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**Daily Dynamics of Blooming of Some Species
from *Lamiaceae* Family**

Dzienna dynamika rozkwitania kwiatów w rodzinie *Lamiaceae*

Abstract. In the years 1995-1997 observations on the daily dynamics of blooming of 32 species (Fig. 1, Nos. 1 to 32) from *Lamiaceae* family were carried out in the melliferous plants collection, in the ISK Puławy. Flower buds of the investigated species are opening only during day-time but considering the different course of this process the species can be classified into 3 groups. The first group contains 10 species with flowers opening mainly in the first part of day, even from 4.00 a.m. and with the peak between 6.00 a.m. and 10.00 a.m.. In the peak hour up to 30-40 (50)% of the daily sum of flowers can be open. Flowers of the second group (12 species) open throughout the day, with a peak between 9.00 a.m. and 2.00 p.m., when in one hour up to 15-30% of daily sum of flowers develop. The third group includes species with flowers opening regularly from 4.00 a.m. to 8.00(9.00) p.m.. During one hour these plants open from a few to 15% of the daily sum of flowers. The course of flowers opening during a day is constant, but it can be modified by unfavorable weather conditions. The studied species from genera *Mentha* L., *Salvia* L., *Leonurus* L. and *Nepeta* L. showed a similar pattern of flower opening. Only within 3 species from genus *Agastache* the differences in the rate of flower opening were observed.

INTRODUCTION

In the botanical and beekeeping literature numerous species from *Lamiaceae* family are mentioned as valuable melliferous plants (Szkłanowska 1957, 1965; Jabłoński, 1968-1997). Blooming from spring till autumn, they are a continuous source of a food flow for honeybees (*Apis mellifera* L.) as well as for wild pollinating insects (Ruszkowski et al. 1997 abc). The data concerning various plants show that the daily dynamics of insect visits on flowers are connected with the daily rhythms of flower opening (Jabłoński and Szkłanowska 1997). The aims of the present investigations were: 1) detailed studies of daily patterns of flower opening of different species inside the same genus from *Lamiaceae* family, 2) a comparison of these patterns between the different genera from this family.

MATERIAL AND METHODS

In the years 1995-1997 investigations were carried out in a melliferous plants collection in the ISK Puławy. Thirty-two species from 22 genera from *Lamiaceae* family were observed (Fig. 1, Nos. 1 to 32). Three species are annual (4, 12, 28), 1 species is biennial (13) and the rest are perennial plants, cultivated or growing in the wild and transplanted into the collection from their natural habitats. The area of experimental plots ranged from 4 to 6(8) m². During a blooming period plants of all species covered the soil surface with a dense carpet. Fertiliser (2-3 kg a⁻¹) was applied once in spring-time. During summer the plots were weeded by hands, as needed. Every year, during 3-5 fine days of a blooming peak of the particular species, the daily dynamics of flower opening was investigated. Depending on blooming abundance, a few to a dozen of shoots were chosen, on which (between 4.00 h and 21.00 h E.E.T.) the opened flowers were counted at one-hour intervals. Then, the freshly opened crowns or only their lower lips were removed.

RESULTS

Flower buds of the studied species opened only during day-time. The course of this process, measured by the number of flowers opened every hour per area unit of the experimental plot can be represented by a curve with one peak in the middle of a day or moved into the first part of a day, or by a line running quite uniformly during a day. It is possible to classify all 32 species into 3 groups depending on different daily patterns of flower opening (Fig. 1):

I group — plants with flowers opening mainly at the beginning of the day. This process often starts even from 4.00 a.m. and attains the highest intensity between 6.00 a.m. and 10.00 a.m. In the peak hour up to 30-40(50)% of the daily number of flowers are opening. The only exception is *Mentha longifolia*-(5), opening slightly more than 20% of all flowers during that time. This group includes the following 9 species: *Teucrium scorodonia*-(1), *Physostegia virginiana*-(2), *Lamium album*-(3), *Satureja hortensis*-(4), *Prunella vulgaris*-(9) and 4 species from genus *Mentha* L. (*M. longifolia*-(5), *M. rotundifolia*-(6), *M. arvensis*-(7), *M. piperita*-(8). Also, *Melissa officinalis*-(10) should be placed in this group. Flowers of this species are opening for an equally short time during the day but the peak occurred slightly later in comparison with the other species.

