Advances in Social Science, Education and Humanities Research, volume 393
The Fifth Technological Order: Prospects for the Development and Modernization of the Russian Agro-Industrial Sector (TFTS 2019)

Development of Spring Wheat Sprouts After Chemical Seed Treatment

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***Abstract*—The article discusses the effect of fungicides to the sowing qualities of seeds, growth and development of sprouts. In the laboratory experiments was revealed the effect of disinfectant, the concentration of their active substance and the duration of the period from treatment on the formation of sprouts wheat soft spring variety Pavlogradka. The action of systemic fungicides Comfort, AltSil, Terrasil, and Alcasar were observed when used at the recommended norm and twice as high after 1, 6, and 12 months from treatment. Options were compared with the control without treatment. The use of drugs in the recommended rate after one month of storage of grains, reduce in germination with 5% to 31%, in comparison with the control variant. On the sprouts were formed 3.53–4.68 pieces of roots with variation of the feature in 32–90%. In these variants of the experiment, the size of the coleoptile did not exceed 1/4–1/5 of the seedling portion. An increase in the period after treatment of the chemical agents Comfort, AltSil and Terrasil with one up to six months affected favorably to laboratory germination, which achieved 82-84%. The roots were formed by 4.4–4.9 pcs., and the coleoptile was 1/2–1/3 part of sprout. Wheat sprouts had no signs of fungal disease damage when using the Alcasar disinfectant after storing the seeds of 6 and 12 months, but their germination rate was 1.3-1.8 times lower. A coleoptile surrounded the grain at the base and formed a bent ring. The study of the effect of chemicals on the level of plant genetic diversity continues under field experiments.**

Keywords—spring wheat, variety, fungicide, seeds, wheat sprout, sowing qualities of seeds.

I. INTRODUCTION

The goal of each breeder is to create varieties of spring wheat with the highest level of productivity. This is the main criterion for the effectiveness of any breeding program. With the selection of wheat, the question of the resistance of varieties to diseases is particularly acute. We need to develop new methods of selection, genetic and physiological-biochemical studies of plants when creating forms and varieties of crops that meet the requirements of production. And also screening (mass check), comparison of laboratory and field results is necessary [1].

Work has been launched to enrich and expand the genetic base for breeding, in connection with intensive race-forming processes in the populations of pathogens of the most harmful diseases occurring in recent years in Western Siberia [2].

To combat diseases and plant pests in the manufacturing sector, various kinds of chemical compounds are used. The benefits of using pesticides and their role in producing abundant, diverse and affordable food are well known. Nevertheless, there is close critical attention of society and the scientific community regarding the use of these substances, the possibility of reducing their use in agricultural production [3]. A number of pesticides have an oncogenic or mutagenic effect that does not have selectivity. With their regular use, an early genetic adaptation of pests occurs. Pesticides top the list of dangerous environmental pollutants. Some of them are toxic, while others, while harmless in themselves, can turn into toxic products with carcinogenic and cytotoxic properties [4].

Evaluation of pesticides for mutagenic activity allows a differentiated approach to their use in crops. The most widely characteric of action of the chemicals used to protect plants has been studied in the last century. The effect of dithiocarbamic acid derivatives - thiuram, zineb, ziram on various biological objects, including plants, was revealed. The active substance tetramethylthiuram disulfide in plants decomposes to tetramethylthiourea and tetramethyl monosulfide, which are more dangerous and cause mutations. Benzimidozoles, which include carbendazim, cause a violation of cell division of the cell, inducing mutations [5]. Azoles inhibit the synthesis of sterols that directly affect membrane permeability [6].

Various processes of growth and development of wheat plants do not respond equally to the action of a particular mutagenic factor. Some of them may not show significant changes or even be stimulated. Others are suppressed to such an extent that the plant either loses viability or becomes less adapted to environmental conditions. Analysis of the effect of doses of pesticides on the germination of seeds, the morpho-physiological characteristics of seedlings of cultivated plants, on the quantitative characteristics of plants, will make it possible to obtain a new source material for practical plant breeding [7]. Integration of the method of chemical mutagenesis with traditional selection methods intensifies selection and raises it to a higher level [8].

