

FRUITS VARIABILITY OF *Hibiscus trionum* L. WEED

Nicolae IONESCU¹, Mihaela Ioana GEORGESCU², Elena SĂVULESCU²,
Aurelian PENESCU², Alexandru LAZĂR¹

¹Agricultural Research and Development Station Pitești, Pitești-Slatina Road No. 5, 117030,
Pitești, România

²University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd.,
011464, Bucharest, România

Corresponding author email: nicolaeionescu50@gmail.com

Abstract

The plant fruit system consists of bi-layered calyx, capsule 5-partitioned, with hairs and a lot of seeds. From determinations resulted in a 10-11 extern bracteoles and intern calyx of 16 mm height and 12 mm width. The capsule weighted 160 mg, had a length of 10 mm, width of 7 mm, and the hairs were 2.5 mm in length. One capsule were formed 26 seeds, which had an average weight of 91 mg, a length of 1.9 mm, width 1.6 mm, and the TSW 3.5 g. Between different characters have been established all correlations. Among the negatives were noted between the number of seeds from a capsule with: seed dimensions ($r = -0.266^{00}$ for length, $r = -0.373^{000}$ for width, and thousand seeds weight (TSW) ($r = -0.362^{000}$). Positive correlations were evident between calyx width with capsule weight ($r = 0.285^*$) and between seed dimensions with TSW ($r = 0.253^{**}$ for length, $r = 0.235^{***}$ for width). Overall plant proved enough large variability that demonstrate high ability to adapt and compete in the agricultural field.

Key words: *Hibiscus trionum*, calyx, capsule, seeds, variability.

INTRODUCTION

Weeds in agricultural fields meet a new stage in their evolution (Teo-Sherrell et al., 1996). Given the reduction of chemical control, there is a readjustment to their new conditions. New measures of control is recommended large for morphological variability studies. The higher their expression, plant is better suited (Chirilă et al., 1986). From a practical standpoint, for effective control investigations are necessary a new complex of investigations. A weed known in agricultural fields is *Hibiscus trionum* L. [pro syn. *Hibiscus dissectus* Wall., *Hibiscus versicarius* Cav., *Ketonia trionum* (L.) Scop., *Trionum annuum* Medik., bladder hibiscus, bladder ketmia, flower-of-an-hour, modesty, puarangi, rosemallow, shoofly, venice mallow, HIBTR code Bayer]. *H. trionum* is Asia, Africa

and Australia (Craven et al., 2011). In the US was introduced as an ornamental plant (Chandler et al., 1974). We can meet over flower gardens in Eastern Europe. It is an annual summer plant with medium to small port, and from the armpit of leaves develop stems with flowers. Flowering occurs in mid-summer to early autumn about 1-2 months. Flowering lasts one day in sunny and remains open for a few hours (Figure 1). During anthesis style and stigma are erect and receptive to receive pollen from other plants. In the absence of pollen, self-pollination occurs. Since the out-crossing seems to be preferable to self-pollination, it could contribute to a greater success of the plant in other walks of life. *H. trionum* containing 28 chromosomes in diploid form. Rarely met tetraploid and very rare hexaploid plants (Murray et al., 2008).



Figure 1. *H. trionum*, flower-of-an-hour



Figure 2. *H. trionum* fruit characteristics

The fruit which they form have a short branch. Each fruit is based on a thin circle there are several spreading bracts that are slender. Follow sepals that make up the calyx, of pale green, membranous, translucent, net-nerve, hirsute and spikes, overgrown around the cup. The capsule of 15 to 20 mm in length, is ovoid in shape, black, with a plurality of simple bristles spread out- Figure 2.

At maturity capsule opens in 5-valve and releases lots of seeds (Westra et al., 1996). Seeds are rough, dull brown or grey, in kidney or heart- shape.

The seed medium size is 2-3 mm. By performing measurements in different conditions of vegetation, it might bring some new elements to describe this species of weed. In this study it was analyzed on a mature plant, the number of spreading bracts, height and width of calyx, weight of coated calyx capsule. The capsules were measured as length, width and length hairs.

Seeds were determined by total number from a capsule, seeds weight, seed length, seed width, and absolute seed weight - thousand seeds weight (TSW).

MATERIALS AND METHODS

Measurements were performed in the third decade of august, past two years. Plants were chosen for several spring crops like maize, sunflower and soybean.

The areas were located in the resort region. From 100 *H. trionum* plants was harvested mature capsules, one piece per plant, which is then brought to the laboratory.

