

Studies regarding breeding value of some long pepper local landraces

Madosa E.^{1*}, Ciulca S.¹, Sasu Lavinia², Velicevici Giancarla¹, Avădanei C.¹, Ciulca Adriana¹, Friskan Ilijana¹

¹U.S.A.M.V.B. Timișoara, Faculty of Horticulture and Sylviculture, ²“Vasile Goldiș” University of Arad

*Corresponding author. Email: madosae@yahoo.com

Abstract Study of variability and heredity ensures the correct utilization of germplasm in breeding process. Starting studies in valorizing local landraces require the evaluation of selection potential and trait heritability. Application of selection is efficient only in processing local landraces which are maintained in culture. Studied biologic material was represented by 8 local landraces collected from West Romania. Breeding potential for few yield components were evaluated for this populations. Heritability is very low for fruit length and pulp weight. Fruit weight is proven to be a trait easily processed by selection, valorous populations being Ceica, Brănești, Rieni or Vinga. Fruit number per plant presents a high heritability in populations Begheiu Mic and Vinga. Regarding fruit weight per plant we remark populations Pocola, Temerești, Begheiu Mic and Brănești. The collection presents variability which can be used in breeding programs, even if the number of collected landraces is low.

Keywords:

long pepper, local landraces, breeding value, yield traits

Study of variability and heredity ensures the correct utilization of germplasm in breeding process. Main breeding objectives for pepper are yield and quality. Large and sweet fruit, colored intensively red, are very appreciated for long pepper. (8) For cultivated pepper, percent of allogamy may be increased, which lead to existence of high variability. (4) natural variability of pepper is highly pronounced, thank to high number of varieties, but also a wide range of forms inside every variety. Along with cultivars, there is also an important and still unvalorized reserve represented by local landraces. These forms present distinct and very important traits. Their processing is possible through selection and by methods of creating variability. (1) exotic germplasm offers a genetic diversity useful in pepper breeding. Such sources are frequently used worldwide. Anyway, potential of exotic germplasm is very poorly exploited. (1)

Trait heredity was examined through different methods and different traits. Heredity evaluation was also made by evaluating variance. From variance study by dialelic hybridization it was established that additivity is essential for fruit weight and diameter, and some special effects, other than additivity, are involved in precocity and fruit length. Starting studies in valorizing local landraces require the evaluation of selection potential and trait heritability. (6)

In long pepper, regarding productivity, the most important traits are number of fruit per plant and fruit size. Number of fruit per plant is lower than in

other varieties because harvesting is made only close to maturity, after red color appears. Average weight of one fruit must exceed 100 g, and their number per plant over 10. (7)

Color has major importance for long pepper. Approximately 20 carotenoids contribute to its color. (2). Red color of pepper comes from capsanthin and capsorubin. Capsanthin is the major carotenoid in mature fruit. Quantities of capsanthin and capsorubin vary depending on cultivar, maturity stage and growth conditions. (9 , 5).

Selection was the most applied in obtaining pepper cultivars. Nowadays, applying selection is efficient only in processing local landraces maintained in culture. Such landraces still exist and many efforts are made in order to collect and valorize them. (7)

Variability, heredity and genetic advance in pepper presents high values which can be valorized in breeding programs, especially by applying selection. High heritability along with a high genetic process represents potential regarding breeding through selection. (10)

Biological Material and Method

Biologic material was collected from counties Timiș, Arad and Bihor. Number of collected populations was low, this variety being less spread in culture. Only 8 local landraces were registered: 4 from Timiș county (Lovrin, Temerești, Begheiu Mic,

Brănești), 3 from Bihor county (Pocola, Ceica, Rieni) and only one from Arad county (Vinga). Control landrace was the old cultivar Kapia de Kurtovo.

Local landrace study was made in field, in comparative cultures, by randomized block method, in three replicates.

When the fruit achieved maturity biometrical measurements could be made over fruit dimension as component elements of yield potential. Yield potential per plant was estimated after last harvest.

