Technological aspects of growing winter wheat in arid conditions

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Abstract. The results of research are into the technologies of an integrated system for protecting winter wheat plants in arid conditions are presented in this article. Field experiments were carried out on a field located in the light chestnut subzone of the dry steppe zone of chestnut soils. The climate is very exchangeable. In the conducted field experiments, winter wheat crops were processed using four technologies for the use of fungicides, herbicides, insecticides in various combinations of tank mixtures. In the process of research, we developed four technology options for an integrated system for the use of modern plant protection products that can be selected by agricultural enterprises with various chemical applications. The most effective option in containing fungal infection was identified and the most cost-effective technology for grain production was 57.2%, yield 1.9 t / ha and the option without using chemical plant protection products - yield 1.3 t / ha, profitability – 41.5%, there was also the largest in the experience the development and spread of soil infection.

1. Introduction
Winter wheat plays a decisive role in ensuring the country's food security. it is a component of the threshold value indicated in the approved Food Security Doctrine in January 2020 in relation to grain - not less than 95% [1, 2]. One of the significant reasons for the under-harvest of winter wheat is the development of diseases, the development of weeds, the spread of pests [4, 5, 6].

During the study, the contamination of crops was root rot, which cause great economic harm to the crop. They spread unevenly, and as a result, seedlings fall out, productive bushiness, grain weight and number in the ear decrease, their quality deteriorates [7, 8]. Damage to the crop by fungal diseases can range from 15% to 40%. Soil is the main source of infection. In years with heavy rainfall, mass transfer through seeds is possible. As a rule, the species composition of mycological pathogens for each ecological and geographical area is diverse. Studies have determined that in the Lower Volga region, the fungi G. gordonii were the predominant species causing root rot; F. oxysporum and C. sativus were less affected. Types of fungi affecting agricultural crops F. culmorum, G. avenacea, F. sporotrichioides, M. nivalis, F. incarnatum, and D. teres were isolated at a low frequency [9]. The reasons for the spread of root rot can be adverse weather conditions, non-observance of crop rotation, surface tillage, improper use of certain drugs to protect plants from a complex of diseases, weeds [4,5].

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Therefore, the importance of improving the seed and plants to reduce the infection of fungal diseases of winter wheat plants with the formation of crop structure elements is obvious. [10,11,12] It is important to note that damaged plants are weakly bushy. Often, at the beginning of flowering, leaf wilting and the dying of producing stems are observed. The grain on the remaining stems is hollow or a complete white-ears appear.

In winter wheat crops from frequently occurring weeds (monocotyledonous, dicotyledonous), the backlash is thrown back, the spherical backworm, the chorispora tender, the field chamomile, the white gauze, the field sow thistle, the field bindweed, the Tartar milkweed, the sow thistle, the milkweed, the buckwheat, the buckwheat, and the highlander they compete for light, habitat, water and nutrients.

Common pests that damage the winter wheat crop in the Lower Volga region: bug bug, bug, bread bug, trips, common drunkard, swedish fly, sawfly, etc.

Under production conditions, the main criteria for choosing varieties of winter wheat is its yield and resistance to lodging, and resistance to diseases is relegated to the background due to the availability of modern means of chemical protection of plants from pests and diseases [7,8].

The purpose of research is the development of technology for the use of chemical plant protection products in an integrated system of plant protection on winter wheat.

2. Materials and methods
The studies were carried out on the experimental field located in the light chestnut subzone of the dry steppe zone of chestnut soils. The climate is sharply continental. The sum of average daily positive air temperatures is 3400-3500 C°. The humus content is 1.2-2.0%, pH = 7.8. Total precipitation for the study period from sowing to harvesting winter wheat fell 119.5 mm. The sum of positive temperatures was 1528 C°.

Field experience laid in accordance with the recommendations of B.A. Armor 4-fold repetition. The area of the accounting plot is 100 m². Crop cultivation agricultural technology - generally accepted for this region.

