

Study of Different Rates of Application of Pendimethalin and Acetochlor on Weed Infestation and Grain Yield of Fababean

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Abstract

A fababean weed control trial was conducted during the 2016-2017 growing season. The aim of this study is to investigate the effect of two pre-emergence herbicides Pendimethalin and Acetochlor on weed infestation in a fababean crop. Dominant weed botanical families in the experimental site belong to Asteraceae and Poaceae. Results showed that the improvement of fababean grain yield depends on the weed control efficacy. Treatment with Pendimethalin at 1228 g/ha widely decrease fababean weed infestations recording 91.7% and 90.56 respectively on visual efficacy rating and weed biomass reduction. Acetochlor at 1050 g/ha recorded the lowest efficacies 53.3% and 62.1% respectively on visual efficacy rating and weed biomass reduction. Plots treated with Pendimethalin at 1228 g/ha recorded the best yields with an average of 3.32 tons / ha.

Keywords: Weed Infestation, Fababean, Pendimethalin, Acetochlor, Efficacy, Biomass, Morocco

Introduction

Food legumes are second in crop rotation in Morocco after cereals (Elalaoui, 2000). Food legumes cover an area of 201 000 hectares (MAPMDREF, 2017). Fababean is the most important food legume, it covers an area of 82 800 ha with a production of 26 560 tons (MAPMDREF, 2017). These crops play several agronomic, nutritional and economic roles (Daoui *et al.*, 2015), as they contribute to the improvement of the soil structure and enrichment through the symbiotic fixation of atmospheric nitrogen and they improve the quality of the human and animal food ration because of their high protein content. In Morocco, fababean production is concentrated in two main areas; Sais region and the Pre-Rif region (Ouazzane, Chefchaouen, Taounate,

Taza) and in the central western region of the country (Chaouia, Abda and Dokkala) (Fatemi *et al.*, 2005). Weeds are a serious constraint to fababean productivity in Morocco especially orobanche and dicotyledonous weeds (Zemrag, 1994; Zemrag, 1997; Zemrag, 1999; Hajjaj 2010; Baye, 2012; Guennouni, 2012; Bouhache and Benmansour, 2014 ; Dahan *et al.*, 2016; Hajjaj *et al.*,2016, Tanji A. 2001; Tanji, 2013; Tanji A. 2018). Indeed, weeds compete with crops using water, nutrients and lights (Spitters and Van Den Bergh, 1982). Dicotyledonous weeds are a serious problem in fababean in Morocco because of the scarcity of registered broadleaf herbicides on this crop (Ezzahiri *et al.*, 2014). Surveys carried out in different regions of Morocco have shown that dominant weed botanical families found in food legumes are *Asteraceae*, *Fabaceae*, *Apiaceae*, *Brassicaceae* and *Poaceae* (Baye, 2015). Pendimethalin in pre-emergence is recommended to control dicotyledonous weeds and could be followed by a post-emergence herbicide which control grass weeds (Fluazifop butyl, Haloxyfop and Cycloxydime) (Baye, 2015). Pendimethalin and Acetochlor are two pre-emergence herbicides that may reduce weed infestation in fababean depending on rates of application and the nature of weed flora infestation. No studies have been conducted on weed efficacy of these herbicides in the Ouazzane region. This study aims to evaluate different doses of Pendimethalin and Acetochlor on weed infestation in fababean in the Ouazzane region, Morocco.

