INSECT ACTIVITY DURING THE DIURNAL FLOWERING OF MENYANTHES TRIFOLIATA

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Abstract: *this study investigates the diurnal flowering behavior of Menyanthes trifoliata, a medicinal plant introduced to Tashkent's environmental conditions, with a focus on analyzing insect activity during peak flowering times. One major challenge in plant acclimatization is often reduced reproductive success due to suboptimal environmental interactions. Over years of observation, M. trifoliata displayed variable fruit production, with a notable increase in fruiting post-2007. This prompted an analysis of insect activity as a potential driver of pollination effectiveness. The study found that M. trifoliata flowers open early in the morning, responding to temperature, humidity, and light intensity, which influence the timing and extent of flowering. Insects, particularly ants and bees, were observed to visit the flowers predominantly between midday and afternoon, when conditions (18-22°C and 75,000 lux) were optimal. These insects appear synchronized with the plant's flowering peak, maximizing pollination potential. Such coordination between flowering and insect activity suggests a successful adaptive mechanism to local climate, enhancing the plant's reproductive success. These findings underscore the importance of ecological compatibility in the acclimatization process and provide insights into strategies that could support the adaptation of introduced species by promoting beneficial insect interactions.*

Keywords: *Menyanthes trifoliata, medicinal plant, insect activity, flowering.*

АКТИВНОСТЬ НАСЕКОМЫХ ВО ВРЕМЯ СУТОЧНОГО ЦВЕТЕНИЯ MENYANTHES TRIFOLIATA

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Аннотация: *в данном исследовании анализируется суточное цветения Menyanthes trifoliata - лекарственного растения, интродуцированного в условие Ташкента, при особом внимании к активности насекомых в период пикового цветения. Одной из основных проблем при акклиматизации интродуцированных растений часто является снижение репродуктивной успешности, связанное с недостаточной экологической адаптацией и неоптимальным взаимодействием с местной фауной. Многолетние наблюдения за M. trifoliata показали переменную плодовитость, при этом количество плодов значительно увеличилось после 2007 года. Это стало основанием для анализа активности насекомых как возможного фактора, влияющего на эффективность опыления. Установлено, что цветки M. trifoliata раскрываются рано утром, при этом время и интенсивность цветения зависят от температуры, влажности и освещённости. Насекомые, особенно муравьи и пчёлы, посещали цветки преимущественно в середине дня и после обеда, когда условия (температура 18–22°C и освещённость 75 000 люкс) были оптимальными. Их активность была синхронизирована с пиком цветения растения, что повышает вероятность успешного опыления. Эта координация между фазой цветения и активностью насекомых указывает на успешный адаптационный механизм растения к местному климату, что, в свою очередь, способствует его репродуктивному успеху. Эти результаты подчёркивают важность экологической совместимости в акклиматизации и указывают на значимость взаимодействий с местными насекомыми для успешной адаптации интродуцированных видов.*

Ключевые слова: *Menyanthes trifoliata, лекарственное растение, активность насекомых, цветение.*

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The study of flowering biology is essential for the adaptation, cultivation, and selection of plants introduced to new climatic conditions. Flowering is a critical phase in a plant's life cycle, and it varies significantly between species. Some plants flower within days, while others may take weeks, as is the case with our study subject, *Menyanthes trifoliata*. In its natural habitat, *M. trifoliata* blooms from late May through June [1]. According to A.A. Makarov [2], it flowers in June in Yakutsk, while in water bodies of the Upper Volga, Tatarstan, and

