

INTEGRATED MANAGEMENT OF WILD CHAMOMILE (*MATRICARIA CHAMOMILLA* L.) POPULATIONS BY TILLAGE

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SUMMARY

Nowadays, environmental, health and economic concerns encourage reviewing our weed management in agriculture. Integrated pest management is one key element in the development of weed management strategies less dependent from herbicides. To reach this goal, impact of different methods of tillage (Combinations of stubble cultivator and moldboard plow) on biology and dynamic of wild chamomile populations was studied in experimental plots of experimental farm of Gembloux Agro-Bio Tech. In summer 2012, wild chamomile densities were significantly lower in plots tilled with a moldboard plow. The use of a stubble cultivator did not significantly affect *M. chamomilla* density. In addition, we found higher wheat yields in plowed plots, indicating that the decrease in *M. chamomilla* densities reduces competition for wheat. These results show well long run impact of plowing and his effect on densities of wild chamomile and the seedbank.

Key words: wild chamomile, tillage, integrated weed management, winter wheat,

INTRODUCTION

Weed management is essential in wheat production because weeds are competing with crop regarding nutrient elements, light and water and can lead to significant yield losses. Their presence can also increase production costs or affect the harvest value because weeds can support development of pests and diseases, disturb harvest or influence wheat humidity rate (Jouy *et al*, 1998; Booth *et al*, 2003; Zoschke *et al*, 2002).

For decades, this management was mainly done by using herbicides (Buhler *et al*, 2000). Last years, chemical weeding in agriculture increasingly raises environmental, health and economic preoccupations. European authorities have set up legislations (directive 91/414, settlement 1107/2009, directive 2009/128) aiming to reduce risks related to the use of pesticides and encouraging integrated pest management. This situation leads professionals and scientists to take interest in the biology and populations dynamic of weeds (Van Acker, 2009; Korres and Froud-Williams, 2001) and to study the impacts of integrated pest management on weeds and crops.

Our study was therefore undertaken in this framework, the main goal is thus to develop weed management strategies combining several ways of control and limiting dependence with herbicides. Tillage can contribute positively to those and can potentially be an efficient weed control method in winter wheat (*Triticum aestivum* L.). This direct way can allow elimination of present weeds before sowing but too to have impact on the soil seed bank.

Our research specifically concerns the determination of wild chamomile (*Matricaria chamomilla* L.) population dynamic and crop yields in an experimental winter wheat crop, in relation to tillage methods.

Five modalities (i.e. different combinations of a stubble cultivator and/or a moldboard plow, including a no-tillage control) were applied during three years (2010-2012), with four replications. These studies were conducted at the experimental farm of Gembloux (Belgium). In each plot, *M. chamomilla* density was recorded throughout the seasons.

MATERIALS AND METHODS

Experimental set-up

Experiments were performed during three growing seasons (2010-2012) at the experimental farm of Gembloux Agro Bio-Tech, Belgium. The field was located on a luvisol in agricultural region of Hesbaye. The crop during the three years of experimentation was winter wheat (variety: Sahara).

Before sowing, five modalities of tillage were applied. It was about five combinations of use of a stubble cultivator and/or a moldboard plow:

- no tillage
- one application of stubble cultivator- no plowing
- two applications of stubble cultivator no plowing
- one application of stubble cultivator and plowing before sowing
- two applications of stubble cultivator and plowing before sowing

Just before sowing, the seedbed was ploughed or not on a depth of 25 cm and was then tilled on a depth of 10 cm with a rotator harrow. Sowing of the winter wheat was carried out on October 30th 2009, November 23th 2010 and October 19th 2011.

Experiment was arranged as a split plot design with four replicates. We still studied a second factor which is the presence/absence of chemical weeding (herbicide application). In a replication, five plots were established on 16 x 6 m corresponding to each modality of tillage. The main plot was divided in two small plots (8 x 6 m) corresponding to two modalities of chemical weeding (presence or absence). Small plots contained an area for identification and count of weeds (3 x 6m), an area for yield quantification (m x 6m) and a buffer area limiting spray drift (3 x 6m).

