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NEW GENOTYPES OF *LUFFA* SPP. OBTAINED AT V.R.D.S. BUZĂU

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Abstract

Luffa cylindrica belongs to the Cucurbitaceae family, being an annual, herbaceous plant, multiplied by seeds. It is a well-defined genre, alongside with the species L. acutangula, L echinata,, L. graveolens, with their origin along with L. cylindrica in the tropics. And the species l. operculata, l. quinquefida and l. astorii are originating in the neo-tropical zone. Of these, these two species originating in India, L. cylindrica and L. acutangula are most common. They have been acclimatized for starters in India and America, then expanded and grown on a large scale for their immature fruits used as vegetables. With the passage of time, the areas of usage have diversified greatly. In Romania, the most known species is Luffa cylindrica, plant introduced in our country after the 1960s, at V.R.D.S. Buzau by dr. ing. Marcela Iosifescu. Though it has been successfully acclimatized in our country, especially in the protected spaces, promoting this culture was quite slow. At present, the spaces occupied by this species are pretty small, insignificant. After 1996, researches regarding the Luffa species were taken over time by the Laboratory of Improvement, aiming the acclimatization of new species and obtaining new creations with distinct biological phenotypical expression. Along with Luffa cylindrica, a special attention was given to the acclimation of new species, of which Luffa acutangula was successfully acclimated. The research continued with the crossing of L. acutangula x L. cylindrica species. By this crossing was obtained an F1 hybrid with intermediate sized fruit and high density of the fibre. From the segregation of the F1 hybrid were obtained in 6 new families, lineage with distinct features and numerous intermediate forms have been removed in the process of improvement. Varieties of Luffa acutangula have very large fruit, in green have recorded an average of 119 cm, unlike Luffa cylindrica, which recorded an average of 56 cm. F1 hybrid has an average length of fruit length of 65 cm. New varieties derived from the crossing of species ranged from L1 to L5 with 91 cm and 48 cm, the smallest value. The researches were completed with the obtaining of new genotypes Luffa cylindrica and L. acutangula with distinct features.

Key words**:** *acclimation*, *hybrid, improvement, L. acutangula*, *L. cylindrica.*

INTRODUCTION

Luffa species have exhibited a special interest for V.R.D.S. Buzău, which is also the first institution in the country where *Luffa cylindrica* was introduced in breeding programs by Ph.D. Engineer Iosifescu Marcela, after 1960. First researches have been channeled towards testing products to combat certain pathogens and diseases in *Cucurbitaceae,* knowing that *Luffa* spp. shows a remarkable resistance within this family.

The *Cucurbitaceae* or vine crop family is a distinct family without any close relatives and includes many important vegetables such as cucumber, melon, watermelon, squash, and gourds.

Plants within *Cucurbitaceae* consist of 95 genera *(*Kousik et al., 2015)

Is a well-defined genre, alongside the species *L. acutangula*, *L. echinata*, *L. graveolens*, which have their origins along with *L. cylindrica* in the tropics. The species *L. operculata*, *L. quinquefida* and *L. astorii* are originating in the Neotropical. Of these, two native species, from India, *L. cylindrica* and *L. acutangula* are most common. They have been acclimatized for starters in India and America, then expanded and grown on a large scale for their immature fruits used as vegetables. In time, the areas of *Luffa* spp. usage have diversified greatly.

Although stages of acclimatization and improvement of the species accounted for a great success in our institution, it did not occupy until now significant areas in culture and no Romanian variety was patented. After 1996, researches focusing on *Luffa* species were resumed in an intensive system with the aim of obtaining new genotypes with precise directions for use and also the acclimation of new species, with an emphasis on *L. acutangula.*

Recent researches confirm that *Luffa* species are plants with multiple uses. The fruit contains triterpenoid saponins: lucyosides A, B, C, D, E, F, G, H, I, J, K, L, M, ginsenosides Re, Rg1, etc. The leaf contains triterpenoid saponins: lucyin A, lucyosides G, N, O, P, Q, R, 21β-hydroxyoleanoic acid, 3-O-β-D glucopyranosyl - maslinic acid ginsenosides Re, Rg1; flavonoids: apigenin, etc. The seed contains polypeptides: luffins P1, S, luffacylin etc. (Partap et al., 2012). As an entomophilies species, preferred by pollinating insects, it presents numerous genotypes.

