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Efficacy and selectivity of some herbicides on winter oilseed rape

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Department of Farming and Herbology, Faculty of Agronomy, Agricultural University, 12 Mendeleev, 4000 Plovdiv, Bulgaria

Abstract. Within the period 2011 – 2014 in the experimental field of the Agricultural University, Plovdiv, field experiments were conducted using the herbicides Teridox (500 g/l dimethachlor), Butizan S (500 g/l metazachlor), which were applied to the soil after planting the crops and before their germination, and also Modaon 4F (48 g/l bifenox) and Butizan S, which was applied to the leaves during the vegetation period of the rape. The experiments were made using the block method over an area of 25 m² in four repetitions. It has been established that the herbicides demonstrate excellent selectivity for this crop, which was measured on the EWRS scale in marks and control the existing annual types: Amaranthus retroflexus L., Portulaca oleracea L., Chenopodium album L., Solanum nigrum L., Setaria spp., Stellaria media L. and self-seeded wheat plants. The weeds in the control sample without herbicides have very high density and on the 40th day after treatment their number reaches 123 plants/m². On average for the period of the survey (2011 – 2014), the efficiency of the applied preparations Teridox, Butizan S and Modaon 4F on the 20th day after treatment ranges from 70.5% to 79.4% for the soil herbicides and from 72.8% for 76.9% for the leaf herbicides. This dependence is preserved to the 45th day after treatment.

Keywords: winter oilseed rape, herbicides, efficacy, selectivity

Introduction

Oilseed rape is one of the main oleaginous crops in our country, which has been grown on a larger scale over the last few years. Like all other field crops, oilseed rape is very sensitive to becoming overgrown with weeds, which reduces the yield and deteriorates the quality of the obtained produce. Some of the most common weeds found in the areas planted with oilseed rape are Raphanus raphanistrum L., Sinapis arvensis L., Stellaria media L., Papaver rhoeas L., Capsella bursa pastoris L., Fumaria officinalis L., Lolium spp., as well as the annual late-spring types – Amaranthus retroflexus L., Solanum nigrum L., Setaria spp. and others. Another serious problem is caused by the self-sowing plants of previously grown grain crops. According to Dimitrova and Ivanova (2008) good control over the annual wheat weeds and the self-sowing plants of grain crops is exercised by the herbicide Agil 100 EK in a dose of 50 ml/ha. Similar results have also been obtained in other countries by Abel (2002), Andersson and Bengstson (1992), Bernotas and Kalvatiene (1997) and Zawadski et al. (2001). In the control of the annual dicotyledonous weeds, we can use Butizan S – 300-350 ml/ha and Sultan 500 SK – 240 ml/ha (metazachlor), applied after sowing and before germination of the crops or during the early stage of the crops and the weeds (Ivanova, 2012; Majchrzak et al., 2008).

The purpose of this study is to examine the efficacy and selectivity of some herbicides applied to the leaves and soil to fight weeds in order to provide clear fields and to increase the yield and improve the quality of oilseed rape.

Material and methods

During the period 2011 – 2014, in the experimental field of the Agricultural University, Plovdiv, we conducted a field experiment with herbicides applied to the soil after sowing and before the germination of crops and also to the leaves during the vegetation period of the oilseed rape conventional type, the Xenon hybrid, grown on a piece of land previously planted with wheat. The experiment was made using the block method, with an area of 25m² of the experimental field, in 4 repetitions (Table 1).

Table 1. Variants of the experiment

<table>
<thead>
<tr>
<th>Variants</th>
<th>Active substance</th>
<th>Dose, ml/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.Zero control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.Modaon 4F</td>
<td>48 g/l bifenox</td>
<td>1000</td>
</tr>
<tr>
<td>3.Teridox</td>
<td>500 g/l dimethachlor</td>
<td>2000</td>
</tr>
<tr>
<td>4.Butizan S (soil)</td>
<td>500 g/l metazachlor</td>
<td>2000</td>
</tr>
<tr>
<td>5.Butizan S (on the leaves)</td>
<td>500 g/l metazachlor</td>
<td>2000</td>
</tr>
</tbody>
</table>

The agro-technical activities were conducted in accordance with the common technology for growing oilseed rape (soil cultivation, fertilization, sowing, rollering). The soil and leaf herbicides were applied using a knapsack sprayer and a working solution of 250 – 300 l/ha. The efficacy of herbicides was registered on:

- the 28th and 45th days after spraying the soil;
- the 20th and 40th days after spraying the leaves.