Herbicide treatments were applied on April 19th 2010, April 14th 2011 and March 26th 2012. Products used were

- Verigal (1.2 l/ha), which is an herbicide against annual and perennial broadleaf weeds containing 250 g/l bifenox and 308 g/l mecoprop-p
- Othello (1.3 l/ha), which is an herbicide against grass and annual broadleaf weeds containing 50 g/l diflufenican; 2.4 g/L iodosulfuron-methyl-sodium; 7.5 g/ l mesosulfuron-methyl and 22.5 g/L mefenpyr-diethyl;

Wild chamomile density

M. chamomilla individuals were counted during winter (if the weather allowed it) during spring and before crop harvest. Counting was performed in 6 delimited areas of 0, 25 m²

located at the same place in each plot for all assessments. These data allowed estimating density of wild chamomile per square meter at punctual time.

Wild chamomile reproduction and development

Reproduction rate was estimated in all plots without chemical weeding on five *M. chamomilla* plants. During the flowering period, number of inflorescences produced by plant was counted. Dry biomass, number of ramifications and total height of each plant were also evaluated.

Wheat yield

Wheat was harvested on August 21th 2010, August 18th 2011, and August 13th 2012. For each plot an area of 10 m² (2 x 5 m) was collected. The humidity rate was reduced to 15% using a drying oven in order to allow comparison between plots.

Data analysis

A two-way ANOVA was carried out to assess the impact of tillage on wild chamomile population dynamics and wheat yield. Tillage was crossed to chemical weeding and both factors were considered as fixed. Statistical analyses were done using ANOVA and General Liner Model (GLM) procedure of Minitab 15 software.

RESULTS

Wild chamomile dynamic and biology

For the growing season 2012, densities of wild chamomile per square meter in plowed plots were lower than in no plowed ones. Impact of plowing was visible as of autumn. Indeed, densities of wild chamomile were poorer in plowed plots in November because moldboard plow had buried present seeds and had prevented access to light and germination. Mean densities in plowed plots were two to three times smaller than in no plowed plot, and it was quite visible throughout the growing season (Figure 1).

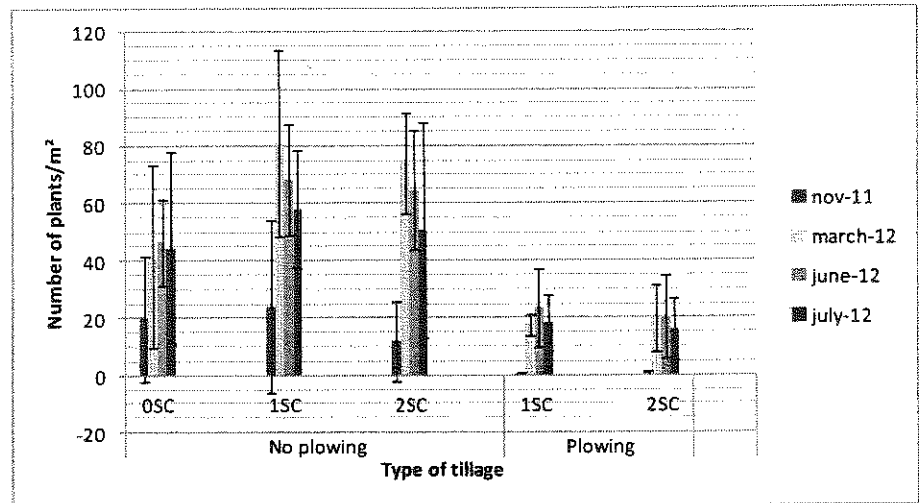


Figure 1. Mean density of wild chamomile (plants/m²) by type of tillage for several dates in the growing season 2011-2012- SC: Use of stubble cultivator

Nevertheless, the trend of the two first growing seasons was rather an increase of the densities with tillage. In the first season, plowing has allowed to go up old seeds and to expose to light and emergence. It was not the case in no tillage plots. But, in the long run, plowing has allowed a diminution/exhaustion of seed bank and stabilization. Indeed, for each growing, a part of seeds produced the previous year was deteriorated in soil by hiding whereas old seeds, raised up in surface, have germinated. In no plowing plot the seed bank has been continuing to grow (Figure 2).

