Proceedings of the 7th Congress on Plant Protection

Доклады 7-ого Конгресса по защите растений

Plant Protection Society of Serbia
Общество по защите растений Сербии

International Organization for Biological Control
-East Palearctic Regional Section (IOBC-EPRS)
-West Palearctic Regional Section (IOBC-WPRS)

Международная организация по биологической борьбе
- Восточно палеарктическая региональная секция (МОББ-ВПРС)
- Западно палеарктическая региональная секция (МОББ-ЗПРС)

Editors/Редакторы

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„Integrated Plant Protection – a Knowledge-Based Step towards Sustainable Agriculture, Forestry and Landscape Architecture“

(November 24-28, 2014, Zlatibor, Serbia)

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„Интегрированная защита растений - научно обоснованный шаг к устойчивому развитию сельского хозяйства, лесоводства и пейзажной архитектуры“

(24-28 ноября 2014 года, Златибор, Сербия)

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PREFACE

The Plant Protection Society of Serbia (PPSS) and two regional sections of the International Organization for Biological and Integrated Control (IOBC-EPRS and IOBC-WPRS), on the occasion of the 60th anniversary of the PPSS organized VII Congress on Plant Protection with a motto: *"Integrated Plant Protection – a Knowledge-Based Step towards Sustainable Agriculture, Forestry and Landscape Architecture"* (November 24-28, 2014, Zlatibor, Serbia). The Congress enabled exchange of up-to-date scientific and technical information on plant protection in Agriculture, Forestry and Landscaping among researchers, teachers, experts in extension and public services and the business community, and promoted international cooperation. The Congress focused on basic knowledge and management practices established in plant protection, as well as on the development of alternative and innovative approaches. In addition, biological control as an important tool for the control of the harmful organisms with a minimal risk for ecosystems was discussed. A total of 209 contributions was presented - 8 keynote presentations, 28 oral presentations and 173 poster presentations - prepared by 467 authors from 26 countries. The Congress Proceedings comprise 65 contributions - 5 keynote presentations and 60 oral and poster presentations in six sessions, prepared by the authors from 18 countries (Algeria, Austria, Bosnia-Herzegovina, France, Georgia, Hungary, Italy, Kazakhstan, Montenegro, Poland, Russia, Rwanda, Serbia, Slovenia, Switzerland, Turkey, Uganda, USA). All contributions were reviewed by members of the Scientific Committee and other reviewers selected and invited by the editors of this publication.

Belgrade, November 2015 Editors

ПРЕДИСЛОВИЕ

Общество по защите растений Сербии (ОЗРС), Международная организация по биологической борьбе с вредными животными и растениями - Восточно палеарктическая региональная секция (МОББ-ВПРС) и Международная организациая по биологической борьбе и интегрированной системе защиты растений - Западно-палеарктическая региональная секция (МОББ-ЗПРС), по поводу 60-летия ОЗРС организировали VII Конгресс по защите растений, под девизом: *"Интегрированная защита растений - научно обоснованный шаг к устойчивому развитию сельского хозяйства, лесоводства и пейзажной архитектуры"* (24-28 ноября 2014 года, Златибор, Сербия). Цель Конгресса была обеспечение континуитета взаимообмена научно-техническими информациями, отвечающими современным требованиям защиты растений в сельском хозяйстве, лесоводстве и пейзажной архитектуре, которые представляют интерес для ученых, исследователей, преподавателей, экспертов-советников в области сельского хозяйства, лесоводства и пейзажной архитектуры, специалистов государственных и коммунальных служб, деловых кругов и средств массовой информации. Целью Конгресса является и продолжение содействия развитию и популяризации международного сотрудничества. Конгресс был концентрирован на основные знания и практический менаджмент в защите растений, а также на развитие алтернативних и новых подходов. Биологическая защита каторая представляет значительный способ для безопасной борьбы с вредними организмими была тоже рассмотривана. На конгрессе представлено 209 презентаций - 8 докладов по приглашению, 28 устных и 173 постер презентаций - которые подготовило 467 авторов из 26 стран. Сборник имеет 65 докладов - 5 докладов по приглашению и 60 устных и постер презентаций, распределенных в шести секциях. Авторы докладов приехали из 18 стран (Алжир, Австрия, Босния-Герцеговина, Франция, Грузия, Венгрия, Италия, Казахстан, Черногория, Польша, Россия, Руанда, Сербия, Словения, Швейцария, Турция, Уганда, США). Рецензенты всех опубликованных докладов в сборнике – члены Научного совета и другие рецензенты, выбранные редакторам этого издания.