Primorsky Krai, it blooms in mid-May to early June. In Ukraine, it flowers from mid-May to June [3]. *Menyanthes trifoliata*, a member of the Menyanthaceae family, was studied in terms of insect activity during its daily flowering phase under introduced conditions in artificial ponds at the "Medicinal Plants" laboratory of the Uzbek Academy of Sciences Botanical Garden. Our long-term observations revealed that between 2000 and 2004, the plant produced few fruits individually, but from 2007 onwards, it began producing large quantities. To understand this phenomenon, insect activity during the plant's flowering cycle was examined. The generative and vegetative organs of *M. trifoliata* form in the leaf axils of annual rhizomes. The flower stalk emerges from the axil of one of the leaves, reaching up to 35 cm in length and ending in a cluster of pale pink flowers. The flowers are fully open, with petals edged in dense fringes. The corolla is crest-shaped, with petals that have serrated, notched, and curled edges. The flowers grow in racemes on stalks, developing early in spring with white or pale pink flowers, 10–15 mm long. The flower stalks are 3–7 cm long, with sepals 2–3 mm, buds 12–14 mm, and flower stalks up to 30 cm [4, 5]. The calyx has five fused sepals that persist with the fruit, and the corolla is funnel-shaped with typically 5 lobes, sometimes 5-7. Nectar glands are located alternately with stamens at the base of the ovary. Observations suggest that the number of stamens correlates with the number of sepals, ranging from 5 to 6. The anthers are four-celled and attached by thick, broad filaments [4, 5, 8, 9]. The fruit is a single-chambered, two-valved capsule. The seeds are non-endospermic and number 6 to 8. The generative organs of *M. trifoliata* develop predominantly between the second and fifth nodes of annual rhizomes. The flowers belong to the group of day-blooming plants, and their blossoms do not close at night, hence the common name "moon flower" [3, 4, 5]. The name of *Menyanthes trifoliata*, known in Russian as “vremya” (meaning “to be on guard” or “to be on duty”), reflects its visibility at night. With its white and pale red flowers, it serves as a warning to travelers of nearby swamps [6, 7].

Diurnal flowering patterns were studied during peak bloom and at the end of the flowering season. Results indicate that bud opening is influenced by environmental factors, primarily air temperature. The plants exhibit a distinct diurnal flowering rhythm, with the first flowers opening at 8 a.m. when the air temperature was 12°C, relative humidity was 78%, and light intensity was 34,000 lux. No insects were observed around the plants at this time. As the temperature increased, the flowering rate also accelerated, reaching its peak at noon. At this point, the air temperature was 18°C, humidity 48%, and light intensity 75,000 lux, with numerous ants and bees observed around the flowers. The highest bud opening (71%) occurred at 2 p.m., with an air temperature of 22°C, relative humidity of 61%, and light intensity of 35,000 lux. After 4 p.m., insect activity around the plants decreased, and as evening approached, the flowers wilted as temperature and light levels dropped.

Conclusion

The study of *Menyanthes trifoliata*, a medicinal plant introduced to the Tashkent region, highlights its flowering patterns and the corresponding insect activity. The flowers of *M. trifoliata* - notable for their delicate, fluffy white appearance - display a diurnal rhythm, remaining open throughout the day. Observations reveal that as daytime temperatures rise (18–22°C) and light intensity increases (reaching up to 75,000 lux), the rate of bud opening intensifies, peaking by midday. This environmental responsiveness indicates that external factors like temperature, humidity, and light levels significantly influence the plant's flowering behavior. In analyzing insect activity, the study found that insect presence (primarily ants and bees) correlates closely with the peak flowering hours. Ants were among the first insects observed around the plant, increasing in number as the day progressed. Bees, crucial for effective pollination, were most active between noon and 4 p.m., when flowering was at its highest. The peak insect activity aligns with the optimal temperature and light conditions, suggesting that both plant and insect behaviors are synchronized with daily environmental fluctuations. This synchronization likely enhances pollination efficiency, which could be a critical factor in the plant’s reproductive success and fruit production, as seen in the increased fruiting after 2007.

In conclusion, *M. trifoliata* exhibits a robust adaptive response to the Tashkent climate, with both flowering and insect visitation patterns finely attuned to daily environmental changes. This study underscores the importance of understanding ecological interactions in the acclimatization of introduced species, as they directly impact reproductive outcomes and, ultimately, the plant’s successful integration into new habitats.

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