EFFECT OF PESTICIDE TREATMENT OF SPRING WHEAT PLOTS ON SEED YIELDS

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The gain in the yields of spring wheat varieties grown from seeds of fungicide-treated plants was 0.23-0.36 t/ha; the gain in the yields of spring wheat varieties grown from seeds of insecticide-treated plants was 0.24–0.31 t/ha. Pesticide-treated parental plants produced seeds with increased productive capacities: when such seeds were sown, the field germinability increased by 3–5%, and the plant survival – by 5–7%.

Key words: wheat, productivity, sowing quality, fungicides, insecticides, productive properties of seeds

Introduction. Academician M.I. Vavilov (1962) pointed out that despite the fact changes caused by different environmental conditions were not inherited in plants, in addressing the issue of the performance of a variety and product quality, non-hereditary variability was crucial. MM Makrushin (1994) noted that along with sowing qualities of seeds, plant growing conditions greatly affected the productive capacities of seeds, when sown in the soil.

M.O. Kindruk et al. [1] thought that the productive capacities of seeds included a wide range of ideas that different seeds of the same genotype (variety) under the same farming conditions of trials could give various yields, and plants could differ in phenotypic and economic characteristics. They highlighted that there was disagreement between scholars and experts concerning the wording "productive capacities" or "yielding qualities." In their view, both of these terms reflect the same concept, although in modern literature the term "productive capacities" is most often used.

Well-known researchers in seed production and science have proven that various yields can be obtained from different batches of seeds of the same variety and reproduction with identical sowing qualities [2].

Literature review and problem articulation. High-quality varietal seeds, which can ensure a gain of 0.2–0.4 t/ha in the yields from their offspring, is one of the most important and cost-effective means to increase the gross grain collection of grain. The absence of pathogenic microflora is one of the most important prerequisites for obtaining seeds with high biological properties. Diseases cause great damage to seeds at all stages of their life [3–5].

Many scientists reported significant disease- and pest-inflicted damage to cereal yields and the effectiveness of plant protection [6–12]. Fungicides applied on winter wheat at the earing onset were found to increase grain yield by 0.46–0.99 t/ha [13]. The highest yield (6.43 t/ha) was achieved by spraying variety Myrlena with fungicide Acanto Plus 28, emulsion concentrate (0.75 L/ha). V.Yu. Suddenko and S.M. Kalenska [14] pointed out that the application of pesticides on spring wheat varieties Elehiia Myronivska and Simkoda Myronivska increased yields from 0.27 to 0.35 t/ha. The swelling activity of seeds increased up to 6%, the germination energy – up to 3%.

S. Avramenko et al. [15] indicated that the high potential of bread and durum wheats could be realized via growing them in accordance with technologies involving integrated use of intensification elements. It is they that should become the basis of modern environmentally friendly technologies for growing spring wheat.

Significant damage to spring wheat fields is inflicted by Eurygaster integriceps and Anisoplia austriaca. In parallel, grain damage by mold, fusariosis and other diseases increases, reducing the laboratory germinability decreases [16].

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In some years in some regions in the south of Ukraine, significant *E. integriceps* -inflicted damage to seeds, which reduced the laboratory germinability by 22–67%, was detected [2].

**Purpose and objectives.** Available literature provides a lot of information about negative effects of pathogens and pests on wheat yields, but effects of pesticides on the productive capacities of produced seeds have been very little studied. This prompted us to conduct an appropriate study. Our purpose was to evaluate the productive capacities of spring wheat seeds depending on the treatment of plots with fungicides and insecticides.

**Materials and methods, experimental part.** In the experiments on the productive capacities of seeds from spring wheat varieties, several indicators were determined. The swelling activity of seeds was determined by M.M. Makrushin’s method [17]; the germination energy, laboratory germinability and 1000-seed weight were determined in compliance with State Standard of Ukraine DSTU 4138-2002 [18]. The strength (intensity) of the initial growth was assessed I.H. Strona’s method [19]. The coleoptile length was measured in accordance with the method of morphological analysis of seedlings [20]. The number of radicles was also counted in accordance with the method of morphological analysis of seedlings [20].

