

## MORPHO-PHYSIOLOGICAL INVESTIGATIONS RELATED TO YIELD AND FRUIT'S QUALITY OF SOME SQUASH LINES (*CUCURBITA* SPP.)

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**Key words:** genealogical selection, productivity, cucurbits

### INTRODUCTION

The *Cucurbitaceae* or vine crop family is a distinct family without any close relatives. The most cultivated and consumed cucurbits are watermelon, cucumber, squash, melon, and gourds. Plants within *Cucurbitaceae* consist of 95 genera (Kousik et al., 2015). *Cucurbitaceae* family includes one of the widest variabilities of fruit size, shape, and color. The cucurbits are consumed as fruits and vegetables, fresh or pickled. Quality traits are assessed according to the maturation phase desired for consumption (mature or immature fruits). In case of some cucurbits the qualitative traits such as sweetness (Brix) and flesh color (carotene content), flavors and aroma are fully expressed only in mature fruits. Other traits, including the seed cavity, fruit size and water content can be important in case of fruits consumed at immature stages. Some cucurbits as for example pumpkins, squash have been grown for the dual usage (Schaffer, 2003).

Their value consists in low content of lipids, important sources of vitamins and significant antioxidant activity. Some studies published by Koffi et al. (2009), investigated lipids and proteins content of *C. pepo*. Medicinal properties of some cucurbits have been investigated and attributed to different part, organs of the plant, especially seeds fruits and flowers.

*Cucurbita pepo* is an annual species, monoecious climber originated to Mexico and cultivated all over the world for its fruits.

In Table 1 general character diversity of species is presented. According to botanical classification *Cucurbita pepo* includes two cultivated subspecies. These two subspecies include fruit-shape different morphotypes:

- subsp. *pepo* - the Pumpkin, Zucchini, Cocozelle, and Vegetable Marrow - this groups are considered to be native in Mexico and till the present it has not been identified in the wild (Xanthopoulou 2019).
- subsp. *ovifera* - Scallop, Crookneck, Straightneck and Acorn.

Phenotypic comparative studies of cucurbits showed that *Cucurbita pepo* is the most polymorphic species of the genus (Paris, 2001). The species was

characterized by its eight morphotypes (Groups of cultivars). Studies on fruit shape concluded that the trait is polygenically inherited and suffer little changes along fruit growth, being important in consumer preference. (Paris 1986), (fig. 1).

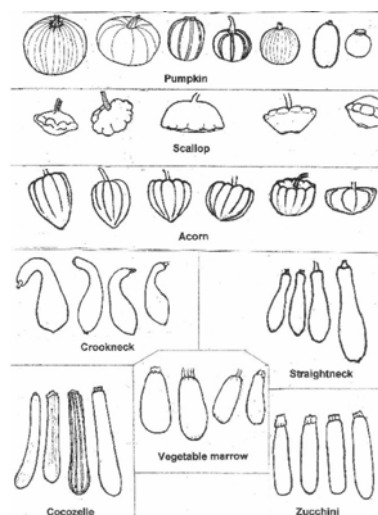


Fig. 1. Schematic representation of *Cucurbita pepo* subsp. *pepo* fruits, according to (Paris, 2018)

Recent studies allowed the identification of SNPs homogeneous distributed over the genome. (Xanthopoulou et al, 2019).

The recent omics development allowed a significant improvement of assortment. Resistant and productive cultivars were developed and currently resources are featured by superior nutritional content exploited for culinarily usage and diversified fruits as colors, shapes, and sizes (Paris, 2018). Breeders and farmers must always connect their activity to consumer preferences and requirements. Comparing the species included in *Cucurbitaceae* family, it seems *C. pepo* is among the most requested but despite the strong demand the number of cultivated resources is low, especially in our areal (Brezeanu, 2010). The aim of *Cucurbita* breeding programs is improvement of fruits yield and quality. Another important aspect considered for improvement are tolerance and resistance to diseases and pathogens,

and sex expression (Lebeda et al., 2006). The species is highly recommended in different diets thanks to its antioxidant profile, vitamins and mineral (table 2).

