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TRICHOSANTHES CUCUMERINA L. A NEW SPECIES ACCLIMATIZED AND BRED IN ROMANIA

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Abstract

Vegetable Research Development Station Buzau is known as an important research centre for acclimatizing and breeding vegetables in Romania. The climate is changing due to numerous factors and is crucial to adapt new species in different areas in order to explore the wonderful world of plants. Trichosanthes cucumerina L. also known as snake gourd and long tomato is grown for consumption and also for various medicinal uses, but some other aspects are still unexplored. Snake guard is studied at VRDS Buzau from 2010 and is a monoecious annual herb climbing with over 5-6 meters high. The plant is vigorous, with many (12-16) slender stems. The male flowers are arranged in raceme and the female are solitary. The fruits are long, over 2 m, at physiologically maturity, but usually for fresh consumption the fruits are harvested at 50-100 cm long. The fruits can be consumed when immature, as it gets a bitter taste with age. The studies have completed so far with patenting of a new cultivar according DUS test, suitable for growing in greenhouse and field, conventional and organic farming.

Key words*: breeding, Cucurbitaceae, phenotype, snake gourd.*

INTRODUCTION

The climate is changing due to numerous factors and is crucial to adapt new species in different areas in order to explore and value the wonderful world of plants. Acclimation involves physiological, anatomical, or morphological adjustments within a single organism that improve performance or survival in response to environmental change (Demmig-Adams et al., 2008). During acclimation the environment has a strong influence on the phenotype of a plant. This phenomenon is defined as phenotype plasticity and plays a key role in plant acclimatization processes. Phenotype plasticity has an enormous importance for plants, since they are sessile organism and cannot escape from unfavourable environmental conditions (Lucini et al., 2020). As a response to acclimation process, new genotypes may appear. For over 60 years, Vegetable Research Development Station (VRDS) Buzau is an important research centre for acclimation and breeding vegetable species in Romania. From year 2010, *Trichosanthes cucumerina* (L.) is studied by the Laboratory of Breeding and Biodiversity from VRDS Buzau. *T. cucumerina* also known as snake gourd, long tomato, snake tomato or viper gourd belongs to *Cucurbitaceae* family. *Trichosanthes* is one of the major genera under this family with 100 species. Only two species *T. anguina* and *T. cucumerina* are monoecious while others are dioecious (Swarup, 2012). Snake gourd has the centre of origin in India or in Indian Archipelago, but the *Trichosanthes* genus is native to Southern and Eastern Asia, Australia and Islands of the western Pacific. *T. cucumerina* can be found wild throughout these areas. The plant is grown as a minor vegetable in many countries of tropical Asia. Recently has been introduced as a new crop of increasing importance in several parts of Africa, including Ghana and Nigeria (Khare, 2007). The fruit is usually consumed as vegetable due to its good nutritional value. The plant has rich content in chemical constituents as flavonoids, carotenoid, phenolic acids which makes the plant pharmacologically and therapeutically active (Busuioc et al., 2020). Scientific studies have shown that is has anti-inflammatory effects (Kolte et al., 1997), antibacterial activity (Redy et al., 2010), anti-dandruff activity (Vishal and Prasahant, 2014), anti-diabetic activity (Arawwawala et al., 2009a; 2009b; Kirana and Srinivasan, 2008; Dias and Imai, 2017), anti-

fertility activity (Devendra et al., 2009), antioxidant properties (Stellus and Nair, 2005; Ademosun et al., 2013), cytotoxic activity (Kongtun et al., 1999), gastro protective activity (Shweta et al., 2012), hypoglycaemic activity (Kar et al., 2003), hepatoprotective activity (Sathesh et al., 2009) and larvicidal efficacy (Rahuman and Venkatesan, 2008). In order to enrich the vegetable assortment and also adapt new species in Romania, the Breeding Laboratory from VRDS Buzau has started an acclimation process with *T. cucumerina*. The results of this work are presented in this article.

