Scientific Papers. Series B, Horticulture. Vol. LVIII, 2014
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

RESEARCH CONCERNING THE ACCLIMATIZATION AND BREEDING OF *MOMORDICA COCHINCHINENSIS*, A CUCURBITACEAE SPECIES

Costel VÎNĂTORU[1], Bianca ZAMFIR[1], Camelia BRATU[1], Viorica LAGUNOVSCHI[2]

[1]Vegetable Research and Development Station Buzău, 23 Mesteacănului Street,
zip code 120024, Buzău, Romania
Phone/Fax: 0040 238 / 722560 Phone 0040 238 / 722593
costel_vinatoru@yahoo.com; zamfir_b@yahoo.com; botea_camelia2007@yahoo.com;
[2]University of Agronomic Sciences and Veterinary Medicine of Bucharest,
59 Mărăşti, District 1, zip code 011464, Bucharest, Romania
Phone/Fax: +40 (21)318 22 66/318 28 88
vluchian@hotmail.com

Corresponding author email: costel_vinatoru@yahoo.com

Abstract

V.R.D.S. Buzau was interested in the acclimatization, breeding and crop production of rare plants since the station foundation in 1957. Rare Plants Laboratory was founded in 1962 and was led by the well known prof. Oros Victor. Here were cultivated for the first time in Romania species as asparagus, rhubarb, fennel, Luffa cilindrica. The Laboratory activity ceased and it was resumed after 1990 to continue valuable creations acclimatizations which were patented and crop production: Cichorium crispum, Cichorium latifolium, Cucumis metuliferus, Momordica charantia. Starting 2010, research were focused on acclimatization and breeding of new species like Momordica cochinchinensis, obtaining the first pot plants. This species shows major interest for prestigious world institues due to their valuable fruits with high content in lycopen, carotenoids and antioxidants. The basic genetical material (seeds) used comes from Vietnam, Nepal and India. The first fruits were obtained in 2012 and in 2013 the yield increased meanwhile it was elaborated the crop technology. Two of the three studied biotypes adapted to climatic conditions of our country. To specify that this new acclimated species can be cultivated only in high protected spaces and pallisate system in our country . After acclimatization phase, research focuses on breeding this species to obtain new distinct varieties adapted to climatic and soil conditions of our country.

Key words: *acclimatization, breeding, biotype, dioecious, Momordica cochinchinensis*

INTRODUCTION

Plant species that we have in the culture in our country, have an area of origin in a particular geographical area, very few of them having origins in our country or in nearby areas. There are few species cultivated in our culture that can fit in endemic populations or species. The introduction of new species or populations of culture in our country was made gradually, in the course of history. For very many species the exact period of introduction in the country and their authors is unknown. After 1990, when circulation outside the country was possible more easily, the laboratory of Genetics and Improvement of the unit aimed to resume the work of acclimatization and introduction to the culture of new species suitable for vegetable growing. Since 1962, this activity has been developed by the laboratory of Rare plants, although it has had outstanding results, in time it was disbanded. Founding members of this laboratory promoted species and varieties of fennel, rhubarb, asparagus, Lufa cilindrica, etc. At present, the laboratory of Genetics and Improvement was able to improve, acclimate and to introduce the cultivation of valuable species: *Momordica charantia, Cucumis metuliferus, Cichorium crispum, Cichorium latifolium, Ocimum basilicum* etc, species of which have been obtained and approved new valuable varieties. In addition, special attention was paid to the species *Momordica cochinchinensis*, which is the subject of this work. This species has not been cultivated and studied so far in Romania. Research has actually started in 2010 by getting the first plants in pots. Although it is a cucurbits and

pedoclimatic features of our country are favourable to this family, this species has presented many unpredictable unknown acclimatization program but that could pass. This species caught the attention especially for its chemical content of the fruit. Phytochemical studies revealed that seed membrane and seed oil are the excellent source of bio-available Beta-carotenes and Lycopene (Voung, 2005) which promotes healthy vision, and inhibit the proliferation of cancer cells. Lycopene levels in fruit are higher than those in any of the plant sources reported a good source of vitamin-E alpha-tocopherol and contain antimicrobial and anti-diabetic properties (Debnath B., Sinha S., Sinha R.K., 2013).

