Acta fytotechnica et zootechnica, Vol. 4, 2001, Special Number
Proceedings of the International Scientific Conference on the Occasion of the 55th Anniversary of the Slovak Agricultural University in Nitra

EFFECT OF AMARANTH GENOTYPES ON SEED PRODUCTION AND WEIGHT OF SEEDS

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Summary

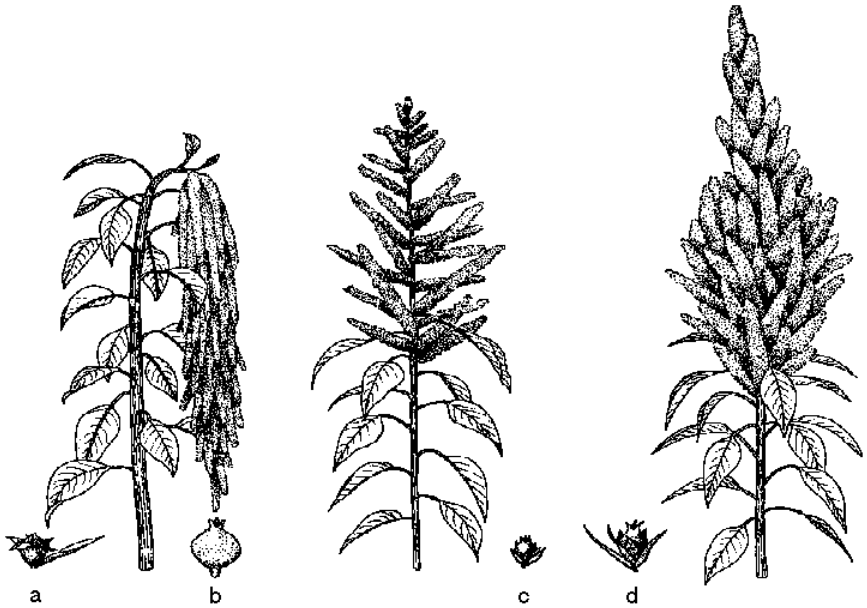
The alochtonous species of Amaranth and it's hybrids have perspective possibilities of utilization in Slovakia, too. In this contribution we aimed our attention at evaluation of effect of Amaranth genotypes on their seed production and weight of a thousand seeds (WTS). Studied genotypes of Amaranth were grown in years 1999 and 2000 in the Active field collection on the Research – Experimental Base of Faculty of agronomy SUA Nitra – Dolná Malanta and in the Botanical garden SUA. The smallest WTS was found at the genotype suitable for fytomass production and for the forage purposes (*A. edulis* cv. 'Elbrus' – 0.30 – 0.32g). The highest WTS was found at genotype suitable for production of seeds and for the food use (*A. hypochondriacus* – 0.63 – 0.70g). The average yield of 2 years (1999 and 2000) varied from 326,7 kg. ha^{-1} to 2492,0 $kg.ha^{-1}$. There was found a high variability in WTS, in the seed production per plant and by canopy in dependence on the grown genotype.

Key words: Amaranth, genotype, WTS, seed production, variability

Introduction

Present and perspective ways of utilization of Amaranth: 1. pseudocereals, 2. energetic and technical crop, 3. forage, 4. source of natural pigments for colourings production, 5. source of proteins, oil, starch and diet fibre, 6. vegetable, 7. decorative plant, 8. plant with healing features (HABÁN – ILLÉŠ, 2001) determine the selection of suitable genetic sources for growing conditions of Europe.
Genetic diversity of Amaranths is determined by high intra-specific and inter-specific variability. Increased number of inter-specific hybrids with a high vitality indicate that unity in flowering biology should be a way of new hybrids formation (HERNÁNDEZ B. – LEÓN, 1994). HEGI (1979) characterizes in detail 47 autochtonous and alochtonous species of *Amaranthus* L. genus in conditions of Central Europe. Utilization of new areas for Amaranth cultivation causes genetic erosion of individual species. From this reason it is necessary to collect and preserve genetic sources from the main production areas, but from the native localities of it`s occurrence, too. Genetic sources of Amaranth introduced to Slovakia were studied by JAMRIŠKA (1990), HABÁNOVÁ (1997), ČERNÁ et al. (1998) and DEBRE – KOLENOVÁ (1999),

Figure 1: Amaranth species – basic genotypes



1. *Amaranthus caudatus* L. 2. *Amarnathus cruentus* L. 3. *Amaranthus hypochondriacus* L.
a, c, d - flower and fruit - bracts; b - fruit

By Itúrbide, G. A. and Mujíca, A. cit in. Hernández Bermejo, J. E. - León, J. (1994); [corrected]

