Research on the efficiency of plant protection products in sowing spring wheat

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Abstract. Losses of agricultural crops from pests, diseases and weeds are on average 30-35%, and in the years of mass spread of harmful organisms, they can reach 60%. Improvement of the chemical method for regulating the number and harmfulness of pathogens, pests and weeds remains one of the priority directions of development of modern plant protection, which is quite justified, since at this stage this method surpasses all others in many parameters, and the emphasis on minimizing use emphasizes the need to regard pesticides and their application especially seriously.

1. Introduction

An increase in the harvest of spring wheat in the Krasnoyarsk Territory largely depends on the efficiency of the use of plant protection products. In Siberia, 75% of phytopathogens of a fungal nature and 80% of a bacterial nature are transmitted through sowing material [1]. Infection of seeds of grain crops with a complex of fungal and bacterial diseases in the regions of the Russian Federation ranges from 55 to 100%. Among diseases of seeds of spring wheat, helminthosporium and fusarium root rot should be highlighted first of all. The annual harvest shortfall in the region from them is on average 5.9%. Root rot not only leads to a shortage of harvests, but also reduces the gluten content in the grain [2, 3].

In recent years, effective protection of grain crops from leaf-stem infections has become very important. The harvest shortfall from them reaches 25-30, and in the years of epiphytoties - 40-60%. The species composition of pathogens of spring wheat diseases is represented by four types of smut, three types of rust, powdery mildew, septoria blight and helminthosporium spot.

According to Academician Surin N.A. (2011), cereals in the Krasnoyarsk Territory, starting from the seedling phase and throughout the growing season, are damaged by a complex of pests: Barley fleas, Cereal leafhoppers, Lema, Intra-stem pests, Wheat thrips, Cereal aphids, Ear miner moth [4].

In the sowing of spring wheat, 91 species of weeds are found, dicotyledonous make up 88%, monocotyledonous (cereals) - 11%. The following species are constantly found: Oatgrass, Field milk thistle, Thistle, Fool hay, Alfilaria, Lambsquarter goosefoot, Goose grass, Dawny hemp nettle, barnyard grass, etc. [5,6].

The harmfulness of weeds will seem even higher if we take into account that a significant part of pathogens and pests, at certain periods and phases of development, use weeds as an intermediate host [7, 8]. As intermediate hosts, weeds contribute to the development of phytopathogens, which negatively
affect the biological, nutritional and technological qualities of the crop, sowing properties of seeds. The researches have shown the presence of phytopathogens on almost all weeds.

Thus, the spring wheat is affected by a wide range of pests and diseases, a large number of weeds are found in crops. Therefore, the development and improvement of the protection of the spring wheat from harmful organisms makes it possible to improve the health of the sowing material, reduce the negative impact on plants during the growing season, which ultimately contributes to an increase in productivity and an increase in the quality of the products obtained.

2. Research methodology and methods

The experiment was carried out at the Minino station of the Krasnoyarsk Research Institute of Agriculture. The soil of the test site is represented by leached chernozem of heavy loamy textural composition. The average humus content was 3.8%, which characterizes the studied chernozem as slightly humus-rich [9, 10].

The investigated scheme of protection of spring wheat included the following preparations: Turion, EC (d.v. - Imazalil + prochloraz + triticonazole) - 0.35 l/t; Elant Premium (d.v. - 2.4-D + dicamba) and Stalker (d.v. - tribenuron-methyl) - 0.5 l/ha, Fabricre EMV (d.v. fenoxaprop-P-ethyl + antidote cloquintoset-mexil) - 1.0 l/ha, Zenon Aero, EC (ae - tebuconazole + triadimefon) - 1.0 l/ha and Tsunami CE (ae - alpha-cypermethrin) at a dose of 0.2 l/ha in case of mass appearance of pests.

The research was carried out on two varieties of spring wheat: Altai 70 (standard) and Uyarochka (selection of the Krasnoyarsk Research Institute of Agriculture).

Repetition of the experiment: 3 times. Plot area was 40 m².

The predecessor is pure fallow. Tillings used were typical for the zone: in autumn - plowing with a soil overturning of 20-22 cm; in spring - early spring harrowing as soon as the soil is ready, cultivation, sowing.

The calculation of the need for seeds is done for each plot, taking into account germination ability, the mass of 1000 seeds and taking into account the purity. Seeds are prepared for sowing, additional cleaning (purity is achieved up to 100%). Germination ability is determined, and weighing batches are prepared for each plot. Before the introduction of fertilizers, an initial operational breakdown of the experience is done. After the presowing cultivation, a breakdown by experience is carried out for sowing on May 15-20. Sowing is 5-6 cm.

The weed estimation of crops is taken into account before the application of herbicides and on the 21st day after their application. For this, a 0.25 m² frame is used. The total number of weeds is calculated and their species composition is determined.

