The effect of herbicides on the infestation of winter wheat crops

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Abstract. Weed vegetation is a serious competitor to cultivated plants. Weed vegetation spends important elements and moisture on its vital activity, thereby reducing the yield. Weed control is an important element of the cultivation technology of any agricultural crop. Winter wheat is the main important crop in the South of Russia, the yield of which affects the quality of life of the population. The use of herbicides is the basis of protective measures against weeds. Modern trends in the development of the agro-industrial complex recommend a reduction in pesticide treatments, however, there is no other alternative for weed control. Our research is aimed at studying the biological effectiveness of herbicidal treatments and their effect on the development of weeds.

1. Introduction
Protection of agricultural crops from weeds remains an important component of the technological process of cultivation [1, 2]. The variety of weeds and their potential harmfulness must always be under control [3]. Modern technologies for the cultivation of winter wheat include herbicidal treatments aimed at reducing the harmfulness of weeds [4, 5]. Chemical control is the main method of weed control. At the present stage of development of production, only the agrotechnical method can help pesticide load. Various methods of processing contribute to the improvement of the state of the soil cover and regulation of the number of harmful objects [6, 7, 8].

On the area of Stavropol Territory, winter wheat crops are infested with weeds by 65% in a medium and strong degree every year. The area treated with herbicides is at least 80% of the entire infested area [1, 2]. This indicates that the bulk of winter wheat crops in Stavropol Territory undergo chemical weeding, which proves topicality of studying the effect of herbicides not only on weeds, but also on the agrocenosis of winter wheat in general.

The purpose of our research was to study the effectiveness of the use of herbicides in winter wheat crops. For this, an experiment scheme was developed by selecting preparations from various chemical groups, a survey was carried out in order to identify the species and quantitative composition of weeds, after processing according to the experiment scheme, the state of the weeds was studied and the biological effectiveness of the treatments was determined.

2. Materials and methods
The experiments were carried out in the crops of winter wheat, Donskaya Yubileinaya breed. The plots were chosen to be leveled along the relief, homogeneous along the soil profile. Agricultural technology
of winter wheat cultivation is generally accepted for this zone. The experiment scheme is presented in Table 1.

Table 1. Scheme of the experiment and consumption rates of the drug

| № | a) Experimental variant | b) Trade name of the drug | c) Active ingredients | Consumption rate of preparations, kg, l/ha |
|---|-------------------------|---------------------------|-----------------------|------------------------------------------|
| 1 | Control                 |                           |                       | -                                        |
| 2 | Pruner, VDG (125+50+12.5 g/kg) | Mefenpyr-diethyl+amidosulfuron+iodosulfuron-methyl-natrium | 0.2 kg/ha               |
| 3 | Aminopelic, VP (600 g/l) | 2.4-D (dimethylamine salt) | 1.0 l/ha               |
| 4 | Pruner, VDG (125+50+12.5 g/kg) + Aminopelic, VP (600 g/l) | Mefenpyr-diethyl+amidosulfuron+iodosulfuron-methyl-natrium + 2.4-D (dimethylamine salt) | 0.1 kg/ha + 0.5 l/ha |
| 5 | i) Prima, SE (300+6.25 g/l) | ii) 2.4-D (ethylhexyl ether)+ florasulam | 0.4 l/ha               |
| 6 | Grench, SP (600 g/kg) | Methylsulfuron-methyl | 0.015 kg/ha            |
| 7 | Prima, SE (300+6.25 g/l) + Grench, SP (600 g/kg) | 2.4-D (ethylhexyl ether)+ florasulam | 0.2 l/ha               |
| 8 | Granstar Pro, VDG (750 g/kg) | Tribenuron-methyl | 0.02 kg/ha            |
| 9 | Granstar Pro, VDG (750 g/kg) + Aminopelic, VP (600 g/l) | Tribenuron-methyl + 2.4-D (dimethylamine salt) | 0.01 kg/ha + 0.5 l/ha |
| 10 | Lontrel Grand, VDG (750 g/kg) + Prima, SE (300+6.25 g/l) | Clopyralid (monoethanolamine salt) + 2.4-D (ethylhexyl ether)+ lorasulam | 0.03 kg/ha + 0.2 l/ha |
| 11 | Dithezan, VP (344+18.8 g/l) | Dicamba + chlorosulfuron (dimethylamine salt) | 0.18 l/ha |
| 12 | Hand weeding | | - | - |

