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AGRO-MORPHOLOGICAL CHARACTERIZATION OF HABANERO PEPPERS FROM THE GERMPLASM COLLECTION OF VEGETABLE RESEARCH DEVELOPMENT STATION BUZĂU

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Abstract

The aim of this study was to assess the agro-morphological traits of different accessions of Habanero peppers from the germplasm collection of V.R.D.S. Buzau. Ten accesions of Habanero peppers were taken into study and had been characterized from agro-morphological point of view, analysing 15 quantitative and 10 qualitative traits. The quantitative parameters were statistically analysed and significant differences were observed in terms of plant height, therefore the maximum value was recorded by accession A110 (131.4 cm), followed by A12A (128.35 cm), A12B (124.85 cm) while the lowest plant height was recorded by genotype A500 (78.4 cm). The length of the fruits varied between 6.70 cm (A128) to 3.50 cm (A13A). Regarding the weight of the one fruit, the highest values was reported by A128 (30.10 g) and the lowest was also registered by A 500 (7.15 g) Following the agro-morphological characterization, it can be concluded that there was a great variability within studied genotypes of chilli peppers. The results will be used in the breeding program to obtain new genotypes adapted to the pedo-climatic conditions of Romania.

Key words: *ANOVA, biodiversity, Capsicum chinense, Romania.*

INTRODUCTION

Hot pepper (*Capsicum* sp.*)* belongs to the Solanaceae family and many authors attribute to the genus thirty-five species, but this is only an estimate number, the list remaining open until the discovery of new species. Of these, only five species are widely cultivated. *Capsicum annuum* L.*, Capsicum baccatum* L.*, Capsicum chinense* Jacq., *Capsicum frutescens* L.*, Capsicuum pubescens* Ruiz & Pav. (Bebeli and Mazzucato, 2008; Padilha and Barbieri, 2016; Xiao-min et al., 2016). The *Capsicum sp*. represent one of the most economically important vegetable crops in the word due to their innovative and versatile uses, both in the food and pharmaceutical industry (González-Pérez et al., 2014) as well as ornamental plants (Rêgo et al., 2009, Lagunovschi et al., 2016).

The centre of origin for hot peppers is considered to be in South America, either in Brazil, along the Amazon or in central Bolivia along the Rio Grande (Kang and Kole, 2013). The first countries in Europe where peppers crops have expanded were Spain and Portugal in 1494, followed by Germany (1542), England (1548) and Hungary (1560) (Ciofu et al., 2004), (Lagunovchi et al., 2016).

In Romania the pepper began to be grown in the 18th century (Andronicescu and Angelescu, 1968).

Habanero peppers (*Capsicum chinense)* are a unique group of plants with a distinct variability in different traits of interest (Montalvo-Peniche et al., 2007). In Mexico, Habanero pepper is traditionally grown as a culinary product for export due to the specific taste and aroma, as well as the content of oleoresin, characteristics that have generated a significant growth in the international markets (Zakia et al., 2013). Furthermore, this species is part of the hottest peppers in the world, their fruits are used in the industrial extraction of capsaicin a valuable component in various pharmaceutical and food products (Butcker et

al., 2012; Canton-Flick et al., 2008; Montalvo-Peniche et al., 2007; Yordanova et al., 2015).
Butcker et al. (2012) states that few Habanero pepper breeding programs exist worldwide, limiting the potential exploitation of this diverse germplasm. For this reason, Vegetable Research and Development Station Buzau (V.R.D.S.) has been studying this species intensively since 1996, but concerns for breeding and large scale crop production of the hot pepper have existed since its foundation in 1957. V.R.D.S. was the first location in Romania where this crop was grown under greenhouse conditions. Over time, Research Station has patented and registered in Official Catalogue of Romanian Crop Plants, four varieties with distinct phenotypic expressivity, respectively, *Decebal, Jovial, Roial* and *Vladimir*.
V.R.D.S. Buzau owns a valuable collection of *Capsicum sp.,* it consists of two hundred genotypes, of these, ten genotypes of Habanero peppers were selected for this study and characterized from an agro-morphological point of view.