The assessment of the development of the disease was calculated using the scale with the designation of the affected surface area of the plant leaves in points. A six-point scale was used, where 0 points - a healthy plant, 5 points - damage to the leaves of the plant over 75% [11].

Pests were counted using a size frame (25 x 25 cm), which was imposed on the soil. Plants and soil were carefully examined and their number was counted, then the number was multiplied by 4. The harvesting of the experiment was carried out with a Sampo 500 combine. Statistical data processing was carried out according to generally accepted methods and State Standards (GOST) [12, 13].

3. Research results

The results of the phytosanitary inspect of the seeds of spring wheat treated with the Turion preparation showed that presowing seed pretreatment promoted the improvement of the seed material of both studied varieties (Table 1). In the control variant, the number of spores in the Altayskaya 70 variety in the first replication was 3750, and in the second - 4000 pcs. Presowing pretreatment significantly reduced the number of spores of smut infections per caryopsis. In the Altayskaya 70 variety in the first replication, the number of spores per caryopsis decreased to 750 pcs.; in the second - to 1000 pcs. An even greater decrease in the spore rate was noted in the Uyarochka variety: in the first replication - to 700 pcs., in the second - to 875 pcs. Most of the spores remaining on the grain after pretreatment lost their viability, as evidenced by a significant decrease in the score of root damage in comparison with the control.
Table 1. Phytosanitary inspect of spring wheat seeds of varieties Altayskaya 70 and Uyarochka.

| Experience option | I replication | II replication |
|-------------------|---------------|----------------|
|                   | Average score of root damage | Average number of spores per caryopsis | Average score of root damage | Average number of spores per caryopsis |
| Altaiskaya 70     |                           |                       |                           |                                 |
| Control           | 0.3                    | 1.5                 | 3750                      | 0.33                           | 1.6                           | 4000                           |
| Turion            | 0.06                   | 0.3                 | 750                       | 0.09                           | 0.4                           | 1000                           |
| Uyarochka         |                           |                       |                           |                                 |
| Control           | 0.2                    | 1.4                 | 3500                      | 0.25                           | 1.5                           | 3750                           |
| Turion            | 0.06                   | 0.28                | 700                       | 0.08                           | 0.35                          | 875                            |

Presowing pretreatment of spring wheat seeds made it possible to significantly reduce the number of spores per caryopsis and to increase the laboratory germination of inoculum on average from 78.0% in the control, to 84.5% in the treated variant in the Altayskaya 70 variety; in the Uyarochka variety - from 76.0% in the control to 83.8% (Table 2).

Table 2. Laboratory germination of seeds of spring wheat varieties depending on pre-sowing seed pretreatment.

| Option   | Replication | Average, % | Difference, % |
|----------|-------------|------------|---------------|
|          | I  | II  | III | IV  |                |
| Altaiskaya 70 |   |     |     |     |               |
| Control  | 77.0| 75.0| 81.0| 79.0| 78.0           |
| Turion   | 85.0| 80.0| 87.0| 86.0| 84.5 + 6.5 |
| LSD(5%)  |     |     |     |     | 2.3            |
| Uyarochka |   |     |     |     |               |
| Control  | 75.0| 76.0| 78.0| 75.0| 76.0           |
| Turion   | 81.0| 81.0| 88.0| 85.0| 83.8 + 7.8 |
| LSD (5%) |     |     |     |     | 1.9            |

Thus, pre-sowing pretreatment had a positive effect on the laboratory germination of seeds, reduced the number of spores per caryopsis and root rot, thereby making the seed healthy.

In a dry year, the infestation of spring wheat crops before treatment with a tank mixture of herbicides was 26.4 pcs / m2. The corps were dominated by dicotyledonous weeds: Green amaranth (Amaranthus retroflexus), Lambsquarter goosefoot (Chenopodium album L.), Thistle (Cirsium arvense), Field milk thistle (Sonchus arvensis). Single specimens of Ruderal hemp (Cannabis ruderalis Janisch.) were also found. Cereal weeds were represented by Oatgrass (Avena fatua), Fool hay (Panicum capillare), and Bristle grass (Setaria viridis (L.) Beauv.).

In a wet year, the weediness of crops was higher, the number of weeds per 1 m² was on average 32.3 pcs. The crops were dominated by dicotyledonous weeds, the largest number of them were the Green amaranth, Thistle, and Field milk thistle. The number of cereal weeds increased in the crops; the
prevailing species was Fool hay which occurred up to 70% of all cereal weeds in the crops; Oatgrass was observed in a smaller amount.

To assess the technical efficiency of the tank mixture of herbicides, 5 points were fixed on each variant with the maximum amount of weeds. Weeds were counted twice - the first one before the treatment with a tank mixture of herbicides, the second one 21 days after the crops were treated. Over the years of our observations, we have noted the cereal-dicotyledonous type of binding. The use of the tank mixture of the studied herbicides made it possible to significantly reduce the content of impurities of rapeseed crops. The technical efficiency of the tank mixture of herbicides on average over the years of the research was 86.3% (Table 3).