II group — plants opening flowers during the whole day with increased intensity between 9.00 a.m. and 2.00 p.m.. Within this group the species whose flower buds develop the most abundantly before 10.00 a.m. can be distinguished. These are: *Lavandula angustifolia*-(11), *Elsholtzia cristata*-(12), *Leonurus sibiricus*-(13) and *Agastache rugosa*-(21). However, the following species: *Leonurus cardiaca*-(14), *Phlomis tuberosa*-(15), *Pycnathemum californicum*-(16), *Salvia verticillata*-(17), *S. nemorosa*-(18), *S. officinalis*-(19), *Origanum vulgare*-(20) and *Agastache nepetoides*-(22) are characterized by the peak of flower opening occurring in midday hours. During one hour of the most intensive flower opening, these species were opening up to 15-30% of the daily sum of flowers.

III group — includes plants whose flower buds are opening almost steadily from morning till evening. This process starts at 4.00 a.m. and ends at 8.00-9.00 p.m.. The following species belong to this group: *Agastache anethiodora*-(23), *Hyssopus officinalis*-(24), *Marrubium vulgare*-(25), *Stachys recta*-(26), *Monarda hybrida*-(27), *Dracocephalum moldavicum*-(28), *Nepeta nuda*-(29), *N. grandiflora*-(30), *N. cataria* var. *citriodoris*-(31) and *Ballota nigra*-(32). During one hour of flower opening of these plants, from a few to 15% of the daily sum of flowers were opened.

The daily course of flowers which start to bloom was modified by weather conditions. The influence of weather on the time and duration of flower opening was observed, for example on 6th July 1996. A warm night and a morning without dew speeded up flower buds opening but also caused an exceptionally early end of this process. During cold and rainy weather some deviations were observed, too. The rate of flower opening slowed down or that process was even totally restrained.