Table 1. Botanical characters for *C. pepo* after (Schaffer, 2003)

Characters	<i>C. pepo</i>
Growth habit	Annual vine or bush
Sex expression	Monococious
Foliage texture	Stiff, upright, harsh and prickly to touch
Foliage shape	Leaves broad, obtuse or acute, usually with 5 deep lobes, margin dentate, upper surface glabrous and lower with glandular club shaped hairs
Tendrils	Tendrils branched
Flowers	Solitary
Calyx	Calyx tube obscurely 5 angled
Flower	Corolla campanulate with erect or spreading lobes, stamens 3, filaments swollen below
Peduncle	5 angled with little or no expansion at fruit attachment
Fruits	Usually of variable size, shape and colour
Seeds	Seeds whitish yellow broadly or narrowing ovate usually with raised, smooth, well-differentiated margin

Table 2. Content of *C. pepo* fruits according to different studies (compilation)

Component	Unit	Average	Minim	Maxim
Energy	kcal	17	13	21
Water	g	94,55	93,30	95,69
Ash	g	0,65	0,49	0,84
Proteins	g	0,50	0,46	0,63
Azot	g	0,08	0,07	0,09
Oil, total	g	0,28	0,19	0,33
Carbohydrates	g	2,28	1,56	3,01
Fiber - total	g	1,73	1,20	2,26
soluble fiber	g	0,78	0,54	0,98
insoluble fiber	g	0,96	0,66	1,27
Zaharoase	g	0,43	0,00	2,46
Glucose	g	0,74	0,55	0,91
Fructose	g	0,92	0,66	1,15
Lactose	g	0,00	0,00	0,00
Maltose	g	0,00	0,00	0,00
Iron, Fe	mg	0,48	0,24	0,65
Phosphor, P	mg	45	38	78
Calcium, Ca	mg	20	12	37
Magnezium,	mg	21	15	30
Potasium, K	mg	258	202	284
Sodium, Na	mg	1	1	2
Zinc, Zn	mg	0,31	0,24	1,40
Vitamine C	mg	14,0	10,2	18,3
Ascorbic acid	mg	13,3	10,2	18,3
Tiaminã	mg	0,037	0,008	0,055
Riboflavine	mg	0,037	0,026	0,046
Niacine	mg	0,491	0,279	0,809
Vitamine B-1	mg	0,100	0,040	0,220
Beta-carotene	mg	192	44	391
Luteine	mg	504	9	1119
Vitamine K-1	mg	27,5	3,0	40,4

Morphological and phenological characterization are key steps in (pre)breeding providing valuable data of genetic resources characterization and evaluation (Balkaya et al., 2010). Another important issue is the determination of seed physiological maturation with impact in seed production since this will affect sanitary and physiological quality. (Silva, 2017).

The aim of this study was to investigate the yield and quality profile of three lines selected for approval.

## MATERIAL AND METHODS

In our study the biological material evaluated was represented by a collection of more than 20 lines. The present work highlights the results of three lines, selected for the best results in terms of yields and quality. The evaluation and characterization of germplasm had as main objectives: morphological and physiological assessment for detection of interest traits to be exploited in breeding and identification of useful resources to be exploited for improving yield capacity, the earliness, resistance to different stress factors. Germplasm evaluation, investigation of morphological and physiological parameters represents an essential condition in breeding to develop new cultivars that are more productive and have a greater food value. Morphological assessment was conducted in experimental field and plant physiology laboratory condition. The investigation included phenological observations, biometrical measurements, and physiological determinations.

The monitoring of physiological parameters included dry matter content, germination, and enzymes activity.

The assessment of total dry matter substance was carried using a gravimetric method, weighing the fresh vegetal material, drying it oven for 24 hours at 105°C. The difference between initial fresh weighing and the one after drying, represents the total dry matter contents, and the obtained results were expressed in percentage. The difference till 100% represents the water content.

Peroxidase (POX) activity was monitored using the spectrophotometric method, the oxidation guaiacol in condition of hydrogen peroxide presence was measured at a wavelength of 420 nm, and the results were expressed in units of peroxidase. Each corresponded to peroxidase-unit variation in the value of 0.001.

Germination - four replicates of 100 seeds for each treatment were placed in germination paper roll, type "germitest", moistened by distilled water, and incubated at alternating temperature of 20°C (16 h no light condition) and 30°C (8 h light). The evaluation was performed at eight days after sowing according to a procedure by (Silva, 2017).

The applied methodology involved the use of modern knowledge as genetic selection, inbreeding

and heredity mechanisms of the main qualitative and quantitative traits, specific to squash.

As initial breeding material, local populations as parents for different genetic recombination were used, varieties from the world and local assortment.

The research method used was repeated individual selection in advanced homozygous hybrid populations. (Potlog A., Velican V., 1971).

After a careful study of the main features, three genitors were promoted in working field from the collection field, which has over 20 lines, local populations, and varieties.

Based on principles of genetic stability of focused characteristics the promotion of parents from the basic field to the working field was made.

In this paper, we present three improved lines featured by characteristics stabilized over time, using as control for the variety *Fără vrej*, Biometric measurements and phenological observations were performed. The investigation was performed based on UPOV criteria applied at all promoted parents.

## RESULTS AND DISCUSSIONS

The initial breeding material was selected and tested for the uniformity of the inbred lines.

