Short Research Article

Chemical weed control of lesser star-thistle (*Centaurea diluta* Aiton) in wheat crop

ABSTRACT

Aims: 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.
Study design: The experimental design was a random block with tree repetitions. Each block contained 4 elementary plots, 3 plots of which are treated with the post-emergence herbicides tested and one untreated control plot.
Place and Duration of Study: Trials were conducted in Ouazzane region of Morocco in January 2017. Calculation of dry *C. diluta* biomass were carried out at weed research laboratory of INRA-CRRA Tangier in March 2017.
Methodology: Treatments were carried out with a backpack herbicide sprayer with nozzle delivering a 3 bar jet. A quardat of 1m x 1m was used to calculate percentage of *C. diluta* density reduction, height reduction and biomass reduction. *C. diluta* dry biomass were determined using drying oven at 75 ° C for 48 hours. Then, weighed with a precision balance.
Results: 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 *C. diluta* density reduction, *C. diluta* height reduction and *C. diluta* dry biomass reduction. 2,4-D at 600 g/ha recorded 75±3.1 %, 84±4.2 % and 94±2.5 % respectively on *C. diluta* density reduction, *C. diluta* height reduction and *C. diluta* dry biomass reduction. Tribenuron-methyl at 9.50 g/ha recorded the lowest efficacies 25±4.9 %, 21±4.8 % and 37±8.1 % respectively on *C. diluta* density reduction, *C. diluta* height reduction, and *C. diluta* dry biomass reduction.
Conclusion: 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. This study should be completed with the assessment of Aminopyralid and Florasulam residues in soils and their phytotoxicities to 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 problem for cereal crops yield reduction in Morocco (Bouhache 2017). Weeds compete with crops using water, nutrients and lights (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 hamful 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). Whole or lobed basal leaves, sinuated, spread out on the ground and fo circle 20 to 60 cm wide. Top leaves are sessiles lancet-shaped or linear. Capitulum about 1 cm wide. Hairless bra outer ones surmounted by a scarious appendage finished by one or more thorns. Internal bracts with s

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appendages. Flowers all tubulous, pink. 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 palea egret persistent 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 belong 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 kills 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. MATERIAL AND METHODS

A weeding trial 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 4 elementary plots, 3 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 was carried out on January 11, 2017 with a backpack herbicide sprayer with nozzle delivering a 3 bar jet. The spray volume per hectare is 200L. Treatments consist on the application of three post emergence herbicide (Table 1). Observations were made 60 days after application of herbicides. Observations concerned Percentage of *C. diluta* density reduction, height reduction and biomass reduction. *C. diluta* density reduction percentage= [*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 quardat of 1m x 1m. *C. diluta* height reduction percentage= [*C. diluta* height in control plots – *C. diluta* height in treated plots] x 100 / [*C. diluta* height in control plots]. *C. diluta* dry biomass reduction percentage= [*C. diluta* dry biomass weight in control plots – *C. diluta* dry biomass weight in treated plots] x 100 / [*C. diluta* dry biomass weight in control plots]. Calculation of dry *C. diluta* biomass were made by collecting *C. diluta* 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 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

3. RESULTS AND DISCUSSION

3.1. Effect on *C. diluta* density reduction

Statistical analysis revealed highly significant differences between treatments (Table 2). Results in Table 2 showed that the best *C. diluta* density reduction was obtained by « Aminopyralid + Florasulam» at (9.9 + 4.95) g/ha which recorded 88±4.1 % of *C. diluta* density reduction. In second position, 2,4-D at 600 g/ha showed satisfying efficacies that did not exceed 75±3.1 % of *C. diluta* density reduction. Weak efficacie was registred by Tribenuron-methyl at 9.50 g/ha which recorded only 25±4.9 % *C. diluta* density reduction. 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*.

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Table 2: Effect on *C. diluta* density reduction

Treatments	*C. diluta* density reduction (%)
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.

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3.2. Effect on *C. diluta* height reduction

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

Table 3: Effect on *C. diluta* height reduction

Treatments	*C. diluta* height reduction
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.

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3.3. Effect on *C. diluta* dry biomass reduction

Statistical analysis revealed highly significant differences between treatments (Table 4). Data in Table 4 indicate that the best *C. diluta* dry biomass reduction was achieved by Aminopyralid + Florasulam at (9.9 + 4.95) g/ha recording 97±1.6 % of *C. diluta* dry biomass reduction. Concerning the effect of 2,4-D at 600 g/ha, results showed excellent efficacy 94±2.5 % of *C. diluta* dry biomass reduction. It is important to mention that there was no significant statistical differences on *C. diluta* dry biomass reduction 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.

Table 4: Effect 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.

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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. This study should be completed with the assessment of Aminopyralid and Florasulam residues in soils and their phytotoxicities to crops grown in rotations.

COMPETING INTERESTS

Authors have declared that no competing interests exist

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