Rich morphological variability occurs in cultivated species of *Luffa* in different growing regions. (Prakash et al., 2013).

At the present, the interest for the species of *Luffa* grew considerably in our country, motivating the initiation of further researches presented in this paper.

MATERIALS AND METHODS

The researches started with the achievement and the enrichment of a germplasm collection for this species. Three species were taken in study: *Luffa cylindrica*, *Luffa acutangula* and *Luffa operculata*. Within the species *Luffa cylindrica* we managed to achieve a large number of genotypes but have been selected for study 3 genotypes with distinct characteristics and stable in descent, two of them obtained at the V.R.D.S. Buzău; one of them has white seed, the other one has black seed and the third one is from Bulgaria. Within the species of *Luffa acutangula,* researches started with the species acclimation, because so far these varieties were not cultivated in Romania. The germplasm collection was established with a total of five distinct genotypes, but one who has demonstrated adaptability and stability to our soil and climatic conditions was the one originating from China, codenamed G2. Within the species *Luffa operculata,* until now, we haven't managed any genotype acclimation that presents adaptability and genetic stability.

The selection methods were the specific ones for cucurbits, and the stabilized families were subjected for hybridization followed by the segregation process. Special attention was paid to isolation areas due to its entomophilies degree. They were cultivated in different greenhouse compartments, to avoid contamination.

RESULTS AND DISCUSSIONS

Researches finalised with the achievement of a solid germplasm collection at this species.

From the *Luffa cylindrica* group, a new variety was achieved that presents distinct characteristics recommending it to be used as a vegetable sponge. The plant is vigorous, with a well developed root system that explores the deeper layers of soil.

In protected areas, the plant reaches the height of six up to eight meters. From the stem, eight-twelve main shoots with numerous secondary shoots develop, and have a capacity of dispersion of over six meters. The stem is vigorous, edged, slightly lignified at the base, with a medium diameter of 16 millimeters. (Fig. 1).

Figure 1. Stem

The plant has a rich foliar device, consisting of scattered leaves on shoots at a distance of 14-18 cm, with a leaf petiole ranging between 18-24 cm, and a diameter between 6-8 mm. Length of leaf varies between 20-30 cm and the width register values between 18-28 cm. (Fig.2.).

Figure 2. Plant and leaf detail

The leaf is composed of 5 lobes, the inferior ones being serrated. The shoots present tendrils to facilitate climbing on the trellising system (Fig.3).

Figure 3. Tendrils

The flowers are yellow, distinct on the plant; the male ones show a long petiole, which varies between 20-40 cm long, with an average diameter of 10 mm and the peduncle length of 1-1, 2 cm. The sepals are sharp and have an average length of 10 mm. The corolla diameter is of 8 cm, flowers are type-5, and number of flowers in florescence is 3-12. Female flowers are solitary and are distinguished by the presence of the miniature fruit at the base of the corolla. First make their appearance are male ones, that are far more numerous than females (Fig.4).

Figure 4. Male and female flower

The fruit is a green cylindrical ridged pepo, with the base slightly narrow than the apex. It has an inner dense network of cellulose fibre, a characteristic that gives it more quality in its use. The plant has a great capacity production, but in normal nutritional conditions it retains a number of 18-22 fruits per plant. (Fig. 5). The production can increase significantly if it interferes with special directing and topping of works for the unnecessary shoots and if is ensured an adequate level of nutrition per phenological phase.

Figure 5. Unripe fruit, dried fruit, sponge

Referring to the recent studied species, *L. acutangula*, the researches finalised with its acclimation, this being a first in our country, and with the achievement of a new variety with distinct characteristics. Regarding the biological specific features of this species, is similar with the *L. cylindrica,* bearing the mention that its fruit are likely to be consumed when fresh. Optimal size of fruit for consumption is of 20 - 40 cm. With this dimension, the fruit diameter at the base is of 6.5 cm, ant the apex diameter is of 7.2 cm. If are not harvested, the fruits lose their softness, spongy fibres appear inside and are unfit for human consumption. Such unharvested fruit can exceed 1 meter in length and as they mature, they turn from green to brown, lose significant weight and decrease greatly its size. (Fig. 6.)

