виявлено істотної різниці з цих показників залежно від складу дражувальної суміші. Енергія проростання та схожість дражованого насіння були майже однаковими за включення в суміш 10 г/п.о. абсорбенту та 61 або 30 мл./п.о. клею за пророщуванні з вологістю ложа 20 і 30 мл. води на одну ростильню.

Тобто, включення в дражувальну суміш 10 г/п.о. абсорбенту та 30 мл./п.о. клею забезпечує достовірне збільшення інтенсивності проростання дражованого насіння на 2-й та 3-й дні обліку, а також енергії проростання і схожості як за вологості для пророщування 30 мл. води на одну ростильню, так і за меншої забезпеченості вологою – 20 мл. води на одну ростильню. Це висновок має важливе практичне значення оскільки весною період сівби та отримання сходів характеризується дефіцитом вологи, а в таких умовах за сівби дражованим насінням сходи не дружні і не рівномірні, що впливає на продуктивність цукрових буряків.

Аналіз факторів, які впливали на енергію проростання та схожість показав, що на енергію проростання значний вплив мали як фактор «вологість» – 35%, так і фактор «драже» – 45%. Взаємодія цих факторів також була не малою – 19,5%.

На схожість насіння значний вплив мав фактор «вологість», який становив 78,9%, а вплив фактору «драже» був значно меншим.

З метою підвищення інтенсивності проростання дражованого насіння його енергії проростання та схожості доцільно в драпувальну суміш включати 10 г/п.о. абсорбенту та 30 мл./п.о. клею. що забезпечує достовірне збільшення цих показників як за вологості для пророщування 30 мл. води на одну ростильню, так і за меншої забезпеченості вологою – 20 мл. води на одну ростильню.

Висновок має важливе практичне значення, оскільки весною період сівби та отримання сходів характеризується дефіцитом вологи, а в таких умовах за сівби дражованим насінням сходи не дружні і не рівномірні, що призводить до зниження продуктивності буряків цукрових.

BIOLOGICAL PECULIARITIES OF FORMATION AND CAUSES OF HETEROGENEITY OF MILLET SEEDS

S. Poltoretskyi[1], V. Bilonozhko[2], A. Yatsenko[1],
N. Poltoretska[1], A. Berezovskyi[1]
[1]*Uman National University of Horticulture*
[2]*Cherkasy National University named after Bogdan Khmelnytsky*

The maximum realization of the genetic potential of the yield of modern varieties of agricultural crops is possible only when sowing high-quality seeds. A seed is the result of the work done by the plant to prolong the existence of its own species. It is the link that supports the continuity of the plant life on our planet. The seed contains information on heredity, origin, features of vegetative and generative processes of plants. It has accumulated huge reserves of energy. All this, as well as its size, fullness, weight, place of formation on a parent plant, conditions of agricultural technologies, the environment and other peculiarities determine the basis of productivity of subsequent generations.

Since ancient times, farmers have tried to select the most valuable and quality seeds, subconsciously seeing large grain. So, at the beginning of our era Lucius Columella in his paper "On Agriculture" wrote about the need to select the best seed: "... it is necessary to select the largest and most important grain and preserve them for a new sowing. This method is the best except on the wet and dry soils". Significantly later, with the development of a number of sciences (botany, genetics, selection, embryology, seed breeding, plant growing, agriculture, ecology, morphology, anatomy, physiology, biochemistry of plants, etc.), the assertion about the decisive influence of seeds, its qualitative indicators on the productivity of the next generation became indisputable. According to the results of reports of various scientists, the share of the influence of quality indicators of seeds in the formation of the future harvest is assimilated to such agricultural measures as soil cultivation, fertilization, peculiarities of cropping and harvesting and reaches 20–40 %.

However, the observation of many scientists allowed us to establish that, depending on a number of reasons, even from one plant or ear, comfrey, corncob, or boll can vary greatly in morphological, anatomical, and physiological-biochemical indicators.