Material And Methods

A trial of weed control of fababean was conducted in Ouazzane region during 2016-2017 growing season. Two pre-emergence herbicides were tested (Table 1). Treatments were carried out using a Backpack herbicide sprayer with nozzle delivering a 3 bar jet. The spray volume per hectare is 200l. The experimental design was a random block with tree repetitions. The distance between the blocks is 2 meters and the distance between plots was 1meter. Each block contained 4 elementary plots, 3 plots of which are treated with the herbicides tested (Table 1) and one untreated control plot. The size of the elementary plots was 2m x 5m (10m²). Pre-emergence herbicides were applied three days after fababean sowing on November 07, 2016. Observations were made on January 11, 2017. Observations concerned visual rating of efficacy on a scale ranging from zero to 100% (where 0% is ineffective while 100% is a total destruction of weeds) and percentage of dry biomass reduction. Weed dry biomass reduction percentage = $[\text{weed dry biomass weight in control plots} - \text{weed dry biomass weight in treated plots}] \times 100 / [\text{weed dry biomass weight in control plots}]$. Calculation of dry weed biomass were made by collecting weeds in each plot using a quadrat 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 SPSS

software version 21.0 using the analysis of variance (ANOVA). The difference among treatment means was compared by Tukey's test at $p \leq 0.05$.

Table 1: Applied herbicides in experimental site

Herbicide treatments	Herbicide active ingredient	rate of application (g/hectare)
Treatment 1	Pendimethalin	614
Treatment 2	Pendimethalin	1228
Treatment 3	Acetochlor	1050

Results And Discussion

1. Weed flora

A floristic survey at the trial site revealed 18 species belonging to 11 botanical families, of which 88.9% are annuals. The dicotyledons contribute 66.6% and the monocotyledons 33.3%. Dominant weed botanical families in the experimental area are *Asteraceae* and *Poaceae* as they contribute more than half of the species diversity in the experimental site (Table 2). Others studies reported that *Asteraceae* and *Poaceae* contribute in total by 26.7 % in Chaouia region (Taleb and Maillet, 1994). This shows the importance of weed infestation of these two botanical families in Ouazzane region.

2. Effect on visual efficacy rating

Statistical analysis revealed significant differences in the efficacy of treatments on fababean weeds. Pendimethalin at 1228 g/ha gave the best efficacy recording 91.7% of weed control (Table 3). Thus, the efficacy of Pendimethalin at 1228 g/ha was different from all other treatments. Acetochlor at 1050 g/ha and Pendimethalin at 614 g/ha recorded lower efficacies with respective efficacies of respectively 53.3% and 63.3%. Others authors reported that Pendimethalin at 1050 g/ha recorded 93.3% of weed control in Meknes region of Morocco (Bouhache and Benmansour, 2014), this result confirms our observation in Ouazzane region. Furthermore, other study in Doukkala region (Morocco) tested the association of Pendimethalin at 600 g/ha with Acetochlor 840 g/ha. However, the observed efficacy of that treatment did not exceed 70% weed control (Tanji, 2012).

Table 2: Weed flora in experimental site

Scientific Names	Botanical families	Life cycle
<i>Anacyclus maroccanus</i> Ball	<i>Asteraceae</i>	Annual
<i>Anagallis arvensis</i> L.	<i>Primulaceae</i>	Annual
<i>Arisarum vulgare</i> Targ.-Tozz.	<i>Araceae</i>	Perennial
<i>Avena sterilis</i> L.	<i>Poaceae</i>	Annual
<i>Bromus rigidus</i> Roth	<i>Poaceae</i>	Annual
<i>Chrysanthemum coronarium</i> L.	<i>Asteraceae</i>	Annual
<i>Chrysanthemum segetum</i> L.	<i>Asteraceae</i>	Annual

<i>Convolvulus arvensis</i> L.	<i>Convolvulaceae</i>	Perennial
<i>Euphorbia helioscopia</i> L.	<i>Euphorbiaceae</i>	Annual
<i>Gallium tricornutum</i> Dandy	<i>Rubiaceae</i>	Annual
<i>Lolium rigidum</i> Gaudin	<i>Poaceae</i>	Annual
<i>Malva parviflora</i> L.	<i>Malvaceae</i>	Annual
<i>Phalaris brachystachys</i> Link	<i>Poaceae</i>	Annual
<i>Phalaris paradoxa</i> L.	<i>Poaceae</i>	Annual
<i>Plantago afra</i> L.	<i>Plantaginaceae</i>	Annual
<i>Ridolfia segetum</i> Moris	<i>Apiaceae</i>	Annual
<i>Sonchus oleraceus</i> L.	<i>Asteraceae</i>	Annual
<i>Vicia</i> spp.	<i>Fabaceae</i>	Annual