MATERIALS AND METHODS

From year 2010, the Breeding and Biodiversity Laboratory from VRDS Buzau has taken into seven genotypes of *T. cucumerina*. Following their evaluation, a single valuable genotype was chosen, in order to facilitate the breeding and acclimatization process and also to prevent the impurity of the genotypes by cross-polination, knowing that the species is, by excellence, allogamous. Throughout the vegetation period, biometric and phenological observations were made with an emphasis on the main characters of the plants. The descriptors used were the one from IPGRI guidelines. Morpho-agronomical descriptors used were: growth habit, plant height (PH), tendrils presence, colour of leaves, leaf margin, length (LL) and width (LW) of leaves, petiole length (PeL), dorsal leaf pubescence, number of secondary shoots (NSS), stem thickness (ST), flower colour, male female flower ratio, flower diameter (FD), peduncle shape, peduncle length (LP), peduncle separation from fruit, blossom end fruit shape, stem-end fruit shape, fruit shape, fruit length (FL), fruit diameter (FrD), fruit ribs, fruit colour, fruit skin texture, flesh colour, number of fruits per plant (NFP), seed colour and surface. The qualitative characters were noted based on visual evaluation while the quantitative traits were counted, measured using metric rulers, caliper and weighed using weighing balance. For quantitative traits, Pearson correlation coefficient was calculated. Means comparison was performed by Duncan test. The period analysed in this study was 2010-2020. Regarding crop management, the planting scheme used was 150 cm between rows and 60-75 cm between plants in a row. The snake gourd is a climbing vine and needs support in order to fully develop. Throughout all the studied years, no serious pathogens were reported who could damage the crop.

RESULTS AND DISCUSSIONS

Trichosanthes cucumerina is a monoecious annual herb climbing with growth of over 5 meters high. The plant is vigorous, with many (12-16) slender stems and tendrils. The leaves are green, simple, alternate and without stipules. The leaf margin is smooth and the degree of pubescence is low on the dorsal leaf. The leaves have 3-5 lobes (Figure 1) with a length varying from 17.5 cm to 34.2 cm and the width also range from 19.3 cm to 23.4 cm. The petiole length varies from 6.4 cm to 17.6 cm.

Figure 1. Types of leaves

The stem thickness was measured as diameter of the main stem from 10^{th}-15^{th} nodes at the time of 20^{th} expanding and it was 7.56 mm. The stems and leaves have a pungent, unpleasant smell, a plant repellent for a number of pests. Being a monoecious plant the flowers are unisexual, regular, white coloured with green and hairy calyx. Corolla is tubular in white lobes fringed and hair like outgrowths. The ratio male and female flower was medium. The flower diameter has an average 4.46 cm. The male flowers are arranged in raceme and the female are solitary. The flowers are open in the afternoon and early in the morning. Pollination is performed by insects, bees, wasp, ants, butterflies and various moths.

If may I say not even the most skilful hands could crochet such a beautiful flower (Figure 2).

Figure 2. Male flower of *T .cucumerina*

Peduncle shape has a sharply angle. The peduncle length varies from 2.1-2.6 cm. Peduncle separation from the fruit is easy. The blossom end fruit and stem end fruit is pointed.
The fruit has an elongate slim shape. The fruit is straight and slightly twisted towards the top, like a snake's tail. If they are not directed properly, they take various forms, depending on the growing environment (Figure 3).

Figure 3. Different fruit shapes and maturity stage of fruit

The fruits are long, which can exceed 2 meters at physiological maturity, but usually are harvested when measure 50-100 cm to be consumed in various culinary preparations; it can replace successfully zucchini. The fruit can be consumed when immature, as it gets a bitter taste with age and inside the fruit it creates an empty interior (Figure 4).
The fruit ribs are intermediate and the colour of fruit is green with dark green stripes when young and dark-red at maturity.

Figure 4. Fruit with seeds

The fruit skin texture is shallowly wavy and the flesh colour cream. The number of fruit per plant is varying from 16-22, but if harvested at the consumption stage, their number increases significantly. If the fruits are harvest when young the yield is around 8-10 t/ha, but the yield may increase to 30 t/ha, if the fruits are harvested when they weight around 1 kg. The seed colour changes from white, grey when immature to brown when mature (Figure 5). In Figure 6 is presented a macro exposure of the seed. It can be noted that the seed surface is slightly wrinkled.

Figure 5. Macro exposure of seed

Regarding plant phenology it was noted, that snake gourd has a long vegetation period over 170 days. The male flowers appear, in general, 30 days after planting. The female flowers bear miniature fruit and appear later, after 40-45 days. The fruit reach physiological maturity after 100 days. The young fruits can be consumed approximately two weeks after fruit setting process.

