

Evaluation of the *D19* pumpkin genotype (*Cucurbita maxima* L.), under the conditions of cultivation on the sandy soils of the southwest of Oltenia

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ABSTRACT

The need for breeding research to obtain new cultivars of baking pumpkin results from the fact that in the Official Catalog of Cultivated Plant Cultivars in Romania, edition 2021, there are only 4 cultivars: 'Alb mare', 'Dorin', 'Baron' and 'Tudor'. As a result, at Dabuleni Research-Development Station for Plant Culture on Sands (RDSPCS), in the period 2020-2022, the 'D19' baking pumpkin genotype was studied as part of the creative breeding process. The results obtained showed that both the weight of the fruit and the thickness of the fruit flesh (determining characters for the agronomic value of a cultivar) recorded constant values from year to year, which constitute important arguments in support of the enrolment of the 'D19' genotype at State Institute for Cultivars Testing and Registration for testing in order to homologation. 'D19' pumpkin genotype also showed good stability for the characters fruit height, fruit diameter, seed cavity diameter and shape index. The statistical analysis of the characters analyzed during the 3 years of the study highlighted the fact that the 'D19' pumpkin genotype behaved well in the pedoclimatic conditions of Dabuleni and steps can be taken to test and approve it as a crop plant cultivar in Romania.

Keywords: pumpkin, cultivar, sandy soils, conservative selection, breeding program

INTRODUCTION

Cucurbita is native to South America and has been widely cultivated for over 10,000 years in America (Grubben *et al.*, 2004) and for more than 500 years in Europe (Paris, H.S. Summer, 1996) where it was known by the indigenous peoples. Pumpkin was introduced to Chile and Argentina before finally spreading to Asia and Europe. Irrespective of altitude, they are cultured in almost all parts of the world (Yadav, *et al.*, 2010). In Europe, pumpkin has been cultivated since the 16th century. In Romania, the first writings in which the pumpkin was mentioned were identified in *Agricultură practică* by D. Alexandrescu, published in 1973, where has been mentioned the following cultivars: yellow pumpkins with hard skin, white pumpkins with thin skin (Vînătoru *et al.*, 2019).

There are three species of *Cucurbita*: *Cucurbita pepo* L., *Cucurbita maxima* Duch. and *Cucurbita moschata* Duch., which have different climatic adaptations and are widely distributed in agricultural regions around the world (Robinson and Decker-Walters, 1997; Paris and Brown, 2005; Wu *et al.*, 2007).

Several studies made by Whitaker and Robinson (1986); Montes-Hernandez *et al.*, (2005), mentioned that the phenotypic diversity within *Cucurbita* populations is high and includes

significant variability in characteristics such as fruit shape, size and color, number and size of seeds, the quality, color and thickness of the fruit pulp.

The edible pumpkin is grown for its fruits, which are consumed at physiological maturity in different forms: baked, boiled, candied, jellies and used to prepare pies, cakes, juices, etc. (Ciofu *et al.*, 2003). Pumpkin seeds are eaten directly as a snack by people around the world, being particularly popular in Arab countries where they are eaten salted and fried (AlKhalifa, 1996). Although pumpkin seeds are rich in oil and protein, and pumpkin could become another source of vegetable oil and protein (Seymen, 2016; Rani, 2021), detailed studies on oil composition and properties are limited.

Although the pumpkin has multiple uses, the assortment of cultivars existing in the Official Catalog of Cultivated Plant Cultivars in Romania from 2022 contains only 4 cultivars: 'Alb mare', 'Dorin', 'Baron', and 'Tudor'. As a result, the improvement of this species in terms of obtaining new cultivars is necessary.

At the research level, the diversity of genetic resources in collections can increase the effectiveness of efforts to improve a species (Geleta *et al.*, 2005). On the other hand, determining the degree of variation of quantitative and qualitative traits present in genetic resources is important in vegetable breeding programs (Escribano *et al.*, 1998).

