Dynamic of black-grass populations depending on the sowing time of winter wheat

J. VANDERSTEEN, D. JAUNARD[1], G. MAHY [2], J-P. BIZOUX [2], A. MONTY [2], M. DE PROFT[3], F. HENRIET [3], F. VANCUTSEM[1] AND B. BODSON[1]

1: Unit of Crop management, Gembloux Agro Bio-Tech, University of Liège, Gembloux Agro Bio-Tec, Belgium

2: Biodiversity and landscape Unit, Gembloux Agro Bio-Tech, University of Liège, Gembloux Agro Bio-Tec, Belgium

3: Plant Protection and Ecotoxicology Unit, Walloon Agricultural Research Center, Gembloux, Belgium

Corresponding author E-mail: delphine.jaunard@ulg.ac.be

SUMMARY

Currently, economic, agronomic and environmental concerns, lead to reduce use of herbicides. This reduction can be help by cultural measures like delay of the sowing date. Four sowing dates of winter wheat from 15th of October to 26th of November were tested. Dynamic of black-grass (*Alopecurus myosuroides Huds.*) populations and their reproduction rate were assessed as well as dynamic of winter wheat for each date. Delay of sowing could significantly reduce reproduction rate of black-grass. It was shown that the emergence rate (pl/m²), but also number of ears per plant and number of seeds per ear of black-grass decreased significantly with the sowing date. This reduction of seeds production already is from sixty per cent for a delay of two weeks sowing.

Key words: Black-grass, sowing date, winter wheat, non chemical management, Wallonia.

INTRODUCTION

Weed management is one of essential elements in our productive agriculture. Indeed weeds compete with crop for sun, water and nutrients (Zoschke et al, 2002). This competition can generate a decrease of yield. Presence of weeds can also increase production costs or affect value of harvest because it can support development of pests and diseases, disturb harvest or influence its humidity rate (Jouy et al, 1998). From decades, the control of weed growth is mainly realized by herbicides. Nevertheless, legislative reduction of active substances added to appear of mechanism of resistance from weeds and environmental concerns lead searchers and farmers to use herbicides with integrated way (Chauvel et al, 2007). Currently, there is a significant interest of reducing their use. Development of appropriate weed management strategies can help to decrease amounts applied.

The main goal of our research is to study dynamic of black-grass populations (*Alopecurus myosuroides* Huds.), in function of the sowing time. Delay of sowing date can be a way to impact the life cycle of weeds. Each black-grass plant can produce between four hundreds and one thousand five hundreds seeds (Van Himme et al, 1975). With a rate of thirty plants per square meter, competition effect between wheat and black-grass can generate important economic losses (Doyle et al, 1986). Other weeds species were studied in the project but these results are not presented in this paper.

MATERIALS AND METHODS

EXPERIMENTAL SET-UP

Field experiments were carried out during one growing season (in 2009-2010) at the experimental farm of Gembloux Agro Bio-Tech, Belgium. The field was located on a Luvisol in the agricultural region of Hesbaye. The previous crop was sugar beets and was harvested on September 2009. Before each sowing, seedbed was ploughed on a depth of 25 cm and a rotator harrow was used before sowing. The winter wheat variety sowed was HOMEROS.

The crop was sown at four different dates, from the 15th of October 2009 to the 26th of November 2009, each one at two weeks of interval. To have same density of wheat in each case, sowing density was adapted in function of the period of sowing and according to agronomic conditions,

increasing from 220 to 375 seeds per square meter (Table 1). The factorial experiment was arranged in a split plot design with four replications for a total of 32 plots per field. The main plots were the chemical weeding or not and the subplots were the sowing dates. Total plot size was 48 m^2 (8x6m) with an area of 3X6m intended for identification, observations and count of weeds. Another area of 2X6m was used for yield quantification and a last area of 3X6m represented the buffer area between plot with and without herbicide treatment.

Table 1. Sowing dates and corresponding density

Sowing date	Density	Herbicide treatment
15th of October 2009	220 seeds/m^2	19th of April 2010
29th of October 2009	275 seeds/m^2	19th of April 2010
13th of November 2009	325 seeds/m^2	19th of May 2010
26th of November 2009	375 seeds/m^2	19th of May 2010

Herbicide treatment was applied on the 19th of April 2010 in the plots sown at the two first dates, and on 19th of May 2010 in the plots sown later (Table 1). The products used were Cossack (300g/ha), herbicide against annual graminaceous and annual dicotyledons containing 9 grams/ha of mesosulfuron, 9 g/ha of iodosulfuron; and Diflanil (250ml/ha), herbicide against annual dicotyledon weeds which means 125 g/ha of diflufenican.

