production problem of excessive fertilizer loss, especially excessive nitrogen fertilizer loss, is also very prominent. The habitual nitrogen application rate of farmers in this study area is up to 360 kg to 450 kg per ha. The yield is between the range of 10500 kg to11250 kg per ha, and the demand for nitrogen is aroung 255 kg per ha. This research has proved that the reasonable nitrogen reduction matched with water-saving cultivation will be the right way for solve the problem in rice production and is of practical significance.

CONCLUSIONS

Excess nitrogen and water influenced negatively the productive tillers. Whereas proper nitrogen rate under OAWD irrigation enhanced the grains number of per panicle, added filled grains percentage, increased grain yield and benefit. Compared with farmers' traditional practice water and nitrogen management, the right allocation of nitrogen fertilizer and irrigation significantly decreased the unproductive tillers, significantly increased the number of population panicles by 5.37%, increased the grains number per panicle by 1.97%, signifycantly increased the filled grain percentage by 6.88%, strength the productive tillers percentage by 18.81%, increased the grain yield 8.72% and benefit by 4146.15 yuan per ha. In addition, it was of an decrease of nitrogen dose by 30%, saving fertilizer cost by 261.36 yuan ha^{-1} of fertilizer, and a saving of irrigation water by 21.7%.

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WEED CONTROL IN OILSEED RAPE (*Brassica napus* L.)

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Abstract

During the period of 2017-2019 a field trial with Clearfield oilseed rape (hybrid PT 200 CL) on the experimental field of the Agricultural University of Plovdiv, Bulgaria was conducted. The experiment included the application of imazamox - containing herbicide products - Cleranda SC, Cleravis SC, Cleravo SC and Clentiga SC together with the adjuvant Dash. The herbicide products were applied at BBCH 11-12 (1st-2nd true leaf) of the crop. The efficacy of the studied herbicides was evaluated by the 10-score scale of EWRS. The highest efficacy against Anthemis arvensis L., Papaver rhoeas L., Galium aparine L., Capsella bursa-pastoris (L.) Medik, Lolium temulentum L., Avena fatua L. and the volunteer Triticum aestivum L. after the application of Cleranda SC + Dash in rates of 2.00+1.00 l/ha, followed by Cleranda SC + Dash in rates of 1.40+1.00 l/ha and Cleravis SC+ Dash in rates of 2.00+1.00 l/ha was reported. For these treatments, the values for plant height, number of brunches per plant, silique number per plant, length of the central silique and yield were the highest.

Key words: *oilseed rape, weeds, herbicides, efficacy, yield.*

INTRODUCTION

One of the main problems accompanying the agricultural production is the weeds. The weeds occur all over agricultural an non cultivated areas every year and are causing great damage to crops, reducing yields and the quality of the production (Kalinova et al., 2012; Tityanov et al., 2010; Tonev, 2000a). Furthermore weeds negatively affect the formation of the yield of agricultural crops as well the shortage of nutrients, which is often also caused by the weed infestation (Manolov and Neshev, 2017; Neshev and Manolov, 2016; Kostadinova et al., 2015; Manolov et al., 2015; Neshev and Manolov, 2014; Goranovska et al., 2014; Neshev et al., 2014; Karimi et al., 2010; Yanchev et al., 2002).

For obtaining optimal yield from the oilseed rape (*Brassica napus* L.) it is necessary to accomplish timely and precise weed control (Tonev et al., 2019; Pavlovic´ et al., 2015; Dimitrova et al., 2014a; Hamzei et al., 2010; Maataoui et al., 2003).

Very important part for the efficient weed management in oilseed rape is determination of their species composition (Tonev, 2000b). There are dynamics in the weed species composition depending on the latitude in which oilseed rape is grown. On the experimental field of the Agricultural University of Plovdiv, Bulgaria dominating weeds in the oilseed rape are *Sinapis arvensis* L., *Raphanus raphanistrum* L., *Anthemis arvensis* L. and *Papaver rhoeas* L. (Tityanov et al., 2009a). These weeds have been reported in various studies by other researchers in Bulgaria (Mitkov, 2014; Mitkov et al., 2009; Delibaltova et al., 2009; Tityanov et al., 2009b; Atanasova and Zarkov, 2005; Atanasova, 2000).

