

## DECLINE OF THE MAIZE LANDRACE CULTIVATION IN EASTERN SERBIA

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### ABSTRACT

State of maize landraces in the eastern Serbia was assessed through a field study and interviews with farmers to determine both presence and extent of the maize landrace utilization. Results indicated that the extent of maize landraces cultivation in this region has significantly diminished during the last few decades, as well as that some maize types seem to have disappeared. The landrace cultivation was strongly related to traditional agricultural practices. Farmers claimed that the maize landraces were more resistant to unfavourable environmental conditions. Efforts to conserve the genetic diversity of maize landraces should be directed to investments into small-scale farming.

**Key words:** *Zea mays*; landrace; interview; questionnaire; *in situ* preservation; traditional practice.

### INTRODUCTION

The presence and development of maize landraces in Serbia has had a long tradition, since they have been cultivated within the area for centuries. Nowadays, maize is the most widely produced crop in Serbia (SIEPA, 2005). However, over the last few decades, the commercial maize varieties have become widely accepted in agriculture worldwide. Commercial hybrids have become broadly used, since they give a higher yield in the short time perspective. As a result, their expansion suppressed cultivation of the landraces, and the areas where landraces had been cultivated have severely diminished.

It is of apparent importance to focus the research of maize landraces on the regions where modern varieties have not yet been widely accepted, since the cultivation of landraces has still an important role in the rural society. Such research activities are important for the monitoring of threats to maize diversity, as well as for a better understanding of social, cultural and

economic factors that have an impact on the maize diversity (Vaz Patto et al., 2007).

The maize landraces in the south-eastern Europe have been genetically isolated from the maize in North America, and the selection processes have led to the development of their advantageous agronomic traits (Leng et al., 1962). Such processes make them worth of attention for conservation of the crop genetic diversity.

It is believed that the southern and eastern Serbia represent a refuge area of the maize landraces, where their traditional cultivation is still being practiced due to an underdeveloped commercial agriculture (Knežević-Jarić et al., 2010). Unfortunately, there is also a profound lack of data regarding the extent of the maize landraces cultivation in these regions.

In this study, the state of maize landraces in the eastern Serbia was assessed through a field study and interviews with farmers, with the aim to determine both the presence and the extent of the maize landrace utilization within the region. The traditional agricultural

practices related to the cultivation of the maize landraces were also explored, to determine both the field conditions and the cultural diversity which led to their preservation.

## MATERIAL AND METHODS

The eastern Serbia is situated on the border of the Carpathian Mountains and represents a combination of the highland and mountain limestone ranges. Inhabitants of this region still maintain many old customs and traditions of agricultural practice. Cattle and the 'primitive' agricultural practice are still

present as a draft force for the field work and processing, due to both natural conditions and a low level of development (SIEPA, 2005).

To acquire information on the presence and current utilization of the maize landraces in this region, as well as on the traditional agricultural practices applied in the cultivation of these landraces, a number of field trips to the eastern Serbia region were conducted. The field trips were conducted during September and October 2008. The general route and visited locations during these field trips are presented in Figure 1. All visited locations were situated within the so-called 'Homolje region'.

