

# Management of Some Noxious Dicotyledonous Weeds in Rape Crops in Southern Romania

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**Abstract:** In recent years, the importance of winter rape (*Brassica napus*) has increased considerably because it provides the raw material for industry, representing a renewable alternative to fossil energy sources. The spectrum of weeds in rape crops has a specific characteristic and it is in constant change. These developments are more obvious if they are studied for a long time, on large agricultural areas, allowing conclusions to be drawn regarding the emergence of new species of weeds or changes in the importance of the already existing weeds. Our observations were made in 2015 and 2016 on rape crops in southern Romania. The conducted research showed that some weeds, such as a few species in the genus *Veronica*, classified as ‘ephemeral’, became dominant in the rape crops. We also found that *Galium aparine* has become more damaging, having a much higher density in rape crops. In this context, the control of these species, both native and alien, is required due to the high cost of production correlated with decreased productivity, and because rape is grown in dense rows that do not enable the mechanical works. The paper presents data on the management of the noxious weeds *Veronica persica* (alien), *Veronica hederifolia* (native), and *Galium aparine* (native) by integrating agro-technical measures with products for plant protection.

**Key words:** Agro-technical measures, herbicides, noxious weeds, rape crops, weed management

## Introduction

In recent years, the importance of winter rape (*Brassica napus* L.) has increased considerably because it provides the raw material for industry, representing a renewable alternative to fossil energy sources (HANEGRAAF et al. 1998, PETERSSON et al. 2007). One of the main problems is the weeds in oilseed rape crops. The spectrum of these weeds has a specific characteristic and is a subject to constant change. These developments are all more apparent if they are studied for a long time and on large agricultural areas, allowing conclusions to be drawn regarding the emergence of new species of weeds or changes in the importance of the already existing weeds (BERCA 2004).

Many studies, observations and conclusions were presented by many researchers (Şarpe et al. 1976, BERCA 1996, 2004, BUDOI & PENESCU 1996, ELLENBERG 1998, HANEGRAAF et al. 1998, CHIRILĂ 2001, LOSOSOVĂ et al. 2004) showing that, as a

general rule, the number of weed species decreases, so as the number of weeds/m<sup>2</sup>, but that new species appear or the importance of the already existing ones changes. Some weed species classified as ‘ephemeral’, such as the alien *Veronica persica* Poir., and the native *Veronica hederifolia* L. and *Galium aparine* L., became noxious, dominant in the rape crops. The species of *Veronica* L. have become more damaging, having a much higher density in rape crops (DIHORU 2004, GRADILĂ et al. 2016). In this context, the control of these aggressive species from rape crops is required due to the high cost of production (MCKENDRY 2002) correlated with decreased productivity, and because rape is grown in dense rows that do not enable the mechanical works. Pre-emergent herbicides in rape crops are an important link for obtaining stable crops. The rape forms 50% of its production since autumn (MORAR 2010), and the crop is demanding regarding the

technology applied in this season, because the plant does not tolerate high density of weeds (PRIMOT et al. 2006). Some weed species (e.g. from the genera *Amaranthus* L., *Chenopodium* L. and *Solanum* L.) do not survive at low temperatures, but the damage is already present before the winter arrival by reducing the culture density (HANZLIK & GEROWIT 2011). There are many weed species that can overwinter and fructify and reach maturity in next spring: *Anthemis arvensis* L., *Capsella bursa-pastoris* (L.) Medik., *Matricaria inodora* L., *Papaver rhoeas* L., *Thlaspi arvense* L. etc. (PEKRUN et al. 1998, HARAMOTO & GALLANDT 2004).

In this context, this paper provides results on the management of the noxious weeds *Veronica persica*, *V. hederifolia*, and *Galium aparine* by integrating agro-technical measures with products for plant protection.

## Materials and Methods

The experimental field was located in southern Romania, at the Didactic farm Moara Domneasca – USAMV Bucharest, in randomised blocks, four repetitions with a surface plot of 24 m<sup>2</sup>, on a reddish-brown soil with a pH of 7.5 and an organic matter content of 2.5%.

The following agro-technical measures were applied:

- practice corresponding to the crop rotations;
- rational choice of the preceding plants;
- deep plowing to 30 cm depth in summer;
- seedbed preparation through two passes with disc harrow followed by milling;
- high-quality hybrids; and
- sowing in optimum time in sowing densities corresponding to the technology of cultivation.

The herbicides metazachlor (400 g/L) and dimetachlor (500 g/L) + clomazone (40 g/L) were applied at 2 L/ha, at pre-emergence.

The weeds control, expressed in efficacy (%),

was assessed on the 14th, 28th and 42nd days of application, and at spring regrowth, in number/m<sup>2</sup> and % control, compared to the untreated plot. Also, observations on the weeds in the experimental plots before treatment and selectivity were performed on each date of the efficacy assessment. Determination of the segetal flora was implemented on a square meter using a metric frame. The statistical treatment of the results was based on the analysis with ARM-9 software (P=.05, Student – Newman – Keuls).