Valuable inbred lines were selected for the main morphological characters, productivity, and quality.

The main characteristics of the lines selected for approval are presented in the tables 3, 4 and in figures 2-6.

Table 3. Morphological aspects of the studied assortment

Var.	Fruit features			
	Shape	Length (cm)	Weight (g)	Color
Fără vrej (ctrl)	cylindrical with ridges on peduncle	14±1	105±3	Greenish white
L 15	cylindrical, slightly prismatic	17±1	165±3	Greenish white
L 6	cylindrical	16±2	170±4	Dark green
L 3	cylindrical	18±1	175±5	Green with streaks

Medium weight of fruits varied from 165 g per fruit to 175 g per fruit, all three selected lines developed heaviest fruits comparing control (figure 2). Similar, total weight per plant register superior values at lines L15, L6, L3 versus control.

The highest number of fruits per plant, was register at line L6, and was positively correlated with total weight of fruit per plant (figure 3).

According to the data displayed in Table 4, the highest value of yield was obtained by L6, 19 t ha<sup>-1</sup> more than control.

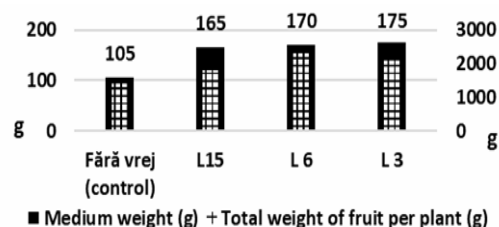


Fig. 2. Medium weight and total weight per plant

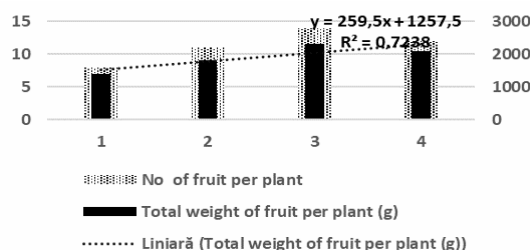


Fig. 3. Correlation between total weight and total number of fruits per plant

Table 4. Synthesis of yield results obtained by the advanced homozygous lines

Variant	Yield		Difference from control	Significance	Resistance to diseases
	t ha <sup>-1</sup>	%			
Fără vrej (control)	65	100	-	***	good
L 15	80	123	+15	***	very good
L 6	84	129	+19	***	very good
L 3	78	120	+13	***	very good

DI 5% = 3,7 t ha<sup>-1</sup>

DI 5% = 4,9 t ha<sup>-1</sup>

DI 5% = 5,1 t ha<sup>-1</sup>

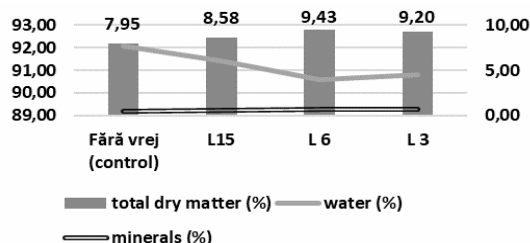


Fig. 4. Variation of total dry matter, water, and mineral content of investigated lines

The pattern of peroxidase enzyme (POX) activity (Figure 6) was selected for investigation due to its implication in germination rate value. The moment of investigation was at fully maturity of fruits.

Comparing with other studies were the investigation were made at different periods after anthesis and taking in consideration the fact that

seeds need a period of fruit rest to fulfill their maturation, we conclude the necessity to continue the study of mature seeds.

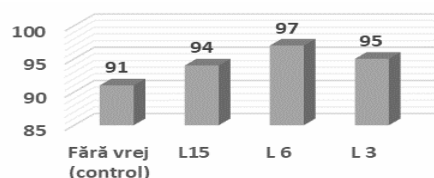


Fig. 5. Seed germination at harvest moment

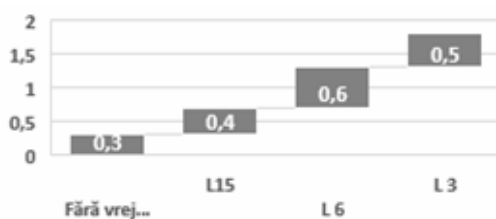


Fig. 6. Peroxidase (POX) activity in squash seeds at harvest moment

## CONCLUSIONS

The data presented highlight the fact that all three lines promoted for breeding have exceeded the established control variety for the area of Moldova, in terms of productivity, and quality.

## ABSTRACT

The studies were performed at SCDL BACAU, on a field collection which included a number of 20 varieties, lines and local populations of *Cucurbita pepo*. Following the improvement works carried out, three of the most stable and homogeneous lines were promoted in the selection field, in comparative and competitive cultures. Validation of the results is sustained by morphological and physiological characterization of selected lines.

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