The weed infestation of crops in the years of research was several times higher than these indicators. The following weeds were predominant: pink thistle (*Cirsium arvense* (L.) Scop.), Tenacious bedstraw (*Galium aparine* L.), bagged sailor (*Centaurea cyanus* L.), field bindweed (*Convolvulus arvensis* L.), perforated mayweed (*Matricaria perforata* Merat.) and others, there were more than 100 weeds per 1 m².

In order to determine the effect of herbicides on weeds, three counts of weed infestation of crops were carried out by the instrumental method with the determination of the species composition of weeds, their number and weight. The first count was carried out before the herbicide treatment in the tillering phase, the second count was carried out after 25 days in the heading phase, and the third count was carried out in the waxy ripeness phase of winter wheat.

### 3. Results

As a result of the research carried out, it was established (table 2) that when using various modern herbicides, one can observe a single tendency in their effect on weeds in the agrocenosis of winter wheat; drugs that belong to the group of chlorophenoxyacetic acid derivatives (Aminopelic, Prima), have a visible suppression of weeds after 3 days; destruction of more than 50% of weeds on 7-9 days, complete destruction of weeds on 9-11 days.
Table 2. Dynamics of weed destruction under the influence of herbicides on winter wheat (average for 2016-2018)

| No. | Experimental variant | First indication, days | Infestation of more than 50%, days | Destruction of more than 50%, days | Complete destruction, days |
|-----|----------------------|-----------------------|-----------------------------------|-----------------------------------|--------------------------|
| 1   | Control (without treatment) | -                     | -                                 | -                                 | -                        |
| 2   | Secator              | 6                     | 11                                 | 15                                 | 18                       |
| 3   | Aminopelic           | 3                     | 6                                 | 9                                 | 11                       |
| 4   | Secator + Aminopelic | 3                     | 10                                 | 15                                 | 16                       |
| 5   | Prima                | 3                     | 5                                 | 7                                 | 9                        |
| 6   | Grench               | 10                    | 12                                 | 18                                 | 21                       |
| 7   | Prima + Grench       | 3                     | 6                                 | 10                                 | 15                       |
| 8   | Granstar Pro         | 7                     | 10                                 | 14                                 | 17                       |
| 9   | Granstar Pro + Aminopelic | 3                  | 5                                 | 9                                 | 14                       |
| 10  | Lontrel Grand + Prima| 3                     | 6                                 | 8                                 | 14                       |
| 11  | Difhezan             | 5                     | 7                                 | 9                                 | 14                       |
| 12  | Hand weeding         | -                     | -                                 | -                                 | -                        |

Such herbicides as Secator, Granstar, Grench, Difhezan stopped the growth and development of weeds as early as a few hours after application, but visible signs of infestation appeared only in 5-7 days, and complete destruction appeared in 14-21 days. These drugs have a systemic effect and in weeds they move along the wood and phloem vessels, so a visible phytotoxic effect a few days later than in chlorophenoxyuskic acid preparations can be observed. When using tank mixtures with the following drugs (Secator + Aminopelic, Prima + Grench, Granstar + Aminopelic, Lontrel Grand + Prima), weed infestation was noted on the 3rd day after treatment, and the complete destruction of weeds occurred only on the 14-16th day after treatment. This is due to the fact that Secator, Grench, Granstar provide a systemic effect on a weed plant, stopping its growth and development, and Aminopelic and Prima have a phytotoxic effect of a more contact nature. As a result, the effectiveness of treatment is significantly increased, the dependence on weather conditions is reduced, and there is also no risk of resistance.

Table 3 shows the results of the effect of the studied herbicides on weeds.