Seed formation is a combination of complex physiological processes which are closely related to the characteristics of fertilization and conditions of the external environment. Thus, a germ is formed as a result of the fusion of genetically and physiologically distinct gametes. In addition, not simultaneous occurrence of morphogenesis phases, the anatomical structure of the conducting system, differences in the activity of the assimilation apparatus, the conditions of nutrition and water supply are the cause of quality heterogeneity of the seed material.

The process of forming and maturing seeds of Panicum miliaceum L. millet goes somewhat unusually. Due to the uneven comfrey appearance and the significant duration of flowering, maturing seeds in various parts of it is also uneven. This phenomenon is a consequence of morphogenesis peculiarities of millet plants at the beginning of the vegetation. Thus, A. A. Kornilov (1960) has established that after the appearance of the first leaf there is an extension of the growth apex and around it there are embryonic tubercles of future branches of the comfrey. They are secondary growth apexes from which the first laminas, branches and inflorescences. It is characteristic for millet that the second-order growth apexes occur only in the lower third of the main apex in such a way that upper branches appear first and have the flowering phase. In turn, each embryotic branch is differentiated, forming spike-like rumples and acquires a pluripartite form.

Simultaneously with ear formation of upper branches, the formation of new growth apexes of ramuluses and their subsequent branches – branches of the third and fourth orders continues. Usually, the lower floral rumple remains underdeveloped, staminal rumples do not grow in it and in the future are in the form of thin husks. The upper floral rumple is larger and in the future, in the middle of its flower scales, there will be one central rumple (pistil) and around it there are three staminal rumples. However, there are known cases where, under certain conditions (short daylight hours), two flower ears were developed and two grains were formed. Also, millet species are known in which two grain ears are well inherited. Rarely millet develops multi flower ears (more than three) but only one–two flowers bear.

The ovary of the millet flower is sessile, oval with two receptacles on long stiles. There are two lodicules at the base of the flower. The pollen is round, smooth and light yellow. Spikes of the upper part of the comfrey are developed normally and spikes of the lower part are often underdeveloped with atrophied flowers.

Many scientists studied peculiarities of millet flowering. A. F. Batalin (1887) considered millet to be a cross-pollinated plant because cross-breeding varieties were observed in compatible sowing of different millet varieties. According to the results of many observations under the conditions of Bezenchuk research station S. A. Belov (1914) concluded that millet is an exclusively self-polluting crop. The same opinion was also observed by S. V. Levitsky (1917) which special studies show that 95–100 % of grain setting under the conditions of comfrey isolation and cross-pollination is possible only due to small insects. K. Frovirts (1985) admitted the possibility of self-pollination, as well as cross-pollination of millet, that is, it is an optional self-pollinator. Later this conclusion was confirmed by other scientists.

The degree of cross-pollination depends on the duration and nature of flowering, as well as the conditions for millet growth. Thus, according to some scientists, under the conditions of Kyiv region, the proportion of grain setting after cross-pollination did not exceed 1 % and in the East of Ukraine it increased to 10–12 %. According to other scientists, under the conditions of Kinel breeding station, cross pollination reached 10 % or more and this type of pollination increased in warm and arid conditions with weak winds.

Subsequent studies have made it possible to clarify which conditions provide exclusively self-pollination and when partial cross-pollination is possible. Summarizing these studies, as well as the results of his own observations, A. V. Vatagin (1960) depending on the weather conditions and the nature of flowering, he identified three types of pollination:

- pollination in a closed flower which occurs in the cloudy cool weather (typical self-pollination);
- pollution occurs under favorable conditions of the warm and sunny weather, polliniums are thrown outside floral scales and after their cracking the pollen is freely dispersed (both types of pollination are possible);
- pollination under moderately favorable weather conditions, when, during flowering, polliniums are cracked quickly and the pollen basically falls on the snout of its own pistil (predominantly self-pollination).