Seed samples from the plots, where in the spring-summer at different stages of organogenesis fungicides Soligor 425 EC (1.0 L/ha; active ingredients – prothioconazole, tebuconazole, spiroxamine), Akula (0.6 L/ha; active ingredients – carbendazim, flutriafol) and insecticides Fas (0.15 L/ha; (active ingredient – alpha-cypermethrin), Karate Zeon 050 CS (0.15 L/ha) (active ingredient – lambda-cyhalothrin) had been applied and the highest significant gain in the yields had been achieved, were tested in the field experiments for productive capacities.

The experimental plot area was 10 m², in six replications. Seeds were sown with a seeder SN-10Ts after soybean with a seeding rate of 5 million germinable seeds per hectare.

The farming techniques in the experiments were traditional and met the zonal recommendations for the Right-Bank Forest-Steppe of Ukraine [21], except for the parameters under investigation.

The field experiments were carried out in accordance with the method of the state trials of plant varieties [22]. The yields were harvested with a combine Sampo-130. The bunker weight of grain was converted to a yield per hectare, with due account for impurities and adjustment for the water content of 14% (DSTU 4138-2002) [18]. Experimental data were statistically processed in special software packages (Excel, Statistica 6.0).

**Results and discussion.** In 2018, the weather during the growing period of spring wheat did not favor a high yield. A small amount of precipitation in the “sowing-seedlings” period delayed germination and made seedlings uneven. Scarce precipitation during the entire growing period of spring wheat decreased the yields. In 2019, the weather negatively affected the yields, output of grade grain and 1000-seed weight. This was attributed to small amounts of precipitation during the “sowing–seedlings” (2.3 mm), “earing - milky ripeness” (32.0 mm), “milky ripeness – wax ripeness” (5.5 mm) and “wax ripeness – threshing” (12.0 mm) periods. The 2020 weather was not entirely favorable for a high yield. The increased average daily air temperature in the “sowing-seedlings” (7.6°C) and “seedlings – earing” (13.8°C) periods and insufficient amounts of precipitation of 4 mm (the multi-year average is 50 mm) and 149 mm (the multi-year average is 150 mm) during these periods delayed the growth and development of plants. In the “milky ripeness - wax ripeness” period, the precipitation amount was 25.9 mm (the multi-year average is 50 mm), and in the “wax ripeness – threshing” period there was no precipitation at all. In the “milky ripeness - wax ripeness” and “wax ripeness – threshing” periods, the average daily air temperature was similar to the multi-year average.

Under the action of fungicides and insecticides, seeds with increased productive capacities were formed on parental plants. When such seeds were sown, the field germinability increased by 3-5% and the plant survival – by 5-7%. Thus, the treatment of spring wheat seed plots with modern fungicides and insecticides significantly improved the phytosanitary condition of the plots, increased the yields of this crop and the quality of seeds. Under the action of these agents, seeds with high productive capacities were produced. The results of evaluating the productive capacities of seeds grown in 2018 and 2019 in the experimental plots, which at organogenesis stages VI, VIII
and X were treated with fungicides Akula (0.6 L/ha) and Soligor 425 EC (0.6 L/ha) and insecticides Fas (0.15 L/ha) and Karate Zeon 050 SS (0.15 L/ha) are summarized in Table 1.

| Pesticide (dose), organogenesis stages | MIP Zlata* | Bozhena* | MIP Raiduzhna** | Diana** |
|---------------------------------------|------------|----------|----------------|---------|
|                                       | Yield, t/ha + to the control t/ha | Yield, t/ha + to the control t/ha | Yield, t/ha + to the control t/ha | Yield, t/ha + to the control t/ha |
| Control (no treatment)                | 3.28       | 3.23     | 3.14           | 3.00    |
| Akula (0.6 L/ha)                      | 3.54       | 0.26     | 3.50           | 0.27    |
| IV + VIII + X                         |            |          | 3.39           | 0.25    |
| Soligor 425 EC (0.6 L/ha)             | 3.56       | 0.28     | 3.52           | 0.29    |
| IV + VIII + X                         |            |          | 3.37           | 0.29    |
| Fas (0.15 L/ha)                       | 3.59       | 0.31     | 3.58           | 0.35    |
| IV + VIII + X                         |            |          | 3.44           | 0.30    |
| Karate Zeon 050 SS (0.15 L/ha)        | 3.60       | 0.32     | 3.55           | 0.32    |
| IV + VIII + X                         |            |          | 3.42           | 0.23    |
| LSD05                                 | 0.23       | 0.24     | 0.22           | 0.18    |