Studies on oilseed rape weeding abroad show the following. The most distributed weeds in Hubey province, China are: *Alopecurus aequalis* Sobol., *Veronica persica* Poir., *Polypogon fugax* Nees ex Steudel, *Malachium aquaticum* (L.) Fr., *Beckmannia syzigachne* (Steud.) Fernald , *Galium aparine* var. *tenerum*, *Poa annua* L., *Alopecurus japonicus* (Zhu Wen Da et al. 2008).

In Gorgan, Golestan Province, Iran the most commonly found weed species are *Phalaris minor* Retz., *Melilotus officinalis* (L.) Pall., *Rapistrum rugosum* (L.) All., *Avena sterilis* subsp. *ludoviciana*, *Veronica persica* Poir. and *Sinapis arvensis* L. (Ataie et al., 2018).

The weed infestation in Germany of oilseed rape is presented mainly by *Matricaria* spp., *Viola arvensis* Murray, *Capsella bursa-pastoris* (L.) Medik., *Stellaria media* (L.) Vill., *Thlaspi arvense* L., *Poa annua* L., *Apera spica-venti*

(L.) P. Beauv., etc. (Hanzlik et al., 2010). Hanzlik and Gerowitt (2012) reported that in the areas with intensive oilseed rape growing the infestation with *Geranium* spp., *Sisymbrium* spp. and *Anchusa arvensis* (L.) M. Bieb. has increased.

In order to protect the environment and human health, the efficient use of material and energy resources in the cultivation of oilseed rape for the control of weeds, non-chemical methods and biological products are applied (Marcinkevičiene et al., 2017; Velička et al., 2016; Marcinkevičiene et al., 2015; Velička et al., 2015).

Organic oilseed rape cultivation is not always efficient and easily applicable. That is why in the practice for unwanted weeds control the application of synthetic herbicides is mainly used. The application of herbicides to rapeseed is one of the most important and responsible points in its agricultural technology (Frisen et al., 2003; Heard et al., 2003; Harker et al., 2003; Senior and Dale, 2002; Tonev et al., 2000a). The successful weed control in oilseed rape depends on the application time of the herbicide product, i.e. from the optimal stages of the weeds and the crop. The soil or early-vegetation herbicide application is more effective in comparison to the traditional spring treatment. By these treatments the oilseed rape crop is released on time from the weed concurrence for water, light, nutrients, etc. (Freeman and Lutman, 2004; Franek, 1994).

The choice of herbicide depends on that if the grown oilseed rape hybrid is selected to be grown by the conventional or Clearfield® technology. In dependence of the weed species at the moment of application in the conventional oilseed rape production a great number of herbicides had been studied: propisochlor, trifluralin, haloxyfop-p-methyl; metazachlor; bifenox; clomazone, napropamide, dimethachlor; alachlor; isoxaben; halauxifen-methyl, picloram; propyzamide, aminopyralid; clopyralid; ethametsulfuron-methyl; clethodim and propaquizafop (Bardsley et al., 2018; Lourdet and Rougerie, 2016; Koleva-Valkova et al., 2016; Zotz et al., 2016; Koprivlenski et al., 2015; Dimitrova et al., 2014b; Dimitrova et al., 2014c; Werner, 2014; Duroueix et al., 2013; Lourdet, 2013; Drobny and Schlang, 2012; Stormonth et al., 2012; Bijanzadeh et al., 2010; Majchrzak and Jarosz, 2010; Tityanov et al., 2009a; Majchrzak et al., 2008; Konstantinovic´, 2007; Franek and Rola, 2002a; Franek and Rola, 2002b; Franek and Rola, 2001).

