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NEW GENOME SOURCES AND SAMPLE CROPS FOR BIOFORTIFICATION OF WHEAT GRAIN WITH IRON AND ZINC

Abstract: *The genotypes were exracted which can gather much iron and zinc in wheat, that is produced and consumed in Uzbekistan. It has been discovered that mainly the effects of genetic factors and conditions caused presence of iron and zinc elements in wheat grains.*

Key words: *biofortification, iron, zinc, wheat, genes, genotype.*

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Introduction

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In various micronutrient-deficient countries, wheat is used as staple food, comprise more than 50% of the diet. About two billion people globally have iron deficiency, especially in the regions where staple foods are based on cereal crops such as wheat[5].

Bread wheat (Triticum aestivum L.) is cultivated on more land than any other crop and produces a fifth of the calories consumed by humans. Wheat endosperm is rich in starch yet contains low concentrations of dietary iron (Fe) and zinc (Zn)[6].

Biofortification, the process of breeding nutrients into food crops, provides a comparatively cost-effective, sustainable, and long-term means of delivering more micronutrients. Biofortified staple foods cannot deliver as high a level of minerals and vitamins per day as supplements or industrially fortified foods, but they can help by increasing the daily adequacy of micronutrient intakes among individuals throughout the lifecycle[1].

Biofortification provides a feasible means of reaching malnourished rural populations who may have limited access to diverse diets, supplements, and commercially fortified foods. The biofortification strategy seeks to put the micronutrient-dense trait in those varieties that already have preferred agronomic and consumption traits, such as high yield[4].

Currently, agronomic, conventional, and transgenic biofortification are three common approaches. Agronomic biofortification can provide temporary micronutrient increases through fertilizers. Foliar application of zinc fertilizer, for example, can increase grain zinc concentration by up to 20 parts per million (ppm) in wheat grain in India and Pakistan, but only in the season it is applied [2]. This is nearly the full target increment set by nutritionists and sought in plant breeding 4].

Data relative to Zn biofortification provides conclusive evidence in favor of the soil and foliar applications of Zn fertilizers. These fertilizers play an effective role in improvement of gain concentration of Zn [7,8]. On the other hand, Fe fertilizers are not exploited to examine their role for improving Fe concentration in cereal gains. All attempts to understand the soil and foliar application of Fe fertilizers are aimed at restoration of Fe levels, improvement of the yield and reversion of Fe deficiency chlorosis. [9,10].

Fe is known to rapidly convert into unavailable forms upon application to calcareous soils and poses poor mobility in phloem, soil or foliar Fe. It is for this reason that Fe is attributed to be less effective than Zn for enrichment of cereal grains [11, 12]. For instance, the increase in grain Fe concentration through foliar spray of FeSO4 or Fe chelates has not been recorded to exceed 36% [13] whilst the foliar application increases grain Zn concentration to a recorded concentration of 2- or 3-fold depending on the plant availability of Zn in soils [8,11]. Some independent studies have also showed that plants exhibit a lack of response to Fe fertilization in terms of grain Fe concentration. In more recent studies, it has been exhibited that the N status of plant plays a significant role in enrichment of ceral grains with Fe.

This has been proved through molecular evidence exhibiting that the vegetative tissue remobilization and trans location of Fe/N/Zn into seed are events maintained by similar genetic mechanisms [14,15].

Biofortification can be achieved through conventional plant breeding, where parent lines with high vitamin or mineral levels are crossed over several generations to produce plants that have the desired nutrient and agronomic traits. Crop improvement includes all breeding activities. Initial product development is undertaken at international research institutes to develop varieties with improved nutrient content and high agronomic performance, as well as preferred consumer qualities[4].

Parallel to crop improvement, nutrition research measures retention and bioavailability of micronutrients in the target crop under typical processing, storage, and cooking practices. Initially, relative absorption is determined using in vitro and animal models and, with the most promising varieties, by direct study in humans in controlled experiments. Randomized, controlled efficacy trials demonstrating the impact of biofortified crops on micronutrient status and functional indicators of micronutrient status (i.e. visual adaptation to darkness for provitamin A crops, physical activity for iron crops, etc.) provides evidence to support biofortified crops as alternative public health nutrition interventions[4].

It is expected that adoption of high-zinc wheat will be driven by its improved agronomic properties compared to current popular varieties, and breeding has focused on both zinc content and resistance to new strains of yellow and stem rust[4].

