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BIOMORPHOLOGICAL FEATURES OF THE SPECIES *CARTHAMUS TINCTORIUS* L.– A PLANT WITH MULTIPLE UTILITIES

Maricica COLŢUN, Alina BOGDAN,
Moldova State University

This article focuses on the study of biomorphological features of *Carthamus tinctorius* L. under the conditions of the Republic of Moldova. Safflower, plant with multiple uses, is a valuable source of flowers, seeds and oil with phytotherapeutic benefits. It is known worldwide as a medicinal plant with strong sedative properties and high therapeutic potential. The conducted research includes the botanical description of the species, the evaluation of ontogenetic and ecological peculiarities, the establishment of development phases, the identification of optimal propagation methods, the reaction of plants to frost and drought and some aspects of cultivation. Safflower goes through a full development cycle, forming edible fruits and viable seeds. The research conducted brought reliable evidence in favor of the introduction of safflower under the pedoclimatic conditions of Moldova, as a promising oilseed, medicinal, honey, ornamental and food plant to enrich the assortment of useful plants, resistant to arid conditions.

Keywords: *safflower, oil, introduction, herbal medicine, cultivation, usage*.

PARTICULARITĂȚILE BIOMOFOLOGICE ALE SPECIEI *CARTHAMUS TINCTORIUS* L.– PLANTĂ CU UTILIZĂRI MULTIPLE

Prezenta lucrare se referă la studiul particularităților biomorfologice ale speciei Carthamus tinctorius L. în condițiile R. Moldova. Șofrănelul, planta utilizare multiplă, reprezintă o sursă valoroasă de flori, semințe și ulei cu beneficii fitoterapeutice. Pe plan mondial, fiind una din plantele medicinale cu însușiri sedative promițătoare și cu un potențial terapeutic înalt. Investigațiile efectuate cuprind, descrierea botanică, evaluarea particularităților ontogenetice și ecologice, stabilirea fazelor de dezvoltare, evidențierea metodelor de propagare, reacția plantelor la înghețuri și secetă, unele aspecte de cultivare. Șofrănelul parcurge întreg ciclu de dezvoltare, dezvoltând fructe comestibile și semințe viabile. Cercetările efectuate permit argumentarea introducerii speciei în condițiile pedoclimatice ale R. Moldova, ca plantă oleaginoasă, medicinală de perspectivă pentru sortimentul de plante utile, rezistente la condiții aride.

Cuvinte-cheie: șofrănel*, ulei, introducere, medicină naturistă, cultivare, valorificare.*

Introduction

Nowadays, plants are one of the most important sources of raw material used in various fields of alternative medicine. In this regard, the study of new forms of medicinal raw materials and their implementation in the science based medicine is one of the main tasks of modern medicine, which provides for the explosive expansion of the sources of plant raw materials. This is explained by the fact that herbal preparations occupy a wide range in the spectrum of pharmacological activity and, as a rule, do not cause side effects when used rationally.

Previous research conducted within the collection of useful plants has allowed the identification of valuable species for the production of medicines, cosmetics and spices, constituting an alternative for the local sources, among which safflower (*Carthamus tinctorius* L.) – a species of the Asteraceae L. family, studied within the "Plant Resources" Laboratory, is of particular interest as a dye, oleaginous, medicinal and honey plant.

Safflower flowers are considered, in the folk medicine, to be an effective remedy for allergies. In traditional Chinese medicine, these flowers are used to make decoctions, used in the treatment of amenorrhea, endometritis, adnexitis, pneumonia and insomnia [1; 2]. Recent research has revealed the antioxidant, anti-inflammatory, calming, antiallergic, hepatoprotective, hypotensive and hypoglycemic actions of safflower. It has been recommended for centuries as a sedative and as a remedy for intestinal diseases. The flowers contain nutrients and are used in the treatment of many conditions, including menstrual pain, and cardiovascular disorders [3; 4]. In addition, safflower inhibits cell proliferation, which makes the prepared extract

useful in the treatment of psoriasis and mutagenic diseases. The use of safflower oil and petals in medicine is relevant, since it is one of the 50 basic medicinal herbs used in Chinese medicine. Valuable oil is extracted from the seeds, containing linoleic acid, which is rich in polyunsaturated acids that help prevent heart conditions [5; 6]. Safflower oil is actively used in cases of obesity or overweight, as it helps normalize digestive metabolism, reduces the amount of visceral fat, while increasing muscle tissue [7]. The oil is actively used in the production of skin- and hair-care products. It is able to reach into the deep layers of the skin, saturating the cells and is therefore included in the formula of anti-aging creams. According to literature data, provitamin A is obtained from the oil and has the highest content of beta-carotene [8].