MATERIALS AND METHODS

The researches were carried out at the Genetic, Breeding and Biodiversity Laboratory from Vegetable Research and Development Station Buzau. The study aimed the evaluation of ten accessions of Habanero peppers noted A10B, A10C, A12A, A12B, A13A, A13B, A76, A110, A128, A500. The breeding method used was repeated individual selection, consisting in homozygosity of the main characters, followed by retention of typical elite plants. Afterwards, the elite plants were isolated under greenhouse conditions in order to keep biological purification of the accessions. The crop technology applied was the one specific for chilli peppers. The seed were sown at the beginning of March in alveolar pallets with 70 cubes with a volume of 50 cm^3 in a mixture a peat and sand, the planting was made in first decade of May, and the planting scheme used was 70 x 35cm. The plants were grown in fence system, during the vegetation period a special care was made using mechanical and manual hoeing and pest disease management. Throughout the vegetation period a sets of 10 qualitative and 15 quantitative descriptors showing continuous variation were selected from the available literature on the crop, IPGRI and UPOV Guidelines. Similar studies were made by Ortiza et al. (2010), they used the qualitative and quantitative traits in the five domesticated species of *Capsicum* for grouping them after assessing inter- and intra-specific variation. Also, Rahman et al. (2017) have been using 22 qualitative and 5 quantitative traits to characterize sixty chilli germplasm collected from different parts of Bangladesh.
The qualitative traits targeted in the study are presented in Table 1.
Statistical analysis was done using the analysis of variance (ANOVA) and statistics indices use for each character were: the means, standard deviation (SD) and coefficient of variation (CV%).

Table 1. Qualitative traits

Descriptors	Polymorphism
Fruit: color before maturity (FCBM)	1. white 2. yellow 3. green 4. Orange 5. purple 6. dark purple 7. other
Fruit: color at maturity (FCAM)	1. white 2. lemon yellow 3. pale orange-yellow 4. yellow orange 5. pale orange 6. orange 7. light red 8. red 9. dark red 10. purple 11. brown 12. black 13. other
Fruit: shape at pedicel attachment (FSP)	1. sharp 2. obtuse 3. truncated 4. cordate 5. lobed
Fruit: neck at base (FNB)	0. absent 1. present
Fruit: shape of blossom end (FSB)	1. sharp 2. bont 3. deep 4. deep and sharp 5. other
Fruit: blossom end appendage (FA) (FA)	0. absent 1. present
Fruit: shape in cross section (FSCS)	3. eliptic 5. angular 7. circular
Fruit: number of locules (FNL)	
Fruit: texture of surface (FS)	1.smooth or very slightly wrinkled 2.slightly wrinkled 3.strongly wrinkled
Placenta: length (PL)	1. <1/4 fruit 2. ¼-1/2 fruit 3. >1/2 fruit

The 15 *quantitative* traits used for agro-morphological characterization were: plant length (PL), plant diameter (PDM), leaf length (LL), leaf width (LW), petiole length (PL),

number of fruits per plants (NF), yield of fruits per plant (YF), fruit length (FL), fruit width (FW), fruit weight (W), weight of fruit pulp (WP), weight of fruit receptacle (WR), pedicel length (PDL), pedicel diameter (PD), pericarp thickness (PT).

RESULTS AND DISCUSSIONS

Throughout the study, a wide variability was note in most of the characters included as descriptors in this research.

Qualitative traits

A total of 10 qualitative characters were recorded and evaluated in order to establish the variability among the studied accessions. During the assessment, six characters showed distinct variation among the studied accessions (FCBM, FCAM, FSB, FSA, FSCS, FNL) and a number of four characters (FNB, FA, FS, PL) showed slightly variation among the accessions. The result of qualitative traits used in this study can be found in Table 2.