MATERIALS AND METHODS

The studies and research carried out on this species were conducted after a thoroughly prepared program developed in several stages. The first phase was that of documentaries and the genetic material of the seeds, respectively. The seeds were obtained with great difficulty, sources from areas with tradition in the cultivation of this species. (Figure 1 and Figure 2) Were purchased and used to experience three genotypes called L1, L2 and L3 are the following background: L1 India, L2-Vietnam, L3-Nepal. The main characteristics of seeds for the three studied genotypes are shown in Table 1.

Figure 1. L1, L2, L3 seeds

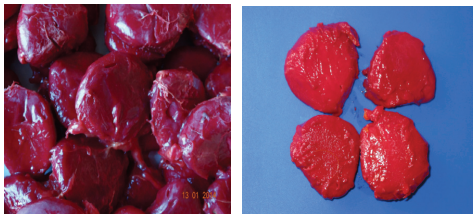

Figure 2. Aryl coated seeds

Table 1 . The main characteristics of seeds

Features / Genotypes		L1	L2	L3
The weight of the seed after extraction (g)		4,5	4,6	4,4
Seed weight after drying (g)		4	3,2	3,2
The weight of the seed/fruit after harvest (g)		85	73,6	83,6
Seed/fruit weight after drying (g)		66	51,2	60,8
Aryl thickness (cm)	Mantle	1,5	1,6	1,4
	Pulp	2	2,1	2,2
Aryl weight (g)		3,6	3,7	3,5
No.seeds / fruit		18	16	19
Seed length (cm)		3,1	3,3	2,8
Width seed (cm)		2,9	2,8	2,6
Seed thickness (cm)		0,7	0,5	0,8

The second stage concerned the acclimatization of species to the pedoclimatic of our country. This stage has embedded the largest volume of work assigned to this programme. There have been observations and detailed measurements starting from seed, continuing throughout the entire vegetation period up to fruition and harvest. The first plants were obtained in potting mixes in the laboratory and then were transferred to the cold greenhouse, without heating, and in the field. This stage was faced with most novelty items which were finally overcome.

The third stage aimed at elaboration of the specific culture. At this stage, were studied several options and technological links such as crop establishment by planting and direct seeding studies on seed germination, seedling production, genotypes growing in pots vegetation in protected areas in the field, planting distances specific to each cultivar, special care and domestic work, monitoring pest and disease occurrence etc.

After purchasing seeds, they were sown in pots filled with peat on 15.02.2009. The first seeds germinate after about 6 months after July 15. In order to solve this situation, research has been directed towards this objective to find a viable solution to reduce germination period. After careful consideration of the seeds was observed that the skin is thick and extremely tough. In this situation it were created several experimental variants of germination: normal

seed sown directly in pots and in the field, seed scarified, pre germinated seeds in water, seed with fissured skin and seed despoiled skin. Following this research concluded that the most effective method is the removal of the skin covering of the seed itself. This version recorded at time of germination in pots 20-30 days after sowing (Table 2).

Table 2. The main phenological data of plant *Momordica cochinchinensis*

Phenological data / Genotypes	L1	L2	L3
Sowing	20.03	20.03	20.03
Rising	16.04	20.04	13.04
Planted	7.05	7.05	7.05
Male plants begin of blooming	20.07	25.07	15.07
Female plants begin of blooming	15.08	8.08	28.07
Fructification	22.08	17.08	12.08
Reached technological maturity	27.10	22.10	15.10

RESULTS AND DISCUSSIONS

Culture can be established in protected areas both through seedling and direct seeding. The best results were obtained in culture through seedling establishment. After emergence of seeds, the plants have a slow progress, until the first normal leaves appear. Then the growth rate accelerates, gaining lush plant appearance. In terms of culture from sowing until planting, seedlings occurs in about 65-75 days (Figure 3). The plant has the appearance of liana, with a bright, lush vegetative growth, can surpass 15 m tall, with a number of extremely high lateral shoots. In protected spaces behave as a biennial herb, on the understanding that in year 2, vegetative development is much stronger, with more abundant fructification and something more (Figure 4).

Figure 3. Seedling, year 1 and year 2

Figure 4. Beginning of vegetation, year 2

In terms of adaptability and expressiveness of the studied genotypes there have not been recorded significant differences between the characteristics of fruit and plant genotype, but L3 proved to be superior in terms of adaptability to the other two. This genotype showed a greater ability of binding and fructification, its seeds were the first to reach physical maturity.

Technology culture and strict observance of technological flux in this species is the main key to success culture.