|                                       | 2019       |          | 2020       |          |
|                                       | Average    |          | Average    |          |
| Control (no treatment)                | 3.18       |          | 3.06       |          |
| Akula (0.6 L/ha)                      | 3.50       |          | 3.14       |          |
| IV + VIII + X                         |            |          | 3.17       |          |
| Soligor 425 EC (0.6 L/ha)             | 3.62       |          | 3.14       |          |
| IV + VIII + X                         |            |          | 3.07       |          |
| Fas (0.15 L/ha)                       | 3.48       |          | 3.09       |          |
| IV + VIII + X                         |            |          | 2.90       |          |
| Karate Zeon 050 SS (0.15 L/ha)        | 3.46       |          | 2.90       |          |
| IV + VIII + X                         |            |          | 2.80       |          |
| LSD05                                 | 0.26       |          | 0.23       |          |

|                                       | Average    |          | Average    |          |
| Control (no treatment)                | 3.23       |          | 3.02       |          |
| Akula (0.6 L/ha)                      | 352        |          | 3.28       |          |
| IV + VIII + X                         |            |          | 3.26       |          |
| Soligor 425 EC (0.6 L/ha)             | 3.59       |          | 3.31       |          |
| IV + VIII + X                         |            |          | 3.16       |          |
| Fas (0.15 L/ha)                       | 3.54       |          | 3.30       |          |
| IV + VIII + X                         |            |          | 3.14       |          |
| Karate Zeon 050 SS (0.15 L/ha)        | 3.53       |          | 3.27       |          |
| IV + VIII + X                         |            |          | 3.17       |          |
| LSD05                                 | 0.26       |          | 0.23       |          |

Note: * spring bread wheat; ** spring durum wheat.
On average for the two years, the gain in the yields of spring wheat grown from seeds of fungicide-treated varieties MIP Zlata, Bozhena, MIP Raiduzhna, and Diana amounted to 0.23 –0.36 t/ha. The gain in the yields of spring wheat grown from seeds of these insecticide-treated varieties amounted to 0.24 –0.31 t/ha. MIP Zlata gave the largest gain (0.36 t/ha) in the yield (in the control its yield was 3.23 t/ha), when treated with fungicide Soligor (0.6 L/ha). Bozhena and MIP Raiduzhna also gave the largest gain (0.33 t/ha and 0.29 t/ha, respectively) with Soligor, while their control yields were 3.52 t/ha and 3.02 t/ha, respectively. Diana, with the control yield of 2.90 t/ha, gave a larger gain when treated with insecticide Karate Zeon (0.15 L/ha).

In 2020, slightly better yields were achieved after the fungicide treatment of parental plants, while the insecticide treatment was more beneficial in 2019. Thus, in 2019, MIP Zlata and Diana gave the highest yields after their seeds had been treated with Karate Zeon; Bozhena and MIP Raiduzhna – in the Fas experiments. In 2020, the highest yields were obtained after seeds had been treated with fungicide Soligor.

Given the conflicting views on the relationships between individual quality indicators and productive capacities of seeds, we evaluated such correlations in the experiments on the influence of abiotic and anthropogenic factors on the sowing qualities and productive capacities of spring wheat seeds in 2019–2020. There were moderate correlations between most of the studied quality indicators and productive capacities of seeds (Table 2).

| Quality indicator                                      | r ± m    |
|--------------------------------------------------------|----------|
| 1000-seed weight, g                                    | 0.41±0.088|
| 100-corcule weight, mg                                 | 0.52±0.082|
| Swelling activity, %                                   | 0.52±0.122|
| Germination energy, %                                  | 0.55±0.120|
| Laboratory germinability, %                            | 0.40±0.125|
| Viability, %                                            | 0.26±0.133|
| Germination vigor, % of germinated seeds               | 0.71±0.137|
| 100-wet sprout weight, g                               | 0.43±0.127|
| 100-wet radicle weight, g                              | 0.70±0.136|
| Number of radicles per sprout                          | 0.68±0.120|
| Morphological score of corcules                        | 0.54±0.135|
| Macrinjuries of corcules (corcule staining), %         | -0.79±1.830|
| Multiple correlation coefficient Множинний (for the 15 above-listed indicators) | 0.87±0.150|

