Scientific Papers. Series A. Agronomy, Vol. LXV, No. 1, 2022
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

STUDY OF SOME GROWTH AND REPRODUCTIVE ELEMENTS IN THE *Cassia angustifolia* SPECIES

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Abstract

Cassia angustifolia (family Fabaceae), popularly known as Senna, is a valuable plant drug in Ayurveda and modern system of medicine for the treatment of constipation. Cassia prefers sandy, light, well-drained soils. In its areas of origin, it grows in bushes and semi-desert pastures, especially in valleys, floodplains and on the banks of rivers. It is found from sea level to altitudes of 1,300 meters. A field experiment was conducted to the National Institute of Research and Development for Potato and Sugar Beet Brasov to highlighting aspects of biology and technology regarding the introduction of the species into culture in Romania. A two-factor experiment was designed, located according to the method of subdivided plots, in three repetitions of the 3 x 3 x 3 type, the length of a variant being 2 m, and the paths with a width of 1 m and 9 rows of plants per plot.

Key words*: biology, Cassia angustifolia, medicinal plant, senna, technology.*

INTRODUCTION

Cassia angustifolia Vahl. is a native plant from Asia, Egypt, Sudan, Saudi Arabia, Yemen, and Pakistan. According to some authors, it has about 580 species. Many of these species are used for medicinal purposes, others are considered ornamental (Trease & Evans, 1983; Evans, 1992) or as a source of tanning material of economical value.

Cassia angustifolia, synonymous with *Senna alexandrina* Mill., belongs to the *Fabaceae* family, *Caesalpinioideae* subfamily, includes shrubs and herbaceous plants distributed throughout the tropics and subtropical regions. Some species are also found in temperate regions (Randell et al., 1998; Savulescu et al., 2018). *Cassia angustifolia* has a variety of uses in Unani medicine, as well as in other traditional medicine systems. The plant is appreciated mainly for its properties, being generally used in ordinary constipation. The laxative principles sennoside A and sennoside B, isolated from senna leaves and pods, are important ingredients in purgative drugs (Tripathi, 1999)

Cassia angustifolia is a perennial plant, 60-80 cm tall, glabrous to subglabrous (Figure 1). The leaves are alternate, paripinnate, having 6-10.5 cm long, with 5-9 pairs of lanceolate leaflets, with the whole edge, with acute tip, long about 1.2-4.5 cm and 3.5-10 mm wide, glabrous hairy on both sides, of pale green colour.

Figure. 1 *Cassia angustifolia* Vahl.
Source: https://www.soin-et-nature.com

The flowers are on type 5, with free, slightly zygomorphic elements, pedicles are 3-4 cm long, grouped in terminal or axillary raceme, up to 15 cm long. The sepals are slightly uneven, yellow-green coloured, 10-13 mm long and 6-9 mm wide. The petals are yellow and slightly uneven, 14-17 mm long and 7-10 mm wide. The 10 stamens are free. The ovary is hairy and stipitate. The plant blooms in April-June. The

fruit is a dehiscent sparsely hairy pod, 5-6 cm long and 1.7-2.3 cm wide, slightly curved, with approx. 10 seeds. The fruits are turning black at maturity. The anatomy of the stem and leaf are similar to the *Fabaceae* family, being reconfirmed in specialized papers (Metcalfe 1979; Toma & Rugina, 1998; Dickison et al., 2005; Lo et al., 2011; Santhan, 2014, Savulescu et al., 2018).

Senna leaves and pods have been used in herbal medicine since ancient times (Bojor & Raducanu, 2001).

Pods contain sennosides, anthraquinones, aloe-emodin, cathartic acid, cathartin, kaempferol, catharkaempferol, chrysophanic acid, rhein, isorhamnetin, emodin, kaempferin, mucilage, phaeoretin, sennacrol, and sennapicrin. Senna leaves contain free anthraquinones and their O- and C-glycosides and free sugars. Newly sprouted leaves after the rain are high in sennosides which decline as the leaves mature. Laxative potency of senna was found to be reasonably uniform in mice with a variation of 25% of the mean, and repeated administration of the doses over many weeks did not cause any tolerance. Sennatin, a preparation containing 20 mg of purified sennosides, reduced colonic transit time by more than half and abolished loperamide-prolonged colonic transit in healthy volunteers (Akbar, 2020).

Cassia angustifolia Vahl (*Fabaceae*), commonly known as “senna” is employed in various indigenous systems of medicine against several diseases and almost every part of the plant has diverse medicinal properties. The seeds are used as an anthelmintic, digestive, and to treat skin diseases and abdominal troubles (Srivastava et al., 2006).

It is contraindicated in intestinal stenosis, intestinal obstruction, Chron's disease, ulcerative colitis, appendicitis, to children under 12 years, the first trimester of pregnancy, lactation, diarrhoea, and dehydration. It is not administered for more than a week. Excessive doses lead to watery diarrhoea, accompanied by intense colic pain and even nausea and vomiting. Although it is used on a fairly large scale, it should be administered only on the recommendation of a doctor (Nadasan, 2003).