Figure 6. Fruits at maturity consumption

Culture can be established through seedlings or direct sowing. In field conditions, the plant

behaves like a tardy plant, therefore it is recommended to be cultivated in the warmer areas of the country. Seedling production is carried out just like the rest of the cucurbits, being performed in alveolar palettes with 28 holes, in order to ensure an appropriate nutrition space. Sowing, for the production of seedlings is made in the first decade of February, and for the field in the first decade of March (Fig. 7).

Table.1. Main fruit characteristics

Variety name	Fruit length (cm)			Weight of the sponge (g)	Seed no./fruit	Seed weight/fruit (g)
	green	dried	sponge			
L.acutangula	119	98	93	41.7	534	64.1
L. cylindrica	56	47	44	26.3	312	37.4
Luffa CxA[1]	65	56	53	28.9	428	51.4
L1	91	82	77	57.8	444	53.3
L2	73	65	61	36.4	462	55.4
L3	63	52	58	22.2	512	61.5
L4	49	40	37	33.8	335	40.2
L5	48	36	32	5.5	279	33.5
L6	59	50	46	38.8	320	38.4

[1]*Luffa C x A– Luffa cylindrica* X *Luffa acutangula*

Figure 7. Seedlings

Planting in protected areas is carried out around April 1, while plantings in the field are made after 1 May. Seedling age should be 55-60 days. Where the establishment of culture is made by direct sowing, sowing in unheated protected areas is carried out after March 20 while in the field after April 20. (Fig.8).

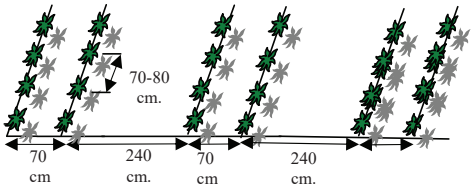

Figure 8. Crop on unshaped terrain establishment plan for protected areas

The species supports several technological variants. It can be established in equidistant rows or strips. It was found that the best results were obtained when the culture was established in strips - 70 cm between rows and 240 cm between bands and between plants on the row 70-80 cm depending on the vigor of cultivar.

After the stabilization and the achievement of the two varieties of *L. cylindrica* and *L. acutangula,* the researches continued with the hybrid combination execution between the selected genotypes, aiming to obtain valuable hybrid creations and the enrichment of thr autochthonous genetic heritage.

Although the research conducted worldwide indicate that the crossing between the species *L. cylindrica* and *L. acutangula* presents sterility in descendents, the hybrid combination achieved at V.R.D.S. Buzău had demonstrated compatibility and manifested a visible phenomenon of heterosis in F1, obtaining a hybrid with intermediate morphological features between the two species, a high yield production and a combined use destination. Young fruits can be used in nutrition and the mature ones are used as a vegetable sponge (Fig. 9).

L. cylindrica ♀ x *L. acutangula* ♂

↓

Hibrid F1

Figure 9. The hybridization plan

The research continued with the segregation of the hybrid made from the crossing of the two different species of *Luffa*. In F2 resulted 6 new genotypes with distinct features and numerous intermediate forms that have been removed in the process of breeding.

After intensive breeding works, these new genotypes were carefully selected and genetically stabilized in order to promote them in subsequent crops.

In what concerns the characteristics of the fruit in the green stage and as a sponger, the measurements showed significant differences between the studied genotypes (table 2).
Analyzing the fruit surface, G4 emphasized with the appearance of the protruding ribs on a smooth surface, unlike most genotypes that have exhibited a slightly rough and ribbed surface (Fig. 10).
Regarding the receptacle, the biggest diameter but also the greatest length was recorded by *L. acutangula,* having respectively 3,2 and 4,8 cm. Also the sponge color differs, having shades ranging from white, greenish white, yellowish and slightly brown.
In terms of sponge density, the genotypes with a small and medium density and by default a rare network are for fresh consumption, while those with high density cellulose fiber, and are intended for use as a vegetable sponge.

Figure 10. Types of surfaces and fibers of the fruit

A dominant character was the black colour of the seeds which was transmitted in lineage for most of the genotypes, an exception being made only by *L. cylindrica* that has white seeds (Fig. 11).