For experimental sowing, seeds of winter wheat of the Kamyshanka 5 variety were used, which is highly resistant to smut diseases, and medium to brown rust, powdery mildew, and root rot. During the study, wheat crops in the spring were thinned out (due to weather conditions), a tribenuron methyl herbicide treatment of 750 g / kg was carried out with a spread rate of 0.02 kg / ha, and in the period after treatment, the biological efficiency was from 82 to 85% 30 days after processing. In the process of work, the following chemical plant protection methods were studied: treatment of seed with a pure dressing agent, a dressing agent in tank mixtures with physiologically active substances in recommended and lowered dosages and the use of a complex of streptotricin antibiotics 32.0 g / l + phytobacteriomyacin BA-120000 EA / ml as a protectant.

3. Results and discussion
Four technologies were studied in an experiment for an integrated system for protecting plants from pests, diseases, and weeds in winter wheat crops:

Technology No. 1 (B-1)
1. Seed dressing: (AI thiabendazole 25 g / l + flutriafol 25 g / l) - 2.01 / t;
2. Treatment of crops with a herbicide (tillering phase) (AI tribenuron-methyl 750 g / kg) - 0.02 1 / ha;
3. Treatment of crops with fungicides: (AI propiconazole 300 g / l + tebuconazole 200 g / l) - 0.41 / ha;
4. Treatment of crops with insecticides: (AI lambda-cygalotrin 100 g / l) - 0.11 / ha.

Technology No. 2 (B-2)
1. Seed dressing: (d.v. diphenoxonazole 30 g / l + ciproconazole 6.3 g / l) - 0.75 1 / t + (d.v. orthocresoxyacetic acid triethanolammonium salt + 1-chloromethylsilatran 855 + 95 g / kg) - 4.0 g / t;
2. Treatment of crops with herbicides (tillering phase) (AI tribenuron-methyl 750 g / kg) -0.02 1 / ha + (AI orthocresoxyacetic acid triethanolammonium salt + 1-chloromethylsilatran 855 + 95 g / kg) - 10.0 g / ha;
3. Treatment of crops with fungicides: (AI propiconazole 300 g / l + tebuconazole 200 g / l) - 0.4 l / ha + (AI humic acids, amino acids, fulvic acids, organic acids, vitamins, agricultural microorganisms) - 0.2 l / ha;

4. Treatment of crops with insecticides: (AI lambda-cyhalotrin 100 g / l) - 0.1 l / ha + (AI Bacillus Subtilis) - 2.0 l / ha.

**Technology No. 3 (B-3)**

1. Seed treatment: (AI complex of streptotricin antibiotics 32.0 g / l + phytobacteriomycin BA-120,000 EA / ml) - 2.0 l / t;
2. Treatment of crops with herbicides (tillering phase) (AI tribenuron-methyl 750 g / kg) - 0.02 l / ha; + (AI humic acids, amino acids, fulvic acids, organic acids, vitamins, agricultural microorganisms) - 0.2 l / ha;
3. Treatment of crops with fungicides: (AI propiconazole 300 g / l + tebuconazole 200 g / l) - 0.4 l / ha + (AI humic acids, amino acids, fulvic acids, organic acids, vitamins, agricultural microorganisms) - 0.2 l / ha;
4. Treatment of crops with insecticides: (AI lambda-cyhalotrin 100 g / l) - 0.1 l / ha + (AI humic acids, amino acids, fulvic acids, organic acids, vitamins, agricultural useful microorganisms) - 0, 2 / l ha;

**Technology No. 4 (B-4)**

1. Seed treatment: (d.v. diphenoconazole 30 g / l + ciproconazole 6.3 g / l) - 0.75 l / t + (d.v. orthocresoxy acetic acid triethanolammonium salt + 1-chloromethylsilatran 855 + 95 g / kg) - 4.0 g / t;
2. Treatment of crops with herbicides (tillering phase) (AI tribenuron-methyl 750 g / kg - 0.02 l / ha; 0.02 l / ha) + (AI orthocresoxyacetic acid triethanolammonium salt + 1-chloromethylsilatran 855 + 95 g / kg) - 10.0 g / ha;
3. Treatment of crops with fungicides: (AI propiconazole 300 g / l + tebuconazole 200 g / l) - 0.4 l / ha + (AI humic acids, amino acids, fulvic acids, organic acids, vitamins, agricultural microorganisms) - 0.2 l / ha;
4. Treatment of crops with insecticides: (AI lambda-cyhalotrin 100 g / l) - 0.1 l / ha + (AI Bacillus Subtilis) - 2.0 l / ha;

Sowing of winter wheat was carried out in the first ten days of September with mandatory seed dressing with various dressing agents (see above). A productive moist ure supply of 0-30 cm ranged from 7.71 to 6.05 mm (table 1).

