AGROECOLOGICAL CONDITIONS OF FORMING CROP YIELD AND QUALITY OF MILLET SEEDS

Abstract. Analytical review of national and foreign literature sources to optimize agroecological conditions of seed crops of millet seed is shown. Data on plant response and quality of the formed seed for nutritious regime of the soil, moisture conditions, light and heat is presented. The analysis found that scientists and manufacturers to this day have no consensus on the impact of agroecological conditions on developing the largest amount of high yield of millet seed. A large number of reports has a considerable antiquity, studies were made in different regional conditions, a comprehensive study of the impact of agroecological factors for forming sowing qualities and yielding properties of millet seed in terms of Right-Bank Forest Steppe of Ukraine was not carried out.

Keywords: millet, seeds, sowing qualities, yielding properties.

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The technology of growing seed and commodity crops has some differences. Many scientists on studying peculiarities of formation of sowing qualities and yielding properties of seeds note that high yield is not the guarantee of obtaining high sowing qualities [1, 2]. In addition, in literature there is data that in conditions of forming maximum yield, seed quality decreases. Thus, according to V. Likhochvor [3], the largest seed yield and its biological usefulness are achieved at the yield level of 4.0–4.5 t/ha. A further increase in productivity and its reduction beyond 3 t/ha does not allow to get high quality sowing material.

In the technology of growing plants in seed crops significant role is given to knowledge of crop biology, critical periods of its development and peculiarities of reaction to abiotic, biotic and anthropogenic factors during formation and development of seeds, reasons of its varying quality [4]. It should be noted that millet has significant differences from other plants of the cereal family in a number of biological properties. First of all – this is a great biological plasticity of the crop, high bushiness (millet is able to generate more than 10 stems) and a very high rate of reproduction (the number of grains in the panicle can vary from 100 to 3000 and more). As a result of it millet is able to give record harvests – to 20.1 t/ha [5].
Significant differences in various varieties of millet are also in precocity. Thus, its growing season varies by more than 2.5 times – from 50 to 130 days [6].

One of the factors that affect seed quality is temperature and humidity during its formation. Thus, long-term effect of soil and air drought causes grain condition of being undersized; they have little heaviness and further form weak shoots. In addition, vigor of undersized seed is increased, so it is poorly preserved.

Other scientists point at ecological heterogeneity of seeds caused by environmental diversity of millet’s formation and developmental peculiarities of reproductive organs. According to the results of research E.G. Kzyzlova [7], the dependence of seed quality of maize on temperatures during pollination-fertilization was manifested in different energy of seed germination and power of its initial growth. In the first two days of pollination average temperature was only 12-14°C and its relative humidity was 60-70%. This led to the formation of seeds with reduced qualities, germination energy declined by 3-4% compared with the indicator of seeds formed by temperature at 20-22°C. Plants formed from seeds with reduced vigor lagged behind in growth and development. The share of impact of seed quality indicators in forming future yield, according to reports of different scientists, is equivalent to agricultural activities such as tillage, fertilization, peculiarities of caring for crops and harvest and reached 20-40% [8].

As a result of observations of scientists [9] compared to other field crops millet also differs by considerable uneven ripening of seeds and strong capacity for its shedding. So, seeds from the top of a panicle ripen first and have the largest heaviness. However, at the time of ripening seeds in the bottom part have already abscised. In the same period, stems and leaves are still green. These peculiarities are quite valuable, as in the case of drought or premature mowing seed formation can continue due to nutrients of a stem and leaves.

Millet belongs to thermophilic crops in which there are absolutely no signs of resistance to the cold – at a temperature of +1°C it is damaged and at –2-3°C – it dies. High temperatures unlike other cereals millet survives quite easily. Yes, even at 40°C its stomata cells within 48 hours retain elasticity and photosynthesis does not stop even at +45°C and above [10].

As a short daylight plant millet ripens most rapidly under conditions of intense lighting during 10-12-hour light day. However, increasing duration of the day during vegetative period slows its transition to the generative development while more leafy mass is forming and further productivity increases [11, 12].

In the scientific literature there is also information about the influence of lighting conditions on the formation of reproductive organs of millet plants and the future harvest. Thus, researchers [13] notice that millet plants are especially sensitive to light intensity. Insufficient light intensity during flowering-fruit formation causes complete infertility of ears and under optimal conditions there is accelerated plant transition to fruiting, a high-quality heavy seed is formed. Furthermore, the authors emphasize that different varieties of millet show different requirements for light intensity.

Influence of light on plants is versatile and it is not only a source of energy but it is also a kind of regulator or stimulus. A complex influence of such action is the sensitivity of plant seeds. The reaction of seeds to light in different species has its own distinctive peculiarities. Thus, seeds of some crops for its action increase their sowing qualities while in others germination inhibiting appears. There are also plants which seeds are neutral in this respect [14].

Zonal conditions of cultivating different varieties of seed millet also affect both the level of productivity and the quality of grain. E.G. Kzyzlova notes that geographical conditions significantly affect the quality of seeds and block varietal differences at 9-16%.

Studies carried out in conditions of Kyiv region found a significant impact of soil and climatic conditions on yielding properties of millet seeds [28]. Thus, yield of the variety Soniachna in 1982 when sowing seeds grown in the experimental farm “Kopylovo” (Makariv district, Kiev region) was 42.6 c/ha (control). When sowing seed of the same variety but reproduced in 1981 at variety stations of forest steppe and steppe conditions increased by 4.2-8.6 c/ha [28].

However, according to the results of integrated environmental variety testing of seed millet on the sum of ranks of genotypic and environmental effects and on the maximum potential of productivity made by O.I. Rudnyk-Ivashchenko [4, 29] it is found that exactly soil-climatic conditions are essential for forming a grain yield higher than millet cultivation area. Thus, among the most favorable ecological niches for growing new varieties of seed millet author has marked regions such as Cherkasy, Chernihiv and Ivano-Frankivsk in which yield varied from 0.37 to 2.03 t/ha compared with an average productivity of variety testing.
Conclusions. Formation and development of seeds on a millet plant does not occur simultaneously, respectively its availability of nutrients also varies. The level of this availability is related with the intensity of photosynthesis and flow of mineral nutrients which in turn are determined by the conditions of external environment. Establishing relationship of these conditions with corresponding seed quality indicators does not have only scientific interest because its morphological and physiological–biochemical properties affect sowing qualities of seed material.

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Уманський НУС став учасником проекту SUAFRI-EPC (Supporting the Uptake of Agri-Food Research Results into Innovation with EPC countries). Основна мета проекту – скоротити розрив між дослідженьми та інноваціями в агропродовольчому секторі країн Східного Партнерства. Проект підтримує наукові розробки та інновації за тематикою «Безпечне харчування, стабільне господарство, морські дослідження та біоекономіка». Дана тематика є однією з пріоритетних та входить у Програму ЄС «ГОРИЗОНТ-2020.»