At the conventional oilseed rape hybrids some of the registered selective herbicides have no satisfactory efficacy against the cruciferous weeds like *Sinapis arvensis* L., *Raphanus raphanistrum* L. and *Descurainia sophia* (L.) Plantl. An alternative for solving this problem is the Clearfield® technology at oilseed rape (Pfenning et al., 2012). In this technology the oilseed rape hybrids are IMI-tolerant (Imidazolinone-tolerant). At these hybrids Cleranda SC (375 g/l metazachlor + 17.5 g/l imazamox) in rate of 1.50-2.00 l/ha + the adjuvant Dash can be applied (Tonev and Mitkov, 2015; Schönhammer et al., 2010; Ádámszki et al., 2010).

In the Clearfield® oilseed rape accept Cleranda SC, the herbicide products Clentiga (250 g/l quinmerac and 12.5 g/l imazamox) + adjuvant Dash in rates of 1.0 l/ha + 1.0 l/ha in autumn (BBCH 10-18) and in spring (BBCH 30-50) can be applied. The product Vantiga D is combined product with three active substances - metazachlor, quinmerac and imazamox. The herbicide is also applied with the adjuvant Dash®. Although the permitted period of use of the product is very long (BBCH 10-18) it is mainly used relatively early - as soon as most of the important weeds appear (Schönhammer and Freitag, 2014).

In comparison with Vantiga D, Clentiga has slightly less activity spectrum and less pronounced soil activity due to the lack of metazachlor, it provides greater flexibility in the choice of application dates and combinations with soil and foliar herbicides.

If there is high weed infestation and difficult soil conditions Schönhammer and Freitag (2014) recommend sequential application Butisan Kombi (metazachlor + dimethenamid-P) before or very early after germination of the oilseed rape followed by application Clentiga.

Schönhammer et al. (2018) reported that the application of Clentiga + Dash in rates of 1.0 l/ha + 1.0 i/ha in combination Runway in rate of 0.2 l/ha showed excellent efficacy against all cruciferous weed species in the study.

Under specific conditions, e.g. high infestation with blackgrass or cranesbill, Clearfield-Clentiga Runway Pack can also be used in spraying systems together with metazachlor, dimethenamid-P or propyzamide-containing herbicides. The aim of the current reaserch is to study the possibilities of chemical weed control in oilseed rape (*Brassica napus* L.) at the agroecological conditions of Plovdiv district, Bulgaria.

MATERIALS AND METHODS

During the vegetation periods of 2017/2018 and 2018/2019 a field trial with the Clearfield® oilseed rape hybrid PT 200 CL on the experimental field of the Base for Training and implementation at the Agricultural University of Plovdiv, Bulgaria was conducted. The study was performed by the Split Plot Method, in 4 replication, with size of the trial plot 20 m².

The experiment included the following tretments: 1. Untreated control; 2. Cleranda SC (375 g/l metazachlor + 17.5 g/l imazamox) + Dash (adjuvant) - 1.40 + 1.00 l/ha; 3. Cleranda SC + Dash - 2.00 + 1.00 l/ha; 4. Cleravis SC (375 g/l metazachlor + 100 g/l quinmerac + 17.5 g/l imazamox) + Dash - 1.40 + 1.00 l/ha; 5. Cleravis SC + Dash - 2.00 + 1.00 l/ha; 6. Cleravo SC (35 g/l imazamox + 250 g/l quinmerac) + Dash - 0.70 + 1.00 l/ha; 7. Cleravo SC + Dash 1.00 + 1.00 l/ha; 8. Clentiga SC (12.5 g/l imazamox + 250 g/l quinmerac) + Dash - 0.60 + 1.00 l/ha; 9. Clentiga SC + Dash - 1.00 + 1.00 l/ha.

