

**original article** | UDC 633.11: 631.53.04: 631.582: 631.582 | doi: 10.31210/visnyk2021.02.03**INFLUENCE OF PRECURSORS AND SOWING TIME OF WINTER WHEAT ON WINTER HARDINESS AND INFESTATION WITH PHYTOPATHOGENS***O. V. Barabolia**ORCID  [0000-0003-4123-9547](https://orcid.org/0000-0003-4123-9547)*V. V. Liashenko*ORCID  [0000-0003-0177-6209](https://orcid.org/0000-0003-0177-6209)*S. M. Doronin**Ye. Yu. Polezhak*

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The article substantiates the topicality of increasing the productivity and quality of winter wheat grain on the basis of little cost, highly effective and environmentally safe measures that are the selection of precursors in crop rotation and sowing time. The purpose of the study is to determine the influence of precursors and sowing time on winter hardiness, diseases and damage with pests of winter wheat plants. Field experiments were carried out according to generally accepted techniques during 2017–2020. To ensure high accuracy of experiments, they were placed in the fields with equaled relief and fertility, which was confirmed by soil and agrochemical surveys materials. The experiments were conducted according to the following scheme: pea; silage corn; 2) sowing time: 01.09; 10.09; 20.09; 30.09; 05.10. The results of the research have shown that the best indicators of winter hardiness of winter wheat plants within were within 3.9–4.8 points, which makes 4.4 points on the average; these indicators were ensured in the case when pea was the precursor. The placement of winter wheat after grain legume to some extent positively affected the development of plants in the autumn period, as well as passing the stages of hardening and, ultimately, increased the general winter hardiness of winter wheat, in comparison with the variants where silage corn was the precursor. The choosing of sowing time was the main factor that affected diseases onset and damage with pests of winter wheat plants. According to the results of the research, precursors did not have a significant impact on this process. At the same time, the infestation with powdery mildew was observed less often if the crop was sown after pea. In its turn, fewer plants were affected with brown rust in cases when wheat areas were placed after silage corn. Sowing time of winter wheat had significant impact on diseases and damage with pests. In this case, the following tendency was observed: the percentage of diseases onset and damage with pests of winter wheat plants gradually decreased from earlier than later sowing time.

Key words: winter wheat, crop rotation, precursors, sowing time, pests, diseases.

ВПЛИВ ПОПЕРЕДНИКІВ І СТРОКІВ СІВБИ ПШЕНИЦІ ОЗИМОЇ НА ЗИМОСТІЙКІСТЬ ТА УРАЖЕНІСТЬ ФІТОПАТОГЕНАМИ

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У статті обґрунтовано актуальність підвищення продуктивності і якості зерна пшениці озимої на основі маловитратних, високоефективних і екологічно безпечних заходів, якими є добір відповідних для них попередників у сівозміні та строків сівби. Метою дослідження є визначити вплив попередників і строків сівби на зимостійкість, ураженість хворобами та пошкодження шкідниками рослин пшениці озимої. Польові дослідження проводили згідно із загальноприйнятими методиками впродовж 2017–2020 рр. Для забезпечення високої точності дослідів розміщували їх у полях, вирівняних за рельєфом і родючістю, що підтверджується матеріалами ґрунтового та агрохімічного обстежень. Дослідження проводили за наступною схемою: 1) попередники: горох; кукурудза на силос; 2) строки сівби: 01.09; 10.09; 20.09; 30.09; 05.10. Результати досліджень показали, що найкращі показники зимостійкості рослин пшениці озимої в межах 3,9–4,8 балів, що у середньому складає 4,4 бали, забезпечується тоді, коли попередником озимини виступав горох. Розміщення озимини після зернової бобової культури деякою мірою позитивно впливає на розвиток рослин в осінній період, проходження стадій загартування і, врешті-решт, підвищує загальну зимостійкість рослин культури порівняно з варіантами, де попередником була кукурудза на силос. Головним фактором, який впливав на ураження хворобами і пошкодження шкідниками рослин пшениці озимої, є вибір строку сівби. За результатами досліджень попередники не мали істотного впливу на цей процес. Водночас ураження борошнистою росою спостерігається менше, якщо посіви розміщені після гороху. Своєю чергою менше рослини уражуються бурюю іржею тоді, коли ділянки розміщувалися після кукурудзи на силос. Істотного впливу на ураження хворобами і пошкодження шкідниками виявляють строки сівби озимої культури. В цьому випадку спостерігається така тенденція: відсоток ураження хворобами і пошкодження шкідниками рослин пшениці озимої поступово зменшується від більш ранніх до більш пізніх строків сівби.

