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Control of weeds in Clearfield® oilseed rape (*Brassica napus* L.)

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Abstract

A field trial with Clearfield® oilseed rape hybrid PX 111 CL was carried out during 2016 and 2017. The aim of the research is to study the control of omitted weeds. The efficacy of the herbicides Cleranda® SC + Dash® and Lontrel™ 72 SG. On the 14th day after treating, unsatisfactory efficacy was found for all variants with Cleranda® SC + Dash®. Good efficacy (50 to 70%) was recorded only against *S. arvensis* L. On the 28th day after the treatments with Cleranda® SC + Dash® + Lontrel™ 72 SG low insignificant efficacy against *L. rigidum* Gaudin, *A. fatua* L. and *F. pratensis* Huds., as well *A. githago* L. and the volunteer *C. sativum* L. was observed. On the 56th day for the higher rate of Cleranda® SC + Dash® the efficacy against the weeds was higher. The highest oilseed rape seed yield was achieved for Cleranda® SC + Dash® + Lontrel™ 72 SG treatments. The application of Cleranda® SC at more developed stages did not control fully the existing weeds. When the product was applied at higher rates, the recoreded efficacy against the broadleaf weeds was more severe.

Key words: oilseed rape, weeds, herbicides, efficacy

Introduction

For obtaining high yields and production quality precise plant protection should be performed. The control of the weeds is among the main factors influencing the obtaining of high yieds (Kalinova et al., 2012; Dimitrova et al., 2014a; Dimitrova et al., 2014b). In the regions where oilseed rape is grown there is difference between the weed species. At the trial filed of the Agricultural University of Plovdiv, Bulgaria dominant weed species are *Sinapis arvensis* L., *Raphanus raphanistrum* L., *Anthemis arvensis* L. and *Papaver rhoeas* L. (Tityanov et al., 2009). The most distributed weeds in Hubei, China are *Alopecurus aequalis* Sobol, *Veronica persica* Poir., *Malachium aquaticum* (L.) Fr., *Beckmannia syzigachne* (Steud.) Fernald, *Galium aparine* L., *Poa annua* L., *Alopecurus japonicus* Steud (WenDa et al., 2008). The weed infestation in winter oilseed rape in Germany is presented mostly by *Matricaria* spp., *Viola arvensis* Murray, *Capsella bursa-pastoris* (L.) Med., *Stellaria media* (L.) Vill., *Thlaspi arvense* L., etc. The most distributed are *P. annua* and *Apera spica-venti* (L.) PB. (Frisen et al., 2003; Hanzlik et al., 2010; Harker et al. 2003; Senior and Dale, 2002).

The choice of herbicide depends on whether oilseed rape hybrid is conventional or Clearfield®. The grown oilseed rape hybrids by this technology are resistant to the herbicide Imazamox. Against *S. arvensis* and *R. raphanistrum* Cleranda® SC at rate of 1500 - 2000 ml/ha + Dash® could be applied (Ádámszki et al., 2010; Delchev, 2014). The successful weed control also depends on the application time, as well as the phenophase of the weeds and the crop (Franek, 1994; Freeman and Lutman, 2004).

The aim of the trial is to study the control of omitted weeds at Clearfield® oilseed rape.

Material and methods

The experiment is carried out at the experimental base of the department of Agriculture and Herbology of the Agricultural University of Plovdiv, Bulgaria. The trial was coducted during 2016 and 2017 by the randomised block design with 3 replications. The size of the harvesting plot was 20 m². The grown oilseed rape hybrid was PX 111 CL. The predecessor crop was winter wheat. On the trial field deep ploughing, disc horrowing and two cultivations before sowing were done. Basic combine fertilization with 250 kg ha^{-1} NPK 15:15:15 and spring dressing with 200 kg ha^{-1} NH_4NO_3 was performed.