Table 2. Qualitative characters of the studied genotype

Accession	FCBM	FCAM	FSP	FNB	FSB	FA	FSCS	FNL	FS	PL
A10B	3	2	4	0	4	0	5	5	3	3
A10C	3	9	3	0	4	0	5	2	3	3
A12A	2	4	4	0	4	0	3	3	3	3
A12B	3	4	4	0	4	0	3	3	3	3
A13A	3	8	4	0	4	0	7	4	3	3
A13B	3	8	4	0	4	0	7	4	3	3
A76	3	4	3	0	1	0	3	3	3	3
A110	3	8	4	0	4	0	5	3	3	3
A128	3	8	5	0	4	0	7	4	3	3
A500	3	2	5	0	1	0	7	3	3	3

The number of fruit locules and fruit color at physiologically maturity has shown a great variability within studied traits. None of accessions have blossom end appendage or neck at the base of fruit. The length of placenta occupied more than half of fruit on all studied accessions and, also, all genotypes have a strongly surface wrinkled. Regarding the fruit color before maturity stage, accession A12A presented yellow fruit, and the rest of accessions have green fruit. The fruit shape of blossom end was deep and sharp for 80% for genotypes, while 20% for genotype presents sharp characters. Majority of the studied accessions have cordate shape at pedicel attachment (60%), and the rest have truncated (20%) or lobed (20%) shape. In cross section, A13A, A13B, A125, A500 showed circular fruits, A10B, A10C, A110 presented angular fruits and A12A, A12B, A76 have elliptic fruits. Number of locules of fruits varied from 2 for A10C, to 5 for A10B. At physiologically maturity, fruit colour in Habanero accessions was lemon yellow (A10B, A500), yellow orange (A12A, A12B, A76), red (A13A, A13B, A110, A128) or dark red (A10C) (Figure 1).

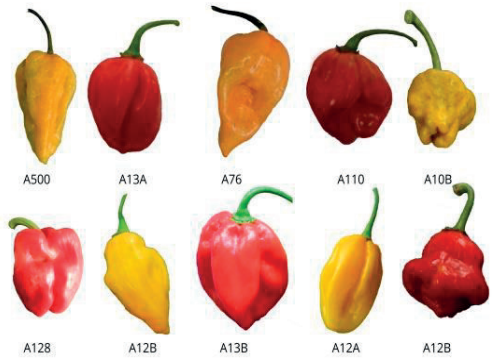

Figure 1. Different types of fruits

Quantitative traits

The quantitative parameters were statistically analyzed and significant differences were observed in terms of plant height, therefore, the maximum value was recorded by accession A110 (131.40 cm), followed by A12A (128.35 cm), A12B (124.85 cm) while the lowest plant height was recorded by genotype A500 (78.40 cm). As regards plant diameter, the maximum value was 127.55 cm (A12B), and the minimum value was 47.25 cm (A500). Crop detail of accession A12B is presented in Figure 2. The intermediate values are found in table 3. The length of the fruits varied between 3.50 cm (A13A) to 6.70 cm (A128**)** and the fruits width varied between 2.77 cm (A76) to 6.43 cm (A128).