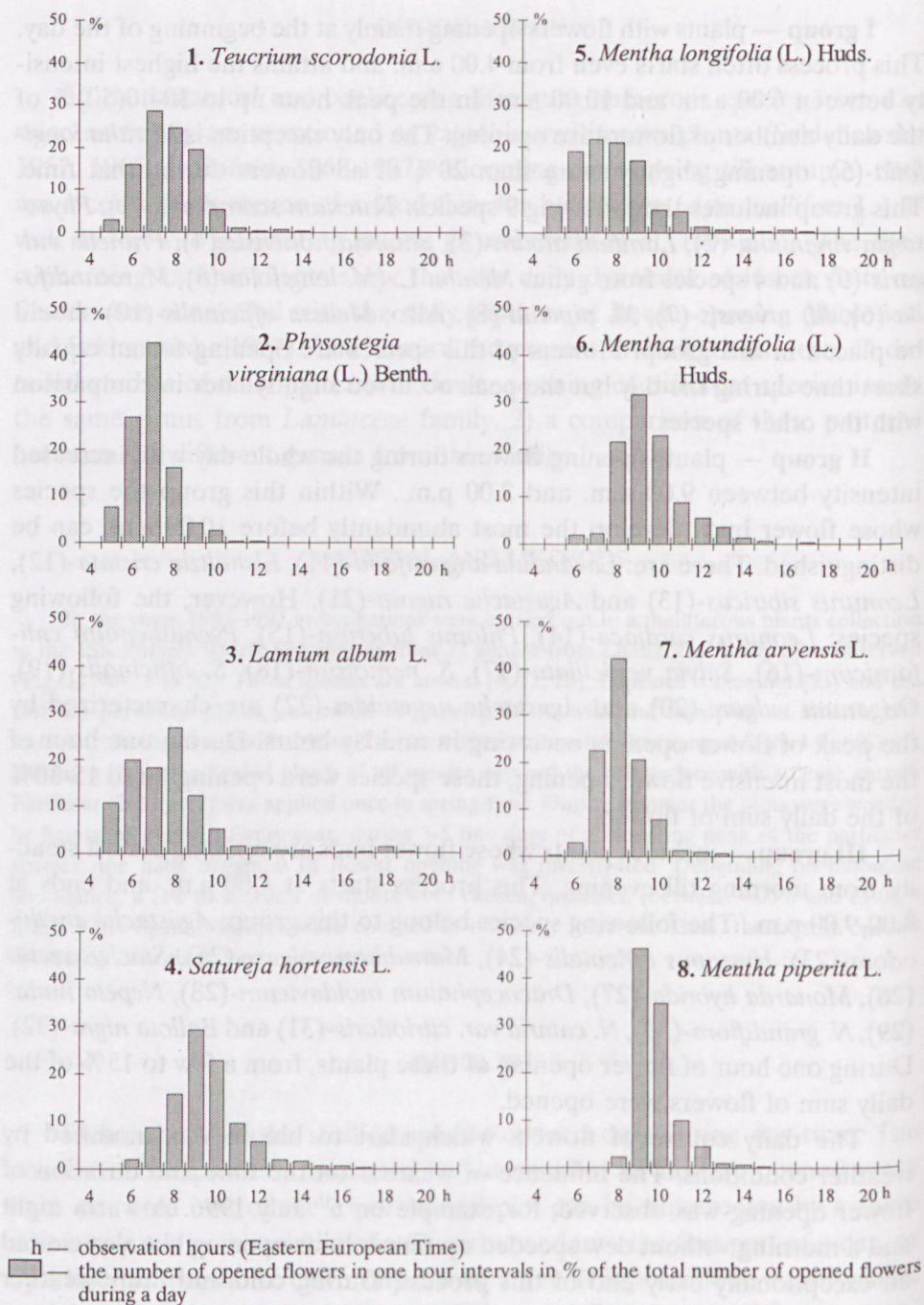
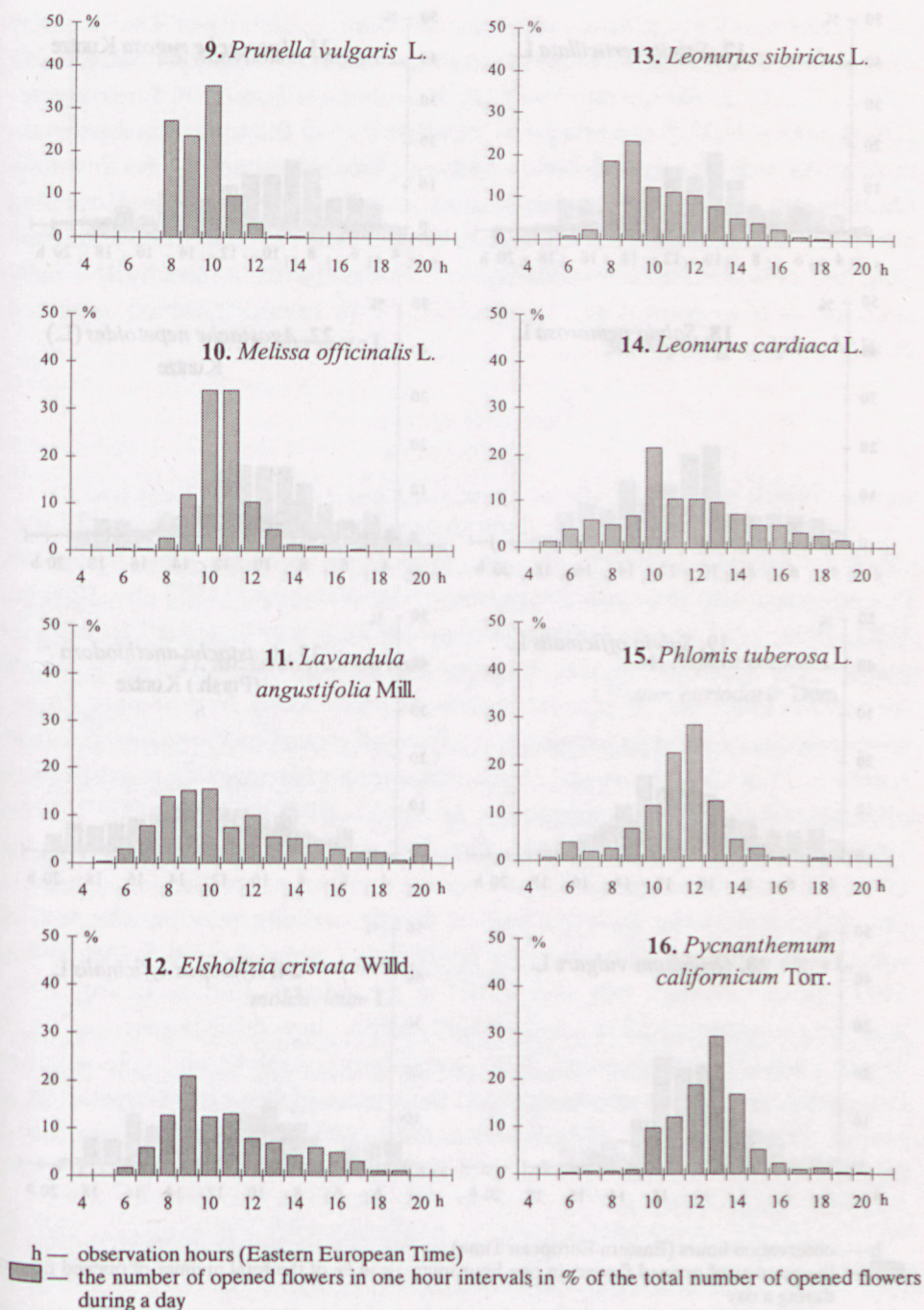