- Fruit length
- Fruit diameter
- Fruit weight
- Number of fruit per plant
- Fruit weight per plant
- Pulp weight

In order to establish breeding value, we calculated selection differential (S), heritability (h^2) and the expected genetic advance (ΔG) (3)

$$S = \overline{x_{sel}} - \overline{x_{pi}}$$

$$h^2 = \sigma_g^2 / (\sigma_g^2 + \sigma_{e/r}^2)$$

$$\Delta G = h^2 \times S$$

Results and Discussions

For long pepper, regarding fruit length and diameter populations have similar selection indexes. For both traits, the control cultivar Kapia de Kurtovo exceeds all populations. (Table 1)

Regarding fruit length, heritability is very low, maximum value being only 0,59, through selection could be achieved the value of 2,37 cm for this trait. Among studied varieties, none can be recommended as useful in selection programs for this trait. Lowest value of this trait was recorded by population Vinga.

Populations from this collection are not valuable regarding fruit diameter. Selection indexes of local landraces are substantially inferior in comparison to control cultivar.

Pulp weight presented a similar situation to previous traits. Heritability of this trait is very low, maximum value being only 0,54 for control cultivar. There are no remarkable populations for application of selection.

Table 1.

Values of selection differential (S), heritability (h^2) and genetic advance (ΔG) for fruit length, fruit diameter and pulp weight, by application of selection in long pepper

No	Population	Fruit length (cm)			Fruit diameter (cm)			Pulp weight (g)		
		S	h^2	ΔG	S	h^2	ΔG	S	h^2	ΔG
1	Kapia de Kurtovo (ctrl)	3,99	0,59	2,37	1,02	0,66	0,67	19,40	0,54	10,44
2	Lovrin	2,58	0,38	0,98	0,43	0,21	0,09	9,76	0,30	2,96
3	Temerești	2,14	0,30	0,63	0,45	0,22	0,10	12,05	0,32	3,87
4	Begheiu Mic	2,41	0,35	0,84	0,53	0,30	0,16	15,40	0,46	7,11
5	Brănești	2,20	0,31	0,68	0,74	0,42	0,31	9,40	0,28	2,67
6	Pocola	2,02	0,27	0,55	0,48	0,25	0,12	10,13	0,29	2,94
7	Vinga	1,85	0,24	0,44	0,60	0,30	0,18	12,32	0,38	4,64
8	Ceica	2,41	0,35	0,84	0,67	0,35	0,24	10,03	0,32	3,18
9	Rieni	2,97	0,45	1,33	0,45	0,22	0,10	9,80	0,31	2,99

Fruit weight in proven to be a trait which can be processed through selection. Expected advance for fruit weight may range between 17,34 g (population Ceica) and 39,53 g population Begheiu Mic) Regarding heritability, local landraces achieved at least the value of control cultivar, over 0,60. valuable for selection process regarding fruit weight are also local landraces Brănești, Rieni or Vinga, all having high heritability and major differences between populations obtained after applying selection. (Table 2)

In comparison to bell and sweet pepper, for long pepper number of fruit pr plant has a high heritability, except local landrace Rieni. Highest values of selection indexes were presented by control cultivar,

but similar values are presented by local landraces Begheiu Mic and Vinga.

Fruit weight per plant presented indexes with different values. For this trait, control cultivar presented indexes with different values. For this trait, control cultivar presents the lowest values of selection indexes, having the lowest heritability (0,49). The most valuable is local landrace Pocola, with a heritability of 0,80, predicts an increase of fruit weight per plant through selection of 438,09 g. Valuable are also local landraces Temerești, Begheiu Mic și Brănești. These landraces are also valuable for other traits (fruit weight and number of fruit per plant). This situation recommends local landraces as a starting material for selection process in order to obtain higher productivity.

Table 2.