Белград, Ноября 2015 Редакторы

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HERBICIDES IN SPRING OILSEED RAPE: SOIL AND FOLIAR APPLICATION

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ABSTRACT

Possibility to chemically control weeds in spring rapeseed has been tested in two locations, Novi Sad and Kragujevac. The following herbicides were tested: Trefgal (a.i. trifluralin), Gamit (a.i. clomazone), Globus (a.i. quizalofop-p-ethyl) and Lontrel 100 (a.i. clopyralid). Combinations of herbicides Trefgal + Gamit and Trefgal + Lontrel 100 showed the highest efficiency on annual broadleaf weeds in both localities. The tested herbicides had no effect on annual and perennial weed species *Agropyrum repens, Cirsium arvense, Cynodon dactylon*, as well as the *Hibiscus trionum*. The herbicide Gamit, in the combination Gamit + Trefgal, exhibited phytotoxicity to the rapeseed crops in both locations. Simultaneously we tested the effect of the herbicides on hectoliter weight of seed and oil and protein content in seed. In Kragujevac, the tested herbicides were not adequately efficient for the weeds present in that location. In Novi Sad, the location predominated by annual broadleaf weeds, the performance of these herbicides was much better. The tested herbicides differed significantly in their effect on the quantity and quality parameters of rapeseed.

Key words: spring rapeseed, weeds, herbicides

INTRODUCTION

The rapeseed (*Brassica napus* L.) belongs to the *Brassicaceae* family and it has a winter and a spring form. The spring form is mainly grown in areas with very cold winters (Kanada, Sweden). In Europe, excluding Sweden, the acreage under spring rapeseed is small (Kondić et al., 2008).

Winter rapeseed cultivars are dominant in European countries (Marinković et al., 2010), but selection and breeding of spring cultivars intensified in Europe in the second half of the 20th century (Mustapić et al., 1984).

Chemical weed control is not a mandatory practice in winter rapeseed and it is performed as needed and not on the entire acreage. In our agricultural practice, the rapeseed is considered a competitive crop and herbicide use is not considered cost-effective (Mitrović et al., 2009). However, questionnaires have shown that herbicides application is practiced both, in the fall and spring (Marisavljević et al., 2007).

The spring rapeseed is less competitive against weeds than the winter rapeseed, especially at the beginning of the growing season. The optimum time for spring rapeseed planting is from mid-March to mid-April, a period that coincides with the emergence of germination and spring weeds (Konstatinović et al., 2007). If seedbed preparation is performed well and the spring rapeseed is planted at optimum date, the crop usually stays weed-free in the early stages of development. However, post-sowing emergence of weed species (15 to 20 days after sowing) can cause reductions in oil yield and quality (Klaaβen, 2006). The same author recommends that, in addition to chemical treatment before or after sowing and before crop emergence, an additional treatment with metazachlor should be performed after crop emergence, to eradicate the weed that emerged in the meantime. Davies (2005) recommends a similar weed control schedule for the spring rapeseed, the difference being the pre-sowing application of trifluralin instead of clomazone and the post-emergence application of metazachlor and clopyralid.