Table 3. The effect of herbicides on weeds in winter wheat crops (average for 2016-2018)

| No. | Experimental variant | Before treatment | After treatment | Before harvesting | Decrease | Biological efficiency, % |
|-----|----------------------|------------------|----------------|------------------|---------|-------------------------|
|     |                      | quantity, pcs/m² | weight of wet weeds, g/m² | quantity, pcs/m² | weight of wet weeds, g/m² |          |                       |
| 1   | Control (without treatment) | 136              | 216.6           | 154              | 1120     | 163                     | 1440     | -                     | -                  |
|   | Herbicide Treatment         | Density Pcs/m² | Hand Weeding | Secator + Aminopelic | Granstar + Aminopelic | Prima + Grench | Prima + Aminopelic | Lontrel Grand + Prima |
|---|-----------------------------|----------------|--------------|----------------------|------------------------|---------------|-------------------|------------------------|
| 2. | Secator                    | 133            | 7            | 210.0                | 26                     | 33.5          | 28                | 40.2                   | 79.1                   | 81.0                   | 80.5                   |
| 3. | Aminopelic                 | 141            | 9            | 223.2                | 29                     | 45.2          | 30                | 49.5                   | 78.7                   | 78.2                   | 80.5                   |
| 4. | Secator + Aminopelic       | 137            | 21           | 217.1                | 21                     | 26.7          | 22                | 34.3                   | 84.1                   | 84.4                   | 84.8                   |
| 5. | Prima                      | 135            | 24            | 215.4                | 24                     | 32.6          | 26                | 39.9                   | 80.9                   | 81.7                   | 82.3                   |
| 6. | Grench                     | 138            | 25            | 218.2                | 25                     | 31.1          | 25                | 38.7                   | 82.0                   | 82.4                   | 82.0                   |
| 7. | Prima + Grench             | 131            | 18            | 232.3                | 18                     | 30.3          | 20                | 35.6                   | 84.9                   | 85.0                   | 86.4                   |
| 8. | Granstar Pro               | 129            | 21            | 201.9                | 21                     | 30.9          | 23                | 36.9                   | 82.3                   | 81.8                   | 83.8                   |
| 9. | Granstar Pro + Aminopelic  | 132            | 17            | 219.0                | 17                     | 25.4          | 19                | 31.8                   | 85.7                   | 85.6                   | 87.3                   |
| 10.| Lontrel Grand + Prima      | 134            | 15            | 221.3                | 15                     | 22.9          | 16                | 30                     | 88.1                   | 86.6                   | 89.0                   |
| 11.| Difhezan                   | 141            | 0.3           | 232.1                | 20                     | 30.9          | 21                | 37.2                   | 85.1                   | 84.2                   | 85.8                   |
| 12.| Hand weeding               | 136            | 7             | 219.0                | 0.3                    | 1.2           | 2.0               | 7.2                    | 98.6                   | 96.8                   | 99.8                   |

F = 45.82; HCP_{0.05} = 4.154 - the effect of herbicides on the amount; F = 48.47; HCP_{0.05} = 4.385 - per mass.

From the data in table 3, it can be seen that the most effective mixtures were tank mixtures of herbicides Secator + Aminopelic, Prima + Grench, Granstar + Aminopelic and Lontrel Grand + Prima. Their biological effectiveness was within 84.8 - 89.0%. These tank mixtures can be recommended for introduction into production.

The choice of herbicidal treatment should depend on the dominant weeds, if the fields are heavily infested with field bindweed, then it is best to use Granstar + Aminopelic tank mixture; if the fields are infested with pink thistle it is better to use Lontrel Grand + Prima tank mixture; if the predominant species is tenacious, Prima + Grench or Pruner + Aminopelic tank mixture is preferable.

### 4. Conclusion

In the course of research, direct and indirect effects of drugs on weeds were established. The direct effect was to suppress the development of weeds and their gradual death. An indirect effect was found in a change in the modes of illumination, humidity, competition of other individuals, a change in the metabolism of cultivated plants, etc., as a result of which there is a change in the structure and functional characteristics of the relationship of consorts in a consortium.

As a result of herbicide treatment in winter wheat crops, the planting density decreased from 136 pcs/m² to 8-29 pcs/m² and biomass from 216.6 g/m² to 25.7 - 49.5 g/m² of weeds, depending on biological effectiveness of herbicides and their mixtures. With the help of hand weeding, the density of weeds was reduced to 2 pcs/m² and the biomass to 7.2 g/m².

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