There were strong positive correlations between the productive capacity, the number of germinated seeds, number of radicles per sprout, sprout weight and multiple index; there was a negative correlation between the productive capacity and macrinjuries of corcules. Therefore, to more objectively assess the productive properties of seeds, in addition to the indicators specified in the State Standard of Ukraine (DSTU 2240-93), we think that in some cases it is expedient to determine indicators that strongly correlate with productive capacity. They are easily determined and can be used by seed inspections as additional indicators characterizing the quality of seed.

**Conclusions.** The results indicate that the treatment of vegetating plants of spring wheat varieties in seed plots with fungicides and insecticides is a reliable way to obtain seeds with high productive capacities. On average for the study years, the gain in the yields of spring wheat grown from seeds of fungicide- or insecticide-treated varieties MIP Zlata, Bozhena, MIP Raiduzhna, and Diana amounted to 0.23-0.36 t/ha. To more objectively assess the productive properties of seeds, in addition to the indicators specified in the State Standard of Ukraine (DSTU 2240-93), we think that in some cases it is expedient to determine indicators (number of germinated seeds, number of radicles per sprout, sprout weight) that strongly correlate with productive capacity.
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ВПЛИВ ОБРОБКИ ПОСЕВІВ ПІШЕНІЦІ ЯРОЇ ПЕСТИЦИДАМИ НА УРОЖАЙНІ ВЛАСТИВОСТІ НАСІННЯ

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Вступ. Одним із найважливіших і економічно вигідних засобів збільшення валових зборів зерна є сортове високоврожайне насіння, здатне давати приріст урожаю в потомстві до 0,2–0,4 т/га.

Мета. Вивчення врожайних властивостей насіння пшениці ярої залежно від обробки посівів фунгіцидами та інсектицидами.

Матеріали дослідження. В дослідах по вивченню врожайних властивостей насіння сортів пшениці ярої вивчали цілій ряд показників: активність кільчення, енергію проростання, лабораторну схожість, силу початкового росту, довжину колеоптиле і кількість зародкових корінців. Зразки насіння варіантів дослідів де вивчали пряму дію пестицидів на урожайність і отримували найбільшу достовірну її прибавку випробовували в польовому досліді на врожайні властивості. Площа дослідних ділянок становила 10 м² у шестиразовій повторності. Сівбу проводили сівалкою СН-10Ц по попереднику соя з нормою висіву 5 млн схожих насінин на гектар. У насіння пшениці ярої, вирощеного на дослідних ділянках, які на VI, VIII та X етапах органогенезу обробляли фунгіцидами Акула (0,6 л/га) і Солігор 425 ЕС (0,6 л/га) та інсектицидами Фас (0,15 л/га) і Карата Зеон 050 CS (0,15 л/га) проводили вивчення урожайних властивостей. Дослідження здійснювали на сортах МІП Злата, Божена, МІП Райдужна і Діана.

Обговорення результатів. За роки досліджень прибака врожайності в сорті пшениці ярої у потомстві від висіву насіння із всіх варіантів оброблених фунгіцидами становила 0,23–0,36 т/га, інсектицидами – 0,24–0,31 т/га. Під дією засобів захисту на материнських рослинах формувалось насіння з підвищеними врожайними властивостями при висіві якого зростали польова схожість на 3–5 %, виживаність рослин на 5–7 %.

Висновки. Результати проведених досліджень свідчать, про те що обробка вегетуючих рослин сортів пшениці ярої на насінницьких посівах фунгіцидами і інсектицидами є надійним заходом отримання насіння з високими врожайними властивостями.