Selectivity of herbicides is reported on a scale of EWRS on 3rd, 7th and 14th day after treatment.

The experimental year 2011 was characterized by a warm and humid autumn. The rainfall within the period September – November was 74.7 mm but it was unevenly distributed (70.4 mm of the rainfall was in October). In 2012, the pre-sowing processing of the soil was conducted under optimal conditions. The rainfall within the period September – November was 65.2 mm but unlike the year 2011, it was evenly distributed: September – 15.1 mm, October – 39.4 mm and November – 10.7 mm. The autumn of 2013 was characterized as being cool and humid, with rainfall of 85.4 mm as the largest
quantity of rainfall was registered in November – 47.2 mm. In September and October the rainfall was 10.2 mm and 28.1 mm, respectively.

Results and discussion

In 2011, the experimental areas sown with oilseed rape were significantly overgrown with weeds belonging to the group of the early-spring ephemeral plants and owing to the warm autumn also with weeds from the group of the late-spring ones. The main representatives of these groups are: ephemera – chickweed (Stellaria media L.), speedwell (Veronica agrestis L.), common fumitory (Fumaria officinalis L.); winter-spring – poppy (Papaver rhoeas L.) and shepherd’s purse (Capsella bursa-pastoris L.); early spring – common wild oats (Avena fatua L.) and ryegrass (Lolium spp.), and late spring – black nightshade (Solanum nigrum L.), common purslane (Portulaca oleracea L.), saltbush (Chenopodium album L.), (Amaranth amaranthus ssp.) and also high density of the self-sowing plants of the predecessor – wheat.

Table 2. Efficacy of herbicides in soil rape 28 days after spraying, average 2011 – 2013

<table>
<thead>
<tr>
<th>Variants</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Average 2011 – 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weeds per m²</td>
<td>Efficacy, %</td>
<td>Weeds per m²</td>
<td>Efficacy, %</td>
</tr>
<tr>
<td>1. Zero Control</td>
<td>138</td>
<td>-</td>
<td>118</td>
<td>-</td>
</tr>
<tr>
<td>3. Teridox</td>
<td>34</td>
<td>75.4</td>
<td>21</td>
<td>82.2</td>
</tr>
<tr>
<td>4. Butizan S</td>
<td>45</td>
<td>67.4</td>
<td>33</td>
<td>72.0</td>
</tr>
</tbody>
</table>

In the variants treated with soil herbicides, on the 28th day after their application, we registered efficacy of 75.4% for Teridox and 67.4% for Butizan S (Table 2). The relatively low efficiency of the soil herbicides is due to the low level of soil moisture in September (3.4 mm) and the high density of the self-sowing plants of wheat – 13 plants/m² in the variant treated with Teridox – 18 plants/m².

Table 3. Efficacy of herbicides in soil rape 45 days after spraying, average 2011 – 2013

<table>
<thead>
<tr>
<th>Variants</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Average 2011 – 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weeds per m²</td>
<td>Efficacy, %</td>
<td>Weeds per m²</td>
<td>Efficacy, %</td>
</tr>
<tr>
<td>1. Zero Control</td>
<td>91</td>
<td>-</td>
<td>96</td>
<td>-</td>
</tr>
<tr>
<td>3. Teridox</td>
<td>19</td>
<td>79.1</td>
<td>23</td>
<td>76.0</td>
</tr>
<tr>
<td>4. Butizan S</td>
<td>27</td>
<td>70.3</td>
<td>29</td>
<td>69.8</td>
</tr>
</tbody>
</table>

On the 45th day after the application, the efficiency of the applied herbicides was higher – 79.1% in the variant treated with Teridox and 70.3% for Butizan S (Table 3). Teridox applied at a dose of 2000 ml/ha controls these weeds: saltbush (Chenopodium album L.) – 86%, shepherd’s purse (Capsella bursa-pastoris L.) – 81%, self-sowing wheat – 78% and common fumitory (Fumaria officinalis L.) – 77%. Butizan S applied at a dose of 2000 ml/ha controls these weeds: poppy (Papaver rhoeas L.) – 82%, saltbush (Chenopodium album L.) -80%, black nightshade (Solanum nigrum L.) – 79% and shepherd’s purse (Capsella bursa-pastoris L.) – 73%. This is due to the freezing of some of the weeds belonging to the group of the late-spring ones, which are not affected by the applied herbicides.