Applied Materials and Methods

The seeds for obtaining the plants were received as a result of the collaboration with the Secuieni Agricultural Research and Development Station – Neamț, Romania. The research was carried out in the period 2021-2024, in the Collection of Aromatic Plants, within the “Plant Resources” Laboratory. Biometric measurements of the plants were carried out during three growing seasons. The plants were grown in plots, in an open field with southern exposure, under ecologically balanced conditions, on a general agrotechnical background. Phenological observations were carried out according to the methods described by I.N. Beideman, throughout the entire growing season [9]. Observations were made on the reaction of plants to light intensity, insufficiency or excess of atmospheric precipitation and the resistance of plants to diseases and pests.

Obtained Results and Discussions

Safflower (*Carthamus tinctorius* L.) is an herbaceous, annual, allogamous, medicinal and honey plant of the family *Asteraceae*, genus *Carthamus*, native to tropical Africa. It has been cultivated since the ancient age as an oil and dye plant, first in India, Egypt and other countries in North Africa, then in West and South Asia. It was first brought to Europe by Arabs, in Spain, from where it spread to France and Italy. In our country, it is cultivated in gardens, on small areas.

Safflower is a plant adapted to semi-arid growing conditions and could expand its potential as an alternative crop in droughty years, which have become more common with climate change. Biological, ecophysiological and technological research on safflower is necessary to promote its cultivation and economic potential. It is necessary to describe the phenological development stages to facilitate crop management and research. This research can provide a useful tool for farmers who intend to cultivate this species. It can be continued with the development of primary cultivation technologies, necessary and recommended in years with low humidity.

Under the conditions of the Republic of Moldova, it develops a branched taproot, which can reach down to 2 m deep in the soil. The stem is erect, cylindrical, smooth, glabrous, 40-100 cm tall. The leaves are sessile, lanceolate or oblong-ovate with serrated margins, glabrous. The flowers are tubular, orange, later red, grouped in capitula, which in turn, grouped by 14-30, form a corymb borne on the stem. Pollination is entomophilous. The fruits are achenes, ovate-elongated, 5-8 mm long, glabrous, white, with slightly angular edges. Usually, 25-60 seeds are produced in a capitulum. The weight of 1000 seeds is 24-40 g. (Fig. 1).

The seeds were incorporated into the soil in early spring, in the period March 24-26, after the completion of soil preparation works, which required tillage and leveling. The soil should be damp to a depth of 10 cm, but not wet. When sowing, the air temperature is recommended to be at least 4 ºC. Seeds treated with fungicides are recommended for sowing. The seeds are incorporated into the soil at a depth of 2.5-5 cm. If necessary, the seeds are mixed with sand or sawdust, for better homogenization and dispersion in the field. The seeds germinate quickly when the air temperature reaches about 15 ºC. After the germination of the achenes, weighing between 0.03 - 0.04 g, the plant emergence was recorded on April 2nd. The seedling goes through a rosette stage, which is characterized by slow growth in height and the emergence of numerous leaves close to ground level. During this period, the root system develops strongly. The plant is cold-resistant, even frost-resistant, but it is less tolerant of fast-growing weeds. Maintenance works begin as soon as the plants sprout. The stem then gradually begins to elongate and branch. Each branch ends in a globular capitulum of a specific shape, delimited by spines. In mature plants, the main root can reach a depth of 2-3

m in the soil, with numerous secondary roots spreading on the sides. Thanks to this root system, safflower is particularly resistant to drought, being ideal to be cultivated without problems in areas where the introduction of an irrigation system is difficult.