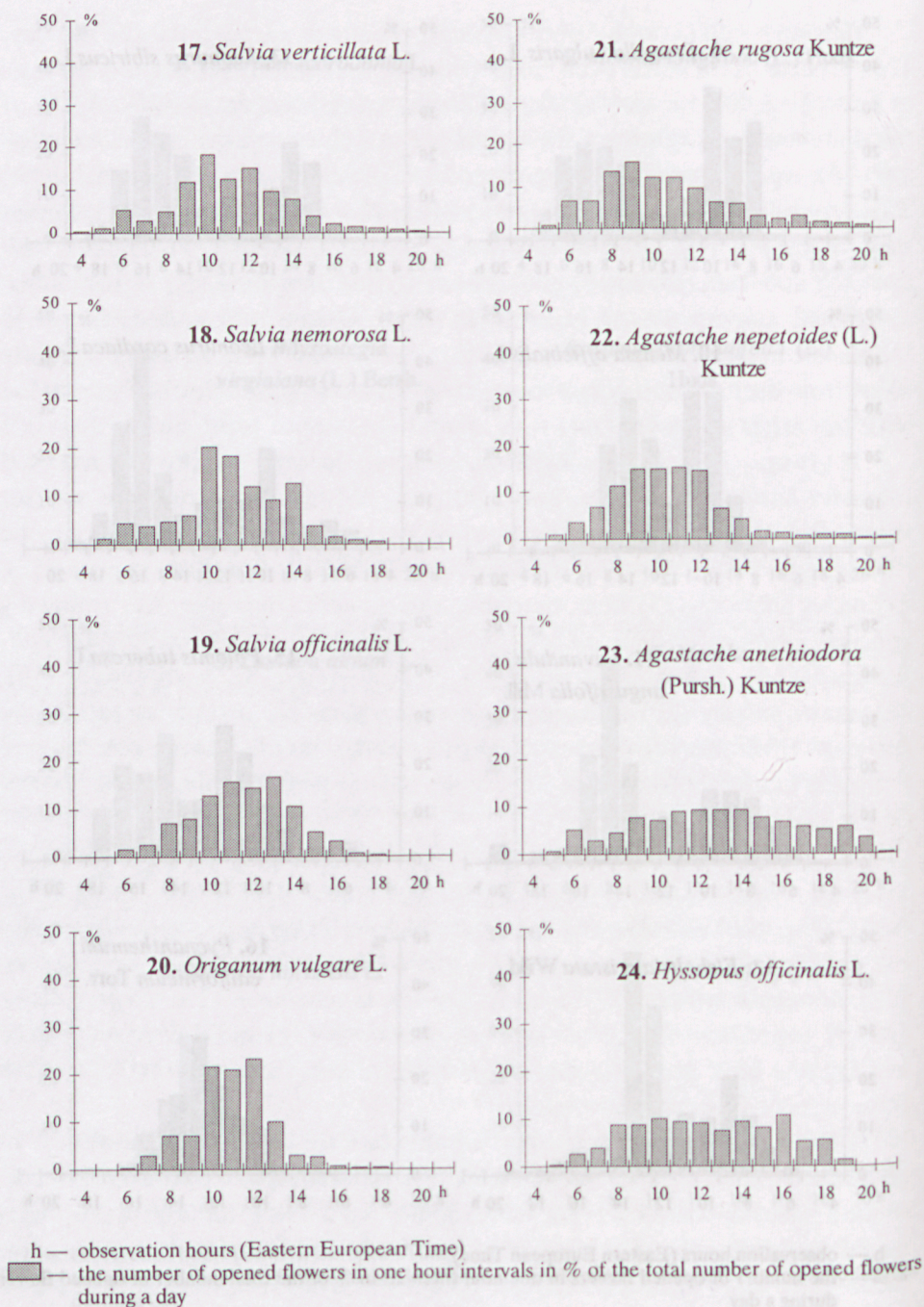


