

***Onobrychis arenaria* (Kit.) DC. - PROSPECTS FOR ITS USE AS A MELLIFEROUS PLANT**

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Abstract

The present study was based on the investigation of the biological characteristics of growth and development of Onobrychis arenaria (Kit.) DC. under the climatic conditions of the Republic of Moldova, with emphasis on its potential use as a melliferous plant. The research was conducted on the experimental plots of the “Alexandru Ciubotaru” National Botanical Garden (Institute). O. arenaria belongs to the family Fabaceae and is a perennial, long-day, heliophilous, polycarpic species. The onset of growth occurs early. The period from the start of the growing season to flowering is approximately 67 days, while seed maturation takes 103-110 days. The flowers are arranged in elongated racemes, comprising 20-100 flowers per inflorescence. Flowering is staggered and prolonged, lasting approximately 20-30 days, depending on plant age and prevailing climatic conditions. Onobrychis arenaria exhibits high melliferous potential, providing nectar and pollen resources for a wide spectrum of insects over an extended period.

Key words: *Onobrychis arenaria* (Kit.) DC., development, insects.

INTRODUCTION

The main food source for insects is the nectar and pollen produced by plants. The melliferous base varies depending on the geographical area and the pedoclimatic conditions characteristic of the region. The quantity of nectar produced by flowers depends on several factors, such as soil, climate, agrotechnical practices etc. (Gluhov, 1973). For example, high temperatures can reduce nectar secretion, heavy rainfall can dilute or wash it away, but moderate rainfall tends to increase nectar production. Since ancient times, honey has been valued not only as food but also for its medicinal properties and energizing effects. Today, it is recognized as a healthy alternative, rich in bioactive compounds that benefit overall health (Ionice, 2024). In the Republic of Moldova, 95% of the beekeeping sector is privately owned. Large producers, which are few in number, typically manage around 400 beehives each. The average local honey production is 24 kg per beehive annually (Programul national de dezvoltare a apiculturii în Republica Moldova pentru 2020-2026). Forecasting the flowering of melliferous crops is based on the flowering period of each botanical species, taking into account the

accumulation of the effective temperature sum during the period from the start of the growing season to the peak flowering of each crop. This heat sum is determined based on an extensive study (Sidarenko, 2015). The same melliferous flower does not always and everywhere produce the same amount of nectar, meaning that the same species may be a highly production honey plant if grown in one area and not productive at all melliferous in another. Studies have shown that to produce 500 grams of honey, bees must make at least 25,000 to 30,000 flights. This immense effort of honeybees is not immediately visible in the field but becomes evident later, in the barns of farmers (Sidarenko, et al, 2010).

O. arenaria is known for its high nectar productivity, flowering earlier than many melliferous crops. It is highly attractive to bees, and its honey has therapeutic properties. Some researchers documented its melliferous productivity, noting that each flower produces about 0.07 mg of nectar and 0.075 mg of pollen. Each inflorescence yields 5.2 mg of pollen, and one plant provides around 262 mg. Under favourable conditions, 15-20 bees can work per square meter planted with sand sainfoin (Atoeva & Olimova, 2024).

The honey productivity of sand sainfoin (*O. arenaria*) can reach up to 225 kg/ha (Pancov, 2009). Other sources indicate that in the second year of growth, honey productivity is around 60 kg/ha, while in the third year, it can increase to as much as 300 kg/ha (Atoeva & Olimova, 2024). Sand sainfoin is valued for its exceptional melliferous qualities, especially in herbaceous pasture mixtures. Pastures provide low- to medium-intensity forage, with peak development in late summer, after the flowering of linden trees and sunflowers, when other forage sources are scarce. (<https://www.scribd.com/doc/77287247/BAZA-MELIFER%C4%82>).

