-1} mixed with adjuvant ADPRO SQUAD 0.113 L ha^{-1} gave highest yield (6.6 t ha^{-1}) followed by Pyroxsulam 0.5 Lha^{-1} mixed with adjuvant ADPRO SQUAD 0.225 L ha^{-1} (5.4 t ha^{-1}) and the standard check Pyroxsulam 0.5 L ha^{-1} alone (5.3 t ha^{-1}) which enhanced grain yield by 19.1% over herbicide alone treated plot. Similarly, Rizwan *et al.* (2018) have reported that the maximum yield and yield attributes were recorded from the recommended rate of Pyroxsulam mixed with adjuvant treated fields. The yield harvested from untreated weedy check plot was significantly lower than the rest of treatments (Table 1).

Table 1: The combined analysis effects of treatments on Spike length, Spike number, plant height, 1000 grain weight, and grain yield of wheat (t ha^{-1}) 2016 -2018.

Treatments	Spike length (cm)	Spike No	PH (cm)	TKW (gm.)	Yield (t ha^{-1})
Pyroxsulam 0.5l/ha + ADPRO SQUAD 0.225 L ha^{-1}	6.5b	454.9c	102.3b	34.6a	5.4b
Pyroxsulam 0.5l/ha + ADPRO SQUAD 0.113l L ha^{-1}	7.4a	565.9a	104.3a	34.5a	6.6a
Pyroxsulam 0.5l/ha + ADPRO SQUAD 0.34 L ha^{-1}	6.7b	482.9bc	100.6cd	34.3a	4.6c
Pyroxsulam 0.5 Lha^{-1} (standard check)	6.7b	502.7b	101.6bc	32.4b	5.3b
Unweeded (check)	6.5b	366.0d	100.1d	31.4b	1.6d
CV%	8.62	5.86	1.29	6.32	6.84

Means with in the same column and the same parameter grouping followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range tests.

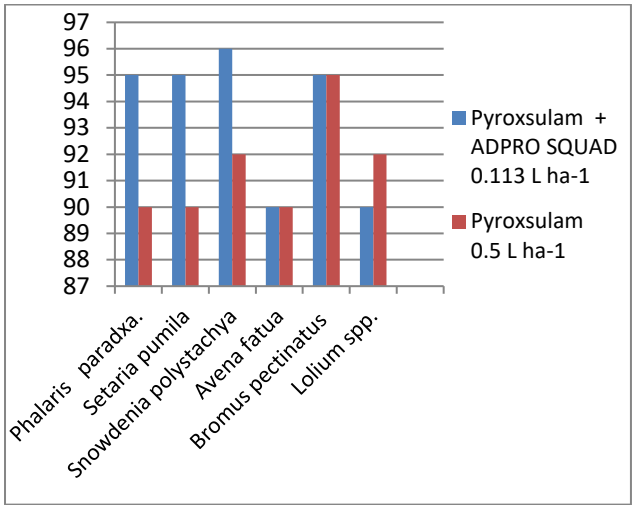

Fig. 1: Efficacy (%) of pyroxsulam 0.5L ha^{-1} + ADPRO SQUAD 0.113 l ha^{-1} as compared to pyroxsulam 0.5 Lha^{-1} on major grass weed species 2016-18.

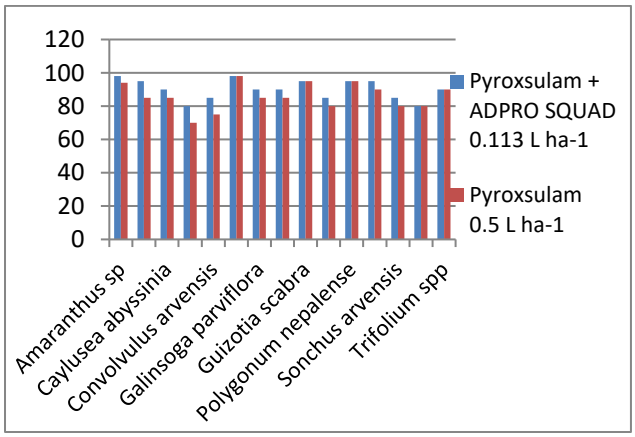

Fig. 2: Efficacy (%) of pyroxsylam 0.5L ha^{-1} + ADPRO SQUAD 0.113 L ha^{-1} as compared to pyroxsylam 0.5 Lha^{-1} on major broad leaved weeds species 2016-18.

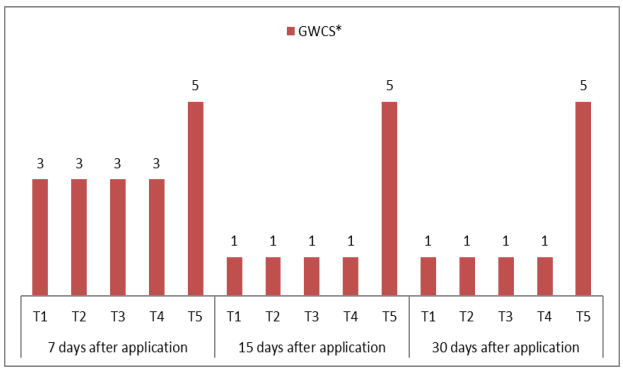

Fig. 3: Results of visual scores at 7, 15 and 30 days after Pyroxsulam 0.5L ha^{-1} + ADPRO SQUAD 0.113 Lha^{-1} and Pyroxsulam 0.5L ha^{-1} alone application on broad leaf and grass weeds in wheat 2016-18. **Note**: *GWSC (General weed control score) where; 1= weeds effectively controlled, 5 = no effect on weed control.

Conclusions and recommend ions

Application of Pyroxsulam 0.5 L ha^{-1} mixed with the adjuvant ADPRO SQUAD @ the rate of 0.113 L ha^{-1} demonstrated that no phytotoxicity due to the herbicide and the rate of adjuvant observed but, severe toxicity was detected on most grasses and broad-leaved weeds with better crop harvested yield and quality compared to the standard check. Therefore, from the finding, it can be concluded that Pyroxsulam 0.5 L ha^{-1} mixed with the adjuvant ADPRO SQUAD @ the rate of 0.113 L ha^{-1} can be recommended as the best management option to improve the yield and quality of wheat in the country.

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