Aidarbekova T. Zh., doctoral student, specialty «Agronomy», https://orcid.org/0000-0001-9486-6734
NPJSC «Kokshetau University named after Shokan Ualikhanov», Kokshetau, Abay str. 76, 020000, Kazakhstan, aidarbekova_t@mail.ru
Khussainov A. T, Doctor of Biological Sciences, Professor, https://orcid.org/0000-0001-6328-4133
NPJSC «Kokshetau University named after Shokan Ualikhanov», Kokshetau, Abay str. 020000, Kazakhstan, abil_tokan@mail.ru
Syzdykova G. T., Candidate of Agricultural Sciences, Associate Professor, https://orcid.org/0000-0002-3511-8311
NPJSC «Kokshetau University named after Shokan Ualikhanov», Kokshetau, Abay str. 76, 020000, Kazakhstan, syzydkova_1956@mail.ru
Alenov Zh. N., Candidate of Agricultural Sciences, Associate Professor, https://orcid.org/0000-0003-3652-3404
NPJSC «Kokshetau University named after Shokan Ualikhanov», Kokshetau, Abay str. 76, 020000, Kazakhstan, naujum@mail.ru

THE INFLUENCE OF METEOROLOGICAL CONDITIONS ON THE DURATION OF THE GROWING SEASON IN THE LINES OF SPRING SOFT WHEAT ON CHERNOZEM SOILS OF NORTHERN KAZAKHSTAN

ANNOTATION

The relevance of the topic lies in the fact that the study of breeding lines of various ecological origins is of paramount importance for breeding. When selecting breeding material, it is necessary to take into account the peculiarities of soil and climatic conditions. For the sharply continental climate of Northern Kazakhstan, one of the most important characteristics of the variety for obtaining a high yield is the duration of the growing season and interphase periods.

This article presents the results of a study of a line of spring soft wheat with a high adaptive ability: high productivity, early maturity, resistance to pathogens and endurance to environmental stress.

The experiments were laid in the Kokshetau Experimental Production Farm LLP in 2021-2022. Agrotechnics adopted for the zone. The predecessor is pure steam. The sowing period is May 22-23, the seeding rate is 3.0 million germinating seeds per 1 ha. 13 lines of spring soft wheat of medium-ripened and medium-early ripeness groups were studied.

The yield, the elements of its structure and the duration of the growing season were determined according to the methodology of the state variety testing.

The studied lines are valuable for practical breeding of spring soft wheat varieties. The growing season of the variety is not constant, but varies depending on both the climatic conditions of the zone and the year of cultivation. The duration of vegetation mainly depends on the temperature and water regime. At the same time, the duration of the growing season from sowing to earing closely depends on the sum of the average daily temperatures, the duration of grain filling, and also on the humidification conditions.

According to our research, the lines were distinguished by an elongated tillering period, and «shoots-earring» (37-46 days), and shortened – «earring-ripening» (38-39 days).

It was found that in the dry at the beginning of the growing season in 2021, the relationship between yield and the duration of the growing season was close in the middle-ripened group r= 0.56, and in the middle-early group the relationship was weak negative r=0.10.

Key words: spring soft wheat, lines, growing season, yield, weight of 1000 seeds, hydrothermal coefficient.

Introduction. One of the most important characteristics of the variety is the duration of the growing season and interphase periods [1]. Therefore, depending on the duration of the interphase period and the duration of optimal conditions during the period of filling and ripening of grain [2]. When cultivating grain crops, it is necessary to pay attention to the specifics of soil and climatic conditions of cultivation and selection of varietal material that should correspond to this climatic zone in order to obtain a high
yield [3]. When choosing a variety, it is necessary to take into account the sum of active temperatures, the period of maximum precipitation, and the spread of certain pests and diseases [2, p. 270].

According to literary sources, the duration of the growing season depends on the genetic characteristics of the variety. However, the rate of reaction of varieties in different years according to meteorological conditions may be different [4].

It was also found that the longer the growing season, the more it positively correlates with the yield of varieties. It should be noted that the lack of moisture determines the level and variation of wheat grain yield in the interphase periods of «sprouting – earing», to a lesser extent – in the reproductive period. Unfavorable conditions during the reproductive period reduce the yield of only one of the elements of its structure: the mass of 1000 grains, since the remaining elements have already been formed [5].