**Table 3. Technical efficiency of the tank mixture of herbicides Agrochemical DF, Minino station, average over the years of research**

| Weed plant species | The number of weeds, sp/m² | Protection effect, % |
|--------------------|-----------------------------|---------------------|
| Oatgrass (Avena fatua) | 6.2 before processing, 1.3 after processing | 79.0 |
| Fool hay (Panicum capillare) | 4.7 before processing, 0.8 after processing | 83.0 |
| Barnyard grass (Echinochloa crusgalli) | 0.5 before processing, 0.1 after processing | 85.7 |
| Alfilaria (Eródi um cicutárium) | 0.7 before processing, 0.3 after processing | 57.1 |
| Ruderal hemp (Cannabis ruderalis Janisch.) | 1.5 before processing, 0.3 after processing | 80.0 |
| Green amaranth (Amaranthus retroflexus) | 6.5 before processing, 0.2 after processing | 96.9 |
| Sagewort wormseed (Artemisia campestris) | 0.4 before processing, 0.1 after processing | 75.0 |
| Green Purslane (Portulaca oleracea) | 1.2 before processing, 0.2 after processing | 83.3 |
| Bristle grass (Setaria viridis L. Beauv.) | 0.9 before processing, 0.2 after processing | 77.8 |
| Lambquarter goosefoot (Chenopodium album) | 1.9 before processing, 0.1 after processing | 94.7 |
| Field milk thistle (Sonchus arvensis) | 2.2 before processing, 0.1 after processing | 95.5 |
| Thistle (Cirsium arvense) | 2.5 before processing, 0.3 after processing | 88.0 |
| Total | 29.2 before processing, 4.0 after processing | 86.3 |

The results of the conducted records of affected spring wheat plants showed that the predominant diseases in the years of the research were Septoria blight (Septoria graminum) and hemintosporiosis (Bipolaris sorokiniana Shoemaker) - (Table 4). The unevenness of the manifestation of diseases by years should be noted; so in a dry year, Septoria blight was the most widespread in the crop, in a wet year, brown rust was strongly manifested. The use of the fungicide Zenon Aero, EC for vegetation allowed to decrease the number of plants affected by leaf-stem diseases. On average, for two years, the effect of protection thanks to use of the fungicide Zenon Aero, EC was 95.7% for Septoria blight, 90.4% for helminthosporiosis, and 95.0% for brown rust. The overall effect of protection of fungicide application was 92.0%.

**Table 4. Results of application of fungicide Zenon Aero, EC in spring wheat crops, Minino station, average over the years of the research**

| Disease (Septoria graminum) | Number of damaged plants, pcs./m² | Protection effect, % |
|-----------------------------|----------------------------------|---------------------|
| Septoria blight              | 23.0 control, 1.8 dressing        | 95.7                |

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During the years of observations, we observed thrips (Haplothrips tritici) and cereal aphid (Schizaphis graminum) in the spring wheat crops. The use of Tsunami insecticide, EC at a dosage of 0.2 l / ha allowed to reduce the number of pests in the crops. The protection effect on cereal aphids was 97.0%, and on thrips it was 92.0%. On average, over two years, the effect of protection against the use of the Tsunami insecticide, EC was 94.0% (Table 5).

Table 5. The results of the application of the insecticide Tsunami, EC in the spring wheat crops, Minino station, average over the years of the research.

| Pest                                | Number of pests, pcs. | Protection effect, % |
|-------------------------------------|------------------------|----------------------|
| control dressing                    |                        |                      |
| Thrips (Haplothrips tritici)        | 23.2                   | 1.8                  | 92.0 |
| Plant louse (Schizaphis graminum)   | 14.4                   | 0.4                  | 97.0 |
| Average                             | 37.6                   | 2.2                  | 94.0 |

Thus, the presented tank mixture of pesticides had a high technical efficiency against harmful organisms in the spring wheat crops.

4. Conclusions

Presowing seed pretreatment of spring wheat varieties before sowing with Turion, EC at a dose of 0.35 l / t contributed to the improvement of the seed. This was manifested in an increase in laboratory and field germination, a significant decrease in the rate of root rot infestation, and an increase in the percentage of survival to harvest.

During the years of researches in the crops of spring wheat, we noted a wide range of both cereal and dicotyledonous weeds. The predominant species of weeds in the crop were oatgrass (Avena fatua), fool hay (Panicum capillare), Green amaranth (Amaranthus retroflexus), as well as Thistle (Cirsium arvense) and Field milk thistle (Sonchus arvensis). The technical efficiency of the investigated tank mixture of herbicides over the years of research was 86.3%.

The technical efficiency of the fungicide Zenon Aero, EC in spring wheat crops was on average over the years of the research 92.0%, of the insecticide Tsunami, EC - 94.0%.

The studied preparations in the recommended dosage have high technical efficiency and are able to fight harmful organisms in spring wheat crops.

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