The herbicides were applied at phenophase 6^{th} – 8^{th} leaf of the crop (BBCH 16-18). The variants of the trial are shown on Table 1. The efficacy of the studied herbicides was recorded by the 10 score visual scale of EWRS (European Weed Research Society) on the 14^{th}, 28^{th} and 56^{th} day after application. The selectivity by the 9 score scale of EWRS was eavaluated (at score 0 there are no dammages on the crop, and at score 9 the crop is competely destroyed). The weed infestation on the trial was presented by *A. arvensis* L., *P. rhoeas* L., *G. aparine* L., *Consolida regalis* S.F. Gray, *Agrostemma githago* L., *S. arvensis*, *Lolium rigidum* Gaudin, *Avena fatua* L., *Festuca pratensis* Huds. and the volunteer *Coriandrum sativum* L.

Table 1. Variants of the trial

Var.	Treatments	Active substances	Rates ml/g ha^{-1}
1.	Untreated control	-	-
2.	Cleranda® SC + Dash®	17.5 g/l Imazamox + 375 g/l Metazachlor	2000+1000
3.	Cleranda® SC + Dash®	17.5 g/l Imazamox + 375 g/l Metazachlor	1500+750
4.	Cleranda® SC + Dash® + Lontrel™ 72 SG	17.5 g/l Imazamox + 375 g/l Metazachlor 720 g/kg Clopiralid	1500+750 +100
5.	Cleranda® SC + Dash® + Lontrel™ 72 SG	17.5 g/l Imazamox + 375 g/l Metazachlor 720 g/kg Clopiralid	1500+750 +150
6.	Cleranda® SC + Dash® + Lontrel™ 72 SG	17.5 g/l Imazamox + 375 g/l Metazachlor 720 g/kg Clopiralid	1500+750 +200
7.	Lontrel™ 72 SG	720 g/kg Clopiralid	200

Results and discussion

The recorded data on the 14^{th} day after treatments showed that the application of Cleranda® SC + Dash® at more developed stages did not control fully the existing weeds. When the product is applied at higher rates the efficacy against the broadleaf weeds was more obvious. The combined application of Cleranda® SC + Dash® + Lontrel™ 72 SG has excellent broadleaf weed control, but did not show good efficacy against the grass weeds *L. rigidum* and *A. fatua* that were in phenophase tillering (Table 2.)

Table 2. Efficacy of the studied herbicides on the 14^{th} day after application (%)

Var. / Weeds	2016							2017						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
A. arvensis	-	15	10	25	50	65	70	-	10	10	35	65	70	65
P. rhoeas	-	25	20	35	50	60	50	-	30	20	40	45	65	35
G. aparine	-	10	5	25	45	60	65	-	10	10	30	50	60	60
C. regalis	-	30	20	30	35	40	45	-	30	25	30	40	45	50
A. githago	-	10	5	15	20	30	30	-	10	10	20	20	45	20
S. arvensis	-	70	50	60	60	70	0	-	65	45	70	75	65	15
L. rigidum	-	30	15	15	35	35	0	-	30	10	10	35	35	0
A. fatua	-	0	0	0	0	0	0	-	5	5	5	0	0	0
F. pratensis	-	20	10	10	20	20	0	-	30	10	10	20	20	0
C. sativum	-	15	5	20	25	30	20	-	10	5	25	30	35	10

In 2016 unsatisfactory efficacy at all variants where Cleranda® SC + Dash® were applied was recorded. Good efficacy (50 to 70%) only against *S. arvensis* was recorded (Table 2). The efficacy against *A. fatua* was 0%. The herbicide Lontrel™ 72 SG showed higher efficacy against *G. aparine* (65-70%). Against the other broadleaf weeds in the trial the efficacy was very low. The herbicide did not have any efficacy against the grass weeds and *S. arvensis*. The obtained results from the second experimental year corresponded to the first year of the study. The differences of the efficacy between the years were insignificant.