According to A.A. Zavalin, E.N. Pasynkov, A.V. Pasynkov [6], the hydrothermal conditions created in the initial vegetation period were not decisive in the formation of the yield value, which is confirmed by the results of statistical processing of the data obtained (R2=0.44). The variability of the duration of the growing season over the years in the same geographical area of cultivation is determined by almost two factors: the average daily air temperature and the amount of precipitation (HTC) [7].

Varieties with longer interphase germination have an increase in the number of productive stems [8].

The data obtained by us show the advantages of medium-early lines and varieties created by scientific centers of Kazakhstan. Due to the slow development from germination to earing, they are more resistant to spring and early summer drought. It is known that varieties with early earing under conditions of high temperature and lack of moisture increase the yield index [9]. M. Bevan, C.Uauy, B.B.H. Wulff, J. Zhou, K.Krasileva, M.D. Clark indicate that the improvement of agronomic phenotypes is based on the analysis of genetic variability of breeding material [10].

In wheat breeding, the interrelationships of three components are often investigated: the number of productive stems per 1 m², the number of grains per ear and the mass of 1000 grains, which largely correlates with yield [11]

The yield of grain crops depends on a number of factors, including the ability of plants to synthesize and redistribute assimilates, form elements of the crop structure, as well as the timing of the development and maturation phases [12].

**Conditions, material and methods of research.** Experiments were laid on the steam predecessor in the Kokshetau Experimental Production Farm LLP in 2021-2022. The area of the accounting platform was 20 m², the total area was 25 m². The repetition is 4-fold. The variants were placed systematically. Sowing was carried out at the optimal time (May 22-23), the seeding rate was 3.0 million germinating seeds per hectare, seeder SZS – 2.1.

Meteorological conditions in the years of the study differed in the amount of precipitation and temperature regime, which affected the duration of interphase periods and the growing season as a whole. The created meteorological conditions also influenced the formation of the main elements of the yield structure. So the hydrothermal coefficient on average for the growing season in 2021 was 0.4, which is almost two times less than the average of long-term data - HTC = 0.9 (Fig. 1).

![Figure 1 – Hydrothermal coefficient (HTC) according to SMS «Shagalaly»](image_url)
In 2021, May was very dry, the HTC was 0.2, whereas in 2022, the average long-term data of the HTC was 0.9. The created meteorological conditions greatly affected the field germination and the appearance of seedlings at the spring soft wheat line.

In June, 2021, there was also a drought, especially in the first and second decade, while the value of the HTC is 0.5, which is 0.9 units less than in 2022. Whereas a good moisture supply in June 2022 (HTK = 1.4) had a positive effect on the passage of the interphase period of «tilling-exit into the tube», with the value of the average long-term data of the HTK = 0.8.

July, in the years of the study, also was differed. So in 2021, the HTC is 0.6, which is 0.4 -0.5 units lower compared to 2022 and with the average long-term data. In August, 2021-2022, the hydrothermal coefficient was 0.12-0.4, which is less than the average long-term data by 0.58-0.3 units (Fig. 1).

The research material was 13 lines of spring soft wheat of medium-ripe and medium-early ripeness groups from 3 breeding centers of Kazakhstan: Research Institute of Agriculture and Crop Production, Pavlodar Research Institute of Agriculture and the A.I. Barayev Research Institute of Agriculture. As a standard, the registered varieties for medium–ripened – Astana and medium-early - Omsk 36 were used.

The soil of the experimental site is ordinary carbonate chernozem, medium–thick, low-power heavy-loamy. The humus content is 4.01%, pH is 7.1. The provision of soil with nitrate nitrogen is average — 9.3 mg / kg of soil, mobile phosphorus is low — 4.0 mg / kg of soil, potassium is high — 360 mg/ kg of soil.

The analysis of the crop structure was carried out on sheaf material from test sites for each sample in 4 repetitions (according to the methodology of the State Variety Testing [13]). Each collected sheaf was analyzed by the number of plants, common and productive stems. The elements of the crop structure were determined in 25 plants in 4 repetitions: the number of grains in the ear, the mass of 1000 grains. Harvesting was carried out at full ripeness by the Wintersteiger combine harvester. The grain yield for each variety and line was carried out to an average standard, 14% humidity and 100% purity.