For the herbicides applied during the vegetation period, on the 20th day after treatment the efficiency is low – 57.7% for Modao 4F – 1000 ml/ha (weed control: poppy (Papaver rhoeas L.) – 67.4%, saltbush (Chenopodium album L.) – 81.7%, black nightshade (Solanum nigrum L.) – 78.4% and shepherd’s purse (Capsella bursa-pastoris L.) – 82.1%) and Butizan S – 2000 ml/ha (weed control: poppy (Papaver rhoeas L.) – 86.8%, saltbush (Chenopodium album L.) – 79.7%, black nightshade (Solanum nigrum L.) – 79% and shepherd’s purse (Capsella bursa-pastoris L.) – 83%). This is due to the low temperatures registered after treatment, which led to the lower efficiency of the applied herbicides and also the presence of self-sowing plants of wheat with density of 6 plants/m² and 10 plants/m² (Table 4).

Table 4. Efficacy of foliar herbicides with rapeseed of the 20th day after treatment, the average for the period 2011 – 2013

<table>
<thead>
<tr>
<th>Variants</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Average 2011 – 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weeds per m²</td>
<td>Efficacy, %</td>
<td>Weeds per m²</td>
<td>Efficacy, %</td>
</tr>
<tr>
<td>1. Zero Control</td>
<td>78</td>
<td>-</td>
<td>113</td>
<td>-</td>
</tr>
<tr>
<td>2. Modao 4F</td>
<td>33</td>
<td>57.7</td>
<td>19</td>
<td>83.2</td>
</tr>
<tr>
<td>5. Butizan S</td>
<td>33</td>
<td>57.7</td>
<td>26</td>
<td>76.9</td>
</tr>
</tbody>
</table>
In 2012, in the variants with soil application of the herbicides we registered the highest efficiency during the three-year period of the experiment (Table 2) despite the large number of self-sowing plants of wheat – 19 plants/m² for Teridox and 28 plants/m² for Butizan S, 82% and 72%, respectively. The higher efficacy is due to the quantity of rainfall after sowing, which improved the activity of the soil herbicides. The selectivity of the two herbicides applied soil was reported (score 1 by EWRS scale). Similar efficacy was also registered in 2013, when on the 28th day after spraying, in the variants with soil application of the herbicides it was 81.3% and 72.3%, respectively, and on the 45th day it reached 81.6% and 78.6%.

Table 5. Efficacy of foliar herbicides with rapeseed of the 40th day after treatment, the average for the period 2011 – 2013

<table>
<thead>
<tr>
<th>Variants</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Average 2011 – 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weeds per m²</td>
<td>Efficacy, %</td>
<td>Weeds per m²</td>
<td>Efficacy, %</td>
</tr>
<tr>
<td>1. Zero Control</td>
<td>71</td>
<td>-</td>
<td>107</td>
<td>-</td>
</tr>
<tr>
<td>2. Modaon 4F</td>
<td>29</td>
<td>59.2</td>
<td>17</td>
<td>84.1</td>
</tr>
<tr>
<td>5. Butizan S</td>
<td>30</td>
<td>57.7</td>
<td>21</td>
<td>80.4</td>
</tr>
</tbody>
</table>

For the herbicides applied to the leaves, the efficacy on the 20th and 40th days in the years 2012 and 2013 was almost identical and ranged from 76.9 to 84.1%. The lowest efficiency of the herbicides was registered in 2011 – from 57.7% to 59.2% (Tables 4 and 5).

During all three years of testing the applied herbicides in the specified doses did not manifest any phytotoxic effect on the oilseed rape, including herbicide Modaon 4F, which show selectivity of the physical basis. This is due to the fact, after its application during the test period in the fall there was no heavy rainfall to disrupt the waxy coating on the leaves of the crop. Selectivity recorded on the 3rd, 7th and 149th days after treatment is score 1 (excellent) by EWRS scale.

Conclusions

On average for the period of the survey (2011 – 2014), the efficiency of the applied preparations Teridox, Butizan S and Modaon 4F on the 20th day after treatment ranges from 70.5% to 79.4% for the soil herbicides and from 72.8% for 76.9% for the leaf herbicides. This dependence is preserved by the 45th day after treatment.

The applied herbicides show very good control over the present weeds belonging to the group of ephemeral plants, the early-spring and the late-spring types, with the exception of the self-sowing plants of the wheat predecessor. The duration of the herbicidal activity is about 40 – 45 days and the selectivity of the preparations regarding the crop is excellent based on the EWRS scale.

Acknowledgements

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