Regarding culture technology were established major technological milestones for the cultivation of this species. In protected areas concluded that the most important technological component is the planting (seed culture) and density. We studied several variants with different densities, but since it was a massive lush plant growth it was determined that the distance between plants in the row must be at least 3 m and minimum 10 m distance between rows. Shortly after planting, plants must have a trellis system, well supported and provided space for developing optimal central axis and lateral shoots. For the trellis system it is recommended not to tie the string at the base of the plant, but at 3-4 leaves above, because the stem at the base, gaining a bulb elongated layout, develop powerful herb that can strangle. The eye of the string should be broad and carefully watched the entire vegetation period. We recommend the using of the trellis system for the lateral shoots. At the top of the greenhouse, to more than 2 m height must be held out pick-up wires from a distance of 30-40 cm between them, because plant creates a powerful vault.

A special attention must be paid to fruit sustaining because the shoots that feed the fruits could be affected. It is recommended to

use support nets similar for melons or to tie the fruits stalk by the support wire. Culture does not require any special snubbing, pinches but only the routing of shoots in vertical and horizontal, at the level of the support system. Water supply is rhythmically during summer when temperatures are high, and twice a week in the spring and once a week in autumn. In terms of disease and pests was found that the species shows genetic resistance against them was not reported until now their attack without having to counter chemical treatments during the growing season. The plant shows a strong well-developed root system consisting of a main root, pivoting and a large number of secondary roots, strongly developed horizontally on the fertile layer from the surface (Figure 5).

Figure 5. Root aspect

The stem is strong, powerful developed and lignified at the base with a high growth rate, up to 2.5 -3 m, then shoots coming from this, take over the mission of forward travel. Plant has a large number of shoots branching off from main which many secondary shoots. The number of primary and secondary shoots is significantly higher in the second year. Main shoots have the appearance of rope vines, slightly lignified, with gray-brown shell with small roughness and the secondary are herbaceous, green. Main shoots have a round shape at the base and top are slightly grooved and the secondary shoots show the entire surface slightly grooved.

Lobed palmed leaf is composed of five lobes, presenting a large number of plant leaves, on the tips of shoots of growth shoots they are small and would submit on the rise they shall increase. The leaves are dark green and have at the base 2-4 glands that secrete a sweet substance similar to bees preferred nectar. The leaves are in the lower layers of the vault, due to lack of light, turn yellow and dry (Figure 6).

The leafs presents a long petiole and after dry does not come loose from the sprout, becoming fibrous. From the same plant shall meet leaves with 2 and 4 glands, rarely 3. The main characteristics of leaves are shown in Table 3.

Table 3. The main characteristics of the Momordica cochinchinensis leaves

Characteristics	Small leaf	Medium leaf	Large leaf
Length (cm)	12	17	19
Width (cm)	12	16	16,5
Petiole length (cm)	5,5	6	5,5
Number of lobes	3	5	5
Number of glands	2	2-4	2-4

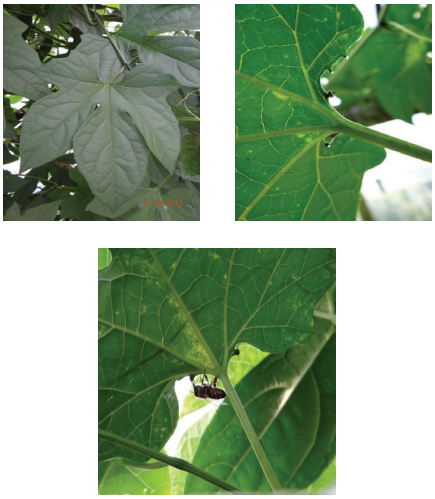

Figure 6. Leaf appearance; leaf with 4 and 2 glands

Shoots presents down of the leaves from place to place tendrils of two types: the ones at the top shoot are in the form of the snail's horns and shall have the task of exploring and search for support (Figure 7) .

They, in time rigidify and shall be fixed in the form of an arc of the support point, appearing in their place other explorer tendrils, helping plant to submit on the rise. If the explorer tendrils do not meet a support point, they wilt, dry and that sprout is commanded to stop

growth, plant directing its energy other shoots. But there are situations when the shoots do not meet support point and then they self support each other very often occurring the phenomenon of self strangulation (Figure 8).