Ключові слова: пшениця озима, сівозміна, попередники, строки сівби, шкідники, хвороби.

Introduction

In Ukraine, winter wheat occupies one of the leading places in terms of sown area. Therefore, the problem of increasing its yield is a leading place and provides favorable conditions for growth and development of plants in the autumn due to the right predecessor. This has a significant impact on their overwintering and, ultimately, on obtaining significant projected yields of high quality food grain.

Despite the fact that unfavorable weather conditions are observed during cultivation, and some years may seem unsuccessful, the sown area of this crop continues to grow every year. According to O. Basanets, for the 2019 harvest, the sown area under winter wheat in Ukraine amounted to 6.45 million hectares, which is 2.8% more than the same period last year. At the same time, there is an increase in sown areas under organic wheat, for which about 197 thousand hectares have already been allocated, and in the future this figure tends to increase [1, 2].

It is advisable to note that for various zones of Ukraine a set of predecessors for winter wheat, which provide its high yields, are different [3, 4]. However, all of them must meet the following requirements: early to release the field, do not dry the soil for a great depth and accumulate sufficient amount of productive moisture before sowing.

However, in modern market conditions there is a tendency to increase the sown areas of such cultures as sunflower, corn grain, soybeans. In this regard, the crop rotation, in which is winter wheat. Mainly, in the current conditions, agricultural crops are located in short rotational four or five remaining crop rotation [5]. However, it is necessary to take into account such a feature of winter wheat that it depends to a greater extent on the predecessor in crop rotation, than from the use of an optimal fertilization system [6].

Therefore, in modern conditions, the role of crop rotation is acute, the main thing is the most effective way of environmental stabilization of the environment and provision of rather high, sustainable and economically adequate winter wheat harvests [7, 8]. Depending on this, agricultural production at this stage requires new requirements for the selection of predecessors for it [9, 10].

According to numerous studies, sowing terms also have a significant impact on growth and development of plants, their frost and winter resistance, plant survival, productive business, productivity and quality of products [11–13]. The correct choice of sowing time, which depends on the soil-climatic conditions, is the most influential technological element. Mainly, it largely regulates the degree of development of plants before restriction, and thus determines the level of resistance to unfavorable factors [14–16]. So, for crops too early sowing, there is a great probability that they can grow. This significantly worsens their reversals [17]. At the same time, the delay with the terms of sowing will not fully form the development of plants that will be poorly bought and suffer from dryness [18, 19].

Favorable-fuel conditions during plant vegetation are the basis for obtaining high yields. As you know, they depend on natural factors that can not be managed or adjusted. At the same time, by changing the sowing periods in the permissible limits, one can affect the provision of plants with heat and solar radiation, that is, not direct optimization of unmanaged factors of life of agricultural crops [20]. Sowing in optimal terms should provide vessels of winter wheat in the autumn period of those stages of organogenesis, from which the level of livelihoods of agrobiocenosis and its productivity [21] depend on the basis.

The peculiarity, during winter wheat sowing, is the duration between its beginning and ending. This gap should be as short as possible, but to determine the sowing period by the number of shoots formed before entering plants in the winter, the end time may differ significantly. At the beginning of the optimal sowing time, a transition of the average daily air temperature through 17 °C, and for their completion – after 15 °C. According to separate data, their duration can fluctuate within 20–25 days, and they can be in a gap of August 20 to September 10–15 [21–23].

The purpose of the work is to determine the influence of precursors and seedlings on winter resistance, disease and damage to pests of winter wheat plants.

The research objectives are: to establish peculiarities of plant growth and development, their resistance to adverse conditions of cultivation dependently on the precursor and sowing of winter wheat; estimate the resistance to damage to the current pathogens.

Materials and methods of research

Field experiments were carried out according to generally accepted techniques during 2017–2020. To ensure high accuracy of experiments placed them in fields of relief and fertility, which is confirmed by soil and agrochemical surveys materials.

Experiments were performed according to the following scheme.

Precursors:

- peas;
- Maize on silage.

Lines of sowing: 01.09; 10.09; 20.09; 30.09; 05.10.