a b c d

Figure 1. Plants of Carthamus tinctorius L.: a) general aspect, b) tubular flowers, c) fruiting stage, d) seeds

Safflower is a long-day plant; the photoperiod requirement is 14 hours. It is intolerant of shade and weed invasions. The normal ontogenetic cycle is followed by about 80% of the specimens, in which the juvenile and virginal stages are about 30 days long. The budding phase occurs in the period May 12-15, followed by the beginning of flowering, which occurs in mid-June. During July-early August the plants reach the full flowering phase, which lasts 40-45 days. Seed ripening begins at the end of August - beginning of September. In mid-September the plants complete their ontogenetic cycle. In July-September the flowers and leaves are harvested.

The seeds are harvested at full maturity. This corresponds to the drying of the leaves and the decrease in the humidity of the achenes below 13%. This period coincides with the month of August - beginning of September. The harvested seeds are conditioned and dried until they reach a humidity of 9%. The growing season lasts 155-160 days (Fig. 2).

	April			May			June			July			August			September		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Carthamus tinctorium L.																		

Figure 2. The development of phenological stages in the species *Carthamus tinctorium* L.

Legend: - beginning of vegetative growth; - budding; - beginning of flowering; - full flowering; – seed ripening.

Other advantages of safflower cultivation are that it does not shed its seeds and is not eaten by birds. Safflower has been cultivated since ancient times, but in limited areas.

Safflower can be affected by a number of diseases: alternariosis, safflower rust, septoria leaf spots, powdery mildew etc. Among the pests, the most common are: ground beetle, safflower fly.

Industrial production of the oil dates back to the middle of the last century. The corolla contains various

yellow and red pigments, including carthamin, a glycoside of the flavone compound carthamidin. The seeds contain oil (37-42%) rich in linoleic (74-79%) and oleic (11-15%) acids, proteins, nitrogen free extract, mineral salts. According to Zamfirescu, the iodine index of this oil is 115.1-155.2, the specific acidity is 0.78-5.76 and the saponification value is 194.0-203.0. It is a semi-drying oil [10].

The experiments carried out show that the species *Carthamus tinctorius* L. can be successfully cultivated under the conditions of the Republic of Moldova, being sown directly in the field in late autumn or early spring. The plants go through the entire development cycle, forming viable seeds. The germination capacity of the seeds is 97%. Research confirms that the species *Carthamus tinctorius* L has a high viability; the plants adapt well to the pedoclimatic conditions of our country and can provide numerous benefits due to their chemical composition, their extracts being recommended as ingredients in cosmetics and medicine.

Conclusions

- The pedoclimatic conditions of the Republic of Moldova are favorable for the cultivation of *Carthamus tinctorius* L. – a species native to tropical Africa. The plants fully complete the ontogenetic cycle. The seasonal observations have proven that the species has a stable type of phenological development.
- The plants reproduce generatively, with seeds being sown in late autumn or early spring. The germination capacity of the seeds is 97%.
- It is a melliferous species. Honeybees visit the flowers to collect nectar and pollen, with high frequency between 10:00 and 14:00.
- The species *Carthamus tinctorius* L., introduced and researched in the National Botanical Garden as a medicinal, food, dye and ornamental plant, can serve as a source of local raw material for various culinary preparations, with dietary qualities, and is also used in the manufacture of margarine.
- The flowers, fruits and oil have therapeutic uses. The active principles possess expectorant, antitussive, bacteriostatic and wound-healing properties.
- The species *Carthamus tinctorius* L. is a promising plant with high therapeutic, melliferous and tinctorial potential, which can be recommended for cultivation in regions with drier climate.

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Data about the authors:
Maricica COLȚUN, PhD in biological sciences, head of the „Plant Resources" Laboratory,v „Alexandru Ciubotaru" National Botanical Garden (Institute), Moldova State University.
ORCID: 0000-0001-8470-3616
E-mail: maricica.coltun@gb.usm, mcoltun@mail.ru;

Alina BOGDAN, researcher, „Plant Resources" Laboratory, „Alexandru Ciubotaru" National Botanical Garden (Institute), Moldova State University.
ORCID: 0000-0002-2069-0454
E-mail: alina.bogdan777@mail.ru

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