Figure 11. Black and white seeds

Observations were made regarding the fruit diameter in three stages: unripe, dried and as a sponge; the significant differences between the three stages were mainly due to dehydration of the fruit. (fig. 12).

Figure 12. Dehydrated fruits and cellulose fiber sponge

Table 2. Fruit characteristics

Variety name	Exterior color of the fruit	Fruit surface		Floral receptacle		Sponge colour	Sponge density	Seed colour
				Diameter (cm)	Length (cm)			
Luffa acutangula	Green	ribbed	Rough	3.2	4.8	Yellowish	Low	Black
Luffa cylindrica	Green	Slightly ribbed	Smooth	2.1	3.7	White	High	White
Luffa CxA	Green	Slightly ribbed	Slightly rough	2.7	4.1	Slightly brown	High	Black
G1	Green	Slightly ribbed	Rough	1.1	3.1	Slightly brown	Medium	Black
G 2	Green	Ribbed	Slightly rough	1.1	2.2	Greenish-white	High	Black
G 3	Light green	Ribbed	Smooth	1.4	4.1	Yellowish	High	Black
G 4	Light green	Heavily ribbed	Smooth	1.8	3.5	White	Low	Black
G 5	Light green	Ribbed	Smooth	0.8	2.8	White	Low	Black
G 6	Light green	Slightly ribbed	Slightly rough	2.5	4.2	Greenish-white	High	Black

Thereby, the upper part of the unripe fruit, the point of grip of the fruit from the stalk, has registered the largest diameter in the case of G2 with 6.6 cm reaching the stage of sponge to 5.1 cm. The greatest difference between the unripe fruit base diameter and the base diameter of sponge was recorded by G1 and G3, with a decreasing diameter of 1.7 cm from one stage to another.

In terms of the middle part of the fruit, the highest diameter value was registered at G2 with 9.9 cm for the unripe fruit and at the opposite boundary is G1 with 5.9 cm as a sponge. Regarding the apex diameter, it was found that G2 registered a maximal value of 11.5 cm as an unripe fruit and a minimal value of 6.7 cm as a dried pepo (Table no. 3).

Table 3. Unripe, dried and sponge fruit diameter

Variety name	Base (cm)			Middle (cm)			Apex (cm)		
	Unripe	Dried	Sponge	Unripe	Dried	Sponge	Unripe	Dried	Sponge
Luffa acutangula	6.1	5.5	4.9	8.9	8.4	7.8	10.8	10.2	8.7
Luffa cylindrica	5.5	4.6	4.0	8.3	7.8	7.1	8.9	8.3	7.6
Luffa CxA	6.3	5.6	4.7	9.5	8.9	8.4	10.9	10.1	9.3
G 1	5.6	4.7	3.9	7.1	6.6	5.9	9.4	8.6	7.9
G 2	6.6	5.8	5.1	9.9	9.6	8.8	11.5	10.8	10.1
G 3	5.6	4.5	3.9	8.9	8.2	7.7	9.7	8.9	8.3
G 4	5.3	4.5	4.0	9.6	9.0	8.4	10.4	9.5	8.9
G 5	3.7	2.8	2.2	7.8	7.0	6.5	7.5	6.7	6.8
G 6	6.3	5.4	4.8	9.0	8.5	7.8	11.1	10.4	9.8

CONCLUSIONS

At the present, researches finalised with the achievement of a solid germplasm collection both for *L. cylindrica* and *L. acutangula*.

For *L. acutangula*, we managed its acclimation, breeding and drafting of the crop technology.

Two new varieties were achieved with distinct destination use, *L. cylindrica* as a vegetable sponge and *L. acutangula* for fresh consumption.

A new hybrid was obtained from *L. cylindrica* X *L. acutangula* crossing, a hybrid that manifests the heterosis phenomenon with a high yield production, strength, genetic resistance at the main pathogens and a mixed use destination. The unripe fruits can be used in nutrition just like zucchini, and when they mature can be used as vegetable sponges because of the high density fibre, volume and their large water retention capacity.

After the achieved hybrid segregated, six new distinct genotypes were obtained, three of which can be used for producing vegetable sponges and three are for fresh consumption.

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