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"EDUCATION AND SCIENCE IN THE CONTEXT OF GLOBAL CHANGES"

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SEED PRODUCTIVITY OF MUSTARD VARIETIES DEPENDING ON SOWING RATE

Fluctuations in climatic resources, with a tendency to increase temperature, today require an expansion of the range of agricultural crops, including oilseeds. This is possible by introducing more drought-resistant crops into the crop rotation, which are able to easily adapt to different growing conditions. One of such crops is white mustard[1/2/3].

This crop grows equally well both in regions with insufficient humidity and in areas with sufficient rainfall.

White mustard (Sinapis alba) is a universal, promising oilseed crop that has many advantages over other cabbage crops and has a wide range of applications and uses: for example, for obtaining vegetable oil and protein.

Depending on the level of quantitative parameters of fatty acids in mustard oil, it is used directly, for food and for preparing various dishes and products. According to many researchers, who indicate that with an erucic acid content of up to 20-30%, mustard oil

[1] Shakalii, S. M., Senchuk, T. Yu., Shevchenko, V. V., Bagan, A. V. & Senchylo, O. O. (2021). Formation of the yield potential of sunflower hybrids depending on the breed of bees. Tavria Scientific Bulletin. 121. 115-121. https://dspace.pdau.edu.ua/handle/123456789/11249 [in Ukraine].
[2] Shakalii, S. M., Chetveryk, O. O. & Malypko, A. V. (2024). The value and prospects of using white mustard. Yield and quality of crop products using modern growing technologies, dedicated to the memory of Professor G. P. Zhemela: materials of the international scientific-practical online conference. Poltava, https://dspace.pdau.edu.ua/handle/123456789/17629 [in Ukraine].
[3] Butenko, S. O. (2022). The influence of plant growth regulators on the quality of mustard seeds in the conditions of the northeastern forest-steppe of Ukraine. Tavria Scientific Bulletin. 124. 10–18. https://doi.Org/10.32851/2226-0099.2022.124.2 [in Ukraine].

can be used in the technical industry, and in particular, for the production of biofuels. Mustard, from an agronomic point of view, is an environmentally friendly and effective resource of organic matter for the soil.

In this regard, both the yield potential and the economic effect of introducing white mustard as a promising oilseed crop will largely depend on the use of cultivation technology methods that are adaptive to local soil and climatic conditions. According to numerous researchers, the seeding rate of a crop is the cheapest and most economically effective method of cultivation technology[4]/[5]/[6].

Crop yield is, first of all, the reaction of the crop to the use of agrotechnical cultivation methods. The seeding rate is one of the most important elements of agricultural technology, which significantly affects the yield of any crop, including white mustard.

During the years of research (2022-2024), mustard yield averaged 1.41-1.69 t/ha, depending on the seeding rate (Table 1).

With an increase in the density of mustard plants, its yield increases to a certain limit, and then, with a further increase in the seeding rate, the yield decreases noticeably. The maximum mustard seed yield was noted in the variant with a rate of 2.5 million similar seeds per hectare and averaged 1.69 t/ha. However, with seeding rates of 2.0 and 3.0 million similar seeds, the mustard yield does not decrease significantly, by only 0.04 and 0.09 with the smallest significant difference of 0.12 t/ha.

Table 1. Yield of white mustard depending on the sowing rate

Seeding rates, million dry seeds/ha	Yield, t/ha			
	2022	2023	2024	Average
2,0 - st	1,60	1,62	1,73	1,65
1,0	1,41	1,50	1,53	1,48

[4] Melnyk, A. V., Butenko, S. O. & Jia Pei Pei. (2019). Prospects for the use of growth regulators with anti-stress effect for oilseed crops of the Brassicaceae family under conditions of climate change in the left-bank forest-steppe of Ukraine. Scientific and practical conference "Climate change and agriculture". Mykolaiv, 212 [in Ukraine].

[5] Voloshyn, P. (2022). Ukrainian oilseed products meet international standards. National Industrial Portal. URL: http://uprom.info/news/agro/ukrayinska-oliyna-roduktsiyavidpovidayemizhnarodnim-standartam/ (access date: 27. 03. 2022). [in Ukraine].

[6] Shakalii, S. M., Yurchenko, S. O., Bagan, A. V., Shevchenko, V. V. & Zaroza A. O. (2022). Peculiarities of sunflower growth and development depending on biological products. Bulletin of the PDAA. 3. 11–17. https://dspace.pdau.edu.ua/handle/123456789/12566 [in Ukraine].

1,5	1,51	1,59	1,55	1,55
2,5	1,67	1,72	1,68	1,69
3,0	1,55	1,64	1,61	1,60
3,5	1,43	1,51	1,59	1,51
4,0	1,27	1,46	1,50	1,41
LSD05	0,09	0,07	0,11	0,12

When the seeding rate deviates in one direction or another, the seed yield decreases, and the minimum is noted in cases with a seeding rate of 4.0 million (1.41 t/ha) and 1.0 million (1.48 t/ha) of similar seeds. It should be noted that this trend was observed during the research years.

In 2022, with a GTK of 0.72 units, the lowest mustard seed yield was formed, which varied from 1.27 to 1.67 t/ha, with a maximum indicator at a seeding rate of 2.5 million and a minimum at a seeding rate of 4.0 million.

