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INFLUENCE OF SEED HETEROGENEITY ON SOWING AND YIELDING PARAMETERS OF RICE CULTIVARS

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The demonstrated that the sowing parameters of rice seeds were significantly influenced by panicle parts from which the sown material had been taken. The best sowing indicators (1000-seed weight, germination energy, laboratory and field germinability) were recorded for seeds gathered from the upper part of the main panicle.

Key words: *rice, 1000-seed weight, germination energy, field germinability, yield, heterogeneity*

Introduction. The rice is the most common groats crop. Ukraine is the farthest country from the equator, where the rice is successfully grown. The Institute of Rice of NAAS has created rice cultivars adapted to the conditions of the South of Ukraine.

In terms of sown areas and gross yield, the rice ranks second, and in terms of yield capacity, this crop ranks first in the world among groats crops [1]. Intensive technologies of rice cultivation involve sowing of high-quality seeds, as they determine biological and economic characteristics of plants; therefore, their quality largely affects the yield volume. Thus, with weather permitting, modern rice cultivars are able to produce high seed yields. However, despite a high productive potential of seeds, the seed germinability in the field is quite low. Some researchers reported that the field germinability of rice seeds did not exceed 25-35%, while in other groats crops it was two to three times higher [2].

Low germinability in the field and uneven seedlings are primarily attributed to the seed quality, while imperfection of farming techniques during the growing period is of secondary importance. One should remembere that it is much easier to grow good-quality seeds and prevent their deterioration than to "restore" them later [3].

In addition, there is no doubt that the use of only high-quality seeds on an industrial scale is an important, untapped reserve for increasing seed production. To obtain high-quality rice seeds with high sowing and yielding parameters, one need to use advanced methods of seed production [4].

Literature review and objective articulation. The ability to form seeds is one of the most important functions, which plants evolved. Genetic programming for obligatory self-formation in the process of long evolution has formed a selective mechanism of seed nutrition in plants. Depending on internal and external factors, seeds produced by a parental plant are heterogeneous by their morphological, anatomical and biological properties. Seeds are formed during the plant life under certain environmental conditions. Due to the effects of various exogenous and endogenous factors during different phases of the parental plant development, seeds have various sowing and yielding parameters. The seed heterogeneity in terms of morphological, biochemical and physiological compositions as well as ability to germinate and ensure a certain productivity of genotypes in the offspring is called "heterospermia". In the production of high-quality sowing material, it is necessary to solve three basic challenges: identification of conditions that would favor formation of seeds of various quality, and choice of criteria for selecting the best seeds and use of objective methods of seed evaluation [5, 6]. Heterospermia is primarily associated with seed size – an important biological and economic indicator that characterizes the suitability of seeds for sowing and their yielding qualities. It is known from publications that the use of the best, ie conditioned, seeds for sowing is equivalent in the effect of fertilizers or better tillage [7].

Seeds of the same batch, or from one plant, or from one inflorescence may differ in their anatomical, morphological, physical, chemical, physiological and genetic characteristics. This phenomenon is called heterogeneity.

Purpose and objectives. The development of a cultivation technology is aimed at maximizing the potential productivity of a crop. To accomplish this, studies of heterogeneity are not only of theoretical but also of practical value, as knowledge of this phenomenon can open new opportunities to improve seed quality.

Materials and methods. The rice, like most other groats crops, is noticeable for a fairly clear manifestation of one of the forms of seed heterogeneity – matrical heterogeneity. In particular, we conducted studies on cultivars of different ripeness groups (mid- and late-ripening) and confirmed that the best sowing parameters (1000-seed weight, germination energy and laboratory germinability of seeds) were intrinsic to seeds formed in the upper part of the main panicle. Naturally, a question about the feasibility of using this phenomenon to select good-quality seeds followed by sowing them in the primary stages of seed production arose.

The experiments were carried out in the trial fields of the Institute of Rice of NAAS of Ukraine in 2019–2020. The weather during the growing period was generally favorable for sufficient yields and harvest of good-quality seeds.