In general, wheat mineral losses are directly proportional to the duration and intensity of milling, but bioavailability increases due to simultaneous phytate reduction. The Punjab Agricultural University is assessing iron and zinc losses associated with traditional milling and cooking methods. An absorption study among women in Mexico showed that total absorbed zinc was significantly greater from the biofortified variety of wheat as compared with non-biofortified wheat [3]. Additional zinc absorption and efficacy research in 2013 will validate this result for genotype-specific variations in phytate concentration, as phytates have an inhibitory effect on iron absorption[4].

Major gaps in knowledge with respect to biofortification exist: more efficacy trials and effectiveness studies are needed to confirm and augment the promising evidence thus far obtained. Scientists must further refine indicators of individual micronutrient status and better understand the importance of cross-nutrient synergies[4].

Materials and research methods. Wheat varieties grown in different regions of the country. The experimental materials are based on the method of atomic absorption spectrophotometry.

Results. It is well-known that the creation of large quantities of protein, iron and zinc-resistant wheat varieties is now becoming a challenge. In some wild varieties, wheat and zinc are higher in wheat grains than in cultured varieties, which provides theoretical basis for the generation of genotypes in biological fortification - the ability to accumulate micronutrients that are essential for health. Biofortification provides agricultural producers with new varieties that can reduce the incidence of nutrient deficiencies by creating protein and micronutrient-rich varieties. To date, more than one hundred samples of flour products have been collected in all regions and regions of the country to check the content of iron and zinc in the flour consumed by the population. It was used in the collection of flour products for sale in shops and ancient wheat varieties of the population living in remote mountainous areas of the Republic.

The amount of iron and zinc micronutrients in all the flour milled products was checked.

The content of iron and zinc micronutrients in wheat varieties produced in different regions of the country

1-table

№	Variety name	Origin	Flour		Bran	
			Fe mg/kg	Zn mg/ kg	Fe mg/ kg	Zn mg/ kg
1	Qizil-sharq	Boysun - Surxondaryo	142	27		
2	Mars	Andijon	123	31		
3	Sanzar-8	Samarqand	119	22		

4	Qora-qiltiq	Boysun - Surxondaryo	107	38		
5	Grekkum	Samarqand	101	37	114	80
6	Yakkabog’	Yakkabog’-Qashqarayo	89	29	100	64
7	Samarqand	Samarqand	80	32		
8	Ravi	SIMMIT	73	29	134	68
9	Xasan-Orif	Sirdaryo	70	31	101	72
10	SIMMIT-o’Z	SIMMIT	67	46	94	95
11	Krasno-vodopadskaya	Kasbi - Qashqadaryo	65	29	76	71
12	Muslimka	Yakkabog’-Qashqadaryo	63	31		
13	Saidaziz	Toshkent	63	28	117	79
14	Shavkat	G’allaorol-Jizzax	59	22	119	53
15	Krasota	Rossiya	56	25	113	61
16	Fravo	Namangan	52	20	60	33
17	Bayavut-1	Sirdaryo	44	25	64	53
18	Boboki	Boysun-Surxondaryo	57	25		
19	Qizil-qora	Yakkabog’-Qashqadaryo	97	39		

As can be seen from the table, some of the ancient varieties of Qizil-sharq, Qora-qiltiq, Grekkum varieties contain iron micronutrients in excess of 100 mg/kg. Mars and Sanzar-8 varieties of local varieties contain more than 100 mg / kg of iron micronutrients.

The highest content of iron micronutrients in the grain of the Qizil-qora and Yakkabog’ varieties of Yakkabog district of Kashkadarya region.

Some of the new varieties for preparation, such as Saidaziz, Shavkat, Boyavut-1, Fravo and Krasota, have low iron content.

Depending on the amount of zinc micronutrients the varieties Qizil-qora, Qora-qiltiq, Grekkum, Mars, Muslimka and Xasan-Orif differed from 39 mg / kg to 31 mg / kg.

Yakkabog, Krasnovodopodskaya, Ravi varieties are also good, with zinc content of 28-29 mg / kg.

In some varieties Qora-qiltiq, Grekkum and Mars, the levels of trace elements of iron and trace elements of zinc were high. In other varieties, the Red Sea and Sanzar-8 are high in iron, but zinc micronutrients are low. There was no correlation with micronutrient content in the analyzed wheat samples.

As a result of investigations it was found that some ancient varieties contain high levels of iron micronutrients in the grain of several other varieties such as Qizil-sharq, Qora-qiltiq, Grekkum and many others.

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