Table 1. Productive moisture reserve in winter wheat crops (Federal Research Center for Agroecology RAS, 2014-2015).

| №/n | Variant      | 0-30 cm          | 0-100 cm        |
|-----|--------------|------------------|-----------------|
|     |              | 19.09.2014. | 15.07.2015. | 19.09.2014. | 15.07.2015. |
| 1.  | B-1 Technology № 1 | 6.05  | 3.83      | 6.05  | 3.83         |
| 2.  | B-2 Technology № 2 | 7.65  | 2.71      | 7.65  | 2.71         |
| 3.  | B-3 Technology № 3 | 6.35  | 3.64      | 6.35  | 3.64         |
| 4.  | B-4 Technology № 4 | 7.71  | 2.61      | 7.71  | 2.61         |
| 5.  | B-5 Control    | 6.34  | 2.79      | 6.34  | 2.79         |

Table 1 shows that the development of plants occurred mainly due to soil moisture reserves. By the time of harvesting (July 2015), there was practically no moisture, especially in the upper soil layer 0-30 cm.

The best field germination (85.0%) was observed in winter wheat plants, where the seeds were treated with a complex of streptotricin antibiotics 32.0 g / l + phytobacteriomycin BA-120,000 EA / ml) - 2.01 / t (technology No. 3), low seed germination was in option 1, with the thiabendazole 25 g / L etchant; flutriafol 25 g / L. In variants 2,4, seed germination did not differ much and amounted to 78-79% with etchants diphenoconazole 30 g / l + cyproconazole 6.3 g / 0.75 l / t. In the control, the germination rate was 87%. This is due to the lack of chemical effects on the seeds.

In our experience, the problem of fungal diseases was solved by using new disinfectants in a tank mixture of physiologically active substances, as well as treating the seed with an antibiotic of the
streptotricin group. When analyzing the phytosanitary state of the root system of winter wheat in the tillering phase for all options, we saw that the preparations well inhibited soil infection, and in relation to the control, they ranged from 27.3 to 72.7% (table 2). In the tubing phase, the drugs continued to contain the infection, and in relation to the control, they ranged from 13.1 to 62.3%. However, the best option for containing the fungal infection was on the first option (technology 1).

During the growth and development of winter wheat plants based on biometric studies, it was noted that plants in the tillering phase had almost the same parameters. However, B-2 (technology No. 2) turned out to be predominant by the length and weight of plants by 14.2 and 25.0% in comparison with the control. In the bumping phase, the ratio of the development of plants in the variants changed. Technology No. 2, by the time of harvesting, prevails in all biometric indicators given in table 2.

Table 2. The defeat of winter wheat plants by root rot (Federal Research Center for Agroecology RAS, 2014-2015).

| Variant       | development, % (PB) | spreading, % (PA) | development, % (PB) | spreading, % (PA) |
|---------------|---------------------|-------------------|---------------------|-------------------|
| B-1 Technology № 1 | 1.5                 | 4.0               | 1.5                 | 4.0               |
| B-2 Technology № 2 | 4.5                 | 10.0              | 4.5                 | 10.0              |
| B-3 Technology № 3 | 2.5                 | 6.0               | 2.5                 | 6.0               |
| B-4 Technology № 4 | 4.0                 | 8.0               | 4.0                 | 8.0               |
| B-5 Control v/o  | 5.5                 | 12.0              | 5.5                 | 12.0              |

When conducting a sheaf analysis of winter wheat plants, a positive effect of the preparations on the productive bushiness, the number of spikelet in an ear, the ear length, etc. was noted. Grain productivity ranges from 1.90 to 1.97 t / ha, while in the control version 1.3 t / ha.

The application of technology 2, contributed to an increase in productive stems and, as a result, increased productivity, which in relation to control amounted to 29.6%. I would also like to note a yield increase for all technologies, which in relation to control is from 25.0 to 27.6%.