BLACK-GRASS DEVELOPMENT OBSERVATIONS

Weeds individuals were counted every two weeks from their emergence and during all the growing season, excepted when climatic conditions were unfavourable. Counting was realized in 6 delimited areas of 0,25 m^2. These areas were located at the same place in each plot for all assessments during the whole growing season.

BLACK-GRASS REPRODUCTION RATE ESTIMATION

In plots without chemical weeding, reproduction rate of black-grass was assess. In each plot, five plants were taken randomly and examined during the flowering and seeds production time (June-July). Ears produced by each plant were counted, and the dry biomass of each plant was quantified. For each plant, seeds production per ear was estimated (mean on three ears). Counting of ears produced per plant, estimation of seeds produced per ear, and development assessments have allowed estimating the production of seeds per plant and also per square meter.

WHEAT YIELD QUANTIFICATION

Harvest tough place on the 10th of August 2010, on delimited area of 12m^2 (2 x 6 m) for each plot. The humidity rate was put at 15% to allow comparison between plots.

ANALYSIS OF DATA

Statistical analyses were done using ANOVA and the General Liner Model (GLM) procedure of Minitab 15 software.

ANOVA test was carried out for finding out the contribution and impact of each sowing time on black-grass population dynamic and on wheat yield.

The generalised linear model (GLM) procedure was used to test differences between reproduction rates for black-grass from different sowing times.

RESULTS

BLACK-GRASS BIOLOGY

Density of black-grass in plots without chemical weeding clearly decreased with sowing date report (Figure 1).

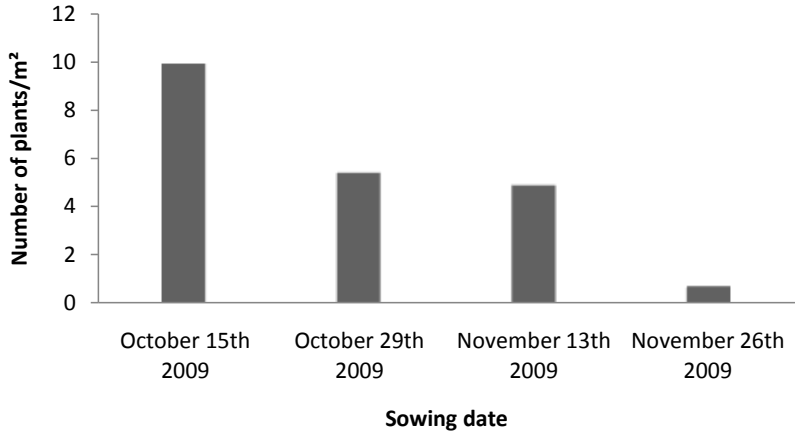
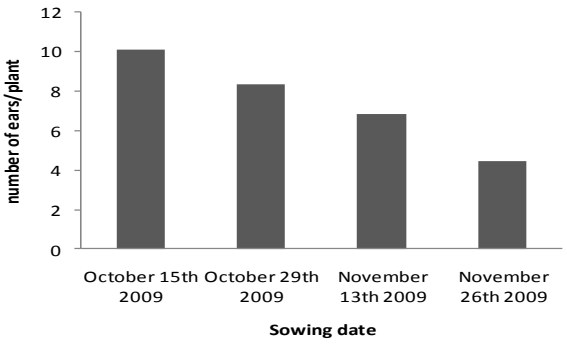
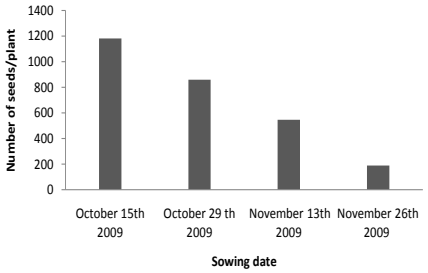


Figure 1. Mean number of black-grass plants per square meter for each date of sowing in July 2010 in plot without chemical weeding.

There is a significant effect of sowing time on the mean number of ears and seeds produced per plant. These numbers decrease with the delay of sowing since the first date (Figures 2 and 3).





Figures 2 & 3. Mean number of ears and seeds produced per plant of black-grass for each sowing date.

From numbers of seeds produced per plant and numbers of plants developed per square meter, seeds production of black-grass per square meter could be calculated. This production is reduced from sixty per cent between the sowing of 15th of October and the sowing of 29th of October. With a delay of six weeks (26th Of November 2009), seeds production was hundred time lesser (Figure 4).