Of 100 capsules were measured: the number of bracts, the height and width of the calyx, capsule weight, capsule length and width, the length of the hairs.

It was determined the number of grains per capsule, the weight thereof, the length and width of the seeds, TSW.

These characters which are expressed variability, was using the histograms method (or frequency polygon, FP%). In this method they were used either as such absolute values or

as the class intervals. Study has highlighted several aspect and namely:

- i) modal amounts (largest frequency),
- ii) limits of the ranges of variability of the characters studied,
- iii) the specifics of each character of the ecotype of weed (Craven et al, 2011) in analyzed area.

Among all 12 characters were analyzed correlations and regressions fixed in equation. These correlations could express some trends in the studied ecotype.

The expression values was used Excel. Another method was the statistical calculation of all values obtained.

It used analysis of variance (ANOVA), for the ranges of variation.

Statistical parameters were calculated using the formula:

$$\bar{a} = \frac{\sum x}{n},$$

where \bar{a} = mean of determinations,

x = determinated values,

$$S^2 \text{ (variance)} = \frac{1}{n-1} \left[\sum x^2 - \frac{(\sum x)^2}{n} \right],$$

$$S \text{ (standard error)} = \sqrt{S^2},$$

$$S \% \text{ (variation coefficient)} = \frac{S}{\bar{a}} 100.$$

Finally it was developed a summary of the data on the study of variability of fruit *H. trionum* characters obtained by determinations.

RESULTS AND DISCUSSIONS

H. trionum variability of fruit characters.

The plant forms o lot of fruits with a specific configuration (*Malvaceae* fam.).

The first segment of the fruit is the bracts circle at the base. Still, the number of 8-10 pieces are elongated, thin, hairy, greenish.

From measurements showed that their number was slightly larg - Figure 3.

The variability of this character was between 7 and 12 tracks.

Modal value was 11 pieces (39%), followed by capitula with 10 pieces (33%). Bracts with few pieces – 7-8, were 1% and 2% respectively.

Capsula with 12 bracts constituted 19%.

The aspect of bracts is characteristic at the fruit base- Figure 4.

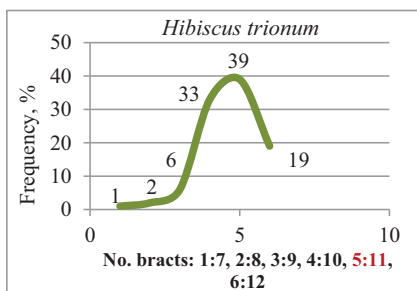


Figure 3. Frequency of papery sepals no. From external calyx



Figure 4. Capsule with specific calyx

Calyx of *H. trionum* fruit has heights between 12 and 19 mm. Greater frequency was 17 mm (29%). This was followed by the 16 mm (24%) and 15 mm (23%). Capsula with short calyx- 12 mm, constituted only 2% (Figure 5). Calyx

width variability was between 7 and 15 mm. The modal value was 12 mm (35%), followed by the 13 mm (27%). Capsula with small values of calyx- 7-9 mm, constituted 1-2% of total (Figure 6).

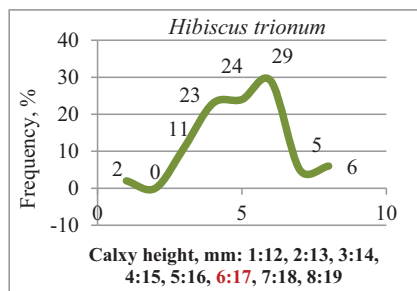


Figure 5. Frequency of calyx height

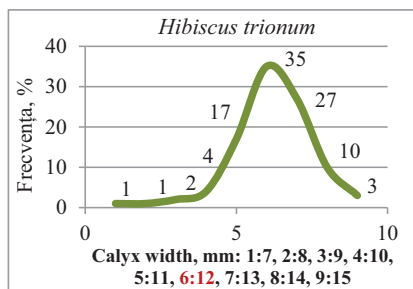


Figure 6. Frequency of calyx width

The weight of an capsule dressed in calyx with bracts at the base, fluctuated between 70 and 250 mg. Greater frequency of those had 170-200 mg (40%) (Figure 7). Near them were 130-160 mg of capsule (38%). Weights were lowest

for capsule with 50-80 mg (2%) and those with over 240 mg (2%). The capsule complex of weed consists in ring of basic bracts, the calyx, and capsules that are a multitude of spreading hairs (Figure 8).