Onobrychis arenaria (Kit.) DC. – sand sainfoin or sandy esparcet – belongs to the genus *Onobrychis* Mill. (family Fabaceae Lindl.) In the Flora Europaea lists, 80 plant species of this genus are described (Kazuharova & Bendassat, 2019), most of them being recognized as forage for grazing animals and honey plants (Mossadegh, 1990; Manning, 2001). In SW Asia, the Mediterranean region and in temperate Europe and Asia, this genus comprises about 170 species (Zohary, 1987). In Armenia, there are records of sainfoin dating back to 1000 BC, and the cultivation of the plant in Armenia and Georgia is described in the 5th century. In Western Europe, it has been known for about 600 years (Şain, 1948; Carasciuc, 1951; Medvedev & Smetannicova, 1981). *O. arenaria* is a tall plant, reaching 30-50 (80) cm in height. The stem is erect, branched, pubescent or nearly glabrous. The stipules are brown, ovate, and acute. The leaves are petiolate, with 5-12 pairs of elliptical leaflets, 10-30 mm long and 2-5 mm wide. The racemes have peduncles 3-4 times longer than the leaves. The calyx is glabrous or pubescent, the corolla is violet-pink, and the pods are sparsely pubescent, 4-6 mm long, with short spines on the surfaces and ridge (Flora Basarabiei, 2020).

MATERIALS AND METHODS

The focus of the study was the plants of the species *Onobrychis arenaria* (Kit.) DC. from the collection of Forage, Honey and Energy Plants at the Laboratory of Plant Resources within the “Alexandru Ciubotaru” National

Botanical Garden (Institute) (NBGI). NBGI is located in the southeastern part of Chişinău, where over 24 types of soil are found, including fertile chernozems. The groundwater is located at depths of 1.5-7.0 meters. The research was carried out during the 2023-2025 growing seasons. The basis of the research was the study of the biological characteristics of growth and development of the plants under the climatic conditions of the Republic of Moldova, conducted according to the methodological guidelines used in NBGI (Novosiolov, 1997). The phenological study was conducted throughout the entire growing season of the plants, from the start of vegetative growth to seed maturation (Beideman, 1974). The phenological data were correlated with the meteorological conditions.

The summer of 2025 was characterized by high temperatures and a significant precipitation deficit. During the season, the total precipitation in the central part of the country ranged from 16 to 60 mm, with a notable lack of rainfall in June and August. In comparison to the summer of 2024, the average air temperature in 2025 was 1.5-2.5°C lower. A similar thermal regime was observed in 2023. The period of research, based on climatic conditions, was marked by high temperatures and a precipitation deficit (Figure 1).

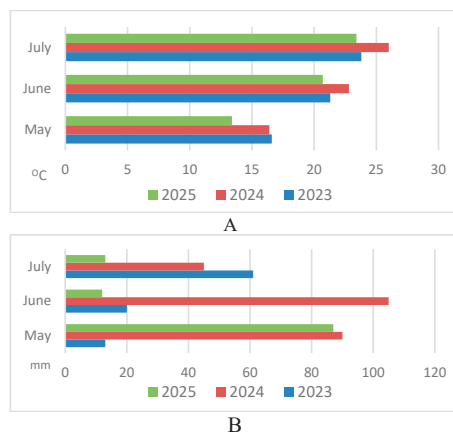


Figure 1. Climatic conditions:
A - air temperature; B - precipitation

The maximum air temperature during the 2024 season reached +39.5°C to +40.9°C, such extreme values being only recorded in 2007 and 2012. A significant precipitation deficit

was noted across almost the entire country in May, July and August. (<https://www.meteo.md/>). The entomological study was conducted during the growing season of the plants, particularly during the generative phase. The list of beneficial insects was updated. The entomological material was studied from spring to autumn, starting from the budding phase of the plants until the end of flowering. Species identification and systematic classification were carried out according to the identification guides: Kryzhanovsky, 1965, Plavilshchikov, 1994.