Values of selection differential (S), heritability (h^2) and genetic advance (ΔG) for fruit weight, number and weight of fruit per plant, by application of selection in long pepper

No.	Population	Fruit weight (g)			Number of fruit/ plant			Weight of fruit/plant (g)		
		S	h^2	ΔG	S	h^2	ΔG	S	h^2	ΔG
1	Kapia de Kurtovo (ctrl)	24,26	0,68	19,50	23,46	0,77	18,11	211,17	0,49	104,33
2	Lovrin	23,08	0,67	18,19	13,18	0,64	8,49	340,02	0,68	232,38
3	Temerești	28,59	0,72	24,32	17,74	0,72	12,82	493,24	0,78	385,81
4	Begheiu Mic	42,65	0,79	39,53	20,66	0,75	15,54	486,23	0,78	378,89
5	Brănești	36,82	0,77	33,29	10,56	0,57	5,99	485,48	0,78	378,14
6	Pocola	24,26	0,68	19,50	16,09	0,70	11,26	546,49	0,80	438,09
7	Vinga	33,61	0,75	29,82	17,45	0,72	12,55	376,91	0,72	269,67
8	Ceica	22,34	0,66	17,34	13,64	0,65	8,93	458,74	0,77	351,64
9	Rieni	36,21	0,77	32,63	8,60	0,49	4,18	252,20	0,57	144,02

Conclusions

1. For long pepper, regarding fruit length and diameter populations have similar selection indexes. For both traits, the control cultivar Kapia de Kurtovo exceeds all populations.

2. Regarding fruit length, heritability is very low, none of the studied landraces can be recommended as useful in selection programs for this trait.

3. Pulp weight presented very low heritability, maximum value being only 0,54 for control cultivar.

4. Fruit weight in proven to be a trait which can be processed thorough selection. Expected advance for fruit weight may range between 17,34 g (population Ceica) and 39,53 g population Begheiu Mic) Regarding heritability, local landraces achieved at least the value of control cultivar. Valuable for selection process regarding fruit weight are also local landraces Brănești, Rieni or Vinga, all having high heritability.

5. Number of fruit per plant has a high heritability, except local landrace Rieni. Highest values of selection indexes were presented by control cultivar, but similar values are presented by local landraces Begheiu Mic and Vinga.

6. Fruit weight per plant presented indexes with different values. For this trait, control cultivar presented indexes with different values. The most valuable is local landrace Pocola, with a heritability of 0,80, predicts an increase of fruit weight per plant through selection of 438,09 g. Valuable are also local landraces Temerești, Begheiu Mic și Brănești. These landraces are also valuable for other traits (fruit weight and number of fruit per plant).

7. Collection presents variability which can be used in breeding programs, even if number of collected landraces is low.

References

1. Bosland P.W., 1993, An effective plant field-cage to increase the production of genetically pure chile (*Capsicum* spp.) seed. HortScience 28:1053;
2. Bunnell R.H., Bauernfeind J.C., 1962, Chemistry, uses, and properties of carotenoids in foods. Food Technol.: 16:36-43.
3. Ciulca S., 2006, Metodologii de experimentare în agricultură și biologie, Ed. Agroprint, Timișoara;
4. Franceschetti U., 1971, Natural cross pollination in pepper (*Capsicum annuum* L.) Proc. Eucarpia Meeting on Genetic and Breeding of *Capsicum*. Turin, Italy. p. 346-353.
5. Harkay-Vinkler, M. 1974. Storage experiments with raw material of seasoning paprika with particular reference to the red color pigment components. Acta. Alim. Acad. Sci. Hung. 3:239-249.
6. Harzallah H., Chalbi N., 1993, Etude de l'heredite de quelques caracteres agronomiques chez le piment (*Capsicum annuum* L.), Le advance genetique passé-t-il par le reperage et l'inventaire des genes?, Ed. AUPELF-UREF, John Liberz Eurotext, Paris: 323-332.
7. Madoșă E., 2003, Caracterizarea agronomică a populațiilor locale de legume colectate din vestul României, Simpozionul "Managementul durabil al resurselor genetice din zona de vest a României – parte esențială a protecției mediului", 18-20 sept.2003, Szeged – Ungaria;
8. Munshi A.D., Behera T.K., 2000, Genetic variability, heritability and genetic advance

- for some traits in chillies (*Capsicum annuum* L.), vegetable Sci. 27: 39-41.
9. Reeves M.J., 1987, Re-evaluation of *Capsicum* color data. J. Food. Sci. 52:1047-1049.
 10. Sreelathakumary I., Rajamony L., 2004, Variability, heritability and genetic advance in chilli (*Capsicum annuum* L.), J.of Tropical Agr. 42 (1-2): 35-37.