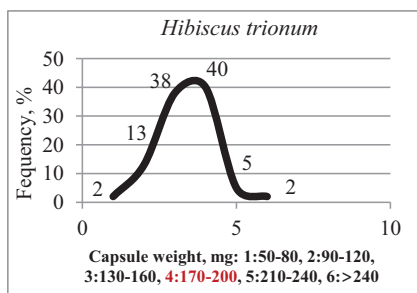


Figure 7. Frequency of capsule weight



Figure 8. Capsular complex of *H. trionum* weed

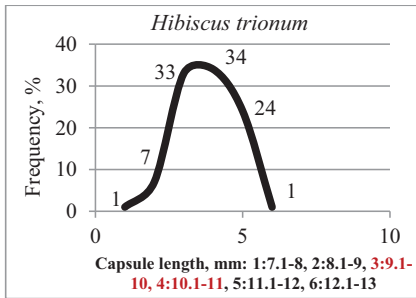


Figure 9. Frequency of capsule length

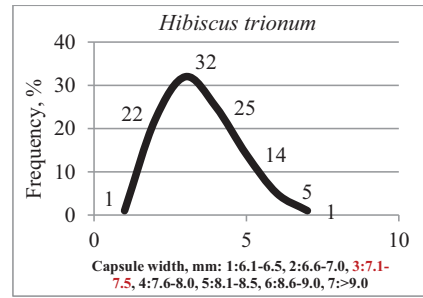


Figure 10. Frequency of capsule width

Capsula shape is cylindrical, rounded at the top, consisting of the 5 valves combined one with each other. The length of the capsula showed values ranging from 7.1 to 13 mm (Figure 9). The highest frequencies they have the capsula between 10-11 mm (34%) and from 9.1-10 mm (33%). The long capsula have been followed by those with 11.1-12 mm (24%). The shortest and the longest capsula have each 1% variability.

The capsula measured in the middle part, had a thickness ranging from 6.1 to 9.0 mm (Figure 10). They dominated capsula with 7.1-7.5 mm wide (32%). They followed those with 7.6-8.0 mm (25%) and 6.6-7.0 mm (22%). The narrowest capsula and the widest ones have 1% by the total.

Hairs of weed capsula demonstrated various lengths. Their size ranged between 1.7 and 3.5 mm (Figure 11). The highest frequency had a brush with 2.3-2.5 mm (27%), followed by the 2.0-2.2 mm and 2.6-2.8 mm, each with 22%. Hairs distribution is relatively uniform on the surface of the capsula and in a big number (Figure 12).

In a capsula of *H. trionum* on forms a large number of seeds. At maturity the 5 rags unfold, and they are released in the agricultural environment. The analysis showed that the total number of seeds per capsula was between 10 and 41 pieces (Figure 13). The seed lot of capsula was between 21-25 (28%) and 26-30

(28%), followed equally by the 16-20 (14%) and 31-35 (14%). Capsula with fewest and the most seeds (10 and 41 pieces) have only 2% each. These grains contained by the capsulae weighted between 20 and 140 mg- Figure 14. The highest frequency of seeds had a total weight of 80-100 mg (45%). There is a direct link between the two determinations (no. of seeds and its weight).

The plant produces specific seeds, kidney or heart-shaped - Figure 18. The dimensions of the *H. trionum* seeds have lengths generally about 2.0 mm, or between 2 and 3 mm. From determinations revealed that they had lengths between 1.7 and 2.1 mm (Figure 15). The highest frequency had seeds of 2.0 mm length (44%), followed by the 1.9 mm (30%). Other lengths together accounted for only 26%.

Width in the middle portion of seed somewhat lower values, which are between 1.2 and 1.9 mm (Figure 16). Modal value was 1.6 mm (32%). The lowest values were 1%, and the highest, 3%.

The absolute weight of seeds expressed by the thousand seed weight (TSW) showed values between 1.1 and 6.0 g (Figure 17). With these values is considered that the seeds of this plant are rarely small and light. The modal value was 3.1-4.0 g (46%), followed by those with 2.1-3.0 g (24%) and those with 4.5-5 g (19%). Smaller and higher values were together 11%.