In the period after emergence of spring rapeseed, broadleaf weeds are dominant in rape plots, while grassy weeds prefer wet and neglected plots (Gunsolus and Oelke, 2000; loc. cit. Konstantinović et al., 2007). Particularly harmful are species from the *Brassicaceae* family (*Sinapis arvensis, Raphanus raphanistrum, Thlaspi arvense, Diplotaxis muralis*) because they develop faster than the crop, shade and smother it. They occur in seed plots too. In practice there is no suitable herbicide for their control, so it is necessary to apply mechanical measures and to treat chemically the previous crop (Konstantinović et al., 2007; Klaaβen, 2006). Large temperature variations in April and the first half of May tend to slow down the growth of rapeseed which results in intensive weed occurrence in the early stages of crops development (Brennan and Thill, 1993). Many weeds, especially those from the *Brassicaceae* family, can in addition to direct damage also cause indirect damage as vectors of harmful fungi and insects. For example, a weed species *Capsella bursa pastoris* is host to a parasitic fungus *Albugo candida* (Leino, 2006; Antonijević and Mitrović, 2007). Harvest of weed-infested crop produces rape seed with admixtures of weed seeds which increase the cost of drying and reduce the quality of oil and proteins (Klaaβen, 2006; Davies, 1999). The above data indicate that it is important to control weeds in spring rapeseed.

The objective of this study was to investigate the possibility of controlling weeds in rapeseed plots and to assess the impact of herbicides on yield and quality parameters of spring rapeseed.

MATERIAL AND METHODS

This study was carried out in 2009 in two locations, Kragujevac and Novi Sad, using the standard method for testing the efficiency of herbicides in rapeseed crops (Anon, 2004). Material for the experiment was spring rapeseed cultivar Jovana, in property of Institute of field and vegetable crops from Novi Sad, Serbia, registered for commercial use. The experiment was set up as a randomized block design with three replicates. Plot size was 30m^2. Basic data for the experiment are shown in tables 1 and 2.

Chemical treatment was performed by means of a backpack sprayer "Solo", with an extension tube fitted

Table 1. Basic data for the experiment

Location	Kragujevac	Novi Sad
Soil type	Pseudogley (parapodzol)	Degraded chernozem
Previous crop	Wheat	Seed pea
Planting date	10 Apr 2009	25 Mar 2009
Application date	08 Apr 2009 Trefgal and Gamit Incorporated in soil	23 Mar 2009 Trefgal and Gamit
Assessment dates	20 May 2009 Lontrel 100 and Globus 1st assessment: 10Jun 2009 2nd assessment: 10 Jul 2009	18 May 2009 Lontrel 100 and Globus 1st assessment: 26 May 2009 2nd assessment: 10 Jul 2009
Harvest	10 Aug 2009	04 Aug 2009

Table 2. Herbicide variants tested

Treatment	Herbicide (active substance)	Dose per ha	Application time
1.	Control	-	-
2.	Trefgal (trifluralin 480 g/l)	2.5 l/ha	Pre-plant – incorporation
3.	Trefgal (trifluralin 480 g/l)+ Lontrel 100 (clopyralid 100 g/l)	1.5 l/ha + 1.0 l/ha	Pre-plant – incorporation + post-emergence and after weed emergence
4.	Trefgal (trifluralin 480 g/l)+ Gamit (clomazone 480 g/l)	1.5 l/ha + 0.2 l /ha	Pre-plant – incorporation
5.	Gamit (clomazone 480 g/l)	0.2 l/ha	Pre-plant – incorporation
6.	Gamit (clomazone 480 g/l)	0.3 l/ha	Pre-plant – incorporation
7.	Lontrel 100 (clopyralid 100 g/l) + Globus (quizalofop-p-ethyl 50 g/l)	1.0 l/ha + 2.0 l/ha	Post-emergence and after weed emergence
8.	Globus (quizalofop -p-ethyl 50 g/l)	2.0 l/ha	Post-emergence and after weed emergence
9.	Control with hoeing	-	-

with eight Lurmark 03 F 110 nozzles. Herbicides were mixed with water, which was applied at a rate of 300 l/ha when rapeseed plants were 10 cm tall and weeds in stage of 2-6 pairs of leaves. In addition to the tested herbicides, the experiment included also two controls (with hoeing and without hoeing).