Thereby, the main goal in our studies is to identify the effect of the chemical compounds (disinfectants) on the

Scientific research was carried out within the framework of the budget project "To create high-yielding varieties of strong food spring and winter wheat and highly protein winter hardy triticale resistant to diseases, drought and negative edaphic factors in the Western Siberia, the organization of their seed production" No. 01.2.00102530 (Section: Using chemical mutagenesis in the creation of adaptive varieties of soft wheat).

quality of seeds to sown and morphological features of the sprouts of spring wheat.

II. Material and Methods

For the experiment, protectants from the class were used: benzimidazoles - Komfort (the active ingredient is carbendazim); triazoles and their derivatives - AltSil, Terrasil (active ingredient tebuconazole); Alcasar (active ingredient difenoconazole + cyproconazole). Komfort is a highly effective systemic fungicide, has both therapeutic and prophylactic effects, a long period of protective action. It is used for seed treatment and sowing of grain crops [9]. AltSil and Terrasil are systemic fungicides with a wide spectrum of action. The active ingredient tebuconazole of these pesticides has protective, therapeutic and eradicating effects. It has a specific effect against all species of rust fungi on crops. The universal two-component system fungicide Alcasar is used to treat cereal seeds against fungal diseases spreading with seeds. The active substances – difenoconazole and cyproconazole – perfectly complement each other and can effectively fight both superficial and internal infections of the grain [10].

According to the experiment scheme (four fungicides in two concentrations), the fungicide solution was sprayed onto the seeds of spring wheat of Pavlogradka variety. The effect of the chemical agent was observed when applied at the recommended norm (n) and twice as high (2n). Option without treatment with fungicide served as the standard. The sowing qualities and morphological features of the sprouts were examined after 1 month, 6 and 12 months after spraying the seeds, which were processed in April 2017-2018. Germination of seeds was carried out in rolls, observing the methods and requirements of Interstate Standard 12038-84 [11]. For the statistical processing of the data of two-factor experiment, the method of variance and correlation analysis according to B. Dospehov was used [12]. The type of the drug is taken as factor A, for factor B - the rate of disinfectant consumption. Statistics was calculated by database software Excel.

In the experiment, one of the varieties of soft spring wheat Pavlogradka is a variety of Lutescens. It is medium late with a growing season of 79 to 93 days. The plant is erect, the stem is strong, thick, hollow. Spike with a beveled narrow shoulder, medium length and medium density, prismatic, white. The grain is large, oval-ovate with a groove of medium depth, red. The mass of 1000 grains is 36-41 g. The originators of the variety are Omsk State Agrarian University and Superelita LLC. The average crop yield per pair is 2.53 t/ha, which is 0.28 t/ha higher than the standard; according to the non-steam predecessor, the yield exceeds the standard by 0.17-0.37 t/ha. It is susceptible to dust smut, highly susceptible to brown leaf rust. It has been included in the State Register for cultivation of the Omsk region.

III. Results and Discussion

Wheat seeds were etched with preparations with the recommended consumption rate: Komfort - 1.5 l/t, Alkasar - 1.0 l/t, AltSil and Terrasil - 0.5 l/t and with an overestimated consumption rate twice. Grains of the control option in the experiment were not treated with dressing agents. After processing, the seeds were dried and laid in bags for storage. Studies with them were carried out according to the experimental design. Germination energy, germination were determined, and sprouts were measured by the main parameters. The results of the laboratory experiment are presented in the table 1.

TABLE I. Seeds germination percentage of the variety Pavlogradka depending on the norm and the period after treatment (mean value of indicators), %

Norm of application of the preparation	after 1 month	after 6 months	after 12 months
standard	81	85	74
Komfort			
n	75	83	62
2 n	59	83	58
Alcasar			
n	73	73	49
2 n	80	62	66
AltSil			
n	77	78	64
2 n	80	84	70
Terrasil			
n	56	72	62
2 n	53	82	64

Dressing agents, having in their composition various active substances, had an uneven effect on the germination rates. The sowing qualities of the seeds treated with the preparations are unstable compared to the control variant. Germination energy is maximum (98-100%), but the formation of full-fledged sprouts in 7 days is not observed on all grains. Influence is exerted by both the etchant rate and the time period from processing.

