

EVALUATION OF THE TECHNOLOGICAL AND ECONOMIC EFFICIENCY OF THE CEREAL CROP VARIETIES RESISTANT TO ABIOTIC FACTORS

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ABSTRACT

After evaluating the agro-biological and economic efficiency, as well as the resistance rate to the abiotic factors [4] in the eared cereal crop varieties bred in the research center for the Crop Gene Pool and Selection at the ANAU, we have also investigated their technological properties and efficiency indices. It has been found out that the multi-row barley variety “Araratyan” completely meets the requirements of beer production in terms of its chemical composition (proteins – 12.79%, mucilage – 2.85%, vitreousness – 56.25 %).

Containing 13.81 % protein, the rye-wheat can be the best raw material for the combined feed production. Due to the high content of mucilage and proteins the spelt varieties are distinguished by high organoleptic properties and thrashing capacity. The mentioned varieties also provide high economic efficiency producing 250.1-426.2 thousand AMD profit per hectare in dry/rainfed conditions.

Keywords: Technological Feature; Membraniferous Property; Vitreousness; Protein; Mucilage; Starch; Profit; Brewing Industry.

INTRODUCTION

The promotion of yield quantity and quality increase in the agricultural crops, and particularly in the cereal crops, is the main strategic direction of the modern agriculture in the Republic of Armenia. The implementation of the aforementioned task is the key to the solution of the problem related to meeting the daily increasing demand of the population for agricultural food products. The agri-food supply chain is extremely important for poverty elimination and for the increase of human living standards. The selection procedures can serve as a sound means for solving the mentioned issue. It will enable to introduce intensive varieties of eared cereal crops

well adapted (providing sustainable and high-quality yield) to the global climate changes and various stressful situations (climatic anomalies, air and soil drought) in the agriculture, which can be rapidly regionalized and introduced in the production.

The breeding of new and valuable forage cereals is of no less significance for the increase of the animal-based food product amounts. Among the mentioned crops the spring barley variety "Araratyan" and the winter rye-wheat variety "Chyughavor", bred in the research center for Crop Gene Pool and Selection at the Armenian National Agrarian University (ANAU), are of significant interest, which are high yielding and rather perspective varieties. They can serve as a raw material for the production of valuable, highly nutritious combined feedstuff.

MATERIALS AND METHODS

The winter rye-wheat, spelt and barley varieties bred in the research center for Crop Gene Pool and Selection, ANAU, have served as study subjects of the current article, in the production of which the wild species of the mentioned crops (except for rye-wheat, which has been bred through the method of analytic selection) have participated as parental forms. They have been experimented in conditions of different zones of Armenia (irrigated conditions in Armavir marz/region and dry/rainfed conditions in Kotayk region/marz) and have provided more than sufficient results in yield capacity. It is worth mentioning that the mentioned varieties were rather resistant to water stress in the dry conditions and as a result of two-year investigations it has been disclosed that they have exceeded the regionalized varieties [4] traditionally cultivated in the same zone in their yield amount (by 7.7-9.2 c/ha). Such results can be obtained only in case of applying any agro-technical event or a number of similar combined measures. The results of the study conducted by an Italian expert D. Nicholson can be considered as the best practice, upon which the author states that when fertilizing the wheat sowings with the dose of N₄₅ in dry conditions, the yield surplus against the standard (control) variant makes only 6.1 c/ha [3].

We have thoroughly examined, first, the agro-biological and economic efficiency of the mentioned varieties and then their resistance to the abiotic factors and to various fungal diseases has been evaluated [4]. Regarding all mentioned indices the discussed varieties have demonstrated unprecedentedly high results due to which their investigations went on so as to find out the content of chemical composition in the grain grown under such stressful conditions. The studies on the chemical composition of the experimented samples were conducted in the laboratory of "Standard Dialog" LLC, while the identification of their physical indicators (grain membraniferous property, its vitreousness) was carried out by our research group.

RESULTS AND ANALYSES

When targeting the application field of the yield harvested from the cereal crops or from other agricultural crops on the whole and when evaluating its technological quality the latter's chemical composition should be first considered including different organic and mineral substances, as well as the amount of various vitamins and aromatic compounds. The average indices of chemical and physical properties of the variety grains are introduced in table 1.