RESULTS AND DISCUSSIONS

To improve and develop the melliferous base as a branch of beekeeping, it is essential to integrate knowledge about plant morphology, physiology, ecology, phytogeography, phytocenology, breeding and phytotechnology, dendrology, phytophenology, and entomology (Iordache, Roșca, & Cismaru, 2007). Leguminous forages are an important category of plants for sustainable agriculture and beekeeping, being species with ecological plasticity, high nutritional value and vitality, which also influence soil fertilization. Sand sainfoin is part of this group of plants, widespread in steppe and forest-steppe areas. It is a perennial plant with a strong taproot. The aerial part forms a bushy growth with ascending shoots, topped with inflorescences. *O. arenaria* plants, under the climatic conditions of the Republic of Moldova, on the experimental plots of the “Alexandru Ciubotaru” National Botanical Garden (Institute), go through the entire ontogenetic cycle annually, flowering and producing viable seeds starting from the first year of life. It is a long-day, light-loving, perennial, polycarpic species, and under favourable conditions, it can flower and produce seeds twice within one growing season. It belongs to the group of leguminous plants with medium development pace and vitality, with a lifespan of 5-10 years, and is considered early in terms of precocity. Phenological research was conducted on the *O. arenaria* plants growing in the collection, as well as on plants in their first year of life (Figure 2A). Seed incorporation into the soil was performed in early April, when recorded

air temperatures ranged from +13.0°C to +15.5°C.

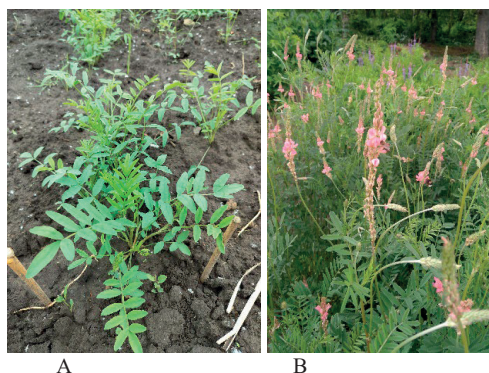


Figure 2. *O. arenaria* in the collection of NBGI:

A - leaf development vegetative stage,
B - budding-flowering generative stage

The germination capacity of the seeds under laboratory conditions was $68.2 \pm 9.03\%$. In the first year of growth, 21 days passed from seed incorporation into the soil to the onset of vegetation, and approximately 75-80 days passed until peak flowering. Flowering (Figures 2B, 3B) is staggered and prolonged, lasting about 20-30 days, and occurs between May and July. Within a single inflorescence, both buds and flowers develop simultaneously, and in some specimens, fruits begin to form at the base of the inflorescence (Figure 3A).



Figure 3. *O. arenaria* inflorescences: A - at different development stages (number of inflorescences on a shoot); B - *Apis mellifera* visiting flowers

The flowers are arranged in elongated racemose inflorescences, each containing 20-100 individual flowers. These inflorescences exhibit acropetal flowering, with the flowers opening sequentially from the base to the apex of the raceme. The length of the inflorescences

ranges from 5 to 9 cm, and when including the floral peduncle, the total length extends to 13-18 cm. Each inflorescence remains in bloom for 8-12 days. The period from the start of vegetative growth to seed maturity is approximately 103-110 days. Beginning in the second year of growth, the plants initiate early vegetative development, typically during mid- to late March, marked by the formation of a leaf rosette. Following this, the plants experience rapid growth, producing green biomass and accumulating essential nutrients. Under optimal conditions, they grow vigorously and exhibit resilience to low spring temperatures. When exposed to similar climatic conditions, the duration of both the vegetative and reproductive phases is nearly identical. By late July, during the fruit development and seed ripening phases, new shoots may emerge.

These shoots are smaller in size, and some may progress into the reproductive phase by the end of the growing season, producing smaller inflorescences. At the end of the growing season, following seed maturation and the decline in air temperatures, the aboveground parts of the plants enter dormancy. The leaves reach the senescence stage and fall, while the stems become desiccated and turn brown. The plants' frost resistance and tolerance to winter drought are primarily attributed to the basal buds and the root system. The timing and duration of the phenological phases (Table 1) can vary depending on plant age and environmental factors, and the temperate climate conditions of the Republic of Moldova support plant growth and the production of viable seeds.