One month after the use of the preparations into the normal (n) compared with the non-treated version leads to a decrease in germination from 5% to 31% due to the presence of seeds with undeveloped roots. Rotten seeds are not observed. This effect was especially clearly observed in the variant using the Terrasil preparation, where the germination capacity averaged 56%. The indicator was 81% in the control variant. Increased concentration of fungicides Komfort and Terrasil after 1 month in treated seeds inhibits germination by 1.4–1.5 times. On the contrary, AltSil and Alkasar preparations positively influenced the indicator, increasing germination to 80%. Interestingly, in the variant with a higher concentration of the active substance (2n), an increase in the period after treatment on 1 month up to 6 months of fungicides Komfort, AltSil, Terrasil affected favorably on laboratory germination, which increased from 24%, 4% and 29% respectively.

Terrasil preparation not only at a concentration of 2n, but at a concentration of n contributed to a sharp increase in germination (1.3 times) after 6 months from etching. According to scientists, tebuconazole as the active substance of AltSil and Terrasil, quickly penetrates into the plant and is evenly distributed in it. It has a growth-regulating effect. However, with a lack of moisture, a deep seeding of seeds, dampness of the soil, its action can go into retardant. At the same time, low germination energy, field germination and delayed emergence of seedlings are observed [13].

Only when exposed to an overestimated rate of the drug Alkasar (2n) after 6 months, a decrease in the germination rate by 1.3 times was recorded. This trend continued after 12 months from treatment, when the number of normally germinating seeds did not exceed 49% (n) and 66% (2n). On the other hand, wheat sprouts in the variants using the Alcasar

seed dressing did not show signs of fungal disease damage (Fig. 1). When using a fungicide to combat pathogens, one can note a pronounced effect [14].

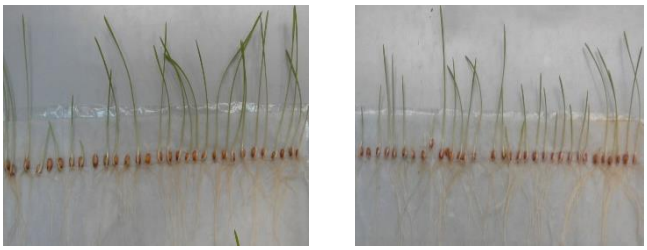

Fig. 1. Wheat sprouts after 6 months from treatment with the chemical agent Alcasar at the recommended norm (n) and at an elevated norm (2n).

Belov D.A. notes that absorption of difenoconazole by seeds and sprouts occurs gradually, because it is less soluble in water than its mixture partner cyproconazole. Most of the first component is concentrated closer to the base of the stem, providing long-lasting protection against various root rot and underlying stem diseases. Cyproconazole is rapidly absorbed and redistributed upstream, providing effective protection of new growth and emerging spikelet [10].

In the control variant (without the use of disinfectant), the period of seed dormancy to 6 months favorably affected the morphological characteristics of the seedlings: the germination percentage is increased, the length of sprout is enlarged and the numbers of rootlets were more. However, in each repetition of the variant of experience visually observed a strong degree of damage to sprouts of grain grains by fungal diseases (Fig. 2).

Morphological and physiological parameters of wheat sprout formed in the experiments were not uniform (tabl. 2).

Morphological features and parameters of wheat sprout after the action of the fungicide at the same concentration differ depending on the time period that has passed from the treatment.

In the experiment with the laying of seeds to identify the sowing qualities after 6 months, the number of rootlets on the average is 5.4–4.9 pieces (coefficient of variation 0.09). This indicator is significantly greater than in the experiment with the laying of seeds after 1 month, where 3.53–4.68 pieces were formed. with variation of the trait in 32–90%. In these variants of the experiment, the size of coleoptile did not exceed 1/4–1/5 of the sprout, while in sprouts after 6 months from processing coleoptile takes 1/2–1/3 part. In the experiment with the laying of seeds to identify sowing qualities after 12 months, the number of roots on average is 4.38–4.98 pcs. (coefficient of variation 0.12). Coleoptile in the formed sprout does not exceed 1/2–1/3 parts.