Material and methods

Observed Amaranth genetic sources were represented by 10 genotypes of field collection (120 genotypes) and were presented by alochtonous species and their hybrids: *Amaranthus caudatus* L. (Z 52-0011, Z 52-0017), *A. cruentus* L. cv. 'Lider' (Z 52-0005), *A. edulis* SPEG. cv. 'Elbrus' (Z 52-0007), *A. hypochondriacus* L. cv. 'Golden' (Z 52-0003) a (Z 52-0004, Z 52-0030, Z 52-0031), *A. hybrid* K-343 (Z 52-0033), *A. hybrid* K-23 (52-0060).
Investigated genotypes of Amaranth were grown in 1999 and 2000 in the active field collection on the Research–Experimental Base AF SPU Nitra – Dolná Malanta and in the Botanical Garden of SUA. Cultivation localities are situated in a warm macro-area and a very dry sub-area of Slovakia, in the above sea level 145 – 180 m. The soil type: brown soil, the soil group: medium heavy soil, the structure of the soil: sandy-loam to loam, the soil reaction– 5,7-6,5 pH_{KCl}. The canopy structure was 0,375m x 0,20m, i.e. 133 333 plants per hectare. Evaluated features were: the weight of a thousand seeds – WTS (g), the production of seeds per plant (g) and the seeds production by canopy ($kg.ha^{-1}$).

Results

By comparison of found WTS values it is possible to state, that values of WTS were higher in the year 1999 (tab.1), when the average values varied from 0,32g (Z 52-0007) to 0,75g (Z 52-0030). In the year 2000 the average WTS values range from 0,30(Z 52-0007) to 0,70g (Z 52- 0003).

Table 1Weight of a thousand seeds (WTS) reached by individual genotypes of Amaranth

Source	Genotype	***WTS [g]***			
		1999	*2000*	$\bar{x}_{(1999-2000)}$	*Significance*
Z 52-0003	*A. hypochondriacus* ´Golden´	0,70	0,70	0,70	**f**
Z 52-0004	*A. hypochondriacus*	0,64	0,58	0,61	c
Z 52-0005	*A. cruentus* ´Lider´	0,73	0,65	0,69	e
Z 52-0007	*A. edulis* ´Elbrus´	0,32	0,30	0,31	a
Z 52-0011	*A. caudatus*	0,63	0,42	0,53	b, c
Z 52-0017	*A. caudatus albiflorus*	0,60	0,59	0,60	c, d
Z 52-0030	*A. hypochondriacus*	0,75	0,63	0,69	e
Z 52-0031	*A. hypochondriacus*	0,69	0,66	0,67	e
Z 52-0033	*A. hybrid* K 343	0,70	0,63	0,66	d, e
Z 52-0060	*A. hybrid* K 23	0,50	0,45	0,47	b

Legend: Homogeneity of the levels – genotypes marked the same letter are not significant in the tested features
Testing of contrasts WTS and genotypes H_d 0,01 = 0,071
Testing of contrasts WTS and the year of cultivation H_d 0,01 = 0,022
Limit difference - statistically significant difference at the significant level 0,99

Using analysis of variance (Tuckey testing) we found statistically significant differences in WTS between individual genotypes, but also between years of cultivation. The smallest WTS were at genotype suitable for production of fytomass and for forage purposes (Z 52-0005 *A. edulis* cv. 'Elbrus' – 0,30-0,32g). The highest WTS were at genotypes suitable for seed production and for food aims (Z 52-0003 *A. hypochondriacus* – 0,70g and Z 52-0030 *A. hypochondriacus* – 0,63 – 0,75g).
The highest production of seeds per plant was found at genotype *A. hypochondriacus* (Z 52-0030) – 23,70 g/plant in 1999. The smallest production was at *A. hypochondriacus* (Z 52-0004) – 2,28 g/plant in 1999. These results are similar to the average seed production indicated by a hectare yield, it range from 304,0 $kg.ha^{-1}$ (Z 52-0004; y. 1999) to 3 160,0 kg. ha^{-1} (Z 52-0030; y. 1999). At the contrast testing of the reached seed yields statistically significant difference was founded. The average yield of two cultivation years 1999 and 2000 was reached from 326,7 $kg.ha^{-1}$ (*A. hypochondriacus*, Z 52-0004) to 2 492,0 $kg.ha^{-1}$ (*A. hypochondriacus*, Z 52-0030). For these two genotypes high variability and diversity in seed production were confirmed in dependence of genetic source origin.