Being a resistant species, it can be grown in saline and rainy conditions. The cultivation of senna does not require high costs for irrigation, manure, pesticides, protection, and other pre- and post-harvest care. This makes the plant an ideal crop for arid regions where water supply, desertification control, sand dune stabilization are major challenges (Pareek & Gupta, 1984).

MATERIALS AND METHODS

The work proposed to highlight some aspects of biology and technology regarding the introduction into culture of the species *Cassia angustifolia* Vahl.

The aim was: acclimatization of the material in the field, by selecting representative plants such as vigour, uniformity and health, the study of plant biology on the growth and development of foliar and reproductive apparatus, adaptability to specific environmental conditions. Determinations were made on the elements of productivity: plant height, number of flowering stems, mass of flowers, number of inflorescences, mass of the underground part, average number of leaves and their mass, mass of plants, production of fresh and dried herba (g/plant).

Pedoclimatic conditions of the experimental area

The experiments were located in the experimental field of the National Research and Development Institute for Potato and Sugar Beet Brasov, the Laboratory of Technology and good agricultural practices, the Department of Medicinal and Aromatic Plants.

The experimental field is located in the Brasov Depression (Barsa Country), at 25°45'E longitude and 45°42'N latitude. The altitude at which the experimental field is located is 520 m (Mihai, 1975).

The climate of the Brasov Depression is temperate continental, characterized by the transition between temperate oceanic and temperate continental climate: wetter and cooler in mountainous areas, with relatively low rainfall and slightly lower temperatures in lower areas.

The chernozomoid soil on which the experiment was based, has a pH between 5.3 and 6.5, being a moderate acid to weak acid soil, with a humus content between 3.5 and 5%, which indicates an average to good supply of organic matter (Vidican et al., 2013).

Climatic characterization of the years 2016-2018 at NIRDPSB Brasov.

The average monthly air temperatures in Brasov, between October 1, 2016 - September 30, 2017, were lower at the beginning of the analysed interval compared to the multiannual average. Thus, in October an average value of 6.9°C was registered. January has a lower value of 8.4° and March has positive values of 6.6°C. The amount of precipitation (688.2 mm) exceeded the multiannual average value by 53.8 mm (8.5%). This year's monthly precipitation level was close to the multiannual average. The agricultural year 2017-2018 was warmer. During the autumn-winter period, the average air temperature was 1.5°C higher than the MAA value (0.7°C). The average monthly temperatures were higher, compared to the multiannual values, in the whole interval October - March, with deviations between 0.5 and 3.3°C. During the vegetation period (April - August) the air temperature was higher by an average of 2.7°C, compared to MAA. The agricultural year 2017-2018 was richer in precipitation compared to the values characteristic of the area, their amount exceeding by 141.3 mm the multiannual value of 177.0 mm. Between April and September, the rainfall was generally below the multiannual values, except in June and July, when they exceeded the multiannual values, especially in June, by more than 100.0 mm (Ghimbav meteorological station, Brasov).

The experimental model. In order to establish the optimal nutrition space, different planting distances were tested, which would allow the mechanization of maintenance works, correlated with the planting period, and adapted to the specific climatic conditions.

The research started by setting up a two-factor experiment, based on the randomized block model, each variant having three rows in three repetitions.

The length of a variant was 200 cm, and the paths were 100 cm wide.

Factor: A - distance between rows, with graduations: 25 cm, 50 cm, 70 cm.

Factor: B - distance between plants per row: continuous row, 15 cm, 25 cm.

The variant with continuous row density/25 cm is considered the control of the experience.

Determinations at plants harvest for herba. Each experimental factor was followed by the dynamics of emergence and growth of the leaf apparatus until flowering, when three plants were harvested from each variant/experimental repetition.

The following biometric determinations were made for each harvested plant: plant height; root mass; the number of leaves and their mass; the number of flowering stems and their mass; average fresh herba production.

Statistical analysis. Experimental data processing and paper writing were done using Windows Vista, Windows XP, Excel and Word. The analysis of variance was calculated for all elements studied, using the PoliFact statistical program - for fully randomized multifactorial experiments, theoretical t values and DL limit differences for 5%, 1% and 0.1%. The interpretation of the experimental data was done after "Analysis of biological variants" (Bonnier., 1957) and "Principles of the methodology of agronomic and veterinary medical research" (Ardelean, 2010).

RESULTS AND DISCUSSIONS

The analysis on the average mass of *Cassia angustifolia* plants on each factor studied in 2016, stand out positive influences of factor A at each graduation, with distinctly significant values in the variant planted at 50 cm between rows, with an average increase of 170.56 g, and the variant with 70 cm between rows with very significant average values of 221.00 g compared to the control (Table 1).