Table 1. Phenological spectrum of *O. arenaria* Kit. (DC.) plants

Month			March			April			May			June			July		
Year	Sowing	Emergence SVG	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
2023	-	17.03			+	+	+	v	v	v	v	v	v	v			
2024	-	15.03		+	+	+	+	v	v	v	v	v	v	v	v		
2025	02.04	23.04						+	+	+	+	v	v	v	v	v	v

Note: SVG – start of vegetative growth; I, II, III – 10-day period of the month,

The flower structure of sand sainfoin complicates self-pollination, as it is an entomophilous species. Seed production is influenced by the abundance of insect visitors to the flowers (Kempf et al., 2015). Pollination in sand sainfoin is mediated by various insect species, with the honeybee (*Apis mellifera*) accounting for approximately 80% of pollination events (Pancov, 2011). Entomophily is essential for the long-term survival of the species, reflecting the close ecological relationship between entomophilous plants and their pollinators (Mantoptin et al., 2001). Previous and current research has shown a high abundance of diverse pollinating insect species during the flowering period of sand sainfoin. These insects are classified within the trophic chain as primarily phytophagous species that feed on pollen, nectar and other plant fluids, as well as zoophagous species. In experimental plots at the NGBI, 15 insect species were identified on *O. arenaria* plants (*A. mellifera*; *Bombus terrestris*, *B. lapidarius*, *B. hortorum*, *Lasioglossum* sp., *Formica rufa*, *F. nigra*,

Cantharis fusca, *Coccinella septempunctata*, *Agapanthia violacea*, *Oxythyrea funesta*, *Dolycoris baccarum*, *Pyrrhocoris apterus*, *Aphis fabae*, *Polyommatus* sp., classified in four orders (Hymenoptera, Coleoptera, Hemiptera, Lepidoptera), and eleven families (Aphididae, Apidae, Cantharidae, Coccinellidae, Cerambycidae, Pantatomidae, Pyrrhocoridae, Scarabaeidae, Lycaenidae, Formicidae, Halictidae (Cîrlig et al., 2021). Hymenoptera represent 50% of the identified entomofaunal population and play a crucial role in the plant world, as both honey-producing and pollinating insects. Bees gather nectar and pollen from flowers, which they then convert into food sources – honey and bee bread – providing the essential nutrients necessary for their metabolic processes (Burenin & Kotova, 1977). The researcher Gluhov, 1937 highlights sand sainfoin as a crop of significant value for beekeeping, noting that its flowers provide a substantial amount of nectar to bees, irrespective of climatic conditions. A healthy bee colony can produce over 4 kg of honey per

day. The honey is aromatic, has a delicate taste, is transparent and does not crystallize quickly. The insect species identified are active throughout the day during the entire flowering period of *O. arenaria*. Since flowering is staggered, insect activity extends over a longer period. Some researchers suggest that for optimal seed yield in sainfoin, pollination by honeybees should be managed (Ivanov, Peresadin & Šilo, 2017). One key factor for this is placing hives closer to the sainfoin fields, increasing visitation by domestic bees and, consequently, boosting both seed and honey production. It is recommended to have 3-4 bee colonies per hectare, with hives spaced 650-700 meters apart (Starodub, 2015). The research highlights the importance of *O. arenaria* plants in both beekeeping and agriculture. These plants can be utilized to establish monoculture plantations for honey production and can also enhance the floral diversity of natural or artificial pastures, providing both forage and melliferous resources.

CONCLUSIONS

Under the climatic conditions of the Republic of Moldova, *Onobrychis arenaria* (Kit.) DC. can be considered a multipurpose species with high melliferous potential, characterized by a long flowering period allowing its integration into the 'honey conveyor'. The studies conducted at the "Alexandru Ciubotaru" National Botanical Garden (Institute) of MSU confirmed that sand sainfoin is a perennial, long-day, heliophilic, polycarpic species. In its first year of life, the time from seed incorporation into the soil to the start of vegetative growth is approximately 21 days, with peak flowering occurring about 75-80 days later. Flowering is staggered and prolonged, lasting 20-30 days between May and July, with each individual inflorescence blooming for 8-12 days. The period from the start of vegetative growth to full seed maturity spans 103-110 days. During the flowering phase, the plants provide nectar and pollen to a variety of insects over an extended period. The presence of melliferous and pollinating species, such as *Apis mellifera* and *Bombus* spp., underscores the melliferous

potential of *O. arenaria* plants and highlights the availability of nectar and pollen, which serve as essential food sources for these insects.

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