MATERIALS AND METHODS

The research was carried out at Dabuleni Research-Development Station for Plant Culture on Sands, in the 2020-2022 period and aimed at improving the 'D19' pumpkin genotype. In this sense, biometric determinations and morphological observations were carried out on the main quantitative and qualitative characters of 100 fruits, obtained in a selection field. When choosing the elites, the health status of the plants, the shape, size and external appearance of the fruits, the color of the pulp, the shape, size and color of the seeds were taken into account.

The study was carried out on a psammosol with low natural fertility, poorly supplied in nitrogen (0.03%), well supplied in phosphorus (165.95 ppm), medium supplied in potassium (80 ppm), with a neutral pH, slightly alkaline (7.2).

During the three years of the study, the following characteristics of pumpkin fruits were analyzed: fruit height, fruit diameter, seed cavity diameter, shape index, fruit weight, pulp thickness, and seed weight per fruit.

The biometric data were processed statistically, calculating for each character the arithmetic mean (\bar{X}), the standard deviation (sd), the coefficient of variation (CV % 0-15 very little variability; 15-30 medium variability; >30 very high variability). The indicators of the central tendency of the sample (mean, median and mode), as well as the indicators of the dispersion of the values around the mean, were statistically processed. Then they were interpreted through Histograms of the class distribution with absolute frequencies for fruit weight, flesh thickness and seed weight.

RESULTS AND DISCUSSION

The data from Table 1 show us that the variability of the fruit height character is small with mean values between 8.50 cm (2020) and 9.10 cm (2021) which indicates that the 'D19' pumpkin cultivar is quite uniform from this point of view. 'D19' genotype shows the same good uniformity (stability) in terms of fruit diameter with mean values between 19.38 cm (2020) and 23.14 cm (2022), seminal cavity diameter between 14.89 cm (2021) and 15.83 cm (2020) and the shape index with 0.37 cm (2022) and 0.44 cm (2020).

Table 1 Variability of some characteristics of pumpkin fruits (*Cucurbita maxima* L.)

Characteristics	Statistical indicators	Years of observation		
		2020	2021	2022
Fruit height (cm)	Average	8.50	9.10	8.61
	Standard deviation	0.90	1.15	0.88
	CV%	10.59	12.63	10.22
Fruit diameter (cm)	Average	19.38	22.73	23.14
	Standard deviation	2.05	1.47	1.42
	CV%	10.57	6.47	6.14
Seminal cavity diameter (cm)	Average	15.83	14.89	15.35
	Standard deviation	1.74	1.38	1.28
	CV %	10.99	9.27	8.34
Shape index (cm)	Average	0.44	0.40	0.37
	Standard deviation	0.06	0.06	0.04
	CV %	13.63	15.00	10.81

*Note: 0-15 Very little variability; 5-30 Medium variability; >30 Very high variability; Values are mean on three years

Table 2 Variability of quantitative characteristics of pumpkin fruits (*Cucurbita maxima* L.)

Characteristics	Statistical indicators	Years of observation			Average / years of study
		2020	2021	2022	
Fruit weight (kg)	Average	2.46	3.70	3.62	3.26
	Standard deviation	0.74	0.58	0.56	0.36
	CV %	30.08	15.67	15.46	11.04
Flesh thickness (cm)	Average	3.55	3.93	4.31	3.93
	Standard deviation	0.64	0.93	0.82	0.51
	CV%	18.02	23.66	19.02	12.98
Seeds weight (g/fruit)	Average	57.17	50.09	64.25	57.17
	Standard deviation	11.18	19.03	18.66	11.18
	CV %	19.56	37.99	29.04	19.56

*Values are mean on three years

Table 2 shows the variability of the fruit weight, pulp thickness and seed weight/fruit characters. Fruit weight in 2020 had an average value of 2.46 kg, and 3.70 kg in 2021, which shows a very high variability for this character. This emphasizes the need to continue the selection process to standardize the material.

