Short Research Article

Effect of post emergent herbicides on *Centaurea diluta* Aiton infecting wheat in Ouazzane region-Morocco

ABSTRACT

High infestations of *Centaurea diluta (Lesser star-thistle)* become a serious problem to cereal farmers in Ouazzane region of Morocco. The aim of this study is to investigate the effect of three post-emergent herbicides on *C. diluta* infestation in a soft wheat crop. The experimental design was Randomized Complete Block Design (RCBD) with three replications. Each block contained 4 elementary plots, 3 plots of which were treated with the three post emergent herbicides and the untreated plots serving as control. Trials were conducted in Ouazzane region of Morocco in January 2017. Treatments were carried out with a knapsack sprayer with the nozzle delivering a 3 bar jet. Calculation of reduction of biomass in *C. diluta* was carried out at weed research laboratory of INRA-CRRA Tangier in March 2017 using an oven at 75^0C for 48 hours. The weights were then taken using a precision balance. A quadrant of $1m^2$ was used to calculate the reduction of density in *C. diluta*. Results showed that treatment with Aminopyralid + Florasulam at (9.9 + 4.95) g/ha and 2,4-D at 600 g/ha gave the best control of *C. diluta* infestations. In fact, Aminopyralid + Florasulam at (9.9 + 4.95) g/ha recorded 88±4.1 %, 86±5.1 % and 97±1.6 % respectively on *reduction of density, height and* biomass in *C. diluta*. 2,4-D at 600 g/ha recorded 75±3.1 %, 84±4.2 % and 94±2.5 % respectively on *reduction of density, height and* biomass in *C. diluta*. Tribenuron-methyl at 9.50 g/ha recorded the lowest efficacies recording 25±4.9 %, 21±4.8 % and 37±8.1 % respectively on *reduction of density, height and* biomass in *C. diluta*. *Thus,* Aminopyralid + Florasulam at (9.9 + 4.95) g/ha and 2,4-D at 600 g/ha could be recommended to farmers in Ouazzane region when *C. diluta* infestation is dominant on wheat. A further assessment of Aminipyralid and Florasulam residues in soil and their phytotoxicities should be evaluated on other crops grown in rotations.

Keywords: Centaurea diluta, soft wheat, Aminopyralid, Florasulam, 2,4-D, Tribenuron-methyl, Morocco.

1. INTRODUCTION

Cereals are the most important crops in Morocco covering 59% of the agricultural area (MAPMDREF, 2019). Weeds are one of the most important problems mitigating cereal crop yield reduction in Morocco (Bouhache 2017). Weeds compete with crops using water, nutrients and sunlight (Spitters & Van Den Bergh, 1982; Zimadahl & El Brahli, 1992; Boutahar, 1994; Taleb, 1996; Bouhache, 2007; Bouhache, 2017). *Centaurea diluta* Aiton (Lesser star-thistle) is a very harmful weed in cereal crops in Morocco. It is a dicotyledonous plant that belong to *Asteraceae* family. It is an annual plant. Stem set, rigid, rowing 20 to 1.50 m high (Tanji, 2005). Lobed basal leaves, spread out on the ground and forming a circle 20 to 60 cm wide. Top leaves are sessile lancet-shaped or linear. Capitulum about 1 cm wide. Hairless bracts, the outer ones surmounted by a scarious appendage finished by one or more thorns. Internal bracts with scarious appendages. Tubular pink flowers. Seeds with brownish bodies striped white, shiny, 2 to 3 mm long and 1.5 to 2 mm wide, with lateral dimple, with a whitish persistent egret 3 to 5 mm long (Tanji, 2005). Tribenuron-methyl is a systemic post-emergence herbicide used in cereal crops to control broadleaf weeds (Ezzahiri, 2017). It belongs to sulfonylurea family that causes inhibition of acetolactate synthase ALS. Sulfonylureas herbicides have low toxicity and used with low amount of herbicide (Ezzahiri,

