SOME BIOLOGICAL FEATURES OF VIRGINIA MALLOW, *SIDA HERMAPHRODITA,* AND PROSPECTS OF ITS USE IN THE REPUBLIC OF MOLDOVA

Cîrlig N., Guţu Ana, Ţîţei V., Gadibadi M., Doroftei v., Ababii A., Daraduda N.
«Alexandru Ciubotaru» National Botanical Garden (Institute),
Chişinău, Republic of Moldova
e-mail: nataliacirlig86@gmail.com

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The family *Malvaceae* Juss. includes about 85 genera with about 1600 species, occurring naturally in tropical and subtropical regions. In Bessarabia, there are 7 genera with 14 species of this family. The genus *Sida* L. includes about 150 species, of which, 2 species occurring in ruderal areas, sporadically, in the centre of the territory of the of the Republic of Moldova: *S. hermaphrodita* (L.) Rusby and *Sida spinosa* L. (Flora Basarabiei, 2020). *S. hermaphrodita*. is a promising species, with multiple utility. It is a perennial, herbaceous plant, known by the common names Virginia mallow, Pennsylvania mallow, River mallow, Virginia fanpetals. Recently, an increasing number of researchers that have studied and mentioned high potential as an ecologically valuable raw material for fodder, fibre, energy production, honey productivity is 120 kg/ha (Bilandžija et al., 2018; Borkowska, 2006; Cumplido-Marin et al., 2020; Ţîţei, 2015).

The goal of our research was to study the growth and development features of the species Virginia mallow, *Sida hermaphrodita*, to determine the phenological stages and to evaluate the quality of the biomass, as feedstock for the production cellulosic ethanol.

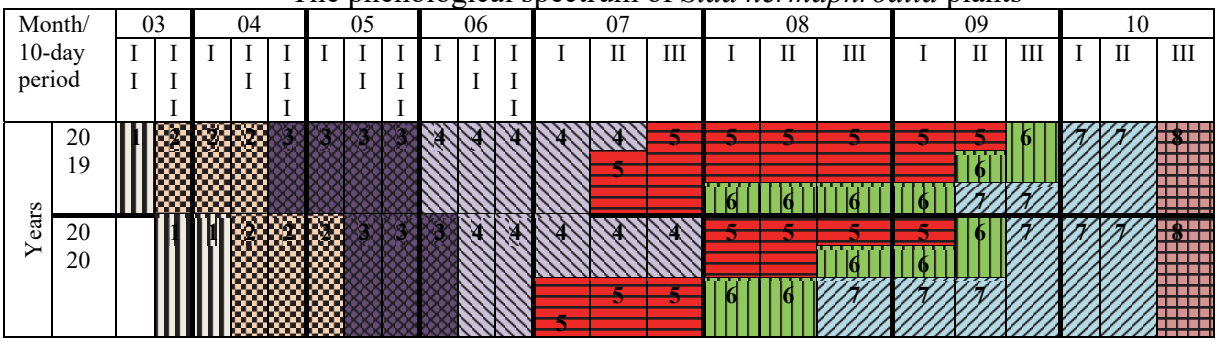
The research of *Sida hermaphrodita* plants was conducted in the experimental sector of the Laboratory of Plant Resources, in the «Alexandru Ciubotaru» National Botanical Garden (Institute) (NBGI) according to the methodology described by (Beideman, 1974; Novoselov et al., 1983). The dry stalks of Virginia mallow (*Sida hermaphrodita*) and corn (*Zea mays*), which served as control, were harvested manually*, chopped with a stationary forage chopping unit, milled in a beater mill equipped with a sieve with diameter of openings of 6 mm. For the* analysis of the content of cell walls, biomass samples were dried in an oven at 85 °C and subsequently milled (<1 mm) and homogenized. Cell wall components of tested dry mass, the amount of neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were investigated using the near infrared spectroscopy (NIRS) technique PERTEN DA 7200 at the Institute for Grassland Brasov, Romania. The cellulose content was calculated as ADF minus ADL and hemicellulose content – as NDF minus ADF. The theoretical Ethanol Potential (TEP) was calculated according to the equations of Goff et al. (2010) based on conversion of hexose (H) and pentose (P) sugars.