Ключові слова: пшениця, урожайність, посівні якості, фунгіциди, інсектициди, урожайні властивості насіння

ВЛИЯНИЕ ОБРАБОТКИ ПОСЕВОВ ПШЕНИЦЫ ЯРОВОЙ ПЕСТИЦИДАМИ НА УРОЖАЙНЫЕ СВОЙСТВА СЕМЯН

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Введение. Одним из важнейших и экономически выгодных способов увеличения валовых сборов зерна является сортовое высокоурожайное семена, способное давать прирост урожая в потомстве до 0,2–0,4 т/га.
Цель. Изучение урожайных свойств семян пшеницы яровой зависимости от обработки посевов фунгицидами и инсектицидами.

Материалы исследования. В опытах по изучению урожайных свойств семян сортов пшеницы яровой изучали целый ряд показателей: активность кильчення, энергию прорастания, лабораторную всхожесть, силу начального роста, длину колеоптиле и количество зародышевых корешков. Образцы семян вариантов опытов где изучали прямое действие пестицидов на урожайность и получали наибольшую достоверную ее прибавку испытывали в полевом опыте на урожайные свойства. Площадь опытных участков составляла 10 м² в шестикратной повторности. Сев проводили сейлкой СН-10Ц по предшественнику соя с нормой высева 5 млн всхожих семян на гектар. В семян пшеницы яровой, выращенного на опытных участках, на VI, VIII и X этапах органогенеза обрабатывали фунгицидами Акула (0,6 л/га) и Солигор 425 EC (0,6 л/га) и инсектицидами Фас (0,15 л/га) и Каратэ Zeon 050 CS (0,15 л/га) проводили изучение урожайных свойств. Исследования проводили на сортах МИП Злата, Божена, МИП Радужная и Диана.

Обсуждение результатов. За годы исследований прибавка урожайности у сортов пшеницы яровой в потомстве от посева семян из всех вариантов обработанных фунгицидами составляла 0,23–0,36 т/га, инсектицидами – 0,24–0,31 т/га. Под действием средств защиты на материнских растениях формировалось семян с повышенными урожайными свойствами при посеве которого росли полевая всхожесть на 3–5 %, выживаемость растений на 5–7 %.

Выводы. Результаты проведенных исследований свидетельствуют, о том, что обработка вегетирующих растений сортов пшеницы яровой на semenоводческих посевах фунгицидами и инсектицидами является надежным мероприятием получения семян с высокими урожайными свойствами.

Ключевые слова: пшеница, урожайность, посевные качества, фунгициды, инсектициди, урожайные свойства семян

EFFECT OF PESTICIDE TREATMENT OF SPRING WHEAT PLOTS ON SEED YIELDS

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Introduction. High-quality varietal seeds, which can ensure a gain of 0.2–0.4 t/ha in the yields from their offspring, is one of the most important and cost-effective means to increase the gross grain collection of grain.

Purpose. To study productive capacities of spring wheat seeds depending on treatment of fields with fungicides and insecticides.

Materials and methods. The following indicators were evaluated: swelling activity, germination energy, laboratory germinability, initial growth strength, coleoptile length and the number of radicles. Seed samples that after pesticide treatment had showed the best results were tested in field experiments for productive capacities. The experimental plot area was 10 m², in six replications. Seeds were sown with a seeder SN-10Ts after soybean with a seeding rate of 5 million germinable seeds per hectare. Spring wheat seeds produced in the experimental plots, which were treated with fungicides Akula (0.6 L/ha) and Soligor 425 EC (0.6 L/ha) and insecticides Fas (0.15 L/ha) and Karate Zeon 050 CS (0.15 L/ha) in organogenesis stages VI, VIII and X, were evaluated for productive capacities. The study was carried out on varieties MIP Zlata, Bozhena, MIP Raiduzhna and Diana.

Results and discussion. Over the study years, the gain in the yields of spring wheat varieties grown from seeds of fungicide-treated plants was 0.23–0.36 t/ha; the gain in the yields of spring wheat varieties grown from seeds of insecticide-treated plants was – 0.24–0.31 t/ha. Pesticide-treated parental plants produced seeds with increased productive capacities: when such seeds were sown, the field germinability increased by 3–5%, and the plant survival – by 5–7%.
Conclusions. The results indicate that the treatment of vegetating plants of spring wheat varieties in seed plots with fungicides and insecticides is a reliable way to obtain seeds with high productive capacities.

Key words: wheat, yield, sowing quality, fungicides, insecticides, productive capacities of seeds