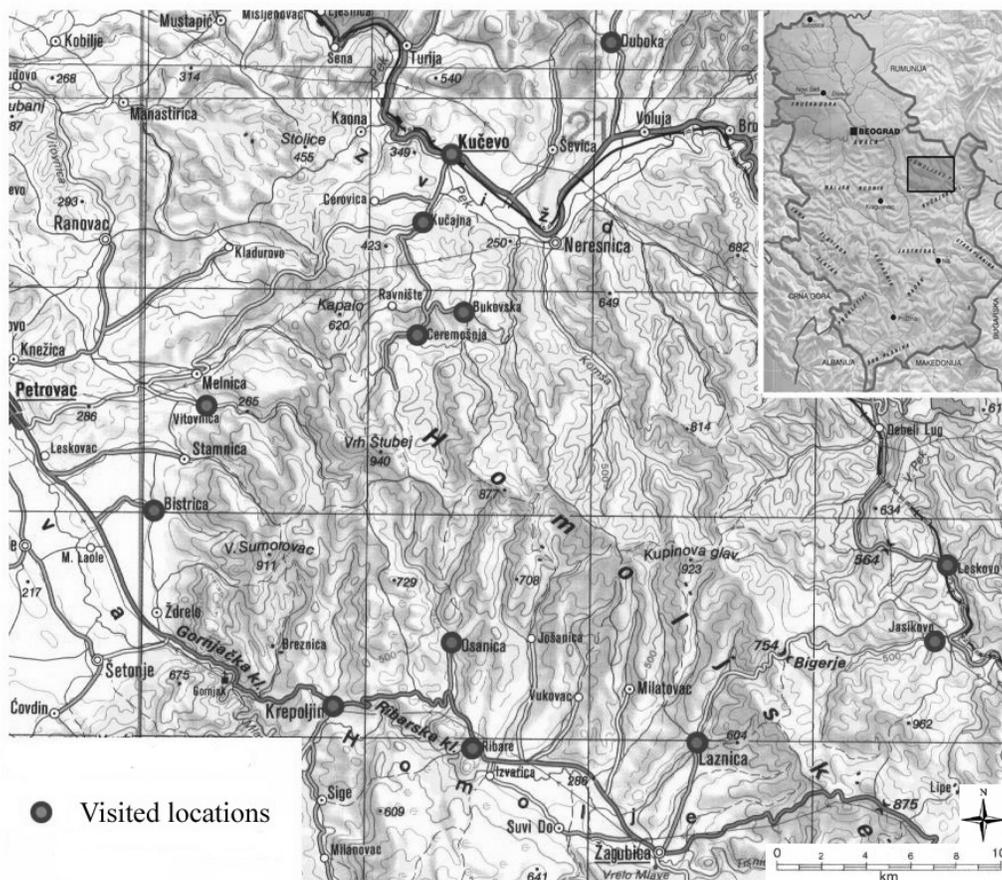


Figure 1. Locations in the Eastern Serbia (Homolje region) where the survey was conducted

The main method for the information retrieval was an interview based on open-ended questions. Since the number of respondents that were included in the survey was not high, the obtained data were analysed

by means of an inductive coding method (Frankfort-Nachmias and Nachmias, 1996; Auerbach & Silverstein, 2003). The responses to each of the questions were coded and, following the method described by Auerbach

and Silverstein (2003) and Coffey and Atkinson (1996), the responses were arranged within a separate document to acquire a better overview of the data. Codes were then revised and organized into more general categories, according to their meaning and resemblance. The described organization of the data into meaningful codes/categories represented the first step of the qualitative data analysis. Within the second step, the defined categories were used to develop the theoretical constructs, which enabled observing the recorded data in a more understandable way. In general, it was expected that the theoretical constructs might provide better understanding of the issues related to the study, such as how to approach the problem of the maize landraces preservation.

## RESULTS

As a result of the survey performed in 13 settlements within the Homolje region, situated in the eastern Serbia, an interview dataset was obtained. Given that the respondents were chosen on the basis of their engagement in cultivation of maize landraces, most of them (86%) were growing at least one maize landrace. However, the extent of the area on which they were cultivating maize landraces was mostly less than 0.1 hectare, and only 18% of the farmers cultivated landraces on more than 1 hectare. According to the respondents, the names of the old varieties that were cultivated by them were “Eight-rowed white”, “eight-rowed yellow”, and “old domestic” maize. The maize varieties with red kernels that were previously cultivated in this region seem to have completely disappeared. All respondents that were engaged in the cultivation of maize landraces claimed that their main motivation had been to use them for their own flour consumption, followed by the preservation of the landrace as a purpose of cultivation (31% of respondents), and commercial purposes (15%). Fifty six percent of respondents claimed that they have been cultivating maize landraces all their life, while 44% claimed that they only recently started with the cultivation. Furthermore, all persons involved

in maize landraces cultivation throughout their life also claimed that their particular maize landraces had been inherited from their parents. Others claimed that they had acquired seeds from the neighbouring villagers, but there was also a general agreement among most of the respondents that there was a strong practice of exchanging seed material.