Table 1: The average indices of the grain chemical and physical properties of the varieties cultivated in dry conditions

Crop	Chemical composition of the grain, %				Grain acidity, ⁰	Physical properties,%	
	protein	mucilage	starch	dry matter		membraniferous property	vitreousness
Rye-wheat	13,81	33,73	69,74	3,44	11,34	-	62,94
Barley	12,79	2,85	76,52	4,56	9,07	13,41	56,25
Spelt, Zv.	13,75	35,24	67,54	2,53	10,14	-	74,71
Spelt,Garni	13,05	34,17	65,43	2,74	11,43	-	72,12

It is known that the determination of protein content is taken as a basic datum for evaluating the qualitative indices in the grains of the cereal crops. In this regard the grain of rye-wheat contains the maximum amount of proteins (13.81%), which exceeds (by 0.88%) the variety "Sis 1" well-known among the cultivated varieties [1]. With respect to protein content the spelt variety "Zvartnots" surpasses the "Garni" variety by 0.70 % and at the same time it should be mentioned that the former variety exceeds the latter in yield capacity as well, the surplus of which makes 2.5 c/ha [4].

Though the barley variety "Araratyan" is a multi-row cultivar it is considered to be a spring crop, which is a very rare phenomenon, since the spring barleys are commonly two-row seeders providing lower yield amount and economic efficiency. That is why, we have set a task to breed a new multi-row barley variety with high yield capacity and resistant to the unfavorable environmental conditions, the chemical composition of which can also meet the requirements of brewing industry. Armenia is a country which excels in the beer production sector, anyhow the raw material is still imported from abroad. Thus, in case of introducing the mentioned variety in the production the import size of the raw material for beer production can be significantly reduced providing the production with the local raw material. The new barley variety contains 12.79 % proteins and according to the requirements of the brewing industry its content shouldn't be lower than 12 % and higher than 14 % [2].

It is noteworthy that the high-quality raw material shouldn't contain great amount of mucilage in the content of proteins and in this respect the barley variety "Araratyan" has demonstrated high results with its 2.85 % mucilage content. The basic premise for high beer output is the high percentage of the starch content, which in the investigated variety has amounted to 76.52 %, and this is more than a satisfactory result. As to the content of dry matters, it amounts to 4.56 %; as barley is a membranous cereal and this is also a reasonable and acceptable index.

When using the grain mass of any cereal crop for this or that technological purposes, it is very important to have knowledge in its acidity content, which in the discussed variety hardly crosses the range of 9° reaching 9.07° (permissible limit is 9-11 °) [2].

With respect to the determined physical properties (indices) the barley variety "Araratyan" also meets the requirements of brewing industry providing 13.41 % membrane content, while in terms of vitreousness the grains are semi-vitreous (glassy) providing 56.25 % result. It is worth mentioning that the high-quality raw material to be used for the beer production should have floury or semi-vitreous texture, which is vividly observed in our investigated variant. Summing up the combined indicators related to the chemical composition and physical properties of the aforementioned barley variety, it can be stated that it fully meets all the grain-specific requirements set for the beer production.

When discussing the content of mucilage it should be noted that it exceeds 30 % in all varieties (except for barley), which is considered to be an above-average index, but the mucilage quality in the rye-wheat is rather low, which is the main reason why its grains aren't used in the bread and bread products manufacturing sector. The spelt varieties (Zvartnots and Garni) have demonstrated sufficient results both in the quantity and quality of mucilage content, which makes 35.24 % and 34.17 % respectively. Here, it should be mentioned that they are high especially in Gliadin content which endows the spelt with high organoleptic quality and technological value.

Unlike the barley variety, the spelt varieties and rye-wheat are bare/membraneless cereals and the content of dry matters didn't surpass the range of 3.44%, which was recorded in the rye-wheat and it is quite predictable due to the high content of celluloses and starch in the grains.

High indicators of vitreousness (72.12-74.71%) observed in the spelt varieties is due to the high content of proteins and to the high-quality mucilage, which has its positive effect on the culinary quality of the grain providing production of structured food. It should be mentioned that from the spelt varieties "Zvartnots" one considerably exceeds the variety "Garni" both in the yield quantity, qualitative indices and in chemical composition of the grain.

After evaluating the newly bred varieties resistant to the abiotic factors from the prospect of the grain chemical composition and technological properties, it is necessary to discuss their economic efficiency as well in order to get a comprehensive insight on the discussed problem. To this end, comparative economic analyses on the varieties experimented in the dry conditions and the traditionally cultivated varieties of the relevant crops grown in the same areas have been carried out (Table 2).