Table 1. The influence of factor A (row spacing) on the mass of *Cassia angustifolia* plants in 2016

Sym	Dist. between rows	Average (g)	%	Differece (g)	Sign.
A1	25	128,11	100,0	0,00	Mt.
A2	50	170,56	133,1	42,44	**
A3	70	221,00	172,5	92,89	***
DL (p 5%)				17,88	
DL (p 1%)				29,59	
DL (p 0.1%)				55,39	

The influence of factor B (distance between plants in a row) on the average mass of plants is very significant in both planting variants: B2 with an average increase of 182.44 g, and B3

with an increase of 216.33 g compared to control B1 (Table 2).

Table 2. The influence of factor B (distance between plants in a row) on the mass of plants of *Cassia angustifolia* in 2016

Sym	Dist. between plants on a row (cm)	Average (g)	%	Difference (g)	Sign.
B1	10	120,89	100,0	0,00	Mt.
B2	25	182,44	150,9	61,56	***
B3	50	216,33	179,0	95,44	***
DL (p 5%)				17,5	
DL (p 1%)				24,65	
DL (p 0.1%)				34,83	

From the data in Table 3, which shows the influence of the interaction between factor A on the average mass of senna plants in the second experimental year, it is observed that planting at 50 cm brought a significant increase in production, with a difference of 28, 11 g compared to the control.

Table 3. The influence of factor A (distance between rows) on the mass of *Cassia angustifolia* plants in 2017

Sym	Dist. between rows (cm)	Average (g)	%	Difference (g)	Sign.
A1	25	132,22	100,0	0,00	Mt.
A2	50	160,33	121,3	28,11	*
A3	70	244,00	184,5	111,78	***
DL (p 5%)				25,21	
DL (p 1%)				41,71	
DL (p 0.1%)				78,08	

The variants planted at 70 cm had very significant increases, reaching differences of 111.78 g, compared to the control variant planted at 25 cm between rows.

Table 4. The influence of factor B (distance between plants in a row) on the mass of plants of *Cassia angustifolia* in 2017

Sym	Dist. between plants on a row (cm)	Average (g)	%	Difference (g)	Sign.
B1	10	110,11	100,0	0,00	Mt.
B2	25	185,78	168,7	75,67	***
B3	50	240,67	218,6	130,56	***
DL (p 5%)				13,67	
DL (p 1%)				19,19	
DL (p 0.1%)				27,09	

From the data on the influence of factor B interaction (distance between plants in a row) on the average mass of *Cassia angustifolia* plants in 2017 (Table 4), it is shown that the results were very significant in all variants compared to the control.

In 2018, the influence of factor A is positively noticed, which reacted favourably to both variants of distance between rows compared to the control variant. The studied variants registered very positive meanings this year (Table 5).

Table 5. The influence of factor A (distance between rows) on the mass of *Cassia angustifolia* plants in 2018

Sym	Dist. between rows (cm)	Average (g)	%	Difference (g)	Sign.
A1	25	134,33	100,0	0,00	Mt.
A2	50	181,78	135,3	47,44	***
A3	70	212,67	158,3	78,33	***
DL (p 5%)				14,77	
DL (p 1%)				24,44	
DL (p 0.1%)				45,75	

The influence of factor B (distance between plants in the same row) on the average mass of *Cassia angustifolia* plants ensures very significant differences compared to the control variant (Table 6), with an average difference of 53.89 g in variant B2 and 85.56 in variant B3.

Table 6. The influence of factor B (distance between plants in a row) on the mass of plants of *Cassia angustifolia* in 2018

Sym	Dist. between plants on a row (cm)	Average (g)	%	Difference (g)	Sign.
B1	10	129,78	100,0	0,00	Mt.
B2	25	183,67	145,5	53,89	***
B3	50	215,33	165,9	85,56	***
DL (p 5%)				8,29	
DL (p 1%)				11,64	
DL (p 0.1%)				16,44	

CONCLUSIONS

Analyzing the results obtained on the influence of the distance between rows and between plants one the same row on some elements of growth and development of the foliar and reproductive apparatus in the species *Cassia angustifolia* with direct results on the average mass of plants, the following assessments can be made:

- in the climate and soil conditions from NIRDPSB Brasov, *Cassia angustifolia* species finds good conditions for growth and development;

- in the three experimental years there are significant and very significant increases in both factors studied compared to the control;
- these results recommend as favourable planting distances 50/70 cm between rows and 25 cm between plants per row.

ACKNOWLEDGEMENTS

This study is part of the ADER 2.4.1. project „Maintaining biodiversity in medicinal and aromatic plants by conserving and enriching the collection of genetic resources and seed production from higher biological categories for species representative of the hill and mountain area ", coordinated by the Secuieni Agricultural Research-Development Station.

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