Table 3: Effect on visual efficacy rating at 60 DAT*

Treatments	Efficacy (%)
Pendimethalin at 614 g/ha	63.3a
Pendimethalin at 1228 g/ha	91.7b
Acetochlor at 1050 g/ha	53.3a
$P\alpha=0,05$	<0,00

Significant differences within the same column and means followed by the same letter do not differ at $P\alpha \leq 0.05$ according to Tukey's test.

* DAT: days after treatment

3. Effect on weed dry biomass reduction

Statistical analysis revealed significant differences between treatments (table 4). Plots treated with Pendimethalin at 1228 g/ha showed the best efficacy recording 90.56% of weed dry biomass reduction compared to weed dry biomass in the control plots. Plots treated by Pendimethalin at 614 g/ha and Acetochlor at 1050 g/ha showed medium weed dry biomass reduction recording only 74.20% and 62.10% respectively. Compared to another study conducted in Tadla region of Morocco in 2010 (Baye, 2012), Pendimethalin at 1200 g/ha showed only 70% of weed dry biomass reduction in a fababean weeding trial. This low efficacy can be explained by the nature of weed flora species since weed infestations differ in agricultural regions of Morocco. Therefore, it is important to adapt rates of application of Pendimethalin in different region according to weed infestation.

Table 4: Effect on weed dry biomass reduction

Treatment	Weed dry biomass reduction (%)
Pendimethalin at 614 g/ha	74.20 a
Pendimethalin at 1228 g/ha	90.56 b
Acetochlor at 1050 g/ha	62.10 a
$P\alpha = 0.05$	0.001

Significant differences within the same column and means followed by the same letter do not differ at $P\alpha \leq 0.05$ according to Tukey's test.

4. Effect on grain yield

Table 5: Effect of treatments on total yield of fababean (tons/ha)

Treatment	Grain yield (tons/ha)
Pendimethalin at 614 g/ha	1.77b
Pendimethalin at 1228 g/ha	3.32a
Acetochlor at 1050 g/ha	1.52bc
control	1.24c
$P\alpha=0,05$	<0,00

Significant differences within the same column and means followed by the same letter do not differ at $P\alpha \leq 0.05$ according to Tukey's test.

Statistical analysis revealed significant differences between grain yields of treated plots (Table 5). Results show grain yield superiority of plot treated with Pendimethalin at 1228 g/ha recording 3.32 tons / ha. The lowest yield is recorded by the control with 1.24 tons/ha. Grain yields of Acetochlor at 1050 g/ha and Pendimethalin at 614 g/ha treatments are also low, recording respectively 1.52 and 1.77 tons/ha. Despite the fact that grain yield recorded by Pendimethalin at 614 g/ha is greater than recorded untreated control grain yield, nonetheless grain yield of Pendimethalin at 614 g/ha remains low compared to the potential of the crop. In addition, it is important to mention that the calculation of correlation coefficient between treatment efficacies and recorded fababean grain yield showed a coefficient of 0.891: highly significant. This means that grain yields are higher as the weed control efficacies of the treatments increase.

Conclusion

This study has shown that the improvement of fababean grain yields is closely related to good weed control. Indeed, Pendimethalin at 1228 g/ha gave the best fababean grain yield recording 3.32 qx/ha and allows to reduce weed infestation by recording 91.70% and 90.56% respectively on visual efficacy rating and weed biomass reduction. Pendimethalin at 1228 g/ha can be recommended to farmers in Ouazzane region. This study should be repeated

at different sites and with different soils to evaluate Pendimethalin and Acetochlor effects on different weed infestation situations.

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