ENVIRONMENTAL CONDITIONS OF FORMATION OF YIELD AND QUALITY OF MILLET SEEDS

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The technology of cultivating seed and commodity crops has a number of differences. Many scientists on the study of formation peculiarities of crop qualities and yield properties of seeds indicate that high yields are not a guarantee of obtaining high crop qualities. In addition, there are data that seed quality decreases under the conditions of maximum yield. Thus, according to V. V. Lykhochvor (2007), the highest yield of seeds and its biological value is achieved at a yield level of 4.0–4.5 t/ha. Further increase of productivity, as well as its reduction beyond 3 t/ha, does not allow us to obtain high quality seed material.

Knowledge of crop biology, critical periods of its development, peculiarities of the reaction to abiotic, biotic and anthropogenic factors during the formation and development of seeds and reasons for its heterogeneity is important in the technology of plant cultivation.

The interconnection of the plant organism with the external environment begins with its formation. With regard to ontogenesis, a seed is the initial stage of plant development. Being formed on the maternal plant, seeds feel the influence of all conditions of the existence of this plant. Factors contributing to the successful growth and development of plants usually contribute to the formation of high-quality seeds and vice versa, those that inhibit plants also impair seed quality.

Growth and development of plants passes for a different combination of environmental conditions. In addition, seed developing on maternal plants is closely related to the leaves that supply photosynthesis products and with the root system providing it with water and nutrients. The level of such provision depends on the effect of environmental conditions. Some of them improve and the others worsen the optimum flow of metabolites to maturing seeds. However, even under the same conditions of ensuring seeds with nutrients, it is influenced by a number of factors, such as uneven length of daylight, quality and intensity of lighting, different temperature, etc. This is especially true for crops with a long period of flowering. As a result, seeds formed on the plant can be in different changing conditions of the external environment. The consequence of such influence of environmental factors is formed seed which, even within the limits of one inflorescence, can have different morphological and physiological parameters.

Thus, it is found that the duration of flowering, filling and maturing seeds in millet varieties on the territory of Ukraine varies from 12 to 50 days. At the same time, seeds are formed in different parts of the comfrey varying in linear dimensions and weight and in terms of seed quality.

It should be noted that millet has significant differences in a number of biological properties comparing with other plants of cereal family. First of all, it is a great biological plasticity of the crop, a high tilling capacity (millet can form up to 10 or more stems), as well as a very high reproductive rate (grain number in the comfrey can range from 100 to 3000 or more). As a result, millet is capable of record yielding up to 20.1 t/ha.

There are significant differences in maturity in different millet varieties. Thus, its vegetation period varies more than 2.5 times – from 50 to 130 days.

One of the factors that influence seed quality is temperature and water regimes during its formation. Thus, the prolonged action of soil and air drought causes underdeveloped state of seeds. They are of low weight and later form weak sprouts. In addition, germination energy of underdeveloped seeds is elevated, so it is poorly preserved.

M. M. Kuleshov (1961) was engaged in a detailed study of the influence of weather conditions on plant development, as well as on the formation of crop qualities and yield properties of seeds. Thus, he found that during the years of high temperatures and a significant lack of moisture, especially during the critical period of crop development, processes of flowering and fruiting of corn seeds lengthened to almost 40 days, the proportion of pollinated corncobs was 41 %, with a yield of 13.3 c/ha seeds. However, in the years favorable for development of seeds, when the average daily temperature and humidity were within the mean long-term values, the duration of pollination was only six days, the share of pollinated corncobs was 97 % and the yield was 59.4 c/ha. At the same time, the author notes that not simultaneous development of plants affects the seed heterogeneity within the variety by cultivating qualities and yield properties.

Other scientists indicate that the biological heterogeneity of seeds is due to not simultaneous flowering and appearance of reproductive organs. Thus, according to the results of E. G. Kyzylova's research (1974), the dependence of corn seed quality on the course of temperatures in the period of pollination-fertilization was manifested in different germination energy of seeds and the strength of their initial growth. In the first two days of pollination, the average air temperature was only 12–14 °C and its relative humidity was 60–70 %. This led to the formation of seeds with reduced crop qualities, germination energy decreased by 3–4 % compared with that in seeds formed at air temperature at the level of 20–22 °C. Plants formed from seeds with reduced germination energy, had slower growth and development.