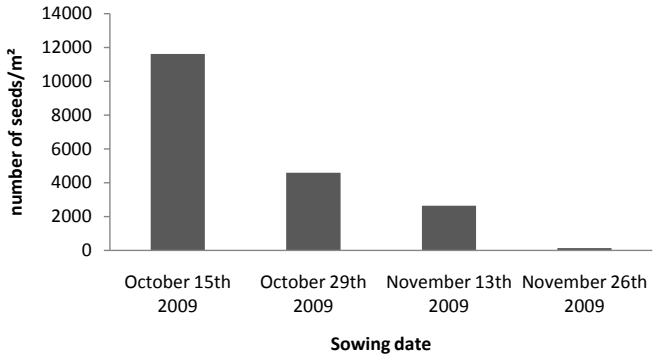


Figure 4: Number of black-grass seeds produced per square meter for each sowing date.

WHEAT

In plots with chemical weeding, yield decreased with the delay of the sowing time, from 9,8 T/ha on the 15th of October 2009 to 8,9 T/ha on the 26th of November 2009 (Figure 5). For the first sowing date, we can allot yield difference between plots with and plots without herbicide treatment due to the black-grass populations. In other sowing dates, black-grass populations are pored but can be detrimental long term and creates seeds bank.

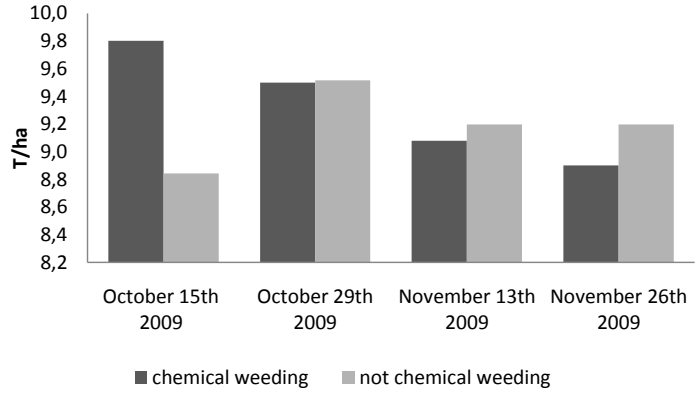


Figure 5. Mean yield of winter wheat per sowing date and for plot with and without chemical weeding.

CONCLUSIONS

We can conclude that in the conditions of the trial, which were normal for Wallonia, it seems possible to reduce the black-grass populations and their reproduction rate by the delay of the sowing time. A delay of two weeks allows yet reducing number of seeds produced to sixty per cent. A longer delay can offer more important decrease in black-grass seeds production but often sowing wheat in late November need a higher seed rate and present more risks due to bad weather conditions. These preliminary results give indications to be confirmed during several years and in other soil and weather conditions.

ACKNOWLEDGEMENT

This work was supported by Direction Générale opérationnelle de l'Agriculture, des Ressources Naturelles et de l'Environnement (DGARNE) du Service Public de Wallonie (SPW). We thank for their

contribution. We also thank staff of Plant Protection and Ecotoxicology Unit (CRA-W), Crop management Unit and Biodiversity and landscape Unit for their assistance.

LITERATURE

CHAUVEL B., DELATTRE M., GUILLEMIN J.-P., COLBACH N. (2007). Des pratiques agronomiques pour gérer une mauvaise herbe résistante aux herbicides. XX^{e} conférence du columa, journées internationales sur la lutte contre les mauvaises herbes. 159-168.

DOYLE C., COUSENS R., MOSS S. (1986). A model of the economics of controlling **alopecurus myosuroides Huds.)** in winter wheat. Crop protection. **Vol 5**:143-150.

JOUY L. & GUILBERT F. (1998). Influence des pratiques culturales sur l'évolution de la flore adventice en grandes cultures. XVII^{e} Conférence du columa, journées d'études sur le désherbage. 79-90.

MOSS S., PERRYMAN S., TATNELL V. (2007). Managing herbicide-resistant blackgrass *(alopecurus myosuroides Huds*.): Theory and practise. Weed technology. **Vol 21**:300-309.

VAN HIMME M. & BULCKE R. (1975). Distribution, extension, et importance d'*Alopecurus myosuroïdes* Huds. En Europe. EWRS. **Vol 2** :23-54.

ZOSCHKE A. & QUADRANTI M. (2002). Integrated weed management: *Quo vadis*?. Weed biology and Management. **2**: 1-10.