Discussion

WTS as an important feature limiting the yield size was observed by HABÁN – ILLÉŠ (2001) and they state values from 0,25 to 1,00g. Higher WTS is characteristic for *A. hypochondriacus* L. Found information correspondents with values (0,6 – 1,1g) stated by JAMRIŠKA (1990). The difference in WTS between individual genotypes found by us connects also with the way of economical utilization. Genotypes cultivated for seed production and seed processing reach higher WTS values (0,6-0,75g). Smaller WTS values (0,30-0,59g) are typical for genotypes cultivated for fytomass production, for decoration purposes etc. Influence of the cultivation year was found also

Table 2 The production of seeds by genotypes of Amaranth

Source	***Genotype***	***Production of seeds***			
		1999		***2000***	
		per plant (g.plant^{-1})	*by canopy (kg.ha^{-1})*	*per plant (g.plant^{-1})*	*by canopy (kg.ha^{-1})*
Z 52-0003	*A. hypochondriacus* ´Golden´	6,00	799,9	5,32	709,3
Z 52-0004	*A. hypochondriacus*	2,28	304,0	2,62	349,3
Z 52-0005	*A. cruentus* ´Lider´	3,76	501,3	4,24	565,3
Z 52-0007	*A. edulis* ´Elbrus´	10,68	1 423,9	6,92	922,6
Z 52-0011	*A. caudatus*	15,78	2 104,0	6,02	802,7
Z 52-0017	*A. caudatus albiflorus*	11,20	1 423,9	11,82	1 576,0
Z 52-0030	*A. hypochondriacus*	23,70	3 160,0	13,86	1 824,0
Z 52-0031	*A. hypochondriacus*	19,84	2 645,3	12,32	1 642,7
Z 52-0033	*A. hybrid* K 343	17,16	2 287,9	16,26	2 167,9
Z 52-0060	*A. hybrid* K 23	7,88	1 050,7	6,92	922,7

Legend:
Testing of contrasts yield per plant (canopy) and genotypes H_d 0,01 = 7,669 [302,16]
Testing of contrasts yield per plant (canopy) and a cultivation year H_d 0,01 = 2,383 [285,94]
Limit difference - statistically significant difference at the significant level 0,99

during vegetation period. Extraordinary warm months in 2000 can be considered as one of the factors decreases WTS, yield per plant and per all canopy, too. The highest yield of seeds per plant 23,70 g/plant was observed at genotype *A. hypochondriacus*. The similar results were observed also in the years 1994, 1995 (HABÁNOVÁ – HABÁN, 1996), who state the yields of *A. caudatus* (5,49 – 21,26 g/plant), *A. cruentus* (4,46 – 18,6 g/plant) and *A. hypochondriacus* (5,49 – 21, 26 g/plant). Big differences in production of seeds per plant and also by canopy (800,0 – 3830 kg.ha^{-1}) were influenced also by graded terms of sowing. Variability in the size of yields by alochtonous species of Amaranth was confirmed also in another localities in the Slovakia (JAMRIŠKA – MIKLE, 1996), in Czech Republic (MOUDRÝ et al., 2000) and also in the Hungary (LAZANYI et al., 1990).

References

ČERNÁ K. – ZIMA, M. – HOJČUŠ, R., 1998: Physiological characteristics of Amaranth species in different canopy densities and nutrition conditions. In: Int. Sci. Conf. – 5th ESA Congress in Nitra, p.338-339.
DEBRE, F. – KOLENOVÁ, K., 1999: Genetic resources of Amaranths. In: Proceedings of 4th European Symposium of Amaranth, Nitra, p. 47-49. ISBN 80-7139-054-2.
HABÁN, M. – ILLÉŠ, L., 2001: In: Seed production of Amaranth genetic resources. Pestovanie a využitie tritikale, láskavca a pohánky, Nitra, p. 50-53. ISBN 80-88943-07-8.
HABÁNOVÁ, M., 1997: Doktorandská práca, Nitra.
HABÁNOVÁ, M. – HABÁN, M., 1996: Vplyv termínu sejby na úrodu semien vybraných druhov láskavca (Amaranthus). In: Biologizácia rastlinnej výroby V. a VI., Nitra, p. 100-103.
HEGI, G., 1979: Illustrierte Flora von Mitteleuropa. Bd. III, Teil 2. Berlin, Hamburg : Verlag Paul Parey. p. 465-516. ISBN 3-489-60020-7.
HERNANDÉZ BERMEJO, J. E – LEÓN, J. (ed.), 1994: Neclected crops: 1492 from a different perspective. Rome : FAO Plant Production and Protection Series, Vol. 26, p. 93-101. ISBN 92-5-103217-3
JAMRIŠKA, P., 1990: Rostl. Výr., Vol. 36, No. 8, p. 889-896.
JAMRIŠKA, P. – MIKLE, F., 1996: Účinok odrody na úrodu semena láskavca. In: Biologizácia rastlinnej výroby V. a VI., Nitra, p. 112-119.
LAZANYI, J. et al., 1990: Acta Agronomica Hungarica, Vol. 39, No.1-2, p. 11-19.
MOUDRÝ, J. - PEJCHA, J. - PETERKA, J., 1999: Vliv genotypu a agrotechniky na výnos láskavce (Amaranthus sp.). In: Collection of Scientific Papers, Faculty of Agriculture in České Budějovice , Series for Crop Sciences, Vol.16., No.2, p. 93-98.