Respondents were asked to describe characteristics, as well as to explain the differences of their maize landraces with respect to commercial varieties. The most important characteristic, as claimed by the farmers, was that the flour of the maize landraces was tastier than the one from commercial varieties. Another often emphasized characteristic was that the cobs and kernels of these landraces are drier and harder than those of other varieties. Moreover, the respondents claimed that the old maize varieties were more resistant to unfavourable environmental conditions, such as drought, and that they reached maturity earlier and had enhanced storage durability. The farmers stated that the maize landraces cultivation was directly related to the presence of the water-mills. In particular, the grinding of maize landraces grain is practiced only in water-mills, which are fairly preserved by the villagers on small nearby positioned mountainous streams. Regarding the respondents' opinion on the number of households in the village that are still cultivating maize landraces, most of the respondents (90%) answered that only a few of them were still practicing the small-scale cultivation, while only a single household appeared to cultivate maize landraces for commercial production. An apparent problem was the aging of the farmers' population, since their children either lacked the interest to continue with the traditional practices or have already migrated to cities.

Application of the inductive coding method provided further insight in the survey results. The answers obtained from the interviews were coded according to the previously identified repeating ideas in an attempt to organize and sum up relevant information, and to recognize what was mutual for codes. As a result of this analysis,

three categories were defined: maize landraces cultivation for commercial benefit, cultivation for landraces preservation and, finally, maintaining the tradition. The last two categories were recognized as a single theoretical construction, named in this study as the “Devotion to the traditional way of living”. However, the first category, although it was implying different motivation for the cultivation of maize landraces, could be considered as a supporting category to this theoretical construction, due to its positive attitude towards the landraces preservation.

## DISCUSSION

According to the results of this study, Serbian farmers have not completely abandoned maize landraces, despite the wide acceptance of the modern varieties for cultivation. Similar findings were obtained as well by Bellon and Brush (1994). However, most of the respondents were growing only small plots of maize landraces in their gardens, while the commercial varieties and hybrids were both widely cultivated, due to the present market demands. The main reason for the persistence of this small-scale cultivation of landraces was the claimed need of maize flour for domestic use, which is in line with the findings of Bellon et al. (2003). Although most of the respondents claimed that these maize landraces are hard to process due to the hardness of their ears and kernels, this also made them more desirable for consumption. Apparently, such flour seems to be much tastier than those of commercial varieties, and easier to preserve for long time. The respondents emphasized its suitability for the preparation of some traditionally made recipes, such as the maize porridge and cornbread. These facts seemed to have large influence on the farmers’ choice to cultivate maize landraces, which is in accordance with the findings of Montes-Hernández et al. (2005). Farmers were accustomed to this type of food, which was inherited as a tradition from their parents, along with the landraces’ seed. Furthermore, growing of maize landraces could be directly related to the old wooden water-mills that are maintained in each village in the region, which are

exclusively used for the landrace flour processing.

Another positive characteristic specified by most of the respondents was the resistance of maize landraces to unfavourable environmental conditions, such as drought and pest infestations. While their lower yield makes them far surpassed by the commercial varieties in the large-scale cultivation, one respondent suggested that the yield still showed certain stability under varying environmental conditions. Drought tolerance is a typical trait of maize landraces from this region (Babic et al., 2012).

There was an additional finding of potential importance that emerged from the interviews. The only maize landraces that were found in the field had white or yellow kernel colour, while the red coloured maize seems to be no longer present in this region. Such finding is alarming, when bearing in mind that maize landraces are not only an important source of potentially useful characteristics for a variety of breeding programs, but also a unique bank of adapted and coevolved genotypes (Lucchin et al., 2003).