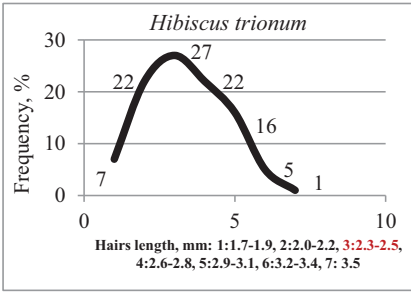


Figure 11. Frequency of hairs length



Figure 12. Mature capsules with specific hairs

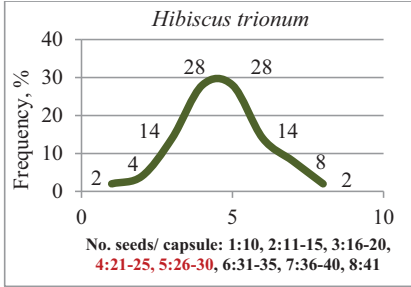


Figure 13. Frequency of seeds no. from one capsule.

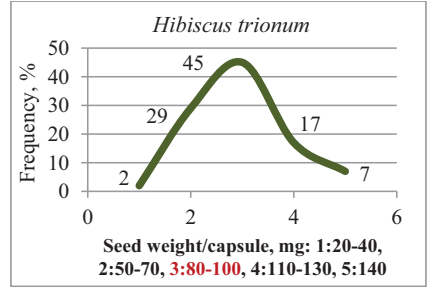


Figure 14. Frequency of seeds weight/capsule

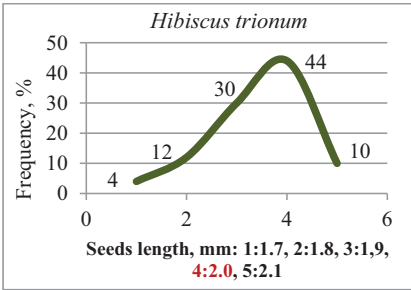


Figure 15. Frequency of seeds length

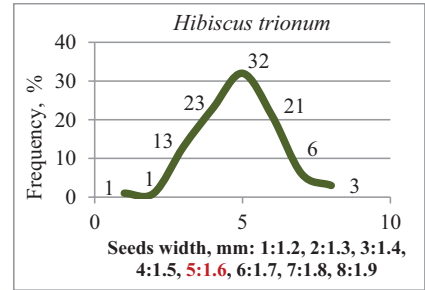


Figure 16. Frequency of seeds width

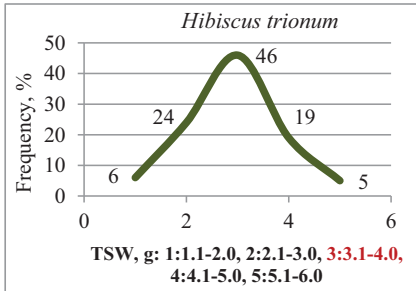


Figure 17. Frequency of thousand seeds weight, TSW



Figure 18. *H. trionum* seeds aspect

Correlations between different characters analyzed. The fruits have shown quite different causal link between the observed characters (Table 1). Among these stand out the negative correlation between the number of seed from a capsule and capsule dimensions ($r = -0.266^{00}$ length, $r = -0.373^{000}$ width) and with TSW

($r = -0.362^{000}$), which shows that when the plant produces bigger and heavier seeds, their number is smaller. The layout is positive to the higher spread and adaptability into the crops. Among the positive linkages, the width of the capsule and total weight of capsule ($r = 0.285^{**}$).

Table 1. Correlations between different fruits characters of *H. trionum* weed

Character	No. bracts	Calyx height	Calyx width	Capsule weight	Capsule length	Capsule width	Hair length	No.seeds/capsule	Seeds weight	Seed length	Seed width	TSW
No. bracts	1	-0.041	0.133*	-0.125	0.209*	0.189	-0.104	0.071	0.056	0.020	-0.055	0.028
Calyx height		1	0.425***	0.241*	0.240*	0.178	0.162	-0.020	0.156	0.126	0.145	0.252**
Calyx width			1	0.285**	0.107	0.304**	0.105	0.035	0.197*	0.276**	0.245*	0.224*
Caps. weight				1	0.281*	0.483***	0.186	0.535***	0.674***	0.185	-0.082	0.228*
Caps. length					1	0.286**	0.141	0.248*	0.064	0.095	-0.095	-0.074
Caps. width						1	-0.010	0.315**	0.405***	0.143	0.066	0.142
Hair length							1	0.094	0.042	-0.041	-0.026	0.030
No.seeds/ caps								1	0.513***	-0.266 ⁰⁰	-0.373 ⁰⁰⁰	-0.362 ⁰⁰⁰
Seed weight									1	0.010	-0.064	0.566***
Seed length										1	0.471***	0.253**
Seed width											1	0.235*
TSW												1

LSD 5 % = 0.19 LSD 1 % = 0.25 LSD 0.1 % = 0.32

Statistical analysis of the weed fruits variability.