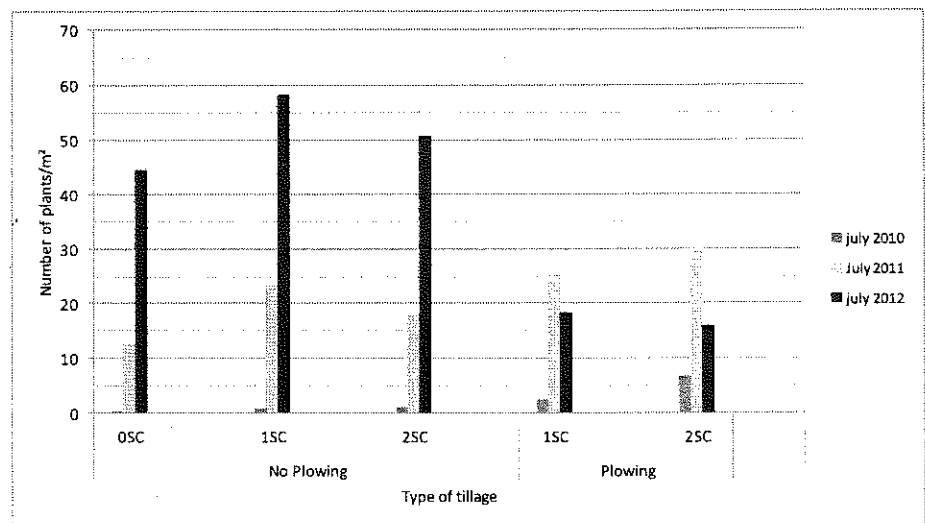


Figure 2. Mean Density of wild chamomile (plants/m²) by type of tillage for each growing season (2009-2010, 2010-2011, 2011-2012) before the harvest crop- SC: Use of stubble cultivator

Regarding development of wild chamomile, tillage doesn't mean to modify production of flowers but year after year, in all modalities, wild chamomile were more developed and the number of produced flowers per plant reached more than one hundred (Figure 3).

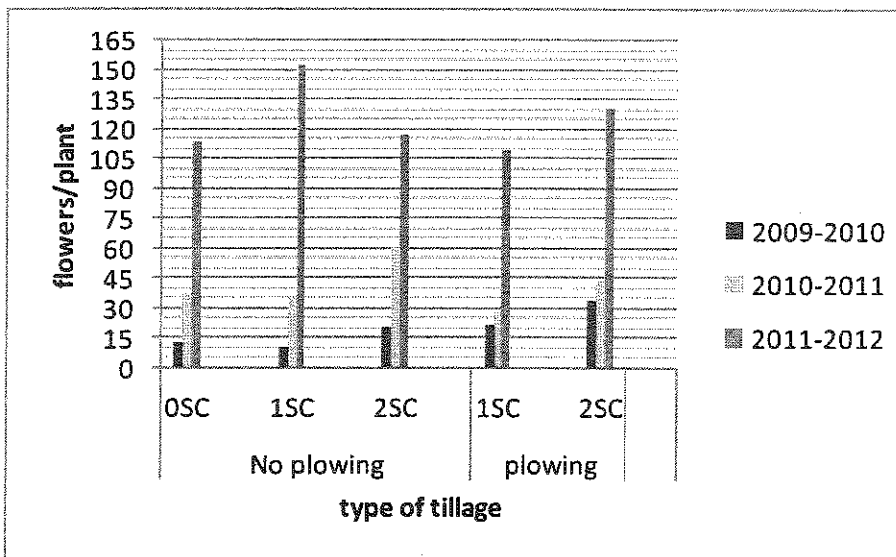


Figure 3. Mean production of flowers by plant of wild chamomile by type of tillage for the three growing seasons (2009-2010, 2010-2011, 2011-2012) - SC: Use of stubble cultivator

Wheat

Impact of plowing on densities of weeds was felt by crop. Indeed, regulation of densities of wild chamomile by plowing allowed limiting concurrency for the crop whereas in plot with no tillage, weeds blocked development of wheat. Number of ear produced per square meter was strongly less in no plowed plots than in plowed ones (Figure 4). Nevertheless, these densities stay low for all plots. That can explain the exceptional development of wild chamomile during years (Figure 3).

