Devil's Thorn (*Emex spinosa* (L.) Campd.) Response to Tribenuron-methyl and 2,4-D in Ouazzane Region of Morocco

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Abstract

A soft wheat weed control trial was conducted during the 2016-2017 growing season. The aim of this study is to investigate the effect of two post-emergence herbicides Tribenuron-methyl and 2,4 D on Emex spinosa infestation in a soft wheat crop. Treatments consist on two Tribenuron-methyl rates of application and two 2,4-D rates of application. The experimental design was a random block with tree repetitions and observations were made 60 days after application of herbicides. Results showed that treatment with Tribenuron-methyl at 9.50g/ha and 14.25g/ha widely decrease E. spinosa infestations. Tribenuron-methyl at 9.50g/ha recorded 87.8%, 86.1% and 90.5% respectively on E. spinosa density reduction, E. spinosa height reduction, and E. spinosa dry biomass reduction. Tribenuron-methyl at 14.25g/ha recorded 96.3%, 95.5% and 98.7% respectively on E. spinosa density reduction, E. spinosa height reduction, and E. spinosa dry biomass reduction. 2,4 D at 400g/ha and 600g/ha recorded the lowest efficacies that did not exceed 75.2% in all observed parameters.

Keywords: Emex spinosa, Soft wheat, Herbicide, Tribenuron-methyl, 2,4-D

Introduction

Cereals are important crops in the farming systems of Morocco (Karrou & *al*., 2008). They are major food and feed crops. Total annual cereal production is estimated at 5 million tons per year. It covers an annual area of 5.3 million hectares (Mapmdref, 2019). Weeds are a serious constraint to cereal productivity in Morocco (Bouhache, 2017). In fact, weeds compete with crops using water, nutrients and lights and led to reduced crop yield (Spitters

& Van Den Bergh, 1982; Zimadahl & El Brahli, 1992; Boutahar, 1994; Taleb 1996, Bouhache, 2007; Bouhache, 2017). *E. spinosa* (L.) Campd. (Devil's thorn) is a noxious weed to cereal crops (Hajjaj, 2010). It is an annual weed that belongs to *Polygonaceae* family. It has a large taproot. Stems usually lying down, ribbed up to 80 cm. Leaves are alternate with triangular shape. Basal flowers are female and tops generally male (Boulet & *al*., 1991). The fruit is an achene with stiff spines due to modified lobes of the perianth (Valdés & *al*., 2002). Nitrophile plant, grazed by animals before the appearance of fruit (Tanji, 2005).Tribenuron-methyl is a cereal post-emergence herbicide acting through the roots and foliage for the control of broadleaf weeds on wheat and barley. Tribenuron-methyl belong to sulfonylurea family that causes inhibition of acetolactate synthase ALS (acetohydroxyacid synthase AHAS). This enzyme is present in plant and micro-organisms, but not in animals (Blair & Martin, 1988; Brown, 1990). Inhibition of the activity of ALS leads to inhibition of synthesis of essential branched-chain amino acids, which causes inhibition of cell division (Ezzahiri, 2017). Corp selectivity of sulfonylurea consists in a detoxification by hydroxylation and conjugation to glucose (Ray, 1984; Rost, 1984; Van Dyck & LaRossa, 1986). Advantages of sulfonylureas herbicides are relatively low amount of herbicide used for weed control with low toxicity (Ezzahiri, 2017). 2,4 D herbicide is a post-emergence herbicide acting through the foliage for the control of broadleaf weeds on wheat and barley. 2,4-D is a member of Phenoxy-carboxylic-acid Family. 2,4-D is an “auxin mimic” or synthetic auxin. This type of herbicide kills weeds by mimicking the plant growth hormone auxin, and when applied at effective doses, causes uncontrolled and disorganized plant growth and the tissues of the plant are damaged, which leads to plant death. (Tu & *al*., 2001). In tolerant monocots such as wheat and barley, metabolism occurs mainly through hydroxylation (Sterling & Hall, 1997). In Morocco, more than 50% of anti-dicot herbicides are phytohormone products (2,4D, MCPA and Dicamba) that can be used at an advanced stage of wheat. ALS inhibitor herbicides are the second category of herbicides (Bouhache, 2017). *E. spinosa* has become a serious problem in cereal crops in Morocco (Hajjaj, 2010). Furthermore, infestations by *E. spinosa* in cereal crops may result in the refusal of the harvest of some farmers by Moroccan seed companies (Onssa, 2019). No studies have been conducted on chemical control of *E. spinosa* in the Ouazzane region. This study aims to evaluate different doses of Tribenuron-methyl and 2,4-D herbicides on *E. spinosa* infestation in soft wheat crop.