To assess meteorological conditions during the years of the experiments, the amount of precipitation and temperature regime were noted in comparison with the average long-term data (SMS "Shagalaly").

The experimental data were analyzed in Microsoft Excel, Agsat (http://www.agstat.com/). According to the results of the analysis of variance, the smallest significant difference was calculated (NCR0.05), and the averages (M), coefficients of variation (Cv) and correlation (r) were calculated according to B.A. Dospekhov [14].

The duration of the growing season, hydrothermal coefficient, yield and elements of its structure have been studied.

**Results and discussion.** In conditions of limited water resources, wheat breeding is updated according to the characteristics that ensure an increase in the efficiency of moisture use [15]. According to A. Nawaz et al. [16], drought in the reproductive phase and the grain filling phase has the most detrimental effect on the setting and ripening of grain. Therefore, for the steppe zone of Northern Kazakhstan, varieties with an extended interphase period of shoots-earring and shortened earing-grain ripening are more adapted to local conditions.

Meteorological conditions during the years of the study had a significant impact on the duration of the growing season. Thus, the year 2021 was characterized by aridity, and this was especially observed during the interphase period «shoots-earring». As a result, a reduction of this interphase period was observed in the studied lines. The availability of precipitation and a decrease in temperature during the second growing season «earing-ripening» contributed to the duration of this period (Table 1).

<table>
<thead>
<tr>
<th>Year</th>
<th>Grade, line</th>
<th>Interphase period, days</th>
<th>Growing season, days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>shoots-earing</td>
<td>earing-maturation</td>
</tr>
<tr>
<td>2021</td>
<td>Medium - ripened</td>
<td>38</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Medium - ripened</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>2022</td>
<td>Medium - ripened</td>
<td>52</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Medium - ripened</td>
<td>44</td>
<td>36</td>
</tr>
</tbody>
</table>
The spring month of May was different in the years of the study. So in May 2021, 7.8 mm of precipitation fell, which is 2 times less than in 2022 (15.7 mm), with an average annual data value of 32.8 mm. The conditions created contributed to the uneven appearance of seedlings in the middle early maturity group (Table 1).

At the level of the Omsk 36 standard, shoots appeared on the 12th day at the line: Erythrosperum 738, Lutescens 857 sp2/07, Lutescens 1206 sp2/19, Lutescens 1143 sp2/09, Lutescens 821 sp2/08, Lutescens 715 sp2/04), on the 11th day at the line: Lutescens 814 sp2/09, Lutescens 1148 sp2/09), later on the 14th day it was noted at the line: (Lutescence 783 sp2/07).

The interphase period of «sprouting-earing» in the middle early group of ripeness in May-July passed with the HTC is 0.5-0.6, which was lower than the average of long-term data of the HTC = 0.8. So, on average, within the group and in the standard variety Omsk 36, this period was 30 days. In the Erythrosperum 738 line, this interphase period is 30 days, and in the Lutescens 1148 sp2/09, Lutescens 857 sp2/05, Lutescens 1206 sp2/19 – 29 days. A longer period was observed in the line Lutescens 783 sp 2/07, Lutescens 821 sp 2/08 and amounted to 32 days. These samples are of interest as a source material in practical breeding. As noted above, for the conditions of Northern Kazakhstan, genotypes that have a slower development – from germination to exit into the tube, turn out to be quite hardy to spring-early summer drought.

The interphase period of «earing-maturation» in the average early ripeness group for the period July-August months, with a value of HTC equal to 0.6-0.1, passed at a value below the average of long-term HTC data equal to 1.0. The average values of the group in this period was 40 days, at this level the indicators were in the line: Lutescens 715 sp2 /04, Lutescens 1206 sp2/19, Lutescens 1148 sp2/09. At the standard level, Omsk 36 (41 days) was observed in the line: Lutescens 814 sp2/09, Lutescens 857 sp2/05, Lutescens 783 sp2/07. For one or two days, this period was shorter in the Erythrosperum line 738 (38 days), and in the Lutescens line 1143 sp2/09, Lutescens 821 sp2/08 - 39 days (Table 1).