The closure of flowers occurs regardless of whether pollination has occurred or not. Repeatedly millet flowers are not disclosed. The duration of flowering of a single flower, depending on the air temperature and the degree of its readiness for flowering, usually lasts from 3–5 to 20–40 minutes.

The first flowers on the comfrey bloom in 2–5 days in the upper part of it and then it spreads downwards. Studies by L. M. Aseyeva (1940) found that in the warm dry and sunny weather, flowering of early and middle-aged varieties begins on average on the second–fourth day after comfrey appearance, flowering of late ripening varieties is on the fourth–sixth day and flowering of very late ripening varieties is on the fifth–eighth day. Pollinium cracking takes place on average 0.5–3.0 minutes after flowering and lasts 1–2 minutes, after which they quickly dry.

The average flowering time of a single comfrey is 6–20 days. At first single buds are blooming and the maximum flowering is observed on the fifth–eighth day. During mass flowering in one day, there are 50–80 buds; sometimes their number reaches 150 flowers. The total plant can have from 300 to 3000 flowers.

Depending on the temperature, during the day millet begins to bloom from 8 to 15 hours. Under the conditions of Kyiv region, the greatest intensity of flowering starts from 11–13 hours, under the conditions of Kharkov it is 10–11 hours and in Vesely Podil it is from 11–12 hours of the day.

Usually, the flowering of all millet plants in the field occurs almost simultaneously and lasts 10–30 minutes. In most cases, millet blossoms at very low temperature fluctuations (20–27 °C) but with significant fluctuations in relative humidity (40 to 70 %). However, there are reports that its flowering is possible at relatively low temperatures of 13–18 °C (Kharkiv region) and extremely high temperatures – 36–41 °C (Kazakhstan). At the same time, taking into account the varietal characteristics, scientists concluded that under the conditions of Forest-Steppe and Polissia, early ripening varieties bloomed at low temperatures (16–19 °C) and ceased to bloom at 25–28 °C. Drought-tolerant Volga and Kazakhstan varieties under the conditions of Steppe zone require about 25 °C to start flowering and cease to bloom only at temperatures above 40 °C.

The observations made by B. V. Yezhov (1947) allowed us to establish that even for a weak wind (1–2 m/s) about 7 % of the pollen is transferred to the distance of 500–700 m from sowing and with an increase in speed to

4.0–4.5 m/s its quantity is increased to 10 % and is transferred to the distance up to 600 m. The author concludes that there is a probability of not only free intravarietal re-pollination but also the threat of intravarietal transpollination under hot weather conditions. Therefore, during sowing of different millet varieties in the plots, it is necessary to have the spatial isolation.

It should also be taken into account that physiologically mature millet flowers open not only under the influence of temperature changes but also from mechanical irritation (for example, rain drops). Knowing this feature, it is recommended to call it artificially (by pulling the rope over crops) to accelerate and increase the mass of flowering. The use of additional artificial millet pollination increases the yield by 1.5–3.0 c/ha.

Under favorable conditions germination of pollen takes place immediately after its penetration on the pistil and after 30–60 minutes, pollen tubes are already reaching the embryo sac and fertilization is in progress. The pollen, which did not fall on the pistil after 15–30 minutes, loses its ability to sprout.

The maturation phase consists of three stages: the first stage is the formation of the germ, the second stage is the formation of the endosperm and the accumulation of nutrients in it and the third phase is the loss of moisture and maturation.

The first stage begins in one day (20–24 hours) after pollination. After 7–10 days, the germ is so mature that it can sprout, although the seed does not have the endosperm and is not filled. Filling lasts 18–24 days after fertilization. Due to not simultaneous flowering, the period of seed formation in a separate comfrey is quite long in time and can last from 25 to 30 days.