According to the results of scientist observations, millet also has a significant unevenness in maturing seeds and a strong ability to fall. So, seeds from the upper part of the comfrey ripen the first and have the greatest weight. However, at the time of maturing seeds in the lower part of it, it already falls. In the same period, stems and leaves remain green. Such features are quite valuable because in the case of drought or premature mowing, the formation of seeds can continue due to the nutrients of stems and leaves.

The same dependence is found concerning other crops. Thus, Y. B. Konovalov (1963) noted that there is a certain correlation between the level of yield, the amount of precipitation and the average daily air temperature in different periods of vegetation for wheat.

Similar data were obtained for rice by M. P. Krasnook with collaborators

(1975). In experiments of V. M. Romanchev (1960), in the early sowing period, the formation of buckwheat grain occurs under less favorable conditions (low positive temperature, excessive precipitation and shortage of solar insolation) which leads to a significant shortage of seed yield (2 c/ha per average yield of 12–14 c/ha). Other properties of seeds also change. So, the phenomenon of seed hardness in perennial legumes is also often the result of arid weather conditions at the time of maturation. Under the influence of weather conditions, husk content and chemical composition of seeds change in cereal crops.

Millet belongs to heat-loving crops which has no signs of winter resistance (at the temperature of +1 °C it damages and at the temperature of –2…–3 °C it dies). Unlike other cereals, millet endures high temperatures quite easily. Thus, even at +40 °C, its ophthalmic cells retain elasticity for 48 hours and photosynthesis does not stop even at +45 °C and above.

As a plant of a short light day, millet matures the fastest under intensive lighting conditions at 10–12 hour light day. However, an increase in light duration during the vegetative period slows down its transition to generative development, with the formation of larger leaf mass and subsequently increasing yields.

The scientific literature also has information on the influence of lighting conditions on the formation of reproductive organs of millet plants and the quality of future harvest. Thus, scientists note that especially sensitive plants of millet to the intensity of illumination. The insufficient intensity of light during the flowering-fruiting period causes complete infertility of ears and under optimal conditions there is an accelerated transition of plants to fruiting and high quality seeds are formed. In addition, the authors emphasize that different millet varieties show different requirements for the intensity of lighting.

The influence of light on plants is versatile and it acts not only as a source of energy but also as a kind of regulator or stimulus. A characteristic example of such an effect is the photosensitivity of plant seeds. The reaction of seeds to light in different species of plants has its own distinctive features. Thus, seeds of some crops for its action increase their crop qualities, while in others there is the inhibition of germination. There are also plants which seeds are neutral in this respect.

Accumulation of organic matter in the process of photosynthesis has its own features in millet plants. Thus, millet photosynthesis is of type C_4. It is very economical with respect to moisture, C_4-plants produce almost twice the amount of carbohydrates per unit of absorbed water compared to C_3-plants and at the elevated temperatures this difference is still increasing. As a typical representative of crops with C_4 photosynthesis type, millet uses nitrogen more efficiently and accumulates a large amount of dry matter per unit of digestible nitrogen. Therefore, even under adverse conditions in critical periods of growth and development, it can form a high level of full harvest. Speaking about the above-mentioned crops with C_4 photosynthesis type, it can be concluded that their high productivity exceeds the productivity of plant crops of C_3-type almost twice, as well as the high resistance of such plants to adverse environmental conditions.

A number of scientists also indicate the influence of weather conditions on individual growth stages and the millet development on the formation of its productive and qualitative properties. So, by drought tolerance millet is one of the first among field crops. Under the conditions of prolonged drought, millet seeds can be 30–40 days or more in anabiosis, without losing vitality. When raining, millet seeds sprout and quickly form a secondary root system characterized by a significant efficiency to use even a small amount of rain. The value of the transpiration coefficient from 162 to 447 suggests that millet requires much less moisture than other cereals for the formation of a dry matter unit and even if it is sufficiently moisturized it continues to consume moisture economically.

According to the data of R. Tretiakov (1963) and a number of other scientists [468, 469], millet is able to restore the turgor even after 45 hours of drought, the yield loss does not exceed 30 % and thousand-kernel weight – 20–25 %.