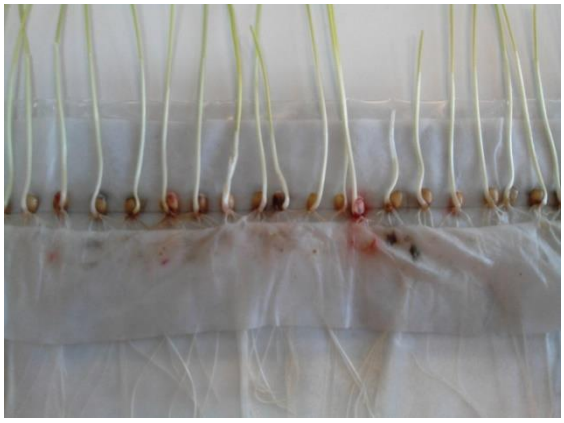

Fig. 2. Wheat sprouts in the control variant after 6 months.

TABLE II. CHARACTERISTICS OF WHEAT SPROUTS OF THE VARIETY PAVLOGRADKA DEPENDING ON THE NORM AND THE PERIOD AFTER TREATMENT (MEAN VALUE OF INDICATORS)

Norm of application of the preparation	**Length of sprout (mm)**			**The number of rootlets**		
	after 1 month	**after 6 months**	**after 12 months**	**after 1 month**	**after 6 months**	**after 12 months**
standard	69.50	77.80	92.20	4.08	4.40	4.80
Komfort						
n	81.85	80.42	85.65	3.95	4.78	4.58
2 n	73.88	80.52	86.48	3.55	4.68	4.83
Alcasar						
n	78.15	75.93	63.10	4.35	4.93	4.78
2 n	53.8	50.80	61.83	3.53	4.90	4.98
AltSil						
n	68.63	81.03	59.23	4.48	4.85	4.68
2 n	70.75	59.80	60.98	4.68	4.40	4.75
Terrasil						
n	50.25	47.63	46.43	4.05	4.55	4.38
2 n	27.35	42.80	41.68	3.58	4.75	4.88
The least substantial difference (LSD) A_{05}	4.36	5.24	5.87	0.40	0.25	0.09
LSD B_{05}	6.80	7.03	6.16	0.38	0.10	0.16
LSD AB_{05}	6.17	7.42	7.03	0.57	0.35	0.07

Coleoptile in variants with the use of the chemical agent Alkasar markedly went around the base of the grain, forming a curved ring (Fig. 1). A change in the shape of coleoptile is not observed either in other variants of drug exposure, or in the control variant.

IV. CONCLUSIONS

In the course of laboratory studies, it can be concluded that the various protectants and their consumption rates have an ambiguous effect on seed germination rates and sprout morphometric parameters. It was revealed that the shelf life of seeds of Pavlogradka variety after treatment of fungicides influences the formation of sprout. Both the inhibitory and stimulating effects of the drugs used were noted.

Under the influence of tebuconazole (as the active substance of AltSil and Terrasil preparations), the sprouts were observed without signs of disease. They were heterogeneous in morphometric parameters.

The fungicide Terrasil in both concentrations clearly had an overwhelming effect on the length of the seedlings after 1 and 6 months from the treatment. Only after 12 months, its application in the norm (n) worked to increase the parameters the length of sprout and the number of roots in comparison with AltSil.

When applying the two-component fungicide Alcasar with the active substances diphenoconazole + cyproconazole, the germination rate was lower than the control, the sprouts were apparently "clean", but their parameters varied greatly.

The best sprouts were formed under the influence of the drug Komfort (the active substance carbendazim), but among them there were many affected by diseases.

Studies under field experiments are needed to identify the relationship between sprouts development and plant productivity and the subsequent assessment of the effect of chemicals on genetic diversity.

ACKNOWLEDGMENT

The publication describes the results that formed the basis for the development of the project "Ecological and genetic study of soft wheat mutant populations induced by means of chemical compounds" No. 20-016-00193A in the Russian Foundation for Basic Research (RFBR) system.

The authors are grateful to the staff of the Center for Breeding and Genetics of Field Crops of the Omsk SAU.

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