The effectiveness of the herbicides was assessed by counting weed plants (number of weeds/m^2). Herbicides phytotoxicity for rapeseed was estimated at the time of herbicide efficiency assessment, visually, on the EWRS scale 1-9: 1 - healthy plants with no symptoms, 2 - slight phytotoxic symptoms, 3 - medium, but clearly recognizable symptoms, 4 - pronounced symptoms whose effect on yield is uncertain, 5 - strong symptoms, growth disorder, chlorosis perceivable, etc., when yield reduction is expected to occur, 6, 7, 8, 9 - severe damage to complete destruction of plants (Anon, 1981). Foliar application of Lontrel 100 and Globus was made on 20 May 2009, when rapeseed plants were about 10 cm tall and most of the weeds were at the stage of 2-6 developed leaves (at the time of treatment, weed infestation rate was not assessed). Rapeseed yield and quality were determined by measuring and analyzing the following parameters: grain yield (kg/30 m^2), hectoliter weight, oil content (%) and protein content (%) in seed. Basic statistical calculations of rapeseed yield and quality were done by the t-test (Mead et al., 1996).

First assessments of weed infestation rate in the crop were done two months after planting, at both sites (Tab. 1). For foliar treatment, assessments were done 30 days after planting. The reason for a rather late performance of the assessments were poor weather conditions (a spell of extreme drought). In Novi Sad, a total rainfall from the beginning of April till mid-May was 15 l/m^2, with temperatures soaring up to 30°C in the first half of May. The experiment in Novi Sad was sprinkler irrigated on 10 April to provoke the emergence of rapeseed plants and weeds. Similar weather conditions were registered in the second location, except for a 30 l/m^2 rainfall at the beginning of May.

RESULTS AND DISCUSSION

Tables 3, 4 and 5 show the results of the first and second assessments of weed infestation (number of weeds/m^2) performed in the locations of Kragujevac and Novi Sad. Data shown in tables 3 and 4 indicate that 15 weed species were present in the location of Kragujevac, 3 grassy (2 perennials and 1 annual) and 12 broadleaf weeds (2 perennials and 10 annuals). *Hibiscus trionum*, *Cynodon dactylon* and *Agropyrum repens* were dominant weeds in the experiment at the time of both assessments in the location Kragujevac. At the time of application of Trefgal and Gamit, which were incorporated on 8 April 2009, the soil was relatively favorably humid and the first substantial rain fell on 30 April 2009 (about 30 l/m^2), which has not reduced the effect of these herbicides.

Table 3. Weed infestation rate in rapeseed crop, Kragujevac location, 1st assessment, 10 Jun 2009

Weeds	Treatment							
	1	2	3	4	5	6	7	8
	number of weeds/m^2							
Agropyrum repens	5	0	6	0	5	2	0	1
Amaranthus retroflexus	3	0	0	0	2	0	0	2
Atriplex patula	2	0	0	0	0	0	0	0
Chenopodium album	4	1	0	1.5	2	2	0	6
Cirsium arvense	0	4	2	0	0	0	0	0
Cynodon dactylon	10	9	11	0	8	0	0	5
Echinocloa crus -galli	4	1	2	2	0	3.5	0	0
Hibiscus trionum	4	4.5*	7	8	6*	5*	8	11
Linaria vulgaris	1	0	0	1	1	0	0	1
Matricaria chamomilla	4	0	0	0	0	0	0	1
Polygonum lapathifolium	3	0	0	3.5	2.5	2	3.5	1.5
Polygonum convolvulus	3	2	0	2	3	2	3	3
Rubus caesius	1	0	0	0.5	0	1	0	1
Vicia craca	1	0	0	0	0	0	0	1
Xanthium strumarium	1	1	0.5*	1	1.5*	1.5*	0	1
Phytotoxicity	-	2	2	2-3	2-3	3-4	2	2

*plants with arrested growth but not destroyed, fhytotoxicity assessment (1-9)