Figure 7. Agressive tendrils


Figure 8. Self strangulated shoot

The plant pollination is entomophilies, being made by insects. In our country conditions, pollination is poor. Under normal conditions, very little flowers seem to be pollinated and to seize. Therefore, in order to increase the number of flowers it is recommended the manual pollination. Recognition male and female plants shall be assessed at the time of flowering. Investigations so far did not reveal any other indication in respect of the recognition sex before the appearance of flowers. Both male flowers and female remain open only one day. After flowering, the next day, the flower tightens, shrivels and then falls (Figure 9).

Figure 9. ♀ Floral buds without bracts; ♀ Floral buds with bracts; ♂Floral bud

Male plants are the first to bloom 3-4 weeks before the female plants. Shows large flowers special form of cups, yellow-cream, and three petals at the base shows a dark brown to black stain. Flower buds are located at the armpit leaves protected by a green bracts as the bud grows, allowing the flower to open out and open. Male flower shows larger than the female (Figure 10 and 11).


Figure 10. Male flower Male flower petals and calyx


Figure 11. The evolution of male flowers

The female plants flower shows distinct size, slightly smaller than the male ones, based on corolla miniature fruit. Flower petals are yellow-based without stains unlike the male ones. The unfertilized and fertilized partially wilting shortly after starting to turn yellow flower stem gradually dries completely (Figure 12 and 13). The same plant can meet two types of flowers with bracts at the base or without bracts. The main features of the male flowers and female are presented in Table 4 (Table 4).

Table 4. The main characteristics of male and female flowers at *Momordica cochinchinensis*

Floral characteristics	♂ flower	♀ flower
Floral bud length (cm)	8,5	4,5
Length of sepals (cm)	1	0,8
Calyx diameter (cm)	3,8	1,2
Number petal corolla	5	5
Petal length (cm)	10	6,5
Number of stamens	6	-
Stamens length (cm)	1,5	-
Flower weight (g)	6	6,4
Pedicel length (cm)	10,5	7
Fruit length after binding (cm)	-	2
Flowers diameter (cm)	11,8	10,4
Lifetime of open flower (days)	1-3	1-3

Figure 12. Evolution of the fertilized flower and unfertilized flower

Figure 13. Unfertilized fruit and manually pollinated flower

After fertilization, the fruit is growing quickly in size, reaching up to 1-1.5 weight kg, featuring green color on the exterior to beautifully ornate physiological maturity with spikes easy aggressive 2 mm high (Figure 14). Round shape fruit has lengthened slightly and fasten with a long peduncle of 12,5 cm rough and fibrous. The main characteristics of the fruit are presented in table 5.

Table 5.The main characteristics of the fruit *Momordica cochinchinensis*

Characteristics	
Weight of the fruit (kg)	1,1
Diameter of the fruit (cm)	13
Height of the fruit (cm)	14,5
Length of peduncle (cm)	12,5
Peduncle base diameter (cm)	2
Peduncle diameter at grip (cm)	0,7
Peduncle diameter in the middle (cm)	0,6
Height ornamental spines (mm)	2
Blossom end diameter (mm)	14
Blossom end form	Star
shape of the fruit	Round high
Pericarp thick (mm)	1
Thickness pulp (mm)	15

Figure 14. Fruit evolution

Mature plant withstand low temperatures close to the freezing threshold, in protected spaces, the pace of growth slows but the fruit never depreciates. The fruit has a rate of growth accelerated after pollination but travels a long period of time from the phenophase green color to orange (Figure 15, 16 and 17).

In Table 6 is presented the variability of the main characters at L1. In terms of the height of the plant, it proves to be stable, with a coefficient of variability low, below 10% (7,35%).

In terms of the size of the fruit are a little larger variability, represented the fruit of 900 g - 1.3 kg.

Table 6. The variability of the main characters at L1

Character	Statistical indices (3 years average)			
	$\bar{X}$	S	CV %	$\bar{X}\pm S$
Plant height (m)	13,6	1	7,35	12,6-14,8
Fruit weight (kg)	1,1	0,2	18,1	0.9-1,3
Fruit lenght (cm)	14,5	2	13,7	12,5-16,5
Fruit diameter (cm)	13	2	15,3	11-15
Seeds (no./fruit)	18	2	11,1	16-20
Seeds weight/fruit (g)	60	5	8,3	55-65