Table 3. Structural analysis of winter wheat (Federal Research Center for Agroecology RAS, 2014-2015).

| Variant       | Weight of stock, kg | Quantity of plants, kg/m | Quantity of sprout in one thing, m² | Length, sm | Length of sprout, sm | Quantity of both wheat beans | Quantity of seeds | Mass of seeds, g | Total yield, ga/m |
|---------------|---------------------|--------------------------|-----------------------------------|-------------|---------------------|-------------------------------|-----------------|-----------------|------------------|
| B-1 Technology № 1 | 565                 | 103                      | 301/244.9                         | 38.4        | 8.3                 | 15.4/1.2                     | 30.7            | 29.8            | 1.90             |
| B-2 Technology № 2 | 555                 | 163                      | 390/312                           | 46.7        | 8.4                 | 15.5/1.4                     | 28.1            | 29.7            | 1.97             |
| B-3 Technology № 3 | 530                 | 148                      | 298/252                           | 40.5        | 8.5                 | 15.5/1.1                     | 31.0            | 30.6            | 1.94             |
| B-4 Technology № 4 | 540                 | 148                      | 376/281                           | 44.3        | 8.4                 | 15.7/1.5                     | 29.3            | 30.6            | 1.90             |
| B-5 Control v/o  | 485                 | 129.0                    | 274/236                           | 37.4        | 6.7                 | 13.9/2.6                     | 17.7            | 28.4            | 1.3              |
| HCP05          | 0                   | 0                        | 0                                 | 0           | 0                   | 0                             | 0               | 0               | 0.11             |

The analysis of the quality of winter wheat grain, the use of various preparations did not adversely affect the biochemical processes occurring in plants [9].

The economic efficiency of using the technologies studied in the experiment was (table 4): the highest profitability by technology 3 with a profitability level of 57.2%, the lowest technology 4 - 48.3%.

Productivity of winter wheat in technology 3 is 1.94 t / ha, in technology 4 is 1.9 t / ha. The cost of pesticides in the total volume was 4–28.3% in technology and 27.8% in technology 3. In the second
option, with the highest yield of winter wheat 1.98 t / ha, profitability was 55.1%, the cost of pesticides in the total cost was 27.7% (table 4).

Table 4. Cost-effectiveness of pesticides in the production of winter wheat grain (Federal Research Center for Agroecology RAS, 2014-2015).

| Indicators          | Control(v/o) | Variant 1 | Variant 2 | Variant 3 | Variant 4 |
|---------------------|--------------|-----------|-----------|-----------|-----------|
| Yield, t/ha         | 1.3          | 1.90      | 1.97      | 1.94      | 1.90      |
| Wastes, RUB         | 10100.0      | 13511     | 13972.2   | 13572.2   | 14092.2   |
| Including Pesticides, RUB | –           | 3411      | 3872.2    | 3475.2    | 3992.2    |
| Price               | 11000        | 11000     | 11000     | 11000     | 11000     |
| Revenue             | 14300        | 20900     | 21670     | 21340     | 20900     |
| Net income          | 4200         | 7389      | 7697.8    | 7767.8    | 6807.8    |
| Ratability , %      | 41.5         | 54.7      | 55.1      | 57.2      | 48.3      |

4. Conclusions
Based on the research, the following conclusions can be drawn:

1. Presuming seed dressing of winter wheat with the preparation of a complex of streptotricin antibiotics 32.0 g / l + phytobacteriomycin BA-120,000 EA / ml helps to create optimal conditions for the initial growth of plants, field germination was 85.0%.

2. The use of a complex of streptotricin antibiotics 32.0 g / l + phytobacteriomycin BA-120,000 EA / ml in the treatment of seeds, increased the resistance of winter wheat plants to root rot in the early stages of development and had a prolonging effect throughout the growing season and amounted to 27.3 to 72.7% relative to the control. However, the best option for controlling fungal infection was in the first option (technology 1 presowing treatment with AI thiabendazole 25 g / l + flutriafol 25 g / l) - 2.0 l / t);

3. When studying the effectiveness of the use of drugs in technologies, it was determined that the highest yield in the second version was 1.97 t / ha, with a profitability of grain production of 55.1%. The highest profitability was on the third option 57.2%, productivity - 1.94 t / ha.

So, in the process of research, we developed four technology options for an integrated system for the use of modern plant protection products that can be selected by agricultural enterprises with various chemical applications. The most effective option in containing fungal infection and the most cost-effective option for grain production were determined in comparison with the option without using chemical plant protection products.

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