

## **GENETIC EROSION OF DIVERSITY IN CEREALS**

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Cereals play an important role in human nutrition. Consequently, one of the main goals in breeding is to obtain varieties with high genetic potential for yield. Modern agricultural production includes the expansion of intensive varieties over large areas that lead to narrow selection criteria in breeding programs. The consequence is a drastic reduction in the number of species and genotypes (genetic erosion), or harming biological diversity of local populations, and spontaneous relatives (biodiversity) in cereals.

Based on detailed inventories of the territory of Montenegro and to some extent in Eastern Serbia, a endangerment of gene pool in cereals could be denoted. The reason for this is a transition to another type of agricultural production, changing land purposes, the presence of nursing homes, and use of intensive varieties. Old varieties and local populations represent the original genetic variability that could be used in breeding programs and

organic production. It is therefore essential to take measures to preserve the genetic resources of cereals.

*Key words:* biodiversity, cereals, genetic erosion, landraces

## INTRODUCTION

The wheat is one of the most represented crops in the structure of sowing in Serbia. It has been used as a diet in our area, since ancient times. Up to the end of XIX century, instinctive selection conducted by farmers had been predominant way of wheat improvement.

The beginning of XX century was a milestone in wheat breeding. In a first couple of decades landraces and domesticated wild relatives in food production were replaced with formally bred and improved crops – varieties. In Serbia, landrace Banatka (Old Banatka) was well spread, not only in Banat and Vojvodina, but also in Sumadija and Kosovo. Until the thirties of the last century wheat landraces had been gradually replaced by “formally” bred varieties: Rumska crvenka, Banatska crvenka, Banatska brkulja, Leganj, Hatvanska šišulja, Prolifik, Sekač, U-1 (Korićeva šišulja).

By the beginning of the Second World War spots of einkorn and emmer wheat in food production still could be found, but more productive formal bred varieties Dakota and Bankut 1205 prevailed. Hungarian wheat ecotypes yielding flour for export to Vienna, to produce the Viennese pastries and cookies, appeared to be starting material in our wheat breeding programs immediately after the Second World War (KASSAI, 1988).

By the end of 50's of XX century, *Triticum durum* and *Triticum vulgare* landraces in spring and winter wheat production still held in Easter Serbia by different names: Starinka, Ranka, Belija, Jedrenka, Vidovača, Gru de primovar (DIMITRIJEVIĆ and PETROVIĆ, 2006, DIMITRIJEVIĆ *et al.*, 2011). MILADINOVIĆ (1961) stated that at that time in E. Serbia *Triticum dicocum* could be collected beside *Triticum durum* and *Triticum vulgare* locally named as Krupnik and Limac.

In early 60's an idea of creating autochthonous wheat breeding program started to shape. Beside wheat varieties out of Serbian breeding programs, a facultative variety Novosadska 1439/3 and the winter variety Novosadska 1446 that played a significant role in the production of wheat and in increasing the yield, Italian formal bred introductions Libelulla, San Pastore, Produttore, Abbonanza, Leonardo and Autonomia were grown. Later on Soviet varieties with better winterhardiness were introduced, particularly Bezostaja 1 (MIŠIĆ, 1988, DENČIĆ, 2001).

In early and mid 70's first intensive Serbian wheat varieties enter largely bread wheat production in Yugoslavia. However, all the way to the mid 70's emmer and einkorn (local name – Krupnik) wheat had been cultivated in Eastern Herzegovina, South-Eastern Bosnia, Eastern Serbia, and some parts of Montenegro - Nikšić field, Skadar Lake, Ljubišnja Mountain, (PAVIĆEVIĆ, 1982).

At the present time in the world and in our country good results have been achieved in breeding of cereals. However, PRODANOVIĆ *et al.* (2006) were among

many (THRUPP, 2000; DIMITRIJEVIĆ and PETROVIĆ, 2006; VAN HEERWAARDEN *et al.*, 2009), who has noticed that the constant striving to get a selection of varieties that are superior to existing ones, leads toward drastic reduction in the number of species and genotypes (genetic erosion), or narrowing of the biological diversity of local populations, and spontaneous relatives (biodiversity) cereals. The influence of man on the intensification of genetic erosion is very high, so it is necessary that collect, preserve, evaluate and utilize the genetic variability of cultivated plants and their spontaneous relatives (REIF *et al.*, 2005, HAMMER and TEKLU, 2008, MILOSEVIĆ *et al.*, 2009, MAM, 2010). That useful genetic variability is still to be more efficiently used for broadening genetic variability of numerous desirable traits in modern wheat breeding (PETROVIĆ *et al.* 2006, PETROVIĆ *et al.*, 2008). Landraces represents an original genetic variability resulted from natural or instinctive selection with good and stable regional adaptability that is specific feature of these genotypes (DOTLAČIL *et al.*, 2002).