Material and Methods

A trial of chemical control of *E. spinosa* was conducted in Ouazzane region of Morocco during 2016-2017 growing season. The experimental design was a random block with tree repetitions. The distance between the blocks is 2 meters and the distance between plots was 1 meter. Each block contained 5 elementary plots, 4 plots of which are treated with the post-emergence herbicides tested (Table 1) and one untreated control plot. The size of the elementary plots was 2m x 5m (10 m²). Treatments were carried out on January 06, 2017 with Backpack herbicide sprayer with nozzle delivering a 3 bar jet. The spray volume per hectare is 200L. Treatments consist on two *Tribenuron-methyl* rates of application and two *2,4-D -ester butylglycol* rates of application (Table 1).

Table 1: Applied herbicides in experimental site

Herbicide treatments	Herbicide active ingredient	rate of application (g/hectare)
Treatment 1	Tribenuron-methyl	9.50
Treatment 2	Tribenuron-methyl	14.25
Treatment 3	2,4-D	400
Treatment 4	2,4-D	600

Observations were made 60 days after application of herbicides. Observations concerned Percentage of *E. spinosa* density reduction, height reduction and biomass reduction. *E. spinosa* density reduction percentage= [*E. spinosa* density in control plots – *E. spinosa* density in treated plots] x 100 / [*E. spinosa* density in control plots]. Calculation of the density at the experimental level of the plot was made by a quardat of one square meter. *E. spinosa* height reduction percentage= [*E. spinosa* height in control plots – *E. spinosa* height in treated plots] x 100 / [*E. spinosa* height in control plots]. *E. spinosa* dry biomass reduction percentage= [*E. spinosa* dry biomass weight in control plots – *E. spinosa* dry biomass weight in treated plots] x 100 / [*E. spinosa* dry biomass weight in control plots]. Calculation of dry *E. spinosa* biomass were made by collecting *E. spinosa* in each plot using a quardat of 1m x 1m. Samples were dried in a drying oven at 75 ° C for 48 hours. Then, dry plant material in each plot were weighed with a precision balance. Statistical analyzes were performed with SPSS software version 21.0 using the analysis of variance (ANOVA).The difference among treatment means was compared by Tukey's test at $p \leq 0.05$.

Results and Discussion

1. Effect on *E. spinosa* density reduction

Results in table 2 revealed that the best *E. spinosa* density reduction was obtained by Tribenuron-methyl at 9.50g/ha and Tribenuron-methyl at 14.25g/ha recording respectively 87.8% and 96.3% of *E. spinosa* density reduction. Contrariwise, 2,4-D at 400g/ha and 2,4-D at 600g/ha showed lower to medium efficacies that did not exceed 75.2% of *E. spinosa* density reduction. It is important to mention that there were no significant statistical differences on *E. spinosa* density reduction between Tribenuron-methyl at 9.50g/ha and Tribenuron-methyl at 14.25g/ha (Table 2).