The heaviest and largest seed is formed in the upper part of the comfrey. There are other 15–20 days from the beginning of seed maturing in the upper part of the comfrey to its full ripeness in the lower part. In addition, the maturation period can be extended even due to not simultaneous formation of comfreys on individual stems of the plant. Therefore, the total duration of the period from comfrey appearance to economic maturity on average lasts 45–50 days. Such inconsistency in maturing grain from different parts of the comfrey causes a significant difference in the yield properties and seed qualities of millet seeds.

Thus, studying processes of maturing and accumulation of dry matter by grain from different parts of the comfrey allowed us to establish that the upper part of the comfrey forms the largest thousand-kernel weight and fully ripens but its share in the total comfrey weight is only 10–20 % (depending on the variety and the ecological group). The middle part of the comfrey is less productive and with lower thousand-kernel weight (80–90 % of thousand-kernel weight from the upper part) but its share in the harvest is about 60 %. In total, this amount of grain (70–80 %) and is the basis of the harvest. In the lower part of the comfrey (20–30 %), thousand-kernel weight is only 60 % of the thousand-kernel weight from the upper part of the comfrey and usually does not mature. Moreover, according to the observations of scientists, these indicators changed slightly, depending on the weather conditions of the year. Therefore, A. F. Yakimenko (1973) concludes that to reduce the period of ear emergence and achieve simultaneous maturing can be carried out only selectively and not by agricultural measures.

Due to not simultaneous maturing of seeds in different parts of the comfrey, harvest time, as well as the duration of post harvest maturing, are important in forming the level of its qualitative indicators. It is found that the duration of this period for millet is on average 12–15 days and under the conditions of optimal drying on the 15-th day its laboratory germination with 30–40 % of seeds (5-th day) increases to 95 % of seeds. This feature needs to be taken into account for the accelerated reproduction of several generations in the selection process.

Millet is characterized by its ability to fall. This is due to the structure of ears which scales hold ripe slippery grain weakly. Delays in harvesting and adverse weather conditions strengthen falling. Observations have shown that seeds from the upper part of the comfrey fall basically, that is, the most productive part of the harvest may be lost.

The research has established a significant dependence of yield properties of millet seeds on its physical characteristics. So, in growing Rubin 2 millet variety, the largest and heaviest fraction of seeds provided the best yields which was selected on a sieve with holes of 2.0 mm and thousand-kernel weight of 8.5 g and the smallest seeds from sieves of 1.8 mm gave the worst yields and thousand-kernel weight was

7.9 g. Accordingly, the advantage of the largest fraction in terms of yield was 2.2 c/ha or 15 %. Such data once again confirm the assertion about the size and weight of its seed material for millet, as a small seed crop.

Millet caryopsis is false chaffy caryopsis of a glomerular, oval or elongate shape with a ratio of width to length, respectively, 0.9; 0.8 and 0.75. The caryopsis consists of the endosperm, germ, membranes and flower husks. The germ is placed in the bottom of the grain and occupies about 25 % of its volume. Thousand-kernel weight varies from 4 to 10–11 g (diploid and tetraploid forms) but can reach 10–14 g (hexa- and octaploid forms). Husk content varies from 10 to 20 %, although in individual forms it can reach 30 %. Depending on the characteristics of grain processing there are two types of groats: whole millet (the kernel released from flower and partly from fruit seed scales and germ); crushed millet (quite large crushed kernels – by-product of whole millet). The harder the grain is, the less crushed millet is obtained. Considerable hardness is characteristic for varieties with vitreous grain endosperm.

Millet contains, on average, 11.5–12.0 % protein, although there are forms characterized by its increased content to 16 and even 20–23 %. Millet proteins are complete, containing 19 amino acids, among which are threonine, valine, leucine, lysine and histidine. The starch content averages 81.0–83.5 % and consists mainly of amylase (20 %) and amilopectin (80 %). However, there are millet varieties in the production which have only amylopectin (sticky varieties) in the grain starch. Growing such varieties is of great practical importance for the food, paper, textile and alcohol industries. Also, millet contains fatty acids (linoleic and palmitic acids), enzymes (amylase, maltose, lipase and catalase) and vitamins (B_1, B_2, B_5, B6 and E) and others. By the content of vitamins B_1 and B_2 millet grain is almost twice as high as other cereals.