The aim of this paper is to present the results of many years of collecting expeditions of old varieties and local populations of small grains.

#### MATERIALS AND METHODS

Plant material was collected from the end of June 2001 to mid-July 2006., in the territory of the Republic of Montenegro. Most of the collected crops were of spring forms cultivated at high altitudes harvested in mid-August. Consequently, the samples were taken at random from the previous season seed stocks. The position of the field and the condition of crop were photographed, and detailed written and audio records of position, condition, origin, usage of the crop were conducted. Farmers were interviewed and notes and contact data were taken. A short survey in Eastern Serbia was carried out in fall of 2004.

The exact position of the farm or of the field (in case the field was far from the farm) was established using Global Positioning System (GPS) - Garmin 12 Channel Receiver Personal Navigator.

#### RESULTS AND DISCUSSION

The territory of Montenegro is very attractive for screening biodiversity due to the specific climate and terrain, specific traditional food production in remote sites and infertile low quality soil. Following previous research and written documents of academics PAVIČEVIĆ (1975), the areas of Durmitor Mountain, Ljubišnja, Sinjajevina, Rumija, as well as, Ljevorečka and Piva areas has been thoroughly checked. Severe erosion of cereal biodiversity was denoted. Though, localities with preserved biodiversity of small grains were found to be isolated, scattered, commonly at high altitudes, with poor or lacking road network at all. The food production is represented exclusively for their own purposes and in small fields.

These are populations spring type cereals, which are well adapted to local agro-ecological conditions and with the cultivation and production technology transferred for decades from generation to generation. According to farmers, yields

are modest, but the investment is small, and the seeds are used for household purposes, for food or feed.

In the region of Durmitor Mountain, in a wider area of the municipality of Žabljak, isolated elderly households still could be found in a very inaccessible villages or scatter remote farms with no or rugged roads at higher altitudes, and with rough climate – short summer period and a long snowy winters. Those localities harbor the last traces of cereal landraces. Older residents of the villages of Durmitor area till remembered that on this ground once the "old" wheat was grown, susceptible to logging, hand harvested, but with fine, smooth dough, giving very tasty bread.

In the village Pitomine, farm of the owner Baranin at the position (43,09°N and 19,06°E), at an altitude of 1536m, a populations of spring two-rowed barley was found, that the host inherited from his father.

Several kilometers away, at locality Bosača (43,09°N and 19,05°E), at 1553m above sea level in the elderly household Novosel a landrace of two-rowed barley was found (Fig. 1). The farm owner said that in past times wheat, barley and buckwheat were extensively grown, but now they cultivate barley for their own purposes, only.



Figure 1. Locality Bosača, at Durmitor Mountain and the Novosel farm where the landrace of two-rowed barley was collected

At the site of Mala Crna Gora (43,12°N i 19,00°E), at an altitude of 1932m in the house of Tomšić population of two-rowed barley was collected. As stated by the host Jevrem Tomšić, they are still holding to landraces, though there were some unsuccessful attempts of switching to modern spring wheat varieties. This is an area with extremely harsh climate, with a height up to 3m of snow, falling nine months a year, a completely isolated village without water or electricity, and succeeds only well-adapted crops of local populations of barley. Due to the specific terrain and inaccessibility of the village, a basic food for the residents is bread baked in their own wood-fired ovens, of dough made of the barley flour obtained in their own small mills (Fig. 2).



Figure 2. Locality Mala Crna Gora, Tomšić house at Durmitor Mountain where samples of two-rowed barley were collected

In village Palež (43,18°N i 19,14°E) at 1431m altitude, in a small holding of Savića, a seed sample of spring barley was obtained. The popular and local name of the barley is “Bušket”, and that particular barley has been grown on that household for 70 years. According to the host, he inherited that seed from his father and his father from his father (grandfather of the host).

On the site Kovčica (43,09°N i 19,12°E), at an altitude of 1437m, in the household Karadžića, samples of rye and white corn were found. In the interview, host stated that, in the past time, landraces of spring wheat, barley, oat, buckwheat

and rye had been grown in that area. Nowadays, the production narrows to rye that is used as food and feed, as well as, rye straw that is good natural, cheap roofing material.

On the small farm of Tomić in scattered village Podgora (43,07°N and 18,18°E) at 1456m of altitude, a seed sample of old balrey was obtained.

On the mountain Ljubišnja, in the villages Vrba, Šule and Nange, interviewing locals one could learn that they dropped growing wheat, favoring Triticale. According to PAVIČEVIĆ (1975), as well as, information obtained in the field, once the area was known as a centre of emmer wheat production (*Triticum dicoccum* and *Triticum dicoccoides*).

Under the very top of the Rumija Mountain nested the small village Lunje consisting of three houses of Lunjić family. That remote and hard accessible place grew the last remnants of landrace Grbljanka (*Triticum turgidum*) that had been grown all along the Montenegrin coast in the past time, fig. 3.