Table 1. Correlation matrix of the main traits

Traits	LL	ST	PeL	LP	LW	FL	PH	NFP	FrD	FD	NSS
LL	**1**										
ST	**0.987**	**1**									
PeL	0.675	0.786	**1**								
LP	-0.118	-0.277	**-0.812**	**1**							
LW	0.098	0.258	**0.801**	**-0.998**	**1**						
FL	-0.303	-0.145	0.499	**-0.911**	**0.919**	**1**					
PH	-0.373	-0.217	0.434	**-0.878**	**0.887**	**0.997**	**1**				
NFP	-0.395	-0.240	0.412	**-0.866**	**0.876**	**0.995**	**0.998**	**1**			
FrD	0.702	0.577	-0.052	0.625	-0.640	**-0.892**	**-0.923**	**-0.932**	**1**		
FD	**0.852**	0.756	0.189	0.419	-0.437	-0.757	**-0.803**	**-0.817**	**0.971**	**1**	
NSS	**-0.852**	-0.756	-0.189	-0.419	0.437	0.757	**0.803**	**0.817**	**-0.971**	**-0.998**	**1**

Values in bold are significant at $p \leq 0.05$, according to Duncan test.

A correlation matrix of the main characters was made in order to establish significant correlations between traits (Table 1).

The significant positive correlation between number of fruits per plant, fruit length and plant height indicates that these traits are efficient in yield determination. The plant height and number of fruits per plant are a complex of desirable traits inherited in a quantitative fashion (Yuan et al., 2002; Manickavelu et al., 2006; Derera et al., 2007; Kassem et al., 2007; Jacobson et al., 2007; Alcivar et al., 2007). In this study it was shown that plant height is significant positive correlated with number of secondary shoots and number of fruits per plant, but negatively correlated with fruit diameter and flower diameter.

Peduncle length is strongly negatively correlated with leaf width, fruit length, plant height and number of fruits per plant. Other studies, on different crops, report a strong negative correlation between peduncle length and number of fruits per plant. The path analysis indicates that peduncle length had the highest direct effect on yield (Khan et al., 2010). Farooq et al. (2018) suggests that strong association of peduncle length with other yield contributing traits may be utilized as an indirect selection criterion for yield improvement.

During the vegetation period, the plant characteristics were measured and synthetic indicators of variation are presented in Table 2. In terms of yield (number of fruit per plant, fruit length and diameter) the coefficient of variation has a value below 35% which represents a stable characteristic, but the petiole length has the coefficient of variation over 35% meaning a high variation between this traits.

Table 2. Mean values of plant characteristics

Quantitative descriptors	Unit	Value ± standard deviation	CV%
Plant height	m	5.36 ± 0.66	12.40
Leaf length	cm	24.03 ± 8.92	37.12
Leaf width	cm	21.66 ± 2.12	9.79
Petiole length	cm	12.46 ± 5.65	45.38
Number of secondary shoots	pcs	14.33 ± 1.52	10.65
Stem thickness	mm	0.73 ± 0.05	7.87
Flower diameter	cm	4.46 ± 0.15	3.41
Peduncle length	cm	2.36 ± 0.21	8.79
Fruit length	cm	114.81 ± 8.38	7.30
Fruit diameter	cm	5.53 ± 0.55	9.95
Number of fruits/plant	pcs	19.2 ± 3.61	18.97

Fruit weight varies from 200 g to 1500 g. Young fruits can be kept in a room with high humidity and temperature of 15°C for 10-14 days (Vînătoru et al., 2019).

CONCLUSIONS

T. cucumerina has met favourable conditions for growing and fruit development in Romania, in field and greenhouse conditions, and it can be recommended to be cultivated in all areas favourable for cucurbit species in the country.

The studies have been completed so far with patenting of a new cultivar that can be successfully cultivated in protected areas and in the field, in a trellis system. The new cultivar will be registered in the Official Catalogue of Romanian Crop Plants. The seeds will be available to the sold from year 2022.

Because during years of study it was not noted any dangerous pathogens that could harm the crop, we recommend to be grown in both conventional and ecological systems.

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