The following rice cultivars were studied: Premium (early-ripening), Vikont, Marshal, Merydian-32 (late-ripening). According to the experiment desing, the panicles of rice cultivars were divided into upper and lower parts. The sowing area was 25 m^2; the record area was 20 m^2. The experiments were carried out in four replications. The farming technique of the experiments was in accordance with the recommendations of the Institute of Rice of NAAS. Seeds were conventionally sown in rows. The yields were harvested and recorded by direct combining in the phase of full ripeness of seeds with a small-sized combine "Yanmar". Phenological observations of plant growth and development were performed during the growing period. Data were statistically processed by traditional methods.

Results and discussion. Our study was planned to evaluate the influence of matrical heterogeneity of seeds on their sowing and yielding parameters in different promising rice cultivars bred in Ukraine: Premium (early-ripening), Vikont, Marshal, Merydian-32 (late-ripening). The growing period of the studied cultivars varied depending on the genotype and cultivation year. Thus, the growing period ranged 110 to 115 days and 125 to 130 days in the mid-ripening and late-ripening cultivars, respectively.

Analyzing the obtained data, we could see that the matrical heterogeneity of seeds in some way affected the quality of seeds. It should be noted that the highest germination energy and laboratory germinability of seeds were recorded when seeds from the upper part of the panicle were sown, regardless of the cultivar (Table 1). These parameters were much lower with seeds from the lower part of the panicle, for all cultivars under investigation. However, it is noteworthy that the germination energy and laboratory germinability of seeds in latter variant ranged within 95–97% and 97–98%, respectively. These values are quite high and correspond to the current standard in Ukraine (DSTU 2240-93) for varietal and sowing qualities of seeds.

As to the 1000-seed weight, the larger and plumper seeds in the upper part of the panicle were, the thinner and less pump they were in the lower part of the panicle. The 1000-seed weight for the upper part of the panicle ranged 30.22 to 27.58 g, depending on the rice cultivar. This parameter for the lower part of the panicle was within 28.78–26.84 g

The 2019–2020 results shoed that the seed quality was affected by matrical heterogeneity of seeds. Therefore, better results were obtained in the plots sown with seeds from the panicle top, and the field germinability was 1.5-fold in comparison with the plots sown with seeds from the lower part of the panicle.

Analyzing the cracking index, we observed its decrease in the plots sown with seeds from the upper part of the panicle, while in the plots sown with seeds from the lower part of the panicle, this parameter, on the contrary, increased. Reduction in the cracking index had a positive effect on the germination energy and laboratory germinability, allowing for an increase in the field germinability.

Table 1.

Major sowing parameters of the rice seed quality before sowing depending on the seed heterogeneity, 2019–2020

Cultivar	Variant	Before sowing				Field germinability, %
		1000-seed weight, g	Cracking index, %	Germination energy, %	Laboratory germinabili-ty, %	
Vikont	Upper part of the panicle	30.22	15	100	100	87
	Lower part of the panicle	28.78	22	98	98	65
Premium	Upper part of the panicle	29.19	14	100	100	81
	Lower part of the panicle	28.48	33	96	98	58
Marshal	Upper part of the panicle	27,75	3	100	100	90
	Lower part of the panicle	27.20	6	96	97	69
Merydian-32	Upper part of the panicle	27.58	7	97	99	83
	Lower part of the panicle	26.84	12	92	95	74

Rice cultivation technologies aimed at maximizing the potential productivity of the crop is the basis of both seed and kernel production, especially in the conditions of new industrial relations. Therefore, our purpose was to develop rice cultivation technologies with due account for its varietal characteristics via studying the effect of rice heterogeneity on yield (Table 2).

Analyzing the yields harvested from the experimental field in the study years, we observed that the rice yield ranged 8.1 to 11.7 t/ha, depending on a combination of the factors of interest. The results demonstrated that the plots sown with seeds from the upper part of the panicle gave significantly increased yields regardless of the cultivar. The maximum yield in this variant was given by Vikont – 11.7 t/ha.

Significantly lower yields from all the studied cultivars were produced in the plots sown with seeds from the lower part of the panicle. The minimum yield was given by Premium – 8.1 t/ha. Our calculations showed that we lost 1.9–2.3 t/ha of conditioned rice seeds when seeds from the lower part of the panicle were used for sowing compared to crops grown from seeds from the upper part of the panicle. Thus, it was found that seeds from the panicle top, regardless of the cultivar, were adventurous in terms of yielding parameters. The use of seeds from the lower part of the panicle reduced the yield parameters of seeds, which led to a shortfall of precious material.