A number of authors (Bellon and Berthaud, 2004; Doebley, 2004; Soleri et al., 2006) have expressed concern that the processes that threaten maize diversity are more complex than it is usually described. Replacement of the landraces by modern varieties, as well as a contamination of landraces by transgenes could be only a part of the problem. Namely, important components of this problem could also be the abandonment of maize landraces cultivation by farmers, due to their migration to more urban areas or shifting to other crops, the aging of the farming population, and the lack of interest by young people to continue with the traditional practices.

*In situ* conservation of landraces is a complex task, but still a necessary one to preserve the crop’s genetic diversity. As described by García (2007), the small-scale farming was the key contributing factor to the maize biodiversity conservation. Therefore, the efforts to conserve the genetic diversity of crops should also be directed towards the preservation of traditional farming practices

by investing into small-scale farming. Smale et al. (2003) and Dhillon et al. (2004) have discussed possible solutions for improving the farmers' position within the current social and economic environment. For example, the landraces and their local varieties should have a potential to be used in organic agricultural production (Prodanović and Šurlan-Momirović, 2006), due to their stability in low-input agricultural systems and to an increased public interest for this type of production. Therefore, the discussed possibility of maintaining the landraces production within the contemporary economic conditions should not be neglected in the development of strategies for conservation of the agro-biodiversity.

According to the findings of this study, some of the traits with potential interest for breeders that are still present among the local maize varieties are the resistance to drought, earlier maturity and the storage durability. These characteristics have been developed and are still maintained under specific agro-ecological conditions. As a result, the efforts for their conservation should be aimed towards the preservation of those environments – the villages that maintain specific agricultural practices, as it was recommended by Pressoir and Berthaud (2004). The on-farm conservation of landraces is a dynamic system that maintains more diverse and locally adapted plant population (Bellon, 2004), and is therefore able to maintain as well the technical, social, cultural and environmental framework within which they have evolved. Moreno et al. (2006) claimed that farmers often rely on their traditional knowledge with regard to the maize cultivation, despite the general tendencies to modernise agricultural sector. Overall, the preservation of maize landraces in the Homolje region could be achieved through an organized effort to conserve the traditional agricultural practices as a cultural heritage of the region.

Future projects should be focused on the improvement of sustainable management of the local biodiversity. Considering the problems of maize landraces preservation identified in the present study, it could be of

importance to motivate farmers to engage more in the conservation efforts. This could be achieved by introducing incentives that would encourage and support farmers to continue the cultivation of the old varieties. Studies that deal with the popularization of the consumption of products derived from these varieties could also contribute to the improvement of the conservation. Certainly, development of a national policy for on-farm conservation should be a priority, since it would establish the basis for sustainable programs for landraces cultivation that would be a part of further social and economical development.

## CONCLUSIONS

The present study revealed a marked decrease in the extent of maize landraces cultivation in the eastern Serbia, as well as an apparent disappearance of some maize landraces types (such as the red-coloured maize) from this region. The obtained findings indicated that the efforts to conserve the genetic diversity of maize landraces should be directed towards maintaining the traditional farming practices by investing into small-scale farming, since the local maize varieties were preserved by that type of cultivation. Gathered information regarding both the agricultural practice and traditional values related to the maize landraces could be of importance for future ethno-botanical research.