As a result, the duration of the growing season in the line of the mid-early ripeness group averaged 70 days, at this level it was observed in the following lines: Lutescens 857 sp2/05, Lutescens 715 sp2/04. At the level of the standard variety Omsk 36 (71 days) was in the line: Lutescens 814 sp2/08, Lutescens 821 sp2/08. A longer growing season – 73 days was noted in the line: Lutescens 783 sp2/07. In this group, lines with a short growing season Erythrosperum 738 (66 days) and lines Lutescens 1148 sp2/09, Lutescens 1206 sp2/19, Lutescens 1143 sp2/09 (69 days) were distinguished.

The duration of the growing season plays and occupies a special role in the formation of future elements of the structure of grain yield and quality. This is especially affected by the agro-climatic conditions during critical periods of growth and development of spring soft wheat, as well as the correct application of agrotechnical techniques, this gives full disclosure of the potential yield and grain quality.

In 2022, before sowing, the reserves of productive moisture in the soil amounted to 70-80 mm, with the HTC value equal to 0.9. The month of May was well provided with soil moisture and soil temperature, which contributed to the appearance of friendly and full shoots.

Shoots appeared on the average for the group on day 12, with the value of the Omsk standard 36 - 13 days. At the same time, there were lines whose shoots appeared on day 10 (Lutescens 814 sp2/09, Lutescens 1148 sp2/09, Lutescens 857 sp2/05), and on Day 11 (Lutescens 783 sp2/07, Erythrosperum 738) (Table 1).

It is important for spring soft wheat to ensure the optimal amount of precipitation and a favorable temperature regime during the interphase period «shoots-earing». The year 2022 was favorable for the passage of this interphase period, which was 49 days with the value of the HTC equal to 1.4, which is more than the average of the long-term data of the HTC equal to 0.8.

The interphase period «earing-maturation» took place at a value of HTC (1.0-0.4) in July-August, this is lower than the average long-term data (HTC = 1.1-0.7).

The average value in the group and in the Omsk 36 standard, the interphase period of «earing-maturation» was 36 days. A longer period was recorded for the Lutescens 783 sp2/076 line (37 days). In comparison with the standards, less than one day was observed in the Erythrosperum 738 line, Lutescens 1206 sp2/19 (35 days).
On average, the growing season of 2022 for the average early line was 80 days, with the value of the Omsk standard 36 (81 days). The longer period was marked by the lines: Lutescens 1148 sp2/09 (83 days), the line: Lutescens 814 sp2/09, Lutescens 1206 sp2/19, Lutescens 821 sp2/08 (80 days). The shortest vegetation period was observed in the line: Erythrosperum 738 (78 days), in the line: Lutescens 857 sp2/05, Lutescens 814 sp2/09, Lutescens 1206 sp2/19, Lutescens 821 sp2/08 (80 days) and in the line Lutescens 783 sp2/07 (80 days) (Table 1).

The duration of the growing season in the studied years was: in the middle-aged 70 days, in the middle-aged 80 days. The studied lines did not have a large difference in the duration of interphase periods and vegetation. In general, it can be noted that the range of variation and the coefficient of variation are less pronounced and largely depend on the conditions of cultivation and genetic characteristics of cultivars (Table 2).

Table 2 – Variability, duration of interphase periods and vegetation in the line of different ripeness groups of spring soft wheat, (2021–2022)

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Medium-ripened (4 lines)</th>
<th>Medium-ripened (9 lines)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interphase period, days</td>
<td>shoots-earling</td>
</tr>
<tr>
<td>Medium, (\hat{x})</td>
<td>46</td>
<td>40</td>
</tr>
<tr>
<td>Lim (limit)</td>
<td>45–47</td>
<td>39–41</td>
</tr>
<tr>
<td>R (scope)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>V (coefficient of variation), %</td>
<td>1.63</td>
<td>2.02</td>
</tr>
<tr>
<td></td>
<td>Medium, (\hat{x})</td>
<td>37</td>
</tr>
<tr>
<td>Lim (limit)</td>
<td>36–38</td>
<td>37–39</td>
</tr>
<tr>
<td>R (scope)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>V (coefficient of variation), %</td>
<td>2.14</td>
<td>1.67</td>
</tr>
</tbody>
</table>

Depending on the soil and climatic zone, it is desirable to use varieties with different ripeness groups, this reduces tension during harvesting and reduces grain losses [17].