The main method of research was a comparative field experiment, which included the following studies and analyzes of soil and plants.

1. The resistance of winter wheat varieties to diseases were evaluated by systematic observations during vegetation, taking into account the number and percentage of affected plants and the percentage of the affected surface of leaves and stems occupied by pustules or spots. The lesions were accounted for before the origin of plants in the winter and when the dairy maturity on the history (upper) and under the flag (second) leaves.

2. Damage to plants pests were accounted for: intra-stems in the fall before the entrance in the winter and spring at the beginning of the tubing, determining the amount and percentage of damaged stems and those killed, and plants; Other pests are also from the beginning of their appearance and for the greatest detection.

3. The yield of winter wheat was determined by collecting and weighing with a standard moisture and purity of 100 %.

4. The main results of the research were treated with methods of mathematical analyzes.

Research results and their discussion

For the survival of plants and obtaining high and stable yield of winter wheat, adaptive properties and resistance to adverse medium factors are important. Ozimin weakens and can die as a result of adverse weather factors. These include: freezing, deprivation, quenching, forming a rubbed ice crust, etc. As a rule, the most exhaustion and death of plants is caused by one, but several reasons.

СІЛЬСЬКЕ ГОСПОДАРСТВО. РОСЛИННИЦТВО

According to our research, it has been established that among the investigated factors the highest influence on the value of this indicator exhibits a period of sowing culture compared to precursors (Table 1).

1. Winter resistance of winter wheat plants depending on precursors and sowing times, scores (on average for 2018–2020)

Predecessor	Sowing period				
	01.09	10.09	20.09	30.09	05.10
Pea	3,9	4,2	4,6	4,8	4,7
Corn for silage	3,5	4,0	4,2	4,3	4,6

In the case when the precursor of winter performed peas, the cross-release score ranged from 3.9 to 4.8, which averaged 4.4 points. Subject to the placement of winter wheat after corn on the silage, the value of this indicator was in the range from 3.5 to 4.6 points, which averaged the experiment 4.1 points. That is, as a result of the conducted studies, it can be said that the placement of winter after grain legume culture to some extent positively affects the development of plants in the autumn period, passing the stages of quenching and, ultimately, increases the total winter resistance of culture plants, compared with variants where the precursor was maize on silage.

At the same time, according to the results of our research, between predecessors, subject to sowing in late terms (05.10), a significant difference between the index of winter resistance is not observed. In this embodiment, the winter resistance index in plants sown after peas, exceeded those in areas where the maize precursor for silage is only 0.1 points.

Thus, depending on the predecessor on average over the years of our research, the highest winter resistance at the level of 4.8 points is obtained on variants where the precursor was peas.

It is advisable to note that significant damage to winter wheat crops inflict damage to pests and damage to diseases. These pathogens not only affect the crop yield, but also significantly worsen its qualitative indicators.

In their experiments, we conducted an observation of the manifestation of winter wheat plants such diseases such as a brown and yellow rust and powdery mildew, as well as damage to such pests like a bug shell and Swedish fly. The results obtained are given in Table 2.

Analyzing the data obtained, we came to the conclusion that the main factor that influenced the damage to the diseases and damage to the pests of winter wheat plants is the choice of sowing time. Precursors, as evidenced by data, did not have a significant impact on this process. In particular, it would be desirable to note that lesions of powdery mildew is observed less if the crops are placed after peas. In turn, less plants are affected by the brown rust in the case when the areas were placed after corn on silage.

At the same time, the lesions of plants with yellow rust depending on the predecessor occurs as follows: in the case when Sowing was performed 01.09 preference has a legume precursor. In the second variant of the sowing, the effect of the precursor is offset, since the value is practically at the same level (see Table 2). In the third variant of sowing time (20.09), the advantage of cereal precursor is observed, and in the following variants, that is, when sowing was carried out respectively 30.09 and 05.10. A minor advantage is again a grain legume precursor.

As for damage to plants pests, as in the previous case, the significant difference between predecessors was not detected. It should only be noted that a slightly smaller percentage of plant damage is observed in sites placed after peas.

However, as evidenced by us data, given in Table 2, a more significant impact on damage to diseases and damage to pests exhibit the timing of winter culture. In this case, we note the following tendency: the percentage of disease and damage to the pests of winter wheat plants gradually decreases from earlier than later sowing.