Table 3. Efficacy of the studied herbicides on the 28th day after application (%)

Var. / Weeds	2016							2017						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
A. arvensis	-	45	40	55	60	75	85	-	40	20	60	65	85	85
P. rhoeas	-	60	50	50	60	60	50	-	60	55	60	50	65	45
G. aparine	-	60	50	50	65	70	75	-	70	65	55	65	75	75
C. regalis	-	60	45	50	60	65	45	-	65	60	60	50	60	50
A. githago	-	65	55	25	30	40	30	-	55	45	35	40	45	25
S. arvensis	-	90	85	90	90	95	0	-	95	95	85	95	95	15
L. rigidum	-	55	50	55	55	55	0	-	55	50	50	65	60	0
A. fatua	-	10	5	10	10	10	0	-	10	10	10	5	5	0
F. pratensis	-	55	45	55	55	55	0	-	55	55	60	60	60	0
C. sativum	-	25	20	30	35	40	20	-	20	15	30	40	45	25

The data from the evaluation on the 28th day after the treatments showed higher efficacy results at variants 2, 3, 4, 5 and 6. In comparison with the results from the 14th day after treatments, better weed control was achieved at the higher herbicide rates (Table 3). The efficacy of Cleranda® SC + Dash® + Lontrel™ 72 SG against *L. rigidum*, *A. fatua* and *F. pratensis*, as well *A. githago* and the volunteer *C. sativum* was insignificant.

Table 4. Efficacy of the studied herbicides on the 56th day after application (%)

Var. / Weeds	2016							2017						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
A. arvensis	-	55	30	90	98	98	98	-	40	25	95	95	98	100
P. rhoeas	-	90	75	65	65	60	50	-	90	75	65	50	65	50
G. aparine	-	85	70	90	90	98	90	-	70	70	85	90	95	95
C. regalis	-	80	75	90	90	95	50	-	85	85	85	95	95	50
A. githago	-	90	85	90	95	95	35	-	85	75	80	90	90	40
S. arvensis	-	100	100	98	100	100	10	-	100	98	98	98	98	20
L. rigidum	-	85	60	75	60	60	0	-	85	60	65	70	65	0
A. fatua	-	35	30	50	35	35	0	-	25	20	35	45	30	0
F. pratensis	-	85	80	75	85	85	0	-	90	75	80	85	90	0
C. sativum	-	60	50	80	90	95	75	-	60	55	70	85	85	70

In comparison with the lowest rates of the alone application of Cleranda® SC + Dash®, at the higher rate of 2000 ml ha^{-1} the efficacy against the weeds on the 56th day after the application was higher (Table 4.). The alone application of Lontrel™ 72 SG at variant 7 showed very low efficacy against the difficult to control broadleaf weeds *P. rhoeas*, *S. arvensis*, *C. regalis* and *A. githago*.

At the end of the vegetation the percentage ratio between the weeds' and crop' biomass was recorded. The obtained results showed that "Nature does not tolerate empty space" i.e. at the variants with low herbicide efficacy, the weeds became dominant. At these variants pronounced compensatory processes were also observed and were in favor of the more resistant and slightly sensitive weeds. At variants 1, 2, 3, 4 and 7 the crop occupied a threateningly small area in comparison with the weeds (Figure 1).