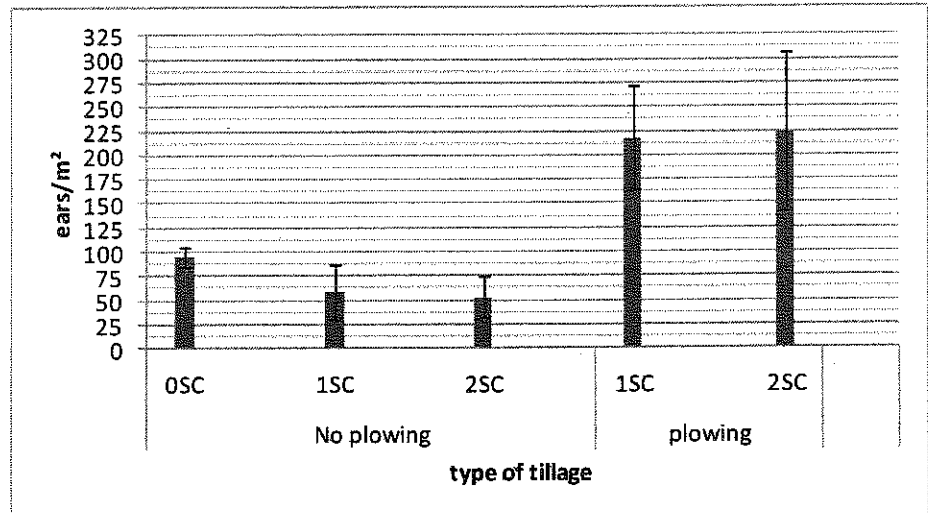


Figure 4. Mean number of ears of wheat per square meter for each type of tillage before the crop harvest 2012

And so, yield was higher in plot with plowing than in plot without plowing. It must also be pointed out that with a limited density of wild chamomile, yield losses were less important as in plot with plowing (Figure 5).

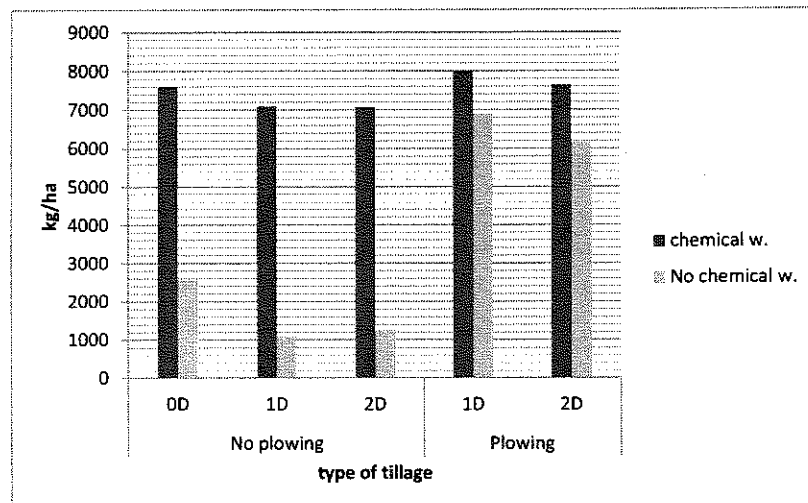


Figure 5. Mean yield of wheat by type of tillage in plots with chemical weeding and without chemical weeding crop harvest 2012

CONCLUSIONS

Tillage with moldboard plow influences densities of wild chamomile populations in winter wheat and allows stabilization in the long run of the seedbank. Tillage can be a useful tool to combine to other indirect or direct methods for control of weeds under agricultural conditions of central Belgium. To confirm these results, experiments are currently under investigation in similar conditions and regarding other species of weeds.

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