The content of chemical compounds in millet grain depends on varietal characteristics and growing conditions. Studies have found that the chemical composition of millet grain depends on the geographic factor (when moving its crops from west to east and from north to south the protein content increased and starch content decreased).

In addition, the change in the chemical composition of millet grain is also influenced by the weather conditions of the year of harvesting. Thus, in dry years, the protein content, as well as vitamin B1 in grain and amylase in starch increases, as well as the overall starch content decreases. The fat accumulation, which content in millet grain on average is 3.8–5.0 %, is promoted by high humidity and moderate temperature regime.

There are significant differences comparing millet with other cereals and in the initial phases of growth and development of plants after falling seeds into the soil. So, it requires for germination only 25–34 % of water from its dry mass. The structure and development of millet root system is typical for plants which photosynthesis in the CALVIN cycle runs on C_4 type. Unlike the first group, millet seeds sprout only with one germinal root which does not die before the end of the plant vegetation and provides some minimum yield. However, the maximum grain yield of millet is determined by the number of nodal (real) roots that grow simultaneously with the germinal one. First, there are roots from the first lowest node, then from the second, third one and so on. The bulk of the root system is located in the layer of soil of 70–90 cm. However, under favorable conditions (deep plowing), it can reach 120–130 cm and absorb moisture from the soil when its contents are close to the limit of the dead stock. The period of its maximum development is on the second half of tillering phase-the beginning of panicle emergence. At this time, millet root system by its weight is much more developed, compared with such spring crops as buckwheat and wheat, yielding only barley and oats.

These features of biology and morphology of seeds and millet plants determine the significant heterogeneity of its seed material. Knowledge and understanding of these features, as well as physiological processes occurring in seeds and plants, will optimize conditions of agricultural technology of millet crops. Full seeds have better optimized metabolism and significant reserves provide more vigorous germination. Under unfavorable conditions for longer periods of time, plants developing from such seeds do not have autotrophic feed and in the future ensure not only the maximum yield but also seeds of better quality.

ВМІСТ БІЛКА У ЗЕРНІ НОВОСТВОРЕНИХ ПОПУЛЯЦІЙ ПШЕНИЦІ ОЗИМОЇ

І. О. Полянецька, В. В. Любич, Ж. М. Новак, М. О. Макарчук
Уманський національний університет садівництва

Прийнявши від народної селекції на початку 20 століття сорти злаків з урожайністю 7 ц/га, наукова селекція створила в кінці століття сорти злаків із генетичним потенціалом продуктивності 100 ц/га. На даному етапі розвитку сільського господарства України створення високоврожайних форм пшениці з високим вмістом білка у зерні є першочерговим завданням [1].

У дослідженнях 2019–2020 років вивчалиашість популяцій пшениці і порівнювали їх з вітчизняним сортомапшениці м’якої озимої Подолянка.

Для вивчення нових номерів пшениці озимої, одержаних від схрещування *Triticum aestivum L. / Triticum spelta L.* — висівали у контрольному розсаднику. Досліджуванішномери F_4–F_5 і сорти пшениці озимої Подолянка, Зоря України висівалиау чотирьох повтореннях. Густота рослиністановила 5 млн./га. Загальна площаaділянки у досліді становила 5 м^2 з послідовнимнрозміщенням ділянок.

Всі найважливіші процеси людини (обмін речовин, здатність рости і розвиватися, розмноження) пов’язані з білками. Білки пшениці є повноцінними за амінокислотним складом, містять усі незамінні амінокислоти – лізин, триптофан, валін, метіонін, треонін, фенілаланін, гістидин, аргінін, лейцин, ізолейцин, які добре засвоюються людським організмом. Проте у складі білків недостатньо таких амінокислот, як лізин, метіонін, треонін, тому