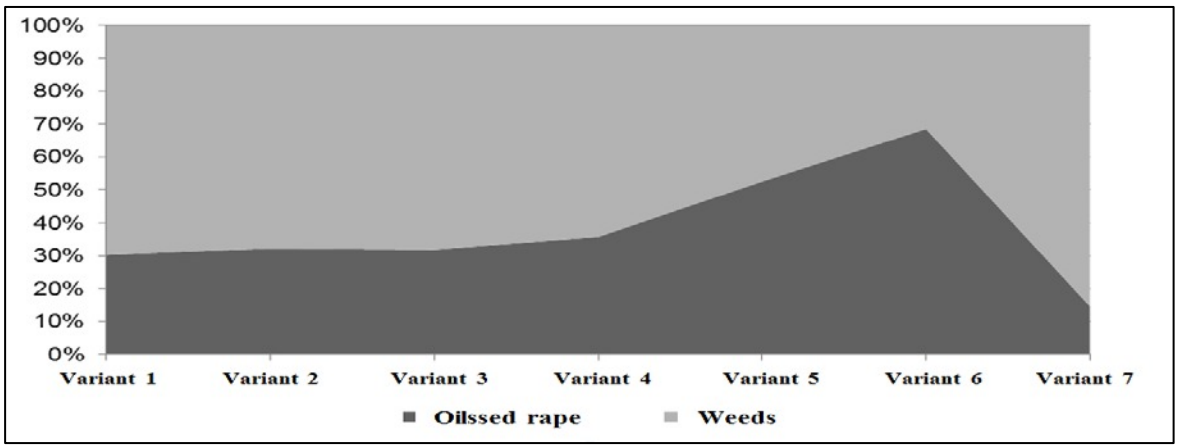

Figure 1. Average weeds to crop biomass ratio for 2016 and 2017 (%)

The results for the productivity showed that during the two experimental years after the combine application of Cleranda® SC + Dash® + Lontrel™ 72 SG at variants 4, 5 and 6 the highest oilseed rape seed yield was achieved (1.98, 2.00 and 2.04 tha^{-1} respectively) (Figure 2). The unsuccessful weed control at the winter oilseed rape can lead to total yield losses (Pacanoski, 2014). That corresponds with the obtained data from variants 2 and 3 where the yields are approximately 50% lower in comparison with the previous three variants – 1.06 and 0.99 t ha^{-1} respectively. The lowest yields among the treated variants were reported at variant 7 – 0.63 t ha^{-1}. The untreated control had the lowest yields – 0.47 t ha^{-1}.

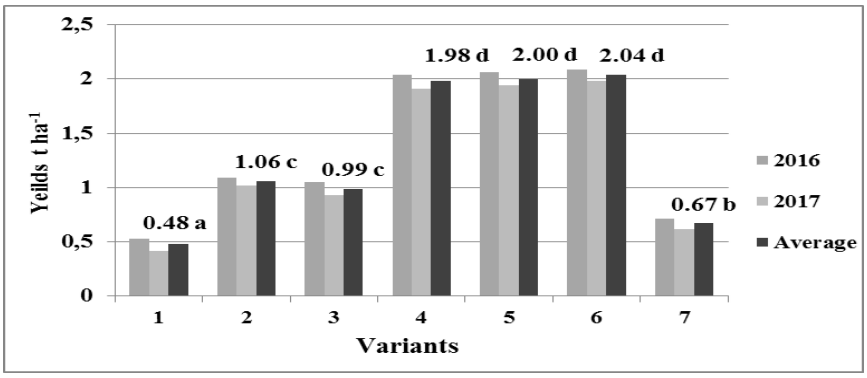

Figure 2. Yield of oilseed rape seeds (t ha^{-1})

Columns with different letters are with proven difference by Duncan's multiple range test ($p < 0.05$).

Conclusions

The application of Cleranda® SC + Dash® at rate of 2000 + 1000 ml ha^{-1} showed higher efficacy in comparison with Cleranda® SC + Dash® at rate of 1500 + 750 ml ha^{-1} against *P. rhoeas* and *G. aparine*.

The alone application of Lontrel™ 72 SG at rate of 200 g ha^{-1} showed higher herbicide effect against *A. arvensis* and *G. aparine*. The efficacy from this treatment was 0% or insignificant against *P. rhoeas*, *C. regalis*, *A. githago*, *A. arvensis*, *A. Fatua*, *L. rigidum* and *F. Pratensis*.

For the yield, the rates of 1500 ml ha^{-1} + 750 ml ha^{-1} + 200 g ha^{-1} for the tank mixture of Cleranda® SC + Dash® + Lontrel™ 72 SG led to obtaining of the highest seed yield – 2.04 t ha^{-1}.

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