Table 2: Effect on *E. spinosa* density reduction

Treatments	*E. spinosa* density reduction (%)
Tribenuron-methyl at 9.50g/ha	87.8 c*
Tribenuron-methyl at 14.25g/ha	96.3 c
2,4-D at 400g/ha	51.5 a
2,4-D at 600g/ha	75.2 b
Pα = 0.05	*< 0,001*

**Significant differences within the same column and means followed by the same letter do not differ at Pα ≤0.05 according to Tukey's test.*

2. Effect on *E. spinosa* height reduction

Results in table 3 showed that the best *E. spinosa* height reduction was obtained by Tribenuron-methyl at 9.50g/ha and Tribenuron-methyl at 14.25g/ha recording respectively 86.1% and 95.5% of *E. spinosa* height reduction (Table 3). Concerning the effect of 2,4-D at 400g/ha and 600g/ha, data in Table 3 showed lower to medium efficacies that did not exceed 72.7% of *E. spinosa* height reduction. It is important to mention that there were no significant statistical differences on *E. spinosa* height reduction between Tribenuron-methyl at 9.50g/ha and Tribenuron-methyl at 14.25g/ha (Table 3). In fact, Tribenuron-methyl belong to sulfonylurea family which mode of action Inhibit the acetolactate synthase (ALS) a key enzyme in the biosynthesis of the branched-chain amino acids isoleucine, leucine, and valine (LaRossa & Schloss, 1984). Enzyme Inhibition affects necessary protein synthesis. Therefore this affect plant growth and height, which is arrested within a few days before plant death.

3. Effect on *E. spinosa* dry biomass reduction

Data in Table 4 indicate that the best *E. spinosa* dry biomass reduction was achieved by Tribenuron-methyl at 9.50g/ha and Tribenuron-methyl at 14.25g/ha recording respectively 90.5% and 98.7% of *E. spinosa* dry biomass reduction. Concerning the effect of 2,4-D at 400g/ha and 600g/ha, results showed lower to medium efficacies that did not exceed 63.8% of *E. spinosa* dry biomass reduction. It is important to mention that there were no significant statistical differences on *E. spinosa* dry biomass reduction between Tribenuron-methyl at 9.50g/ha and Tribenuron-methyl at 14.25g/ha (Table 4). These results are in line with those of Abouziena & *al*. (2008) who reported that Tribenuron-methyl applied at 14.28g/ha resulted in marked reduction in the dry weight of *E. spinosa* when compared with unweeded treatments recording 93.5% of *E. spinosa* dry biomass reduction. Moreover, same authors reported that Tribenuron-methyl was better than hand weeding. This is because manual weeding eliminates only inter-rows weeds, while weeds located close to wheat plants are not controlled (Abouziena & *al*., 2008).

Table 3: Effect on *E. spinosa* height reduction

Treatments	*E. spinosa* height reduction
Tribenuron-methyl at 9.50g/ha	86.1 b*
Tribenuron-methyl at 14.25g/ha	95.5 b
2,4-D at 400g/ha	62.8 a
2,4-D at 600g/ha	72.7 a
Pα = 0.05	*< 0,001*

**Significant differences within the same column and means followed by the same letter do not differ at Pα ≤0.05 according to Tukey's test.*

Table 4: Effect on *E. spinosa* dry biomass reduction

Treatments	*E. spinosa* dry biomass reduction
Tribenuron-methyl at 9.50g/ha	90.5 b*
Tribenuron-methyl at 14.25g/ha	98.7 b
2,4-D at 400g/ha	55.4 a
2,4-D at 600g/ha	63.8 a
Pα = 0.05	*< 0,001*

**Significant differences within the same column and means followed by the same letter do not differ at Pα ≤0.05 according to Tukey's test.*

Conclusion

This study has shown that the herbicide Tribenuron-methyl at 9.50g/ha and 14.25g/ha gave the best control of *E. spinosa*. However, statistical analysis revealed no significant differences between these two rates of application. 2,4-D herbicide showed low to medium control of *E. spinosa*. Tribenuron-methyl at reduced rate of 9.50g/ha can be recommended to farmers in Ouazzane region when *E. spinosa* infestation is dominant. This study should be repeated with different herbicides with different modes of action to evaluate their effect on *E. spinosa*.

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