The thickness of the pulp had close values in the 3 years of the study: 3.55 cm in 2020, 3.93 cm in 2021 and 4.31 cm in 2022, with the coefficient of variation having a medium value in 2020 (18, 02 %) and 2022 (19.02 %) and high in the 2021 year (23.66 %).

The study of the variability of the weight of seeds in a fruit showed that from this point of view the 'D19' pumpkin genotype has medium variability in 2020 year (19.56), high variability in 2022 year (29.04) and very high variability in 2021 year (37.99).

On average over the 3 years of study, the coefficient of variation recorded values between 11.04% (fruit weight) and 12.98% (pulp thickness), which indicates that for these characters the D19 genotype is uniform (stable).

The sample mean in the three years of study was 3.26 kg, with values between 2.46 kg (2020) to 3.70 kg (2021). The histogram of all analyzed fruit weight values is asymmetric to the left, (values are higher than the average), being different from the normal distribution, a sign that there are significant influences between the years of study in terms of fruit weight. The frequency of elites by variation classes shows that 56 of the elites fall into the 3-3.5 kg variation class (Figure 1).

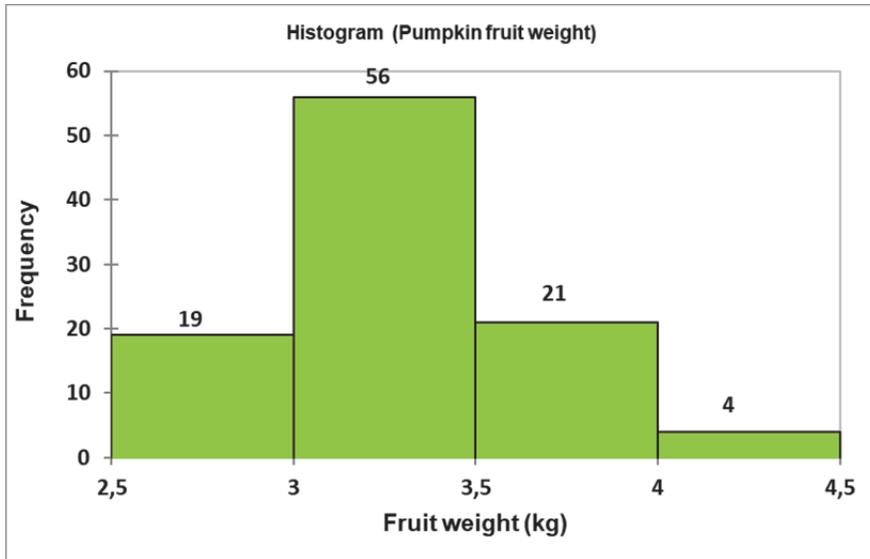


Fig 1. The frequency of elites in the 'D19' pumpkin genotype, by absolute class intervals, for the fruit weight character