However, in 2023 and 2024, with different degrees of moisture content of the GTK of 0.84 and 1.40, respectively, mustard productivity was at the same level and averaged 1.58 and 1.60 t/ha on average according to the experiment, with a variability of 1.46-1.72 and 1.50-1.68 t/ha. It should be noted that the greatest influence on seed formation is exerted by weather conditions in the "flowering-ripening" phase. This phase in both years was characterized by humid conditions, the hydrothermal coefficient was 1.14 and 1.48. This confirms the biological characteristics of mustard, which determines its high need for moisture during flowering and ripening. Among the studied options, the highest average yield over the years of the study, obtained with a sowing rate of 2.5 million similar seeds, was 1.69 t/ha; the smallest – in the case of sowing rates of 4.0 and 1.0 million similar seeds – 1.41 and 1.48 t/ha, respectively. The difference was significant and amounted to 0.28 and 0.21 t/ha, with NIR - 0.12 t/ha.

The results of our research showed that the number of branches and pods on a

[7] Zhuravel, V. M. & Budilka G. I. (2013). Black and white mustard - an alternative to sunflower. Grain. 4. 85–91 [in Ukraine].
[8] Melnyk, T. I., Ali Sh. & Kolosok, V. G. (2020). Quality of white mustard seeds depending on the variety and sowing rates in the conditions of the northeastern Forest-Steppe of Ukraine. Tavria Scientific Bulletin. Kherson. 113. 92–97 [in Ukraine].
[9] Oilseed flax, mustard. Strategy for the production of oilseeds in Ukraine (uncommon crops): monograph /I. A. Shevchenko et al. Zaporizhzhia: Status, 2017. 44 [in Ukraine].

mustard plant varied greatly over the years, the coefficient of variation was 20.4-27.3 and 20.5-31.4%, respectively. The greatest branching of plants was noted in the variant with a sowing rate of 1.0 million similar seeds, the number of branches on a plant was 4.2-7.4 pieces.

Accordingly, in this variant there was a greater number of pods per plant, which on average amounted to 69.1 pieces, varying from 60.4 (2022) to 80.4 pieces (2022). This is because with a low seeding rate there were fewer plants per unit area. On the other hand, fewer plants allowed for fewer seeds to be obtained, which led to a decrease in the overall yield. The minimum number of pods in mustard was noted on plants with a seeding rate of 4.0 million, which amounted to 34.9-37.9 pieces over the years.

The largest number of pods (37.9-80.4 pieces) of mustard plants was formed in 2022, the lowest number of pods per plant was noted in 2024, and was within 34.9-60.4 pieces.

The amplitude of variation in the mass of seeds from one plant, which on average amounted to 21.9-34.9%. In 2024, the mass of seeds from one plant was the largest and amounted to 2.02-3.73 g, which was 0.56-0.71 g and 0.04-0.58 g more than in 2022 and 2023, respectively. It should be noted that the highest productivity of one plant was noted in the variant with a seeding rate of 2.5 million (2.98-3.73 g). The smallest mass of seeds from one plant was noted in the variant with a seeding rate of 4.0 million, which amounted to 1.44-2.02 g over the years. The number of seeds in one pod was 4-6 pieces, the variability of this indicator over the years was 5.3-13.9%.

In 2022, the mass of 1000 seeds was 6.05-6.50 g, with the largest seeds formed in the variant with a rate of 1.5 million, small ones - at a rate of 4.0 million. In the conditions of 2023 and 2024, the mass of 1000 seeds was practically the same and amounted to 5.83-6.10 g and 5.82-6.08 g, respectively. The largest seeds were at a rate of 2.5 million. On average, over three years, larger mustard seeds were obtained in the variant with a sowing rate of 2.5 million similar seeds, the mass of 1000 seeds of which reached 6.19 g. The lowest seed size indicators were noted in variants with a sowing rate of 4.0 million - 5.92

g (Table 2).

Table 2. Indicators of the structure of the white mustard crop (2022-2024)

Seeding rates, million dry seeds/ha	Plant height, cm	Number of branches per plant, pcs.	Number of pods per 1 plant, pcs.	Number of seeds in 1 pod, pcs.	Weight of seeds from 1 plant, g	Weight of 1000 seeds, g
2,0 - st	92,5	3,9	46,6	5,4	2,84	6,09
1,0	91,7	5,6	69,1	5,9	2,38	6,00
1,5	92,8	5,5	47,2	5,7	2,68	6,15
2,5	91,4	5,0	48,8	5,7	3,47	6,19
3,0	89,5	3,9	38,5	5,1	2,24	5,97
3,5	90,8	3,2	37,0	5,0	1,79	5,97
4,0	88,8	3,2	35,9	4,9	1,64	5,92

The positive effect of the seeding rate on the formation of productive white mustard stalks has been established. It was found that the mustard seeding rate of 2.5 million similar seeds allows you to create crops with an optimal leaf surface and maintain it for a long period of time.

In our studies, when sowing mustard with a seeding rate of 2.5 million similar seeds, its seed productivity reached the highest value (1.69 t/ha). The highest indicators of the mustard yield structure elements are indicated in the variant with a seeding rate of 2.5 million similar seeds per hectare. Here, the most optimal number of pods (48.8 pcs.) per plant, the number of seeds (5.7 pcs.) per pod, the value of the plant's seed productivity (3.47 g) and large seeds (6.19 g) were formed.

When growing white mustard in the conditions of the Forest-Steppe of Ukraine in order to obtain high and stable yields of seeds with high quality, we recommend: sowing white mustard of the Talisman variety in a regular way with a sowing rate of 2.5 million similar seeds per hectare.