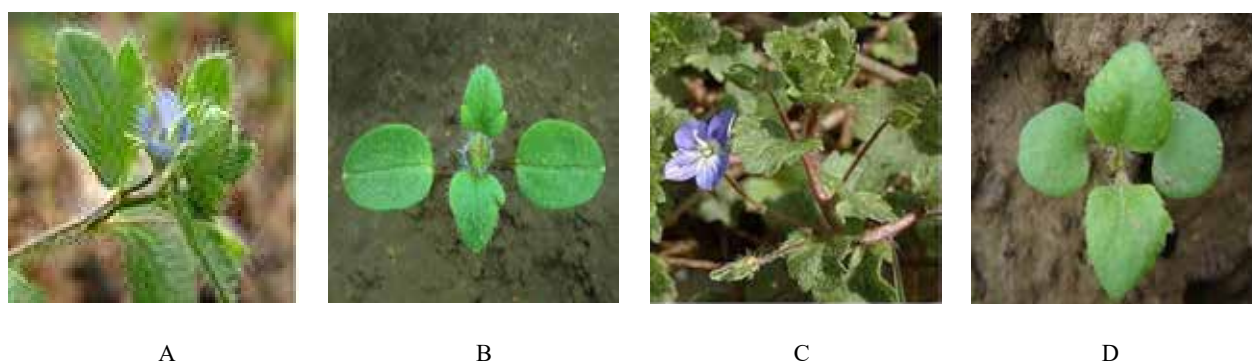
## Results and Discussion

Rape crop is sensitive to weed infestation in the early stages (CHIRILĂ 2001). The predominant weeds present before treatment were: the alien species *Veronica persica*, and the native species *V. hederifolia* and *Galium aparine* (Table 1). There were also other less important species: *Echinochloa crus-galli* (L.) P. Beauv., *Setaria* spp., *Matricaria* spp., *Chenopodium album* L., *Convolvulus arvensis* L., and *Lamium purpureum* L. The agro-technical measures applied had the effect of reducing the biological reserve of weed seeds but did not stop the growth and the development of the noxious weeds. Crop rotation is the best agro-technical method for the weed control because it reduces the weed density, reduces the reserve of weed seeds in the soil, reduces or eliminates specific weed infestation and avoids the appearance of the resistance phenomena.

Some species in the genus *Veronica* are considered noxious weeds, the most important of which being two species: the native *V. hederifolia* subsp. *hederifolia* and the invasive alien *V. persica* (DIHORU 2004). These two species are difficult to distinguish in the phase of cotyledons. *Veronica hederifolia* has large cotyledons, elliptical or oval, slightly narrowed towards the tip, petiole with numerous long hairs or glabrous, whereas *V. persica*

**Table 1.** Spectrum of weeds before treatment

Treatment	Weeds					
	<i>Veronica persica</i>		<i>Veronica hederifolia</i>		<i>Galium aparine</i>	
	Density		Density		Density	
	plants/m <sup>2</sup>	ground (%)	plants/m <sup>2</sup>	ground (%)	plants/m <sup>2</sup>	ground (%)
Untreated	16.0	18.0	20.3	24.5	7.3	8.8
Metzachlor 2 L/ha	15.3	17.0	16.5	19.5	3.5	4.0
Dimetachlor + clomazone 2 L/ha	15.5	16.5	15.8	18.8	3.5	4.3
LSD (P=.05) (Least Significant Difference)	5.54	-	5.24	-	3.52	-



**Fig. 1.** *Veronica hederifolia* (A and B) and *V. persica* (C and D)

**Table 2.** The efficacy of herbicides in control of noxious weeds in rape crop on the 14th day of treatment

Treatment	Weeds					
	<i>Veronica persica</i>		<i>Veronica hederifolia</i>		<i>Galium aparine</i>	
	Density (plants/m <sup>2</sup> )	Efficacy (%)	Density (plants/m <sup>2</sup> )	Efficacy (%)	Density (plants/m <sup>2</sup> )	Efficacy (%)
Untreated	20.5	0.0	17.0	0.0	14.0	0.0
Metzachlor 2 L/ha	4.0	80.0	4.0	78.0	3.0	79.0
Dimetachlor + clomazone 2 L/ha	2.5	88.0	2.5	86.0	1.0	89.0
LSD (P=.05) (Least Significant Difference)	3.28	-	3.56	-	1.57	-



**Fig. 2.** The effectiveness of herbicides on rape crop on the 14th day of treatment: A – an untreated plot; B – a plot treated with dimetachlor + clomazone; C – a plot treated with metazachlor

has spatula shaped cotyledons, simple, elliptical or oval, regularly dentate (Fig. 1).

In these conditions of weed infestation, the herbicides applied in pre-emergence had a good efficacy in control of the weeds present in the rape crop on the 14th day of treatment (Table 2).