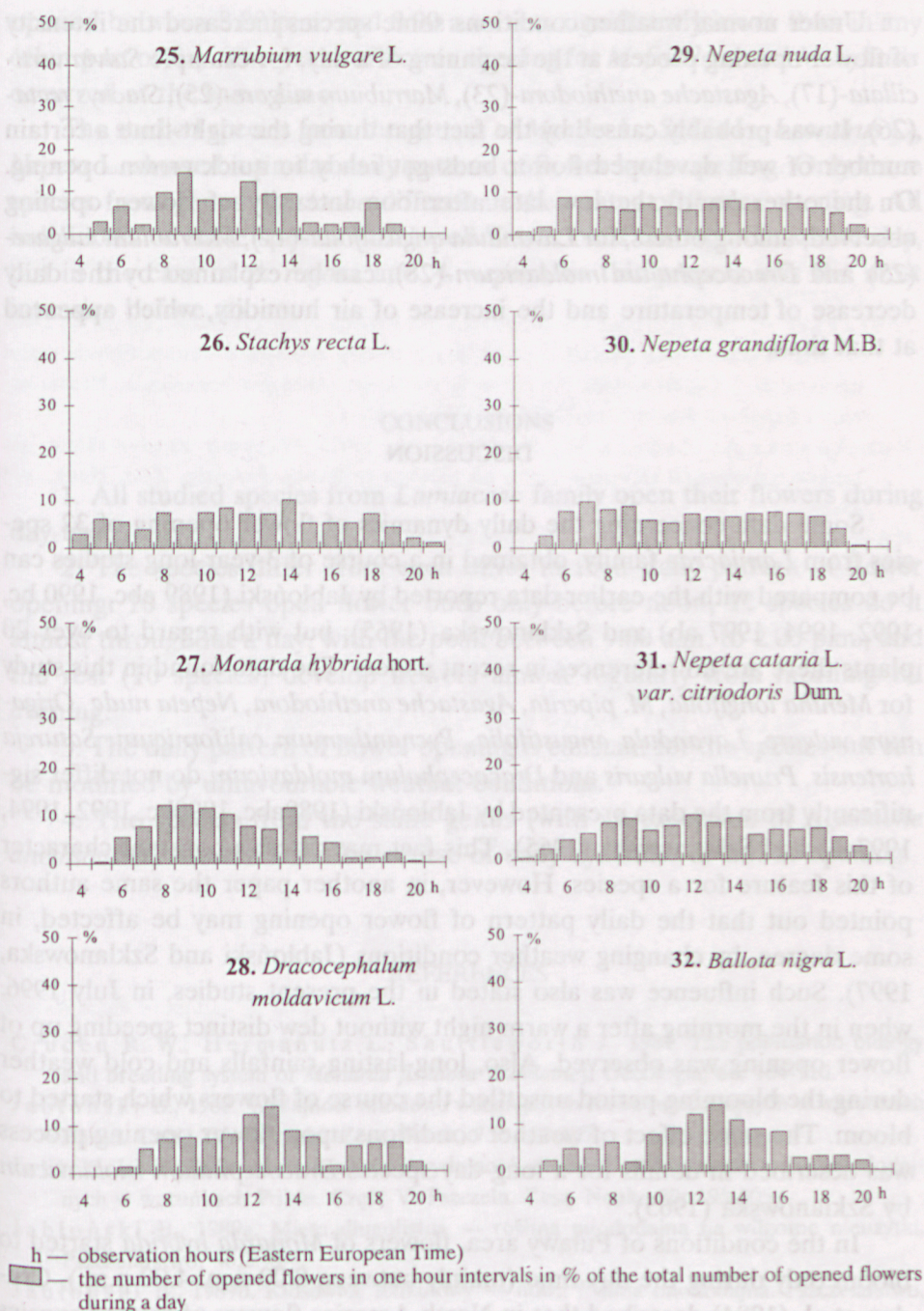
Fig. 1. The daily dynamics of blooming of investigated species