Figure 3. Village Lunje, Rumija Mountain, the last stand of landrace Grbljanka

On the way Mateševo-Podgorica, in the area Lijeva Rijeka, village Slacko (42,65°N i 19,45°E), at 1235m above sea level, in the household of Adžić, sample of landrace of rye, passed from generation to generation, was collected. The landlord said that once this area nurtured wheat, rye, oats, buckwheat and white corn, and now spring rye is cultivated, along with white potatoes. PAVIČEVIĆ (1975, 1982),

stated that this territory was known by the production of wheat *Triticum durum* and *Triticum turgidum*, under local name Rogosija.

In the village of Gradina (43,10°N i 19,29°E), at an altitude of 1232m, the slopes of Sinjajevina Mountain, in the house Čabarkapa samples of rye, buckwheat and barley were collected (Fig. 4). In this area, according to the words of the villagers, they have not cultivated cereals for ten years. At present, mostly represented animal production led that fields have been converted to pasture. In seventies of the twentieth century this area was represented by the production of einkorn (*Triticum monococcum*) and emmer wheat (*Triticum dicoccum*), PAVIČEVIĆ (1975).



Figure 4. Locality Gradina, Sinjajevina Mountain slopes, where the seed of rye, buckwheat and barley was collected

In the area of Piva River, municipality of Plužine, in the village Zabrđe (43,13°N i 18,76°E) at an altitude of 1381m in the house of Jovović, spring wheat seeds was collected. That wheat has been sown for decades, since the Second World War. Host said that the grain was milled in his own mill and baking bread all year. Harvest is in the middle of August. The host claimed that the yield was low, but they were satisfied with the quality of flour and bread.

A short-term research conducted in autumn of 2004., in Eastern Serbia has shown that the presence of good road network shifted traditional food production to

intensive, modern, agriculture even in some quite remote villages. Consequently, the landraces MILADINOVIĆ (1961) found and reported to be grown in that region in 50's and early 60's, are now replaced with formally bred varieties of small grains.

Perennial, detailed field research in Montenegro, conducted by Dimitrijević and Petrović, has shown that a serious threat and the loss of a gene pool of cereals were in progress. This is particularly true for wild relatives and landraces of small grains. Landraces of *Triticum* genus are especially endangered. On remote spots in isolated terrain and high altitudes landraces of barley, rye and white maize could still be found, grown by elderly households in small areas for their own purposes. There are many reasons that led to the erosion of genetic diversity of cereals: switch to another type of agricultural production, changing land purposes, the presence of nursing homes, climate change, as well as intensive use of varieties of cereals. Conversion of arable land into construction land in Nikšićko polje has led to complete disappearance of emmer wheat, which was extensively grown at the beginning of the 70's (PAVIĆEVIĆ, 1982). The complete erosion of emmer landraces was witnessed on Ljubišnja Mountain, where Triticale, raspberry, and livestock production substituted emmer wheat. Due to economic and social reasons landrace Grbljanka has been reduced to traces, as well.

#### CONCLUSION

A significant erosion of genetic diversity of cereals was observed at the visited areas. A large number of landraces and old varieties of small grains, which represent the original genetic diversity, have been lost. Former remote villages and farms, during a past few decades, have become more accessible, in most of cases that caused the replacement of landraces by cultivated varieties or land has changed purpose. However, in isolated, remote villages and farms, lacking good roads or without any road network, the last traces of almost exterminated cereal biodiversity still could be found. The urgent and prompt action is required to preserve and regenerate endangered genetic diversity.

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## **EROZIJA GENETIČKOG DIVERZITETA STRNIH ŽITA**

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Žitarice imaju važnu ulogu u ljudskoj ishrani, pa se oplemenjivanjem teži da se dobiju sorte sa visokim genetičkim potencijalom za prinos. One odgovaraju savremenoj poljoprivrednoj proizvodnji, koja uključuje širenje intenzivnih sorti na velikim površinama i kriterijume oplemenjivanja vodi u istom smeru. Posledica je drastično smanjenje broja vrsta i genotipova (genetička erozija), odnosno suženje biološke raznovrsnosti lokalnih populacija i spontanih srodnika (biodiverziteta) strnih žita.

Na osnovu detaljnog inventarisanja na teritoriji Crne Gore i delimično u istočnoj Srbiji, uočena je ugroženost genskog fonda strnih žita. Razlog ovome je prelazak na drugu vrstu poljoprivredne proizvodnje, promena namene zemljišta, prisustvo staračkih domaćinstava, klimatske promene, kao i korišćenje intenzivnih sorti žitarica. Stare sorte i lokalne populacije predstavljaju originalnu genetičku varijabilnost, mogu da se koriste u programima oplemenjivanja i u organskoj proizvodnji. Stoga je bitno da se preduzmu mere za očuvanje genetičkih resursa žitarica.

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