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## REFERENCES

- Auerbach, C.F., Silverstein, L.B., 2003. *Qualitative data: An introduction to coding and analysis*. New York University Press, New York and London.
- Babic, V., Vancetovic, J., Prodanovic, S., Andjelkovic, V., Babic, M., Kravic, N., 2012. *The identification of drought tolerant maize accessions by two-step cluster analysis*. Rom. Agric. Res., 29: 53-61.
- Bellon, M.R., 2004. *Conceptualizing interventions to support on-farm genetic resource conservation*. World Dev., 32(1): 159-172.
- Bellon, M.R., Berthaud, J., 2004. *Transgenic maize and the evolution of landraces diversity in Mexico. The importance of farmers' behavior*. Plant Physiol., 134: 883-888.
- Bellon, M.R., Berthaud, J., Smale, M., Aguirre, J.A., Taba, S., Aragón, F., Díaz, J., Castro, H., 2003. *Participatory landrace selection for on-farm conservation: An example from the Central Valleys of Oaxaca, Mexico*. Genet. Resour. Crop Ev., 50: 401-416.
- Bellon, M.R., Brush, S.B., 1994. *Keepers of maize in Chiapas, Mexico*. Econ. Bot., 48(2): 196-209.
- Coffey, A., Atkinson, P., 1996. *Making sense of qualitative data*. SAGE Publications Inc, Thousand Oaks.
- Dhillon, B.S., Dua, R.P., Brahma, P., Bisht, I.S., 2004. *On-farm conservation of plant genetic resources for food and agriculture*. Curr. Sci., 87(5): 557-559.
- Doebly, J., 2004. *The genetics of maize evolution*. Annu. Rev. Genet., 38: 37-59.
- Frankfort-Nachmias, C., Nachmias, D., 1996. *Research methods in the social sciences*. Arnold, London.
- García, J.B., 2007. *Maize adoption and biodiversity conservation in Mexico*. Proceedings of the Conference "Micro Evidence on Innovation in Developing Economies (MEIDE)", 31<sup>st</sup> May – 1<sup>st</sup> June 2007. UNU-MERIT, Maastricht, Netherlands.
- Knežević-Jarić, J., Prodanović, S., Iwarsson, M., Minina, A., 2010. *Diversity of maize (Zea mays L.) landraces in Eastern Serbia: morphological and storage protein characterization*. Maydica, 55: 231-238.
- Leng, E.R., Tavčar, A., Trifunović, V., 1962. *Maize of southeastern Europe and its potential value in breeding programs elsewhere*. Euphytica, 11: 263-272.
- Lucchin, M., Barcaccia, G., Parrini, P., 2003. *Characterization of a flint maize (Zea mays L. convar. mays) Italian landrace: Morpho-phenological and agronomic traits*. Genet. Resour. Crop Ev., 50: 315-327.
- Montes-Hernández, S., Merrick, L.C., Eguiarte, L.E., 2005. *Maintenance of squash (Cucurbita spp.) landrace diversity by farmers' activities in Mexico*. Genet. Resour. Crop Ev., 52: 697-707.
- Moreno, L.L., Tuxill, J., Moo, E.Y., Reyes, L.A., Alejo, J.C., Jarvis, D.I., 2006. *Traditional maize storage methods of Mayan farmers in Yucatan, Mexico: implications for seed selection and crop diversity*. Biodiv. Conserv., 15: 1771-1795.
- Pressoir, G., Berthaud, J., 2004. *Population structure and strong divergent selection shape phenotypic diversification in maize landraces*. Heredity, 92: 95-101.
- Prodanović, S., Šurlan-Momirović, G., 2006. *Genetički resursi biljaka za organsku poljoprivredu [Plant genetic resources for organic production]*. Faculty of Agriculture at the University of Belgrade, Belgrade – Zemun, Serbia. (In Serbian)
- SIEPA, 2005. *Facts about Serbia*. Serbia Investment and Export Promotion Agency, Belgrade.
- Smale, M., Bellon, M.R., Aguirre, J.A., Rosas, I.M., Mendoza, J., Solano, A.M., Martínez, R., Ramírez, A., Berthaud, J., 2003. *The economic costs and benefits of a participatory project to conserve maize landraces on farms in Oaxaca Mexico*. Agr. Econ., 29: 265-275.
- Soleri, D., Cleveland, D.A., Cuevas, F.A., 2006. *Transgenic crops and crop varietal diversity: the case of maize in Mexico*. Bioscience, 56(6): 503-513.
- Vaz Pato, M.C., Moreira, P.M., Carvalho, V., Pego, S., 2007. *Collecting maize (Zea mays L. convar. mays) with potential technological ability for bread making in Portugal*. Genet. Resour. Crop Ev., 54: 1555-1563.