2017). « Aminopyralid + Florasulam» is a systemic post-emergence herbicide used in wheat to control broadleaf weeds (Ezzahiri, 2017). It has two modes of action due to the Florasulam which is an ALS (triazolopyrimidines family) and the Aminopyralid (picolinic acid family) which is a systemic auxin, controlling a wide range of weeds (Ezzahiri, 2017). 2,4 D is a systemic post-emergence herbicide for the control of broadleaf weeds on wheat. It belongs to Phenoxy-carboxylic-acid Family. It exterminates weeds by mimicking the plant growth hormone auxin, and causes uncontrolled and disorganized plant growth and the tissues of the plant are damaged (Tu & *al*., 2001). In Ouazzane region of Morocco, high infestations of *C. diluta* become a serious problem to cereal farmers. These infestations are probably due to the provenance of infested wheat seeds from other regions of Morocco. No studies have been conducted on chemical control of *C. diluta* in the Ouazzane region. This study aims to evaluate the effect of three herbicides on *C. diluta* infestation in a soft wheat crop.

2. MATERIALS AND METHOD

A weeding trial was conducted in Ouazzane region of Morocco during 2016-2017 growing season. The experimental design was Randomized Complete Block Design (RCBD) with three replications. The distance between the blocks was 2 meters and the distance between plots was 1 meter. Each block contained 4 elementary plots, 3 plots of which were 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 was carried out on January 11, 2017 with a Knapsack herbicide sprayer with nozzle delivering a 3 bar jet. The spray volume per hectare is 200L. Treatments consisted of the application of three post emergence herbicide (Table 1). Observations were at 60 days after application of herbicides. Observations concerned percentage of reduction of density, height and biomass in *C. diluta*.

Reduction of density in C. diluta = [*C. diluta* density in control plots – *C. diluta* density in treated plots] x 100 / [*C. diluta* density in control plots],

Calculation of the density at the experimental level of the plot was made by a quadrant of 1m x 1m.

Reduction of height in C. diluta = [*C. diluta* height in control plots – *C. diluta* height in treated plots] x 100 / [*C. diluta* height in control plots].

Reduction of biomass in C. diluta = [*C. diluta* biomass weight in control plots – *C. diluta* biomass weight in treated plots] x 100 / [*C. diluta* biomass weight in control plots].

Calculation of *C. diluta* biomass was made by collecting *C. diluta* in each plot using a quadrant of 1m x 1m. Samples were dried in a drying oven at 75 ° C for 48 hours. Then, dry plant material in each plot was weighed with a precision balance. Statistical analyzes were performed with IBM SPSS Statistics, version 21.0 using the analysis of variance (ANOVA).The differences among treatment means was compared by Tukey's test at p= .05.

Table 1: Applied herbicides in experimental site

Herbicide treatments	Herbicide active ingredient	rate of application
Treatment 1	Tribenuron-methyl	9.50 g/hectare
Treatment 2	Aminopyralid + Florasulam	(9.9 + 4.95) g/hectare
Treatment 3	2,4-D	600 g/hectare
Control	unweeded control	unweeded control

3. RESULTS AND DISCUSSION

3.1. Effect on *reduction of density in C. diluta*

Statistical analysis revealed significant differences between treatments (Table 2). Results in Table 2 showed that the best reduction of density *in C. diluta* was obtained by « Aminopyralid + Florasulam» at (9.9 + 4.95) g/ha which recorded 88±4.1 % of reduction of density *in C. diluta*. In second position, 2,4-D at 600 g/ha showed satisfying efficacies that did not exceed 75±3.1 % of reduction of density *in C. diluta*. Weak efficacy was registered by Tribenuron-methyl at 9.50 g/ha which recorded only 25±4.9 % of reduction of density in *C. diluta*. This results are in line with those of Mayerova & *al*. (2018) who reported that « Pyroxsulam + Florasulam + Aminopyralid» and 2,4-D resulted in a marked decrease in the density of *Centaurea cyanus*.

Table 2: Effect of post emergence herbicides on *reduction of density in C. diluta*

Treatments	*Reduction of density in C. diluta* (%)
Tribenuron-methyl at 9.50 g/ha	25±4.9 [a]
Aminopyralid + Florasulam at (9.9 + 4.95) g/ha	88±4.1 [c]
2,4-D at 600 g/ha	75±3.1 [b]
Pα = .05	*< .001*

Data represented are mean ± standard deviation for (n=3).Significant differences within the same column and means followed by the same letter do not differ at p= .05 according to Tukey's test.