cont. Fig. 1. The daily dynamics of blooming of investigated species



cont. Fig. 1. The daily dynamics of blooming of investigated species



cont. Fig. 1. The daily dynamics of blooming of investigated species

Under normal weather conditions some species increased the intensity of flower opening process at the beginning of a day, for example *Salvia verticillata*-(17), *Agastache anethiodora*-(23), *Marrubium vulgare*-(25), *Stachys recta*-(26). It was probably caused by the fact that during the night-time a certain number of well developed flower buds got ready to quick crown opening. On the other hand, the low late afternoon intensity of flower opening observed, among others, for *Lavandula angustifolia*-(11), *Marrubium vulgare*-(25) and *Dracocephalum moldavicum*-(28), can be explained by the daily decrease of temperature and the increase of air humidity, which appeared at that time.

DISCUSSION

Some data concerning the daily dynamics of flower opening of 32 species from *Lamiaceae* family, obtained in a course of 3-year-long studies can be compared with the earlier data reported by Jabłoński (1989 abc, 1990 bc, 1992, 1994, 1997 ab) and Szklanowska (1965), but with regard to over 20 plants there are no references in recent papers. The data found in this study for *Mentha longifolia*, *M. piperita*, *Agastache anethiodora*, *Nepeta nuda*, *Origanum vulgare*, *Lavandula angustifolia*, *Pycnanthemum californicum*, *Satureja hortensis*, *Prunella vulgaris* and *Dracocephalum moldavicum* do not differ significantly from the data presented by Jabłoński (1989abc, 1990bc, 1992, 1994, 1997ab) and Szklanowska (1965). This fact may attest a constant character of this feature for a species. However, in another paper the same authors pointed out that the daily pattern of flower opening may be affected, in some degree, by changing weather conditions (Jabłoński and Szklanowska, 1997). Such influence was also stated in the present studies, in July 1996, when in the morning after a warm night without dew distinct speeding up of flower opening was observed. Also, long-lasting rainfalls and cold weather during the blooming period unsettled the course of flowers which started to bloom. The same effect of weather conditions upon flower opening process was described in details for a long-day species *Dracocephalum moldavicum* by Szklanowska (1965).