The values obtained were characteristic. Thus the number of bracts at the bottom of the capsule was 10.6 pieces, the calyx has a height of 16 mm and a width of 12 mm. The capsule

weighed 160.8 mg. It has length of 10 mm, a width of 7.6 mm and 2.5 mm hairs long. A capsule produced an average of 26 seeds, which weighed 91 mg. The seeds have a length of 1.9 mm, width of 1.6 mm and 3.5 thousand seeds weight (Table 2).

Table 2. Statistical indices of *H. trionum* fruits

Indices*	Calyx			Capsule				Seeds				
	Bracts no.	Length mm	Width mm	Weight g	Length mm	Width mm	Hair length	Capsule no.	Weight mg	Length mm	Width mm	TSW g
\bar{a}	10.64	16.00	12.16	160.8	10.36	7.561	2.495	26.13	90.9	1.942	1.586	3.515
s^2	0.980	2.422	1.853	0.001	0.831	0.450	0.155	45.02	0.001	0.016	0.017	1.099
s	0.990	1.556	1.361	0.034	0.911	0.671	0.394	6.710	0.024	0.128	0.130	1.048
Cv%	9.30	9.73	11.19	21.39	8.79	8.87	15.77	25.68	2.64	6.58	8.19	29.82

* \bar{a} -media, s^2 -variance, s-standard error, Cv-variation coefficient

CONCLUSIONS

A widespread species that cause significant damage in field crops is *Hibiscus trionum* L. weed. Existing type in these areas in the south is well adapted to the specific biology. To a control through its management's good to know as many morphological characters. Currently it has been found that species expressing a wider variability could contribute to finding the most appropriate methods of

control. Morphological variability, especially reproductive, being less known, may express cross-type existing in these conditions (Table 3). Thus, the fruit was based on several large bracts and bigger calyx. The capsule had somewhat smaller dimensions, with 2.5 mm hairs. The seed of capsule were several and weighted about 1/2 of the capsule. The seed dimensions were smaller also. The mass of a thousand seeds (TSW) was relatively low.

Table 3. Values of fruit characters variability, *H. trionum* weed

	Character	Literature	Research
Calyx	Bracts no.	8 - 11	7 - 12
	Length, mm	-	12 - 19
	Width, mm	-	7 - 15
Capsule	Weight, mg	-	70- 250
	Length, mm	15 - 20	7.8 – 12.9
	Width, mm	-	6.4 – 9.2
	Hair length, mm	-	1.7 – 3.5
Seeds	No./ capsule	-	10 - 41
	Weight, mg	-	20- 140
	Length, mm	2.0 – 3.0	1.7 – 2.1
	Width, mm	-	1.2 – 1.9
	TSW, g	-	1.28-5.88

REFERENCES

- Chandler J.M., Dale J.E., 1974. Comparative growth of four malvaceous species. Proceedings of the 27th Annual Meeting of the Southern Weed Science Society: 116-117.
- Chirila C., Pintilie C., 1986. Buruienile din culturile agricole și combaterea lor. (XXIV). *Hibiscus trionum* L. Productia Vegetala, Cereale și Plante Tehnice, 38(1):25-27.
- Craven L.A., de Lange P.J., Lally T.R., Murray B.G., Johnson S.B., 2011. The indigenous Australasian bladder ketmia species (*Hibiscus trionum* complex, *Malvaceae*). New Zealand Journal of Botany 49: 27-40.
- Murray B.G., Craven L.A., de Lange P.J., 2008. New observations on chromosome number variation in *Hibiscus trionum* s.l. (*Malvaceae*) and their implications for systematics and conservation. New Zealand Journal of Botany, 46: 315- 319.
- Teo-Sherrell C.P.A., Mortensen D.A., Keaton M.E., 1996. Fates of weed seeds in soil: a seeded core method of study. Journal of Applied Ecology, 33(5):1107-1113.
- Westra P., Pearson C.H., Ristau R., Schweissing F., 1996. Venice mallow (*Hibiscus trionum*) seed production and persistence in soil in Colorado. Weed Technology, 10(1): 22-28.