During both experimental years a predecessor of the oilseed rape was winter wheat. On the whole experimental field the following measures were performed: fertilization with 300 kg/ha with N:P:K = 15:15:15, followed by deep ploughing on 25 cm of depth. Before the sowing of the oilseed rape one disking on the depth of 15 cm and two harrowing operations of a depth of 8 cm was done. In spring, dressing with 250 kg/ha with ammonium nitrate was applied.

On the experimental field, before the sowing of the crop, artificial infestation with seed of *Anthemis arvensis* L., *Papaver rhoeas* L., *Galium aparine* L., *Sinapis arvensis* L., *Lamium purpureum* L., *Capsella bursa-pastoris* (L.) Medik, *Lolium temulentum* L., *Avena fatua* L., as well as seeds from winter wheat was accomplished.

The sowing of the oilseed rape in 2017 is done on the 22.09., and on the 18.09., in 2018.

The herbicide application was performed in 1st – 2nd true leaf stage of the crop (BBCH 11-12) with size of the working solution - 200 l/ha.

The biological efficacy was reported on 14th, 28th and 56th day after the herbicide application. The efficacy against the weeds was evaluated by the 10-score visual scale of EWRS.

The efficacy results were compared with the untreated control.

The selectivity of the studied herbicides was evaluated on the 7th, 14th, 28th and 56th day after the herbicide application by the 9-score visual scale of EWRS (at score 0 - there is no damage on the crop, and at score 9 there is complete death of the crop).

The biological yield as well as the following biometric indicators have been identified and analyzed: plant height, number of brunches per plant, silique number per plant, length of the central silique.

Reported biometric indicators were processed with the software package SPSS 17 - module two-factor analysis of variance for Windows 8. The difference between the evaluated treatments was statistically analysed by ONE WAY ANOVA.

RESULTS AND DISCUSSIONS

On the experimental field of the Base for Training and Implementation at the Agricultural University of Plovdiv in both experimental years only annual weed species from two biological groups were reported. From the group of winter-spring weeds the three dicotyledonous weeds were found: *Anthemis arvensis* L., *Papaver rhoeas* L., *Capsella bursa-pastoris* (L.) Medik. The monocotyledonous winter-spring weeds were presented only by *Lolium temulentum* L. The early spring weeds were presented by the broadleaf species *Galium aparine* L., *Sinapis arvensis* L., *Lamium purpureum* L. and the grass weed *Avena fatua* L. on the trial area a volunteer winter wheat - *Triticum aestivum* L., was observed. The efficacy of the studied herbicides is presented on tables 1, 2 and 3. The presented data is average for both trial years.

From the obtained results on the 14th day after the herbicide application against *A. arvensis, P. rhoeas* and *S. arvensis* the efficacy of Cleranda SC + Dash - 2.00 + 1.00 l/ha was 88.3, 88.3 and 100%, respectively. Against the weeds *P. rhoeas* and *S. arvensis* the applicatipn of Cleranda SC + Dash - 1.40 + 1.00 also controlled the weed. An excellent control - 98.3% against the difficult-to-control weed in the *S. arvensis* after the treatment with Cleravis SC + Dash in both examined rates was recorded. The usage of Cleravis SC + Dash in the high rate - 2.00+1.00 l/ha ensured good efficacy against *P. rhoeas* - 85%. The lowest efficacy in the experiment after the application of Clentiga SC + Dash - 0.60 + 1.00 l/ha against *A. arvensis* and *P. rhoeas* e was reported 21.7 and 38.3%, respectively (Table 1).

Regarding the weed *G. aparine* on the 14th day after the treatments average for both years, the highest efficacy after the application of Cleravo SC + Dash - 1.00 + 1.00 l/ha – 93.3%, followed by Cleravis SC + Dash - 2.00 + 1.00 l/ha - 90% was found. The lowest efficacy was recorded after the application Cleravis SC + Dash - 1.40+1.00 l/ha and Clentiga SC + Dash - 0.60 + 1.00 l/ha - 78.3% (Table 1).