In order to estimate the economic efficiency of the experimented crop varieties the yield surplus resulted from the mentioned varieties has been calculated comparing it with the yield of the varieties regionalized in the same conditions. In this respect the barley variety “Araratyan” has been second to none throughout the whole experimental period, which has recorded 9.2 c/ha yield surplus. In this indicator the spelt variety “Zvartnots” significantly exceeds the “Garni” variety, which is related to the high yield capacity of the mentioned spelt variety. To calculate the resulted profit rate, technological development diagrams have been designed for all crops summing up the implemented works and the financial resources spent for their implementation.

Table 2: The indices of the economic efficiency in the new varieties against the same indices of the traditionally cultivated varieties

Crop	Yield capacity of the varieties, c/ha	Yield capacity of traditionally cultivated varieties c/ha	Yield surplus in the crop varieties, c/ha	Sale price of 1 c product, thousand AMD	Cost of variety product per hectare, thousand AMD	Expenses per hectare, thousand AMD	Profit received per hectare, thousand AMD
Rye-wheat	38,1	30,0	8,1	9,0	342,9	84,5	258,4
Barley	27,1	17,9	9,2	12,5	338,8	88,7	250,1
Spelt, Zv.	18,8	11,1	7,7	27,7	520,8	94,6	426,2
Spelt,Garni	16,3	11.1	5,2	27,7	451,5	94,6	356,9

Based on the current wholesale prices stated for the sale of the abovementioned crop grain in the RA (Republic of Armenia), the cost of the product received per 1 ha land area has been estimated. The highest indicator (520.8 thousand AMD) in this respect has been recorded in the spelt variety “Zvartnots”, while in the barley and rye-wheat varieties these indices have made 338.8 and 342.9 thousand AMD respectively. Based on the financial expenses spent for the yield return, the profit rate per hectare has also been calculated, the results of which are rather satisfactory for dry conditions (up to 385 mm precipitation rate). The mentioned indices have amounted to 356.9-426.2 thousand AMD/ha for the spelt varieties, while for the barley and rye-wheat varieties they are 250.1 and 258.4 thousand AMD/ha respectively.

Thus, based on the results of comprehensive investigations carried out by our research group during the research trials and upon the conducted estimations for the economic efficiency, the following conclusions can be drawn:

1. The rye-wheat variety “Chyughavor” is distinguished not only by its unprecedentedly high yield capacity [1], but also by an extremely high value of its grain chemical composition, and using it in the sector of combined feed production, the branch of intensive animal husbandry can be developed raising the productivity of the farm animals and the quality of the manufactured food product, which is the most important objective for solving the problems touched upon in the current article.
2. Being simultaneously a multi-row and spring crop, the barley variety “Araratyan” can easily substitute the two-row spring crops in the mountainous regions of Armenia, which considerably lag behind (by about 25 %-29 %) the experimented varieties in their yield capacity index. When complementing the aforementioned by the fact, that the given variety completely meets the requirements stated by brewing industry, the insight on the characteristics of the discussed crop variety becomes more fundamental and complete.
3. The spelt varieties “Zvartnots” and “Garni” provide sustainable and full grain yield in the dry conditions (with leading position of “Zvartnots” variety), besides, they are distinguished by high resistance rate to the stressful situations, by the best chemical composition for the grain and their high technological values. Another no less important property recorded in these varieties is their thrashing capacity.

By supplementing all the stated facts by the desired indices of the economic efficiency, it becomes quite obvious that after successfully passing the variety testing and getting recorded as completely established crops, all experimented crop varieties can be easily regionalized in the dry (rainfed) conditions providing high profitability rate under water stress conditions.

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REFERENCES

1. Baqoyan, Sh.I. The study of a number of Triticale varieties and its perspective forms in conditions of the Ararat valley in the RA. PhD thesis, 2004, 144 p.
2. Martirosyan, H., Hovhannisyan, M., Abovyan, M. Evaluating the efficiency and resistance towards the abiotic factors in the newly bred varieties of the cereal crops, *International Journal of Agriculture and Environmental Research*, Volume: 06, Issue: 01 "January-February 2020". DOI: 10.46609/IJAER.2020.v06i01.004

3. Melikyan, A.Sh., Martirosyan, H.S. - Grain science with basics of plant growing, Yerevan, 2017, 206 p.
4. Nielsen, D.C. and Halvorson, A.D. Nitrogen fertility influence on water stress and yield of wheat. Agron J. 89, Italy, 1991, pp.563-567.