Under the climatic conditions of the Republic of Moldova, the growing season of *Sida hermaphrodita* starts in late March / early April. From the base of the stems and from the rhizomes, buds appear, which later give rise to shoots. The leaves are simple, but palmately cleft into 3 to 7 elongated lobe tips, 10 to 20 cm long and borne on petioles. The vegetative phase lasts for about 70 days after the beginning of the growing season, then the budding stage begins and the plants enter another ontogenetic phase. By the end of June, the plants enter the generative phase. The plants are characterized by high green mass productivity and high growth rate. In May, the growth rate is 5-6 cm/day. After the budding stage begins, the growth becomes slower (2-3 cm/day). In June the plants reach 240-262 cm in height. The plants bloom in July, flowers are rich in nectar and pollen, throughout the day its visited by a large number of pollinating and honey insects, especially the species *Apis mellifera* and *Bombus* sp. Being researched by some specialists as a honey plant, the phenological study is of particular interest. The budding, flowering and fruiting are staggered. Depending on the

climatic conditions recorded in the years of research, the flowering stage started in the middle or end of July, and ended in mid-September (Table 1).

Table 1

The phenological spectrum of *Sida hermaphrodita* plants



1 – the beginning of growing season; 2 – leaf development, 3 – stem development, 4 – budding, 5 – flowering, 6 – fruit development, 7 – seed ripening, 8 – the end of the growing season

The examination of *Sida hermaphrodita* plants based on several biometric parameters (number of flower buds, flowers, fruits in different stages of development (full development and ripening)), allowed the evaluation of the process of growth and development under the climatic conditions of the country. A 260 cm tall plant has about 7-12 shoots. Each shoot can have 8-12 lateral branches, with 13-22 inflorescences, in an inflorescence there are 4-8 flowers. For the veracity of the data, a statistical analysis was performed (Table 2).

Table 2

The biometrical and statistical analysis
of the shoots of *Sida hermaphrodita* in the generative stage

Biometric parameters / Stage	Statistical parameters											
	Min.	Max	x	S_x	Min.	Max	x	S_x	Min.	Max	x	S_x
	July				August				September			
Flower buds	9	42	23,83	±5,41	5	19	12,67	±2,2	4	14	8,67	±1,54
Flowers	2	6	3,2	±0,64	8	12	9,5	±0,61	6	33	12,33	±4,22
Fruits (development)	-	-	-	-	9	30	20,67	±3,28	8	59	30,17	±7,73
Fruits (ripening)	-	-	-	-	1	3	2,17	±0,65	8	24	13,00	±2,48

S_x - standard error; x - average

In mid-July, the average number of flowers on a branch is 3,2 ± 0,64, the number of buds being much higher (23,83 ± 5,41). In August, the number of flowers increases (9,5 ± 0,61). During this period the fruits start developing. The shoots analyzed in September are characterized by the presence of generative organs in all stages of development: flower buds (8,67 ± 1,54), flowers (12,33 ± 4,22), developing fruits (30,17 ± 7,73), ripe fruits (13,00 ± 2,48).

The weight of 1000 seeds is 3,30-3,90 g. The germination capacity of the seeds under laboratory conditions is 45%.

The analysis of lignocellulose composition suggested that the dry matter of *Sida hermaphrodita* contained 556 g/kg cellulose, 241 g/kg hemicellulose and 131 g/kg acid detergent lignin, but corn stalks – 417 g/kg cellulose, 250 g/kg hemicellulose and 82 g/kg acid detergent lignin. The estimated content of fermentable monosaccharides in *Sida* biomass: 99,0 g/kg pentose sugars and 39,6 g/kg hexose sugars, but in corn stalks – 75,1 g/kg and 41,1 g/kg, respectively. The estimated theoretical ethanol yield from cell wall carbohydrates averaged 578 L/t in *S. hermaphrodita* substrate, as compared to 485 L/t in corn substrates. Bilandžija et al. (2018) remarked that the contents of cellulose, hemicellulose and lignin in *Sida hermaphrodita* biomass in dependence of harvest period were 39,03-45,04 %, 27,33-30,10 % and 19,85-25,44 %, respectively.

Conclusions. The species *Sida hermaphrodita* is characterized by high adaptive potential, fast growth and staggered budding / flowering, which considerably increases the nutrition period for honey-producing insects. *A. mellifera* is the most common insect species detected on plants, which demonstrates the melliferous potential of Virginia Mallow. The biomass can serve as feedstock for the production of cellulosic ethanol.

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