According to the results of observations by M. A. Murzamadieva (1975), the easiest millet tolerates drought in the beginning (the period of sprouts-stem elongation), as well as at the end of the vegetation (the maturing phase). However, the lack of moisture during the period of ear emergence and maturing significantly reduces the number of fruiting ears in the comfrey. Also, weight characteristics of seeds are also worsened (its thousand-kernel weight and grain unit). In addition, according to O. I. Rudnik-Ivashchenko (2009), during the formation and filling grain, more protein content accumulates in the weather conditions with high temperature and reduced air humidity of.

It is known that the excess moisture of soil and air during seed formation also have a negative impact on its qualitative indicators. Under such unfavorable conditions, fungal diseases of plants are strongly developed and the intensity of respiration is sharply increased. The consequence of such phenomena is the increased hydrolysis of organic matter in grain and the outflow of products of hydrolysis into leaves, stalks and partly to the root system.

It is also known that different varieties of origin react differently to the influence of weather factors of the harvesting year. According to E. Nesterenko (1962), depending on the weather conditions, seed quality of different wheat varieties varies unevenly. Thus, thousand-kernel weight of Skelia variety varied from 31.5 to 42.5 g and of Diamand variety from 24.1 to 39.4 g.

Zone conditions of cultivating different varieties of millet grain also affect the yield level and grain quality. E. G. Kizilova (1974) notes that geographic conditions significantly affect seed quality and overlap varietal differences by 9–16 %.

The investigations carried out under the conditions of Kyiv region showed a significant influence of soil and climatic conditions on the yield properties of millet seeds. So, Soniachne variety yield in 1982, sown with seeds grown in Kopylovo experimental farm (Makariv district, Kyiv region), amounted to 42.6 c/ha (check variant). When it was sown with seeds of the same variety but reproduced in 1981, this indicator increased by 4.2–8.4 c/ha in variety test plots of Forest-Steppe and Steppe zones.

However, according to the results of a complex ecological varietal testing of grain of millet varieties in terms of genotypic and ecological effects and the maximum productivity potential performed by O. I. Rudnik-Ivashchenko (2011), it is found that the soil and climatic conditions are the main factor for the grain formation than the zone of growing millet. In this case, among the ecological niches, the following areas, such as Cherkasy, Chernigiv and Ivano-Frankivsk, were noted as the most favorable for the cultivation of new varieties of millet by the author. In comparison with the average yield of varietal testing, their increase ranged from 0.37 to 2.03 t/ha.

Consequently, the formation and development of millet seeds does not occur at the same time, respectively, and the availability of its nutrients is also uneven. This level is associated with the intensity of photosynthesis and the supply of mineral nutrients, which, in turn, are determined by the conditions of the external environment. The establishment of the relationship between these conditions and corresponding quality indicators of seeds is not only of scientific interest, because morphological, physiological and biochemical properties influence the seed quality of the seed material.

РЕЗУЛЬТАТЫ СЕЛЕКЦИОННОЙ РАБОТЫ ПО ЛЬНУ-ДОЛГУНЦУ В РЕСПУБЛИКЕ БЕЛАРУСЬ С ИСПОЛЬЗОВАНИЕМ КЛАССИЧЕСКИХ МЕТОДОВ СЕЛЕКЦИИ

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Гибридизация, как метод селекции, не смотря на широко используемые в настоящее время биотехнологические методы, методы генетической инженерии, является неоспоримо важной и востребованной. Она включает комплекс приемов, направленных на получение гибридных растений с изменением наследственности и использованием её для выведения новых сортов. Создавая гибридизацией нужный исходный материал, удается значительно ускорить ход селекционного процесса. Последовательным скрещиванием наследственно расщепляющихся родительских форм селекционеры создают новые формы растений.

Гибридизацию относят к категории комбинативной селекции, так как основной целью при этом является получение потомства с новой совокупностью генетически обусловленных признаков и свойств. Последующим отбором и направленным воспитанием гибридного потомства новые ценные признаки и свойства закрепляются и усиливаются.

В период 2015-2020 годов с использованием внутривидовой гибридизации и последующего многократного индивидуального отбора в РУП «Институт льна» Республики Беларусь были созданы и в последствие районированы по республике новые сорта льна-долгунца различных групп спелости Лада, Мара, Маяк, Рубин, Дукат, Талер[1].

Данные сорта обладают высокими и стабильными урожаями льнопродукции, устойчивы к воздействию неблагоприятных биотических и абиотических условий среды, обеспечивают получение относительно высокого качества льноволокна.