Table 2

Rice seeds yields depending on the seed heterogeneity, t/ha, 2019–2020

Cultivar (factor A)	Part of the panicle (factor B)		Mean for factor A
	Upper part of the panicle	Lower part of the panicle	
Vikont	11.7	9.5	10.57
Premium	9.9	8.1	8.98
Marshal	10.6	8.3	9.45
Merydian-32	10.9	8.7	9.80
Mean for factor B	10.77	8.63	

LSD_{05} Significance level of the share differences for the factors: A -0.128; B – 0.131
Significance level of the mean values of the (main) effects: A – 0.091; B – 0.065

Analysis of variance proved the differences in the influence shares of the studied factors on the rice yield (Fig. 1).

It was found that the seed heterogeneity had the greatest impact on the yielding parameters and seed productivity of plants, as its share was 76.4%. The cultivar peculiarities contributed

22.4% to the impact on the seed yield. The A-B factor interaction was insignificant (0.5%); the influence of residual factors (primarily weather factors) was also insignificant (0.7%).

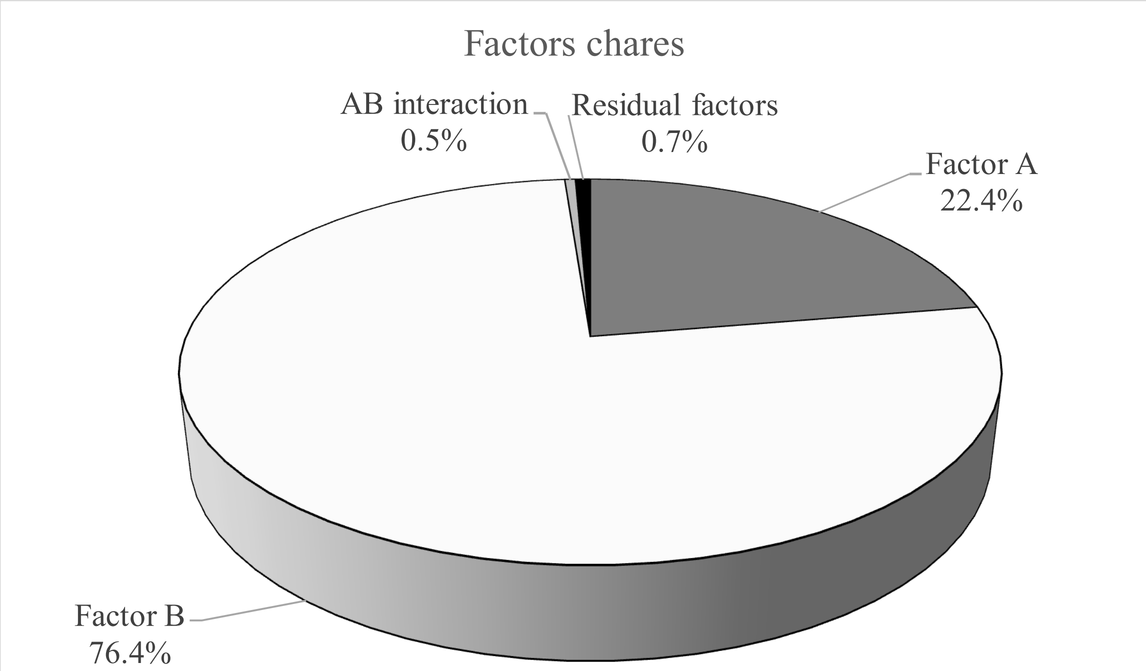

Fig. 1. The factor shares in the influence on the rice seed yield depending on the cultivar peculiarities (factor A) and seed heterogeneity (factor B),%

Conclusions. The study revealed that, to obtain stable yields with high sowing and yielding parameters, it is necessary to use high-quality seeds, in particular seeds from the panicle top, regardless of the cultivar. Analysis of variance proved the maximum share of the seed heteroggeneity in the impact on the seed yield. The use of seeds from the lower part of the panicle for sowing led to waste of planting material and thinned crops, resulting in reduced yields, which in turn meant low-quality seeds.

Thus, the matrical heterogeneity-based selection of rice seeds from the upper part of the panicle in the primary stages of seed production is an important technological approach.