All of the tested herbicides showed some effect on the weeds present in Kragujevac, however, because of the presence of grassy weeds and an increased number of plants of *Hibiscus trionum*, which was not effectively controlled by the application, the overall effect of herbicides was unsatisfactory. If total number of weeds/m^2 is taken as a parameter of efficiency, then the following herbicide combinations were most effective in this location: Trefgal + Gamit (1.5 l/ha + 0.2 l/ha) and Trefgal + Lontrel 100 (1.5 l/ha + 1.0 l/ha) but this conclusion can not be considered as fully reliable. The reason for doubts is a highly uneven distribution of weeds in the trial, where individual plots were under great pressure of *Agropyrum repens*, *Cynodon dactylon, Cirsium arvense*, *Rubus caesius* and a parasitic angiosperm *Cuscuta campestris*, which parasitized both weeds and rapeseed plants.

The herbicide Gamit, in the combination Gamit + Trefgal, exhibited phytotoxicity to the rapeseed crops in both locations. The rapeseed plants treated with the combination Trefgal and Gamit in the amounts of 1.5 l/ha + 0.2 l/ha exhibited low phytotoxicity which was manifested as etiolation of individual leaves totalling about 10% of the plant foliage at the stage of 1-3 true leaves. The plants treated with Gamit alone, in the amount of 0.2 l/ha, exhibited similar symptoms. Gamit applied in the quantity 0.3 l/ha caused somewhat more pronounced symptoms, etiolating about 20% of the plants at the stage of 1-3 true leaves. These symptoms are known to occur in response to the application of clomazone based herbicides, and they are temporary and disappear in the course of further plant growth. The phenomenon was discussed by Davies (2005).

In the location of Novi Sad, 15 weed species were registered, one grassy (perennial) and 14 broadleaf weeds (2 perennials and 12 annuals). Regardless of a similar number of weed species as in the Kragujevac experiment, the number of weeds was significantly lower, ranging from 2 to 10 weeds/m^2. In both locations, the combinations Trefgal + Gamit (1.5 l/ha + 0.2 l/ha) and Trefgal + Lontrel 100 (1.5 l/ha + 1.0 l/ha) were most effective in weed control. In this experiment too, certain weeds were unevenly distributed (in patches or as individual plants). The effective performance of pre-emergence application timings ofherbicide was observed on reduced growth and population of weeds from the very beginning, which increased seed yield in rapeseed significantly. Similar result has been reported by Khan and Mumtaz (1995), Yadav et al. (2004. and Singh et al. (2001). Application of herbicides decreased the weed density over control. Effectiveness of herbicides in controlling weeds has been reported by Yadav et al. (2004). Bagherani and Shimi (2002) have also reported that among five herbicides (trifluralin, ethalfluralin, cyanazine, alachlor and propyzamide), the most efficient treatment was trifluralin. In order to determine as precisely as possible the impact

Table 4. Weed infestation rate in rapeseed crop, Kragujevac location, 2nd assessment, 10 Jul 2009

Weeds	Treatment							
	1	2	3	4	5	6	7	8
	number of weeds/m^2							
Agropyrum repens	5	0	6	0	5	2	0	1
Amaranthus retroflexus	3	1	1	0	2	0	1	2
Atriplex patula	2	0	0	0	0	0	0	1
Chenopodium album	4	2	3	1.5	4.5	1	2	6
Cirsium arvense	3	3.5	2	1	0	0	0	0
Cynodon dactylon	13	11	14	0	10	0	0	7
Echinocloa crus -galli	4	1	2	2	1	0	0	0
Hibiscus trionum	10	8*	7	8*	6*	5*	8	11
Linaria vulgaris	1	0	0	1	1	0	0	1
Matricaria chamomilla	4	0	0	0	0	0	0	1
Polygonum lapathifolium	3	2	0	4	3.5	2	4	2
Convolvulus arvensis	3	2	0	2	3	2	3	3
Rubus caesius	1	0	0	1	0.5	1	0	1
Vicia craca	1	0	0	0	0	0	0	1
Xanthium strumarium	2	2.5	0	2	2.5*	2*	0.5	1
Phytotoxicity		2	2	2	2	2	2	2

*plants with arrested growth but not destroyed, phytotoxicity assessment (1-9)

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