Against the weed *L. purpureum,* at all studied treatments the efficacy was excellent. The lowest efficacy was observed after the application of Clentiga SC + Dash - 0.60 + 1.00 l/ha - 90%. The results about the efficacy against *C. bursa-pastoris* showed that it varies in a narrow range. The best control was recorded for treatment 5-91.7% (Table 1).

With regard to the control of *L. temulentum*, the best results on the 14th day after treatments were reported after the application of Cleranda SC + Dash - 2.00 + 1.00 l/ha - 83.3%. On the second place for efficacy was treatment 2 - 81.6%, followed by treatment 5 - 80%.

Cleranda SC + Dash - 2.00 + 1.00 l/ha showed the highest efficacy against *A. fatua* and *T. aestivum* volunteer was the highest on the 14th day after the application 83.3 and 90%, respectively. The lowest efficacy against *A. fatua* after the treatment with Clentiga SC + Dash - 1.00 + 1.00 l/ha was reported (Table 1).

On the 28th day after the herbicide application in both experimental years the highest efficacy against *A. arvensis*, *P. rhoeas*, *L. purpureum*, *L. temulentum*, A. fatua and *T. aestivum* volunteer after the treatment with Cleranda SC + Dash - 2.00 + 1.00 l/ha was observed 91.7, 91.7, 100, 88.3, 88.3 and 90%, respectively (Table 2). Very good efficacy against these weed species was also recorded for the treatment Cleranda SC + Dash - 1.40 + 1.00 l/ha. The lowest efficacy against this weed association with accept *A. fatua* after the application of Clentiga SC + Dash - 0.60 + 1.00 l/ha was found. The highest efficacy against *G. aparine* (93.3%) on the 28th day after treatments with Cleravis SC + Dash - 2.00 + 1.00 l/ha and Cleravo SC + Dash 1.00 + 1.00 l/ha was recorded. The lowest control was recorded for the treatment of Clentiga SC + Dash - 0.60 + 1.00 l/ha - 80%.

Under the conditions of the trial *S. arvensis* is the most sensitive of all weed species. On the 28th day at all variant 100% efficacy was recorded against *S. arvensis*. Similar results were found for *L. purpureum* (Table 2).

For the weed *C. bursa-pastoris* on the 28th day after application, the highest efficacy was observed for the treatments with Cleranda SC + Dash in both examined rates - 91.7%. Very good control against this weed (90%) was found for variants 3 and 6. The lowest control was recorded for the treatment Clentiga SC + Dash - 0.60 + 1.00 l/ha - 86.7%.

The results at day 56 after treatment from both trial years maintained the trend in efficacy of the previous two reporting dates. The herbicidal effect of all the variants studied was found to be highest during the third reporting date. This can be explained by the sufficient duration of action of the herbicides on the weeds and their ability to maximize their implementation.

In the third reporting date, the highest biological efficacy against *A. arvensis*, *P. rhoeas*, *G. aparine*, *C. bursa-pastoris*, *L. temulentum*, *A. fatua* and *T. aestivum* volunteer was recorded for the treatment with Cleranda SC + Dash - 2.00 + 1.00 l/ha - 95, 91.7, 100, 95, 91.7, 88.3 and 98.3% (Table 3). The efficacy of 100% against the weed *G. aparine* after the application of Cleravis SC + Dash - 2.00 + 1.00 and Cleravo SC + Dash 1.00 + 1.00 l/ha. It is correct to note that except for Cleranda SC + Dash - 2.00 + 1.00 l/ha, 95% efficacy against *C. bursa-pastoris* after the application of Cleravis SC + Dash - 1.40 + 1.00 l/ha was recorded (Table 3).

Average for both trial years, on the 56th day, 100% efficacy against *S. arvensis* and *L. purpureum* for all treatment was recorded.