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ВПЛИВ РІЗНОЯКІСНОСТІ НАСІННЯ НА ПОСІВНІ І УРОЖАЙНІ ВЛАСТИВОСТІ СОРТІВ РИСУ

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Мета. Розробка технології вирощування спрямована на максимальну реалізацію потенційної продуктивності культури. Для цього вивчення різноякісності має не тільки теоретичне значення, а й практичне, так як пізнання цього явища може відкрити нові можливості поліпшення якості насіння.

Матеріали і методи. В 2019–2020 рр. проводили польові та лабораторні дослідження в рисовій сівозміні Інституту риса НААН. Агротехніка експерименту відповідала вимогам методики дослідної справи за Доспєховим Б.О.

Обговорення результатів. Висвітлено результати дослідження закономірностей формування продуктивності нових сортів риса, а також його насіннєвої якості в залежності від матрикальної різноякісності. Врожайність у польовому досліді за роки дослідження змінювалася в межах від 8,1 до 11,7 т/га в залежності від тих чи інших досліджених чинників. Установлено, що висока врожайність риса формувалася на дослідних ділянках, засіяних насінням з верхньої частини волоті н від сорту. На дослідних ділянках, засіяних насінням з нижньої частини волоті, відмічено недобір насіннєвого матеріалу від 1,85 до 2,30 т/га у порівнянні з попереднім варіантом. Таким чином, сівба насінням з нижньої частини волоті призводить до нераціонального використання насіннєвого матеріалу, в результаті чого відбувається зрідженість посіву та як результат – зниження врожайності, що в свою чергу викликає зниження якості насіння.

Висновки. Таким чином, застосування у первинних ланках насінництва рису відбору насіння на базі прояви матрикальної різноякісності у межах верхньої частини волоті є важливим технологічним прийомом. Це сприяє підвищенню врожайності та якості насіннєвих посівів рису, що дозволяє прискорити впровадження нових сортів у виробництво.

Ключові слова: *рис, маса 1000 насінин, енергія проростання, польова схожість, врожайність, різноякісність.*

INFLUENCE OF SEED HETEROGENEITY ON SOWING AND YIELDING PARAMETERS OF RICE CULTIVARS

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Purpose and objectives. The cultivation technology development was aimed at maximizing the potential productivity of the crop. To accomplish this, studies of heterogeneity are not only of theoretical but also of practical value, as knowledge of this phenomenon can open new opportunities to improve seed quality.

Materials and methods. In 2019–2020, the field and laboratory experiments were carried out in the rice crop rotation of the Institute of Rice of NAAS. The farming technique of the experiment met the requirements for experimentation, as Dospekhov B.A. described.

Results and discussion. This article covers the results on the performance patterns of new rice cultivars and their seed parameters, depending on the matrical heterogeneity. The yield in the field experiments across the study years ranged 8.05 to 11.68 t/ha, depending on a combination of the factors under investigation. It was found that the rice produced high yields in the plots sown with seeds from the upper part of the panicle, regardless of the cultivar. In the plots sown with seeds from the lower part of the panicle, there was a shortfall of planting material from 1.85 to 2.30 t/ha in comparison with the plots sown with seeds from the upper part of the panicle. Therefore, sowing seeds from the lower part of the panicle means irrational use of planting material, resulting in thinned crops and decreased yields, which in turn leads to the production of low-quality seeds.

Conclusions. Thus, the matrical heterogeneity-based selection of rice seeds from the upper part of the panicle in the primary stages of seed production is an important technological approach. This contributes to an increase in the yield and quality of rice seeds, allowing for accelerated implementation of new rice cultivars into production.

Key words:*rice, 1000-seed weight, germination energy, field germinability, yield, heterogeneity.*

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INTRA-POPULATION VARIABILITY OF OIL CONTENT AND FATTY ACID COMPOSITION IN MODERN HEMP CULTIVARS

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The intra-population variability of the oil content, selection of plants with the maximum oil content, trait fixing in the selection process, and optimization of the fatty acid composition of oil in hemp seeds were investigated.

Keywords: *breeding, cultivar, inbreeding, oil content, fatty acid composition*

Introduction. Polymathic breeding material, which includes inbreeding lines, inter-line, cultivar-line and line-cultivar tetrahydrocannabinol-free hybrids, has been created. In order to assess their prospects for breeding and production, we studied the intra-population variability of