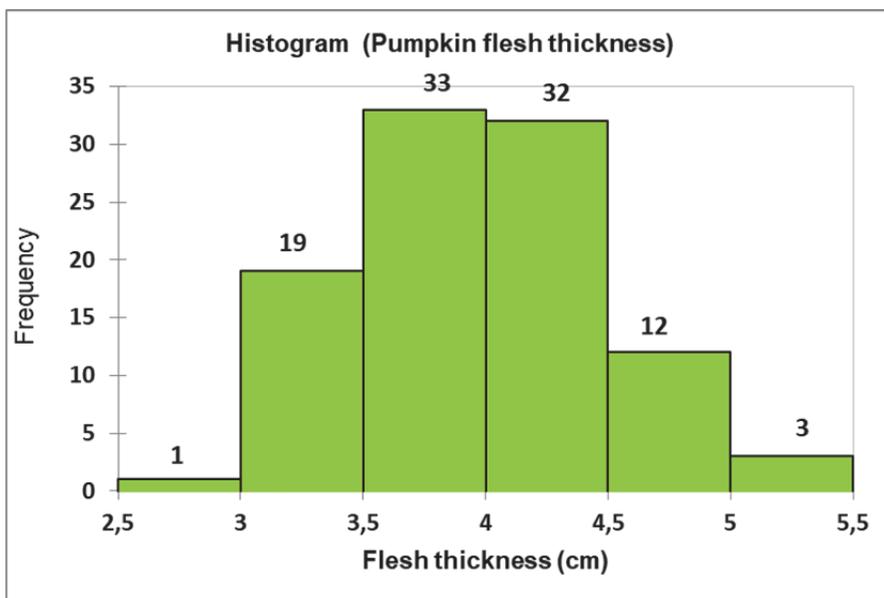


Fig 2. The frequency of elites in the 'D19' pumpkin genotype, by absolute class intervals, for the thickness of the fruit pulp character

Regarding the thickness of the flesh (the edible part of the 'D19' pumpkin), it is found that 96 of the elite fruits have a thickness between 3.0 – 5.0 cm (Figure 2), which qualifies the 'D19' genotype as very valuable.

Although the seed weight of a pumpkin fruit has high variability from year to year, so the mean value was 57.17grams in 2020 and 64.25 grams in 2022, on average over the 3 years of study 81 of the elites have a seed weight/fruit between 44-72 grams (Figure 3).

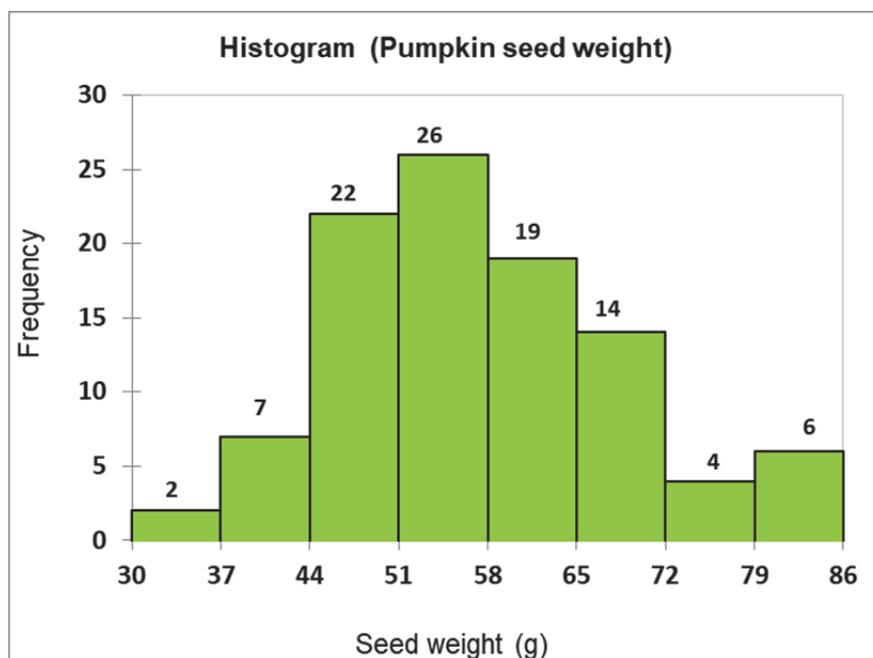


Fig 3. The frequency of elites in the D19' pumpkin genotype, by absolute class intervals, for the character seeds weight / fruit

CONCLUSIONS

The results obtained on 'D19' pumpkin genotype showed that both the weight of the fruit and the thickness of the fruit flesh have constant values from year to year 3.55 cm in 2020, and 4.31 cm in 2022 year, the variability for these characters being very small.

The 'D19' pumpkin genotype also shows good stability for the characters' fruit height with values between 8.50 cm (2020) and 9.10 cm (2021), fruit diameter, seed cavity diameter 14.89 in 2021 year and 15.83 in 2020 year.

The statistical analysis of the characters analyzed during the 3 years (2020 – 2022) shows that the 'D19' pumpkin genotype behaved well in the pedoclimatic conditions of Dabuleni and can be enrolled at State Institute for Cultivars Testing and Registration for homologation.

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