Average for the period, the lowest efficacy on the 56th day against the weeds *A. arvensis*, *P. rhoeas*, *L. temulentum*, *A. fatua* and *T. aestivum* (Table 3) was observed for the treatment with Clentiga SC + Dash - 0.60 + 1.00 l/ha. The application of Clentiga SC + Dash - 1.00 + 1.00 l/ha against *G. aparine* and *C. bursa-pastoris* was with the lowest efficacy. The same efficacy was observed for the applications of Cleravo SC + Dassh in both evaluated rates against *C. bursa-pastoris.*

The visual observations of phytotoxicity over the two experimental years indicated that all imazamox-containing herbicides at the appropriate doses exhibited excellent selectivity for the oilseed rape in the study.

The productivity of the oilseed rape hybrid was also was also evaluated. The results show that for the treated variants there is a positive correlation between their biological efficacy against weeds and the crop yield.

As a result of the high weed infestation of the experimental field with competitive weed species, a low average yield of the untreated control was reported - 1.170 t/ha (Table 4).

The highest oilseed rape seed yield after the treatment with Cleranda SC + Dash - 2.00 + 1.00 l/ha - 3,520 t/ha. High yield was also reported for the treatments of Cleranda SC + Dash - 1.40 + 1.00 l/ha and Cleravis SC + Dash - 2.00 + 1.00 l/ha - 3.470 t/ha and 3.417 t/ha, respectively. It should be noted that, the difference between the yields obtained in the three variants were not statistically proved.

The lowest productivity among the treated variants after the treatment with Clentiga SC + Dash in both examined rates - 2.207 t/ha and 2,333 t/ha. There were not statistically proved differences between these two treatments. The reason for this is probably the low efficacy against *L. temulentum*, *A. fatua*, *A. arvensis*, *P. rhoeas* and the volunteer *T. aestivum* (Table 3).

In all the variants treated, the yield obtained is higher than that of the untreated control and its increase is statistically proven at the level of significance gD = 5% (Table 4).

Accept biological efficacy, selectivity and yield some of the main biometrical indicators were tracked. For the indicator height of the plants at the end of the vegetation it was found that the shortest were the plants from the untreated highly infested with weeds control. This difference is statistically proven at the level of significance 5%. The results showed that in the presence of weeds, the crop plants compete with them and as a consequence, in severe weed infestation the oilseed rape remains suppressed and plants were shorter in in habitus – 124.8 cm. The highest plants were reported for the treatments with Cleranda SC + Dash - 1.40 + 1.00 l/ha, Cleranda SC + Dash - 2.00 + 1.00 l/ha and Cleravis SC + Dash - 2.00 + 1.00 l/ha - 162.9, 160.2 and 158.4 cm, respectively. There were no statistically proven differences between these three treatments. These results correlate with bio-efficiency and yield data. In the other variants treated, the values of the indicator ranged from 135,1 to 150,3 cm.

For the indicator number of brunches per plant there was also observed difference. The lowest brunch number was found for the control - 6,6. The highest number of brunches was found to be for the treatments 3, 2 and 5 - 9.2; 9.0 and 8.8 branches per plant respectively. At the above mentioned three treatments there were no statistically proved differences. There were no significant differences in the number of branches per plant for variants 4, 6, 7, 8 and 9.

Silique number per plant is one of the most important indicators influencing the production of oilseed rape. The comparative analysis of the untreated control with the other studied variants shows that there are statistically proven differences in favour of the herbicide-treated variants.

The highest results were obtained after the treatment Cleranda SC + Dash in rates of 2.00 + 1.00 l/ha and 1.40+1.00 l/ha, as well as after the treatment of Cleravis SC + Dash - 2.00 + 1.00 l/ha - 404.0, 398.0 and 377.3 siliques per plant respectively. No statistical difference was found between these treatments. Among the treated variants, the lowest was the result for this studied indicator after the application Clentiga SC + Dash - 0.60 + 1.00 l/ha - 286.7 siliques per plant. Among the other treatments the siliques number per plant per plant varied from 290.0 to 353.7 (Table 4).

Regarding the indicator length of the central silique it was reported that the lowest results were found to be for the untreated control - 3.9

cm. This difference is statistically proven at a significance level of 5%. At treatments 8 and 9 the length of the central silique was 4.6 and 4.7 cm.