According to L.M. Mishchenko, M.V. Terekhin, M.M. Terekhin, the correlation coefficient between the duration of the growing season and the mass of 1000 grains in an unfavorable year was \(r=0.2\), favorable \(r=0.5\ldots0.8\) [18].

According to I.V. Kurkov [19], a reliable relationship was established between the period «shoots-earling» with the following components of the crop structure: the number of grains in the ear \((r=0.73)\), the mass of grain from the main ear \((r=0.76)\) and the mass of the whole grain \((r=0.67)\).

Between the duration of the period «earning-ripening» there is no reliable correlation between the productivity of the ear, the plant and the grain size [20].

The correlation between the growing season and yield in the lines of different ripeness groups was expressed in different ways. Excessive lengthening of the «sprouting-earling» period in mid–early lines had a negative relationship with yield \((r \text{ from } -0.05 \text{ to } -0.07, \ p =0.05 \text{ - 0.27})\), since it led to a reduction in the period of grain formation and filling [20 p. 66]. Our data are consistent with the results of A.T. Babkenov et al. [21], who reported a weak correlation between the yield and the mass of 1000 grains \((r \text{ from } 0.03 \text{ to } -0.33)\).

In the conditions of Northern Kazakhstan, according to long-term data, drought is more often observed at the beginning of the growing season, and the maximum amount of precipitation falls in July. In this regard, it is necessary to cultivate varieties with a longer first interphase period «inputs-earling» in this zone. In the dry year 2021, the correlation between the interphase period «shoots-earling» with the yield in the middle-ripened line is average positive \(r = 0.43\), in early-ripening it is weak \(r = 0.02\). This is due to the slow development in the initial phases of growth and development, the culture tolerates drought more easily. The conjugacy of yield with the interphase period «earning-maturation» in 2021 has an average positive \(r = 0.42\), and a weak negative \(r =-0.21\) in the middle-early ones. Thus, in 2021, which was characterized by an early-summer drought, the yield in the middle-ripe group closely correlates with
the duration of the growing season (r= 0.56). Whereas in the middle early group, this relationship is weak negative r =-0.10.

Table 3 – Correlation relationship (r) between yield and weight of 1000 seeds and vegetation periods of different ripeness groups of black soft wheat

<table>
<thead>
<tr>
<th>Years</th>
<th>Weight of 1000 seeds, g</th>
<th>Shoots-earing</th>
<th>Earing-maturation</th>
<th>Growing season, days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Medium - ripened</td>
</tr>
<tr>
<td>2021</td>
<td>r =0.41</td>
<td>r =0.43</td>
<td>r =0.42</td>
<td>r =0.56</td>
</tr>
<tr>
<td>2022</td>
<td>r =0.85</td>
<td>r =0.35</td>
<td>r =-0.96</td>
<td>r =-0.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mid - early</td>
</tr>
<tr>
<td>2021</td>
<td>r =0.55</td>
<td>r =0.02</td>
<td>r =-0.21</td>
<td>r =-0.10</td>
</tr>
<tr>
<td>2022</td>
<td>r =0.23</td>
<td>r =0.09</td>
<td>r =0.19</td>
<td>r =0.16</td>
</tr>
</tbody>
</table>

The meteorological conditions created in 2022 during the first growing season led to an elongation of vegetation in the middle-ripened group. In the favorable year 2022, the correlation of yield with the interphase period «shoots-earing» in the middle-ripening group is average r = 0.35, and in the middle-early lines it is weakly positive. The conjugacy of yield with the interphase period «earring-maturation» in the middle-ripened line is close negative r = -0.96, and in the middle-early weak positive r = 0.19. At the same time, it was found that the correlation coefficient of yield with the growing season is weak negative r =-0.30. And in the middle early group, this connection is weak positive r = 0.16. In the mid-early group of the line, the yield is closely related to the mass of 1000 grains, to a lesser extent with the growing season. In the middle-ripened group, a close relationship was established between the yield and the mass of 1000 grains in a favorable year r = 0.85, and in a dry year it is average r = 0.41 (Table 3).