On the pre-emergence application, the metazachlor herbicide is absorbed by the germinating weed seeds and as a consequence the new weed plants are destroyed immediately after emergence. Good seedbed preparation and sufficient soil moisture favours taking over the active substance and increases

effectiveness. If the soil is dry, the effect is initiated after the first rain. On the 14th day of treatment, the metazachlor had a satisfactory efficacy in the control of *V. persica*, *V. hederifolia* and *G. aparine*, while the herbicide with two active substances (dimetachlor + clomazone) provided a good control of the annual weeds. Subsequent observations (on the 28th and 42nd days of treatment), did not confirm the good results of herbicides applied at the pre-emergence (Table 3 and Table 4). On the 42nd day of treatment, the metazachlor and dimetachlor + clomazone had a low efficacy in the control of *V. persica*, *V. hederifolia* and *G. aparine*.

**Table 3.** The efficacy of herbicides in control of noxious weeds in rape crop on the 28th day of treatment

Treatment	Weeds					
	<i>Veronica persica</i>		<i>Veronica hederifolia</i>		<i>Galium aparine</i>	
	Density (plants/m <sup>2</sup> )	Efficacy (%)	Density (plants/m <sup>2</sup> )	Efficacy (%)	Density (plants/m <sup>2</sup> )	Efficacy (%)
Untreated	34.5	0.0	26.0	0.0	16.5	0.0
Metzachlor 2 l/ha	18.5	47.0	14.0	46.0	4.5	83.3
Dimetachlor + clomazone 2 l/ha	13.5	60.8	9.5	93.4	3.0	92.3
LSD (P=.05) (Least Significant Difference)	3.50	-	2.13	-	1.59	-

**Table 4.** The efficacy of herbicides in control of noxious weeds in rape crop on the 42nd day of treatment

Treatment	Weeds					
	<i>Veronica persica</i>		<i>Veronica hederifolia</i>		<i>Galium aparine</i>	
	Density (plants/m <sup>2</sup> )	Efficacy (%)	Density (plants/m <sup>2</sup> )	Efficacy (%)	Density (plants/m <sup>2</sup> )	Efficacy (%)
Untreated	42.0	0.0	34.0	0.0	22.0	0.0
Metzachlor 2 l/ha	26.0	38.0	19.5	43.0	12.0	45.0
Dimetachlor + Clomazone 2 l/ha	22.0	47.0	17.0	50.0	8.0	64.0
LSD (P=.05) (Least Significant Difference)	4.75	-	3.83	-	3.22	-

**Table 5.** Weeds present in the experimental plots at spring regrowth

Treatment	Weeds						
	<i>E. crusgalli</i>	<i>Setaria</i> spp.	<i>Matricaria</i> spp.	<i>Veronica</i> spp.	<i>G. aparine</i>	<i>L. purpureum</i>	<i>C. bursa-pastoris</i>
	Density (plants/m <sup>2</sup> )						
Untreated	11.5	14.0	7.8	42.0	9.3	9.8	4.0
Metzachlor	11.8	15.8	3.0	9.5	3.5	4.3	1.8
Dimetachlor + Clomazone	9.8	13.5	2.0	7.5	2.8	3.5	1.3
LSD (P=.05) (Least Significant Difference)	4.04	4.75	1.54	4.02	1.61	1.69	1.08

No phytotoxicity symptoms were registered in the experimental plots. Neither symptoms such as chlorosis, necrosis and deformation of leaves, nor reduction of the plants height, distortion and delay of the anthesis were observed.

On the 14th day of application in the treated plots, the rape plants were more vigorous and with a higher density compared with the untreated plots (Fig. 2).

The density of weeds per square meter was determined also in the spring season when the vegetation started. Besides the weeds present in autumn, a new species of weed emerged, namely *Capsella bursa-pastoris*, but the weedy species of *Veronica* continued to be the dominant species (Table 5).

## Conclusions

The degree of weed infestation in the rape crop was very high, the weed species present were: the alien *V. persica*, and the native *V. hederifolia* and *G. aparine*. The dominant species belonged to genus *Veronica*. The number of weeds per square meter of *V. persica* and *V. hederifolia* on the 42nd day of treatment exceeded 70 plants/m<sup>2</sup>.

The agro-technical measures applied had the effect of reducing the biological reserve of weed seeds but did not stop the growth and the reproduction of the noxious weeds. The herbicides applied in pre-emergence had a good efficacy in the control of the annual weeds in the rape crop on the 14th day of treatment. Subsequent

observations (on the 28th and 42nd days of treatment) did not confirm the good results of herbicides applied in pre-emergence for control of the weedy species present in rape crops, with the density of weeds per square meter being high. No phytotoxicity symptoms were registered in the experimental plot.

The control of the noxious weedy species in the rape crop is required due to the high cost of production correlated with decreased productivity, and because rape is grown in dense rows that do not enable the mechanical works.

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