Table 3. Means of studied accession

Code	A10B	A10C	A12A	A12B	A13A	A13B	A76	A110	A128	A500	Mean	SD	CV%	p value
PL	93.45	107.0	128.35	124.85	117.06	81.50	84.45	131.40	99.30	78.40	104.58	20.09	19.21	< 0.0001
PDM	72.05	82.35	103.25	127.55	79.60	90.50	51.30	100.85	64.15	47.25	81.89	24.78	30.26	< 0.0001
LL	18.20	16.30	15.25	15.85	13.50	18.05	16.15	16.80	19.85	12.89	16.28	2.12	13.00	ns
LW	5.60	4.85	6.05	5.50	7.10	9.60	6.77	8.35	10.70	4.85	6.94	2.02	29.09	ns
PL	5.60	5.00	2.80	2.65	4.10	4.75	2.90	3.15	3.40	2.77	3.71	1.07	28.94	ns
NF	29.50	38.00	35.00	7.85	35.00	23.50	22.50	39.50	13.50	36.00	28.04	10.87	38.77	< 0.0001
FL	3.87	4.57	3.90	5.28	3.50	4.83	6.45	4.17	6.70	5.71	4.90	1.11	22.69	ns
FW	4.33	4.33	3.55	3.00	3.62	5.08	2.77	3.95	6.43	2.77	3.98	1.14	28.60	ns
W	9.06	13.07	11.88	11.40	9.09	24.39	15.79	12.36	30.10	7.15	14.43	7.29	50.55	< 0.0001
WP	5.40	10.12	9.86	9.24	8.21	21.47	12.21	10.94	22.61	6.50	11.65	5.83	50.04	<0.0001
WR	3.66	2.95	2.02	2.17	0.88	3.51	4.28	1.37	7.34	1.04	2.92	1.94	66.35	< 0.0001
PDL	5.45	5.75	3.55	3.69	3.32	4.13	2.48	3.42	4.29	3.15	3.92	1.02	26.00	ns
PD	0.37	0.38	0.36	0.32	0.21	0.35	0.74	0.25	0.54	0.16	0.37	0.17	45.72	< 0.0001
PT	0.72	1.67	1.61	1.95	1.69	2.23	4.15	2.35	2.56	1.47	2.04	0.91	44.43	< 0.0001

SD-standard deviation, CV-coefficient of variation, NS-insignificant PL-plant length, PDM-plant diameter, LL-leaf length, LW-leaf width, PL-petiole length NF-number of fruits per plants,), FL-fruit length, FW-fruit width, W-fruit weight, WP-weight of fruit pulp, WR-weight of fruit receptacle, PDL-pedicel length, PD-pedicel diameter, PT-pericarp tickness

Figure 2. Crop detail A12B

Regarding the weight of the fruits, the highest values was reported by A128 (30.10 g) and the lowest was also registered by A500 (7.15 g). The weight of fruit pulp had the highest value for A13B with 21.47 g, followed by A76 with 12.21 g and the smallest value was 5.40 g had by A10B. The highest value for fruit receptacle weight was registered by A128 with a value of 7.34 g and the smallest value was 0.88 g (A13A). A detailed crop imagine for A13B can be found in Figure 3 and also a crop detail for A13A is presented in Figure 4. Regarding the fruit yield per plant highly significant differences were observed. The highest yield per plant was found in germplasm A13B (826.44 g) and the lowest yield per plant was found in A12B (102.03 g).

The fruits of A76 showed the highest pericarp thickness (4.15 mm), followed by A128 (2.56 mm), and lowest value was recorded by A10B (0.72 mm). The length of pedicel varied from 2.48 cm to 5.75 cm; the highest value was found in A10C and lowest in A76. The diameter of the pedicel varied from 0.16 cm (A500) cm to 0.74 cm (A76).

Figure 3. Crop detail A13B

In Table 3 are presented the mean values of studied accessions followed by standard deviation, coefficient of variation and p value. The results of statistical analysis showed a great variability within studied genotypes.

Figure 4. Crop detail A13A

CONCLUSIONS

Following the agro-morphological characterization, it can be concluded that there was a great variability within studied genotypes of chilli peppers. Significant variation was observed in terms of quantitative parameters and the highest variation was observed in weight of fruit receptacle. At the same time, most of the qualitative characters showed distinct variation among the germplasm studied accessions. The number of fruit locules and fruit color at physiologically maturity has shown a great variability within studied traits.
The results will be used in the breeding program to obtain new genotypes adapted to the pedo-climatic conditions of Romania.

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