Acknowledgements

This research was sponsored through grants from Scientific Grant Agency of the Ministry of Education of Slovak Republic, under contracts No. 1/6231/99 Deepening of Theoretic Knowledge of the Growing and Use of Amaranth. The authors are indebted to mentioned institution for sponsorig this research work.

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QUALITATIVE FEATURES OF THE STORED APPLES BASED ON THE RESULTS OF SENSORIAL ANALYSIS

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Summary

We concentrated our work to the evaluating of quality one of the most important fruit variants – apples. Beside the biological and hygienic quality that actually affects the whole quality of fruit to which a consumer attributes the highest importance. the next crop during the storage. We have to sag that by compiling the results of measurements and evaluations scientific sensorial analysis which in the matter of objectivity puts stress on the selection of suitable evaluating methods, the selection of appropriate evaluators and even puts stress on the own duration of on evaluation and it is able to notify clearly and exactly a different suitability of individual variants for

***Key words*:** aplles, quality, storage, sensorial analysis

Introduction

Fruit and vegetable belong to a group of agricultural products whose qualitative features can be evaluated by physical, chemical, biological and sensorial analyses in the original, storage and sensorial analyses in the original, storage and processed forms. There has been a rapid increase of an interest in an evaluating the sensorial quality in last few years.
A sensorial analysis which deals with stating the organoleptic features of food mostly by human senses is an important part of a science about food, independently objective, if it operate in conditions providing optimal and reproducible results.

Material and methods

We aimed an attention in our research to noticing the qualitatives qualities of apples by using methods sensorial analysis. There was observed a dynamism of changes in analysed features during the storage of samples in model storage with modified atmosphere. There were the following climatic conditions in a storage – the temperature 0°C, relative humidity 95 %, N_2 96 %, CO_2 3 %, O_2 1 % . There were classified six autumn an winter varietes of apples like: Denar, Prima, Golden Delicious, Idared, Champion and Melodie.
The apples were stored for seven months in a storage with modified atmosphere. There were also relaized checkings of a quality of the apples that happened in a regular 7-week intervals. A sensorial quality was classified by an evaluating exam with a scale. To classify the apples there was used a descriptor for classifying the apples which watches a sensorial quality of apples in 12 features – the balance of fruits, the wholeness of fruits, the shape of fruit and their weight, freshness, the basic and the covering colour of a peel, the peel texture, the colour of a flesh, the taste and the smell.

Results and discussion

The best sensorial quality had Prima variety before storage. This variety was marked by high evaluations its exterior, textural, gustatory and smelling features. The firmness of a flesh, the smell and the storage Prima variant had a firm flesh but insubstantial while the winter variants had only firm flesh. Smell and taste of a sample were more intensive than they were in Idared and Golden Delicious variants at the beginning of the storage. There occured intensified differencies were caused by the fact ripeness that the winter varietes were riping to their consumptional and were inceasing their sensorial quality, and the autumn ones were loosing their optimal consumptional, ripeness so they were overrinping and the quality perceived by the senses was falling. A sample Golden delicious had the best sensorila quality which improved its qualitative qualities in the features like the solidity of a flesh, the juiciness and the taste in the second classification.
Differencies in a sensorial quality observed among the samples were mostly noticable in the fruid and the fourth evaluation. Variants like Golden Delicious and Idared had the best sensorial quality in this period. The quality of the apples was at the median level 7-8 in the important descriptors of texture, smell and taste. Prima variant had the lowest sensorial quality at the end of the storage. This variant got very low evaluation in features like the colour of a flesh and its furning to brown colour, the firmness of a flesh and the taste. Even Denar variant had a very low evaluation in the feature concerning the firmness of a flesh in these variants was defined as a very little resistant towards making a flesh sore and vitreous flesh.
A sensorial quality of the apples was falling during the storage in features such as the wholeness of fruts, the freshness of fruits, the colour of a flesh and its furning to brown colour, the firmness of a flesh, the juiciness, the smell and the taste.
Winter variants Idared, Golden Delicious an Champion reached in the freshness of fruits, the colour of a flesh and its turning to brown, the firmness of a flesh, the juiciness, the smell and the taste very low or sometimes middle variability.
Autumn variants had the more significant differencies in a quality of these features at the beginning and at the end of the storage. The apples reached the middle and mostly high level of variability in the observed features.