Figure. 15. Fruit evolution

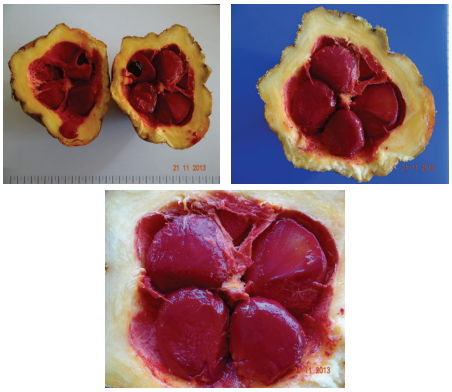

Figure. 16. Mature fruit sections

In the table no.7 the variability of the main characters is presented for L 2. The values are close to those of L2 to L1, variability is higher by registering to the weight of the fruit on the plant with a coefficient of 21.4%. And in terms of seeds number per fruit was recorded 12,5% variability.

Table 7. The variability of the main characters at L2

Character	Statistical indices (3 years average)			
	$\bar{X}$	S	CV%	$\bar{X}$±S
Plant height (m)	15.4	1.2	7,7	14.2-16.6
Fruit weight (kg)	1,4	0,3	21.4	1.1-1.7
Fruit lenght (cm)	14,6	2.2	15	12,4-16.8
Fruit diameter (cm)	13.8	1.2	8.6	12.6-15
Seeds (no./fruit)	16	2	12.5	14-18
Seeds weight/fruit (g)	51.2	3.6	7	47.6-54.8

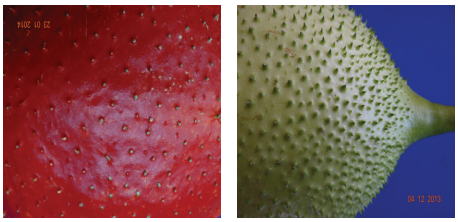

Figure 17. Fruit spines detail

Table 8. The variability of the main characters at L3

Character	Statistical indices (3 years average)			
	$\bar{X}$	S	CV %	$\bar{X}$±S
Plant height (m)	12.6	1.2	9.5	11.4-13.8
Fruit weight (kg)	1,75	0,10	5.7	1.65-1.85
Fruit lenght (cm)	16.4	1.2	7.3	15,2-17.6
Fruit diameter (cm)	12.8	0.8	6.2	12-13.6
Seeds (no./fruit)	19	3	15.7	16-22
Seeds weight/fruit (g)	60.8	5.4	8.8	55.4-66.2

For all the studied characters, L3 has demonstrated reduced varibilitate coefficient of less than 10%, except the number of seeds in the fruit that has a higher coefficient of variability, 15.7%. recorded values and the results obtained demonstrate that this line is genetically superior and at the same time registering the highest production/plant.

CONCLUSIONS

Research undertaken for acclimatization and placing in the culture of the species *Momordica cochinchinensis* till now have been completed with a great success.

All three genotypes showed a great capacity of adaptation to the pedoclimatic features of our country. This feature has been observed better at L3 genotype.

Were obtained for the first time harvestable fruits with germinable seeds in protected unheated spaces. Currently we are working on improvement of the studied genotypes for stabilization of the main characters and the distinctively and uniformity (DUS) with the purpose of reaching of new varieties.

Specific technology has been developed for growing species in protected areas.

REFERENCES

Borghi B., 1979. Miglioramento genetico delle Cucurbitacee- Ministero Agricultura e Forestre, Salerno, Italy.

Drăcea I., 1972. Genetică. Editura Didactică și Pedagogică, București, p. 317-332.

Debnath B., Sinha S., Sinha R.K., 2013. In Vitro differentiation and regeneration of *Momordica cochinchinensis*, p. 1-3.

European Association for Research on plant Breeding, 1988. Cucurbitaceae 88, Institut national De La Recherche Agronomique, Paris, France.

Vuong L.T., 2005. *Momordica cochinchinensis*, Rosa Roxburghii, Wolfberry And Sea Buckthorn. Highly Nutritional Fruits supported by tradition and science, p. 259-266.

Potlog A.S., Suciu Z., Lăzăreanu A., Nedelea G., Moisuc A., 1989. Principii moderne în ameliorarea plantelor. Editura Facla, Timișoara, p. 83-93.

Doruchowski Roch W., 1992. Fifth Eucarpia Cucurbitaceae Symposium, Poland. Research Institute of vegetable Crops Skierniecewice and Warsaw, University of Agriculture Warsaw, p. 56-78.