**Conclusion.** The manifestation of interphase periods and the vegetation period in the studied lines is genetically determined, while their variability is largely related to the climatic conditions of the environment.

The obtained correlations between the yield and the duration of the growing season in the line of different types of ripeness largely explain the biological possibilities of forming their productivity of spring soft wheat.

**REFERENCES**


ТУЙІН

Такырыптың өзектілігі артықлықтық жылдық шығу тегі бар селекциялық өндірістің нәтижелерін ұзақтығына қарсы реттеу өзенге мұнайды. Селекциялық және өндірістік таңдау қезеңінде топырақ-кливүйлердің өңіріліктерін ескеру қажет. Солтустіқ Қазақстандық күрт континенттік климаты жағдайларында жоғары өнімділік және қоршаған зерттеулерде құралынған әрелінің стрессісін асеріне қарсы қоршаған. Тәжірибе 2021-2022 жылдары «Қоғамда әліқұрылық-өндірістік шаруашылығы» ЖІШС-де жүргізілді. Алғы ере – таза сүрі жер. Себе герміні 22-23
мамыр, себу мөлшері 1 гектарға 3,0 млн. өнгіш тұқым. Орташа ерте және орташа пісетін топтағы жаздық жұмысқа бідайдың 13 линиялары зерттелді.

Оңимділік, оның құрылымының элементтері және вегетациялық қезеңдер үшін техникалық, сопртоқтығы мемлекеттік сорт сынау эдістемесі бойынша анықталды. Зерттелетін линиялар жаздық жұмысқа бідай сортағын практичкі оқиғалар осіру үшін құны өзгертілді. Сортың вегетациялық қезеңдің тұрақты емес, бірақ аймақтың климаттық жағдайына қарай, орташа жылына қарай бағаланысты өзгереді. Вегетациялық кезеңді үзактығы негізінен температура мен су режиміне байланысты. Сонымен қатар, егіндері сөбұғанда қармақтанған дайынға вегетациялық қезеңдің үзактығы ортша тәуліктік температураның молшеріне, өнімділік, оның құрылымының элементтері және вегетациялық кезеңдің ұзақтығы мен сорттың адаптациялық тәулік температураның мөлшеріне, дәннің толығуы, сопртоқ құрылымына, бағалыдық болуына байланысты.

РЕЗЮМЕ

Актуальность темы заключается в том, что изучение селекционных генотипов различного экологического происхождения имеет первостепенное значение для селекции. При отборе селекционного материала необходимо учитывать особенности почвенно-климатических условий.

Для резко континентального климата Северного Казахстана одной из важнейших характеристик сорта для получения высокого урожая является продолжительность вегетационного и межфазного периодов.

В данной статье приведены результаты исследования линии яровой мягкой пшеницы, обладающей высокой адаптационной способностью: высокая продуктивность, скороспелость, устойчивость к патогенам и выносливость к стрессовым воздействиям окружающей среды.

Опыты закладывали в ТОО «Кокшетауское опытно-производственное хозяйство» в 2021-2022 гг. Агротехника принята для зоны. Предшественник - чистый пар. Срок посева 22-23 мая, норма высева 3,0 млн. всхожих семян на 1 га. Изучали 13 линии яровой мягкой пшеницы среднеспелой и среднеранней группы спелости.

Урожайность, элементы её структуры и продолжительность вегетационного периода определяли по методике государственного сортопытания. Исследуемые линии представляют ценность для практической селекции сортов яровой мягкой пшеницы. Вегетационный период сорта – величина не постоянная, а варьирует в зависимости как от климатических условий зоны, так и года возделывания. Продолжительность вегетации в основном зависит от температурного и водного режима. При этом продолжительность вегетации от посева до колошения тесно зависит от суммы среднесуточных температур, продолжительности налива зерна, еще и от условий увлажнения.

По данным наших исследований линии отличались удлиненным периодом кущения, и «всходы-колошение» (43-45 дней), и укороченным – «сходение-созревание» (38 дней).

Установлено, что в засушливые в начале вегетации в 2021 году свяж урожайности с продолжительностью вегетационного периода была в среднеспелой группе тесной р= 0,56, а в среднеранней группе свяж слабая отрицательная р= 0,10.