3.2. Effect on *reduction of height in C. diluta*

Statistical analysis revealed significant differences between treatments (Table 3). Results in Table 3 showed that the best reduction of height in *C. diluta* was obtained by « Aminopyralid + Florasulam» at (9.9 + 4.95) g/ha which recorded 86±5.1 % of reduction of height in *C. diluta* (Table 3). Concerning the effect of 2,4-D at 600 g/ha, data in Table 3 showed high efficacy 84±4.2 % of reduction of height in *C. diluta*. It is important to mention that there was no significant statistical differences on *Reduction of height in C. diluta* between « Aminopyralid + Florasulam» at (9.9 + 4.95) g/ha and 2,4-D at 600 g/ha (Table 3). However, Tribenuron-methyl at 9.50 g/ha showed very weak efficacy recording only 21±4.8 % of reduction of height in *C. diluta*.

Table 3: Effect of post emergence herbicides on *reduction of height in C. diluta*

Treatments	*Reduction of height in C. diluta*
Tribenuron-methyl at 9.50 g/ha	21±4.8 [a]
Aminopyralid + Florasulam at (9.9 + 4.95) g/ha	86±5.1 [b]
2,4-D at 600 g/ha	84±4.2 [b]
Pα = .05	*< .001*

Data represented are mean ± standard deviation for (n=3).Significant differences within the same column and means followed by the same letter do not differ at p= .05 according to Tukey's test.

3.3. Effect on *reduction of biomass in C. diluta*

Statistical analysis revealed significant differences between treatments (Table 4). Data in Table 4 indicate that the best reduction of biomass in *C. diluta* was achieved by Aminopyralid + Florasulam at (9.9 + 4.95) g/ha recording 97±1.6 % of reduction of biomass in *C. diluta*. Concerning the effect of 2,4-D at 600 g/ha, results showed excellent efficacy 94±2.5 % of reduction of biomass in *C. diluta*. It is important to mention that there was no significant statistical differences on reduction of biomass in *C. diluta* between « Aminopyralid + Florasulam» at (9.9 + 4.95) g/ha and 2,4-D at 600 g/ha (Table 3).Tribenuron-methyl at 9.50 g/ha showed weak efficacy that did not exceed 37±8.1 %. In fact, Gauvrit (1996) has mentioned that herbicides have extremely varied properties, both from a physicochemical and biological point of view. Moreover, weeds differ in their plant surface properties (shape, hair, and cuticle) that affect the penetration of the herbicide into the tissues of the target weed. Weed species also differ in their ability to metabolize herbicides. Thus, this explains the differences in sensitivity of weeds according to the herbicide applied. On the other hand, it is important to mention that all herbicides tested in this study were perfectly selective and no toxic effect were registered on wheat plants for the period of growth stages after emergence.

Table 4: Effect of post emergence herbicides on *C. diluta* dry biomass reduction

Treatments	*C. diluta* dry biomass reduction
Tribenuron-methyl at 9.50 g/ha	37±8.1 [a]
Aminopyralid + Florasulam at (9.9 + 4.95) g/ha	97±1.6 [b]
2,4-D at 600 g/ha	94±2.5 [b]
Pα = .05	*< .001*

Data represented are mean ± standard deviation for (n=3).Significant differences within the same column and means followed by the same letter do not differ at p= .05 according to Tukey's test.

4. CONCLUSION

This study has shown that the herbicide Aminopyralid + Florasulam at (9.9 + 4.95) g/ha and 2,4-D at 600 g/ha gave the best control of *C. diluta*. Tribenuron-methyl at 9.50 g/ha showed weak control of *C. diluta*. Thus, Aminopyralid + Florasulam at (9.9 + 4.95) g/ha and 2,4-D at 600 g/ha can be recommended to farmers in Ouazzane region when *C. diluta* infestation is dominant. A further assessment of Aminipyralid and Florasulam residues in soil and their phytotoxicities should be evaluated on other crops grown in rotations.

COMPETING INTERESTS

Authors have declared that no competing interests exist

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