Thus, plants of early sowing (the first and second option) were more affected by the brown rust and yellow rust. At the same time, in the variant, where 20.09 were produced by 20.09. Best indicators were obtained, as with the defeat of the brown rose and defeating yellow rust, compared to the embodiment, where the plants were sown 30.09. The smallest plants of winter wheat are affected by data by illnesses in the lowest sowing time, which in our case corresponds to 05.10.

СІЛЬСЬКЕ ГОСПОДАРСТВО. РОСЛИННИЦТВО

2. Diseases and damage to pests of winter wheat plants depending on precursors and sowing times, % (on average for 2018–2020)

Term sowing	Predecessor	
	Pea	Corn for silage
Brown Irrigation Crop Disease		
01.09	26.5	26.1
10.09	22.7	22.4
20.09	15.5	15.2
30.09	18.8	18.4
05.10	13.5	12.9
Yellow Iris Crop Disease		
01.09	34.1	34.7
10.09	28.5	28.5
20.09	26.6	25.9
30.09	27.4	27.7
05.10	16.1	16.3
Powdery mildew		
01.09	25.3	25.6
10.09	22.2	22.7
20.09	16.1	16.5
30.09	11.9	12.0
05.10	8.2	8.5
The Swedish Fly		
01.09	22.5	22.8
10.09	16.2	16.7
20.09	8,8	9.2
30.09	5.7	6.2
05.10	3.1	3.2
chinch, corn-bug		
01.09	4.2	4.5
10.09	2.6	3.1
20.09	2.3	2.7
30.09	1.2	1.4
05.10	1.1	1.1

Analyzing the lesions of winter flour plants, a tendency towards a significant decrease from earlier than later sowing. It should be noted that among diseases that affect winter wheat plants, in our conditions, a significant advantage has a yellow rust, indicator of lesion of which two other diseases are predominant in 1.5–2 times. It is not possible to note the fact that the late sowing periods in 2–3 times reduce the damage to the wheat of winter culture wheat diseases that were analyzed.

Sufficiently significant influence exhibit sowing terms and damage to plants pests. As evidenced by the received data (Table 2), greater damage to the Swedish fly, the percentage of damage from which significantly predominates the percentage of damage to the tortoise. The results of the research showed that, provided earlier sowing terms, the percentage of damaged plants fluctuated within 22.5–22.8 % in the first and 16.2–16.7 % of the second variants. Starting from the moment when Sowing was carried out on 20.09 (the third option) the value of the index of plant damage to this pest decreased at a time and amounted to 8.8–9.2 %. A significant decrease in this indicator is observed in the variant where SIVBU was performed 30.09, and a particularly significant decrease is observed in the variant when sowing 05.10.

As it was already noted by us, the clop-turtle had a significantly smaller percentage of damage to winter culture plants. However, in this case, it is necessary to note the fact that as in the previous case, the plants were damaged the least in sowing of 30.09 and especially 05.10 than for sowing earlier, respectively, 1.09, 10.09 and 20.09 (Table 2).

In general, analyzing the results obtained, we conclude that, provided that, subject to late sowing terms, regardless of the predecessor, there is a significant reduction in the damage to winter wheat plants and their damage to pests. In this regard, the choice of sowing time can be considered as an endless and environmentally safe agrotechnical measure of protection of winter wheat crops.

Conclusions

1. The best indicators of winter resistance of winter wheat plants within the range of 3.9–4.8 points, which averages 4.4 points, ensured in the case when the precursor of winter performed peas. The placement of wintering after grain legume culture to some extent positively affects the development of plants in the autumn period, passing the stages of quenching and, ultimately, increases the overall winter resistance of culture plants, compared with variants where the precursor was corn per silo.

2. The main factor that influenced the damage to diseases and damage to the pests of winter wheat plants is the choice of sowing time. According to the results of research, precursors did not have a significant impact on this process. At the same time, the damage of powdery mildew is observed less if the crops are placed after peas. In turn, less plants are affected by the brown rust in the case when the areas were placed after corn on silage.

3. Significant influence on defeating diseases and damage to pests exhibit periods of sowing of winter culture. In this case, the following tendency is noted: the percentage of damage to diseases and damage to the pests of winter wheat plants gradually decreases from earlier than later sowing time.

Prospects for further research – considered as an affirmation of precursors of seedlings of winter wheat for yield and quality of grain.

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