Table 1. Efficacy of imazamox-containing herbicides on the 14th day after the treatments (% by EWRS)

Treatments	*A. arvensis*	*P. rhoeas*	*G. aparine*	*S. arvensis*	*L. purpureum*	*C. bursa-pastoris*	*L. temulentum*	*A. fatua*	*Volunteer T. aestivum*
1. Untreated control	–	–	–	–	–	–	–	–	–
2. Cleranda SC + Dash – 1.40 + 1.00 l/ha	83.3	88.3	85.0	100	95.0	90.0	81.6	81.6	83.3
3. Cleranda SC + Dash – 2.00 + 1.00 l/ha	88.3	88.3	88.3	100	95.0	90.0	83.3	83.3	90.0
4. Cleravis SC + Dash – 1.40 + 1.00 l/ha	78.3	81.7	78.3	98.3	93.3	86.7	61.7	68.3	75.0
5. Cleravis SC + Dash – 2.00 + 1.00 l/ha	71.7	85.0	90.0	98.3	100	91.7	80.0	71.7	85.0
6. Cleravo SC + Dash – 0.70 + 1.00 l/ha	53.3	81.7	88.3	93.3	100	90.0	31.7	46.7	76.7
7. Cleravo SC + Dash – 1.00 + 1.00 l/ha	71.7	76.7	93.3	96.7	100	88.3	53.3	60.0	81.7
8. Clentiga SC + Dash – 0.60 + 1.00 l/ha	21.7	38.3	78.3	88.3	90.0	88.3	3.3	25.0	33.3
9. Clentiga SC + Dash – 1.00 + 1.00 l/ha	38.3	38.3	85.0	95.0	95.0	83.3	13.3	21.7	43.3

Table 2. Efficacy of imazamox-containing herbicides on the 28th day after the treatments (% by EWRS)

Treatments	*A. arvensis*	*P. rhoeas*	*G. aparine*	*S. arvensis*	*L. purpureum*	*C. bursa-pastoris*	*L. temulentum*	*A. fatua*	*Volunteer T. aestivum*
1. Untreated control	–	–	–	–	–	–	–	–	–
2. Cleranda SC + Dash – 1.40 + 1.00 l/ha	88.3	90.0	90.0	100	98.3	91.7	83.3	83.3	88.3
3. Cleranda SC + Dash – 2.00 + 1.00 l/ha	91.7	91.7	91.7	100	100	90.0	88.3	88.3	90.0
4. Cleravis SC + Dash – 1.40 + 1.00 l/ha	78.3	78.3	85.0	100	98.3	88.3	63.3	70.0	83.3
5. Cleravis SC + Dash – 2.00 + 1.00 l/ha	76.7	85.0	93.3	100	100	91.7	81.7	71.7	88.3
6. Cleravo SC + Dash – 0.70 + 1.00 l/ha	56.7	81.7	90.0	100	100	90.0	31.7	46.7	76.7
7. Cleravo SC + Dash – 1.00 + 1.00 l/ha	73.3	83.3	93.3	100	100	88.3	53.3	60.0	85.0
8. Clentiga SC + Dash – 0.60 + 1.00 l/ha	21.7	38.3	80.0	100	93.3	88.3	3.3	25.0	33.3
9. Clentiga SC + Dash – 1.00 + 1.00 l/ha	38.3	40.0	85.0	100	98.3	86.7	13.3	21.7	43.3

Table 3. Efficacy of imazamox-containing herbicides on the 56th day after the treatments (% by EWRS)

Treatments	*A. arvensis*	*P. rhoeas*	*G. aparine*	*S. arvensis*	*L. purpureum*	*C. bursa-pastoris*	*L. temulentum*	*A. fatua*	*Volunteer T. aestivum*
1. Untreated control	–	–	–	–	–	–	–	–	–
2. Cleranda SC + Dash – 1.40 + 1.00 l/ha	88.3	90.0	98.3	100	100	93.3	86.7	85.0	91.7
3. Cleranda SC + Dash – 2.00 + 1.00 l/ha	95.0	91.7	100	100	100	95.0	91.7	88.3	98.3
4. Cleravis SC + Dash – 1.40 + 1.00 l/ha	78.3	78.3	95.0	100	100	95.0	68.3	70.0	93.3
5. Cleravis SC + Dash – 2.00 + 1.00 l/ha	80.0	86.7	100	100	100	95.0	81.7	76.7	90.0
6. Cleravo SC + Dash – 0.70 + 1.00 l/ha	65.0	80.0	98.3	100	100	90.0	40.0	53.3	76.7
7. Cleravo SC + Dash – 1.00 + 1.00 l/ha	80.0	83.3	100	100	100	90.0	58.3	63.3	88.3
8. Clentiga SC + Dash – 0.60 + 1.00 l/ha	31.7	45.0	93.3	100	100	91.7	3.3	25.0	48.3
9. Clentiga SC + Dash – 1.00 + 1.00 l/ha	38.3	50.0	91.7	100	100	90.0	13.3	30.0	53.3

Table 4. Yield and biometrical indicators of oilseed rape hybrid PT 200 Cl, treated with imazamox-containing herbicides in the period of 2017-2019

Treatments	Yield, t/ha	Plant height, cm	Number of branches per plant	Silique number per plant	Length of the central silique, cm
1. Untreated control	1.170 a	124.8 a	6.6 a	127.0 a	3.9 a
2. Cleranda SC + Dash – 1.40 + 1.00 l/ha	3.470 f	160.2 e	9.0 c	398.0 e	5.4 d
3. Cleranda SC + Dash – 2.00 + 1.00 l/ha	3.527 f	162.9 e	9.2 c	404.0 e	5.5 d
4. Cleravis SC + Dash – 1.40 + 1.00 l/ha	3.220 d	150.3 d	7.8 b	353.7 cd	5.3 d
5. Cleravis SC + Dash – 2.00 + 1.00 l/ha	3.417 ef	158.4 e	8.8 c	377.3 de	5.3 d
6. Cleravo SC + Dash – 0.70 + 1.00 l/ha	2.893 c	149.8 d	7.6 b	329.3 c	5.2 cd
7. Cleravo SC + Dash – 1.00 + 1.00 l/ha	3.200 d	148.9 d	7.6 b	333.3 c	5.3 d
8. Clentiga SC + Dash – 0.60 + 1.00 l/ha	2.207 b	135.1 b	7.4 b	286.7 b	4.6 b
9. Clentiga SC + Dash – 1.00 + 1.00 l/ha	2.333 b	141.4 c	7.5 b	290.0 b	4.7 b
	gD5% = *19.6974*	*gD5%* = *5.9796*	*gD5%* = *0.8043*	*gD5%* = *35.1769*	*gD5%* = *0.5371*

CONCLUSIONS

The highest efficacy against *Anthemis arvensis* L., *Papaver rhoeas* L., *Galium aparine* L., *Capsella bursa-pastoris* (L.) Medik, *Lolium temulentum* L., *Avena fatua* L. and the volunteer *Triticum aestivum* L. after the application of Cleranda SC + Dash - 2.00 + 1.00 l/ha and followed by Cleranda SC + Dash - 1.40+1.00 l/ha and Cleravis SC + Dash - 2.00 + 1.00 l/ha was recorded.

From the analysis of biometric indicators for the oilseed rapeseed hybrid PT200 CL: plant height, number of brunches per plant, silique number per plant, length of the central silique and yield were the highest for the treatment of Cleranda SC + Dash in both examined rates 2.00 + 1.00 l/ha and 1.40+1.00 l/ha, as well as Cleravis SC + Dash - 2.00 + 1.00 l/ha. Of all the variants studied, the lowest values were reported in the untreated control.

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