In the conditions of Puławy area, flowers of *Monarda hybrida* started to bloom only during the day-time (mainly between 8.00 a.m.-4.00 p.m.). Cruden et al. (1984) described that in North America flowers of related species *M. fistulosa* opened also during the night-time. But the percentage of flowers

opened between 8.00 p.m. and 8.00 a.m. was significantly lower than in any other part of day. The peaks of flower opening for *M. fistulosa* and *M. hybrida* occurred at the same time.

The studied species from the genera of *Mentha* L., *Salvia* L., *Leonurus* L., *Nepeta* L. showed a similar daily pattern of flower buds opening. Only three species from genus *Agastache* differed in their rates of flower opening. All individuals of these species developed flower buds through the whole day, but in the case of *A. rugosa* and *A. nepetoides* this process was the most intensive before noon.

CONCLUSIONS

1. All studied species from *Lamiaceae* family open their flowers during day-time.
2. The species differ from each other in their daily pattern of flower opening: 10 species open flower buds only before noon; 12 species do it almost throughout a day, with the peak between 9.00 a.m. to 2.00 p.m., and the rest (10 species) develop flowers almost regularly from morning till evening.
3. The daily pattern of flower opening is constant for the species but can be modified by unfavourable weather conditions.
4. The species from the same genus (with an exception of *Agastache anethiodora*) showed a similar course of daily dynamics of flower opening.

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STRESZCZENIE

W latach 1995-1997 badano dzienną dynamikę rozkwitania 32 gatunków kwiatów z rodziny *Lamiaceae*. Doświadczenia prowadzono na terenie Instytutu Sadownictwa i Kwiaciarnictwa w Puławach w kolekcji roślin miododajnych.

Stwierdzono, że kwiaty badanych gatunków rozkwitają tylko w dzień, ale ze względu na różny przebieg tego procesu można je podzielić na 3 grupy. Rośliny należące do pierwszej (nr 1-10) charakteryzują się kwiatami rozkwitającymi głównie przed południem, często już od 4 rano, ale najintensywniej między 6 a 10. O tej porze w ciągu jednej godziny otwiera się nawet do 30-40 (50)% pąków sumy dziennej. Kwiaty gatunków następnej grupy (nr 11-22) rozkwitają cały dzień, jednak ze zwiększoną intensywnością między 9 a 14 i wtedy najwyższy procent kwiatów rozwiniętych w ciągu jednej godziny sięga 15-30% dziennej sumy. Pąki roślin ostatniej grupy (nr 23-32) rozkwitają prawie równomiernie od rana do wieczora, a w ciągu jednej godziny otwiera się od kilku do 15% sumy całodziennej. Dzienny przebieg

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rozkwitania kwiatów danego gatunku jest cechą stałą, ale niesprzyjające warunki pogody mogą w pewnym stopniu ten proces modyfikować. Opady i ochłodzenie opóźniały lub prawie całkowicie hamowały rozkwitanie. Natomiast przyspieszone otwieranie pąków, stwierdzono po ciepłej nocy, gdy rano nie wystąpiła rosa.

Różne gatunki z rodzaju: *Mentha* L., *Salvia* L., *Leonurus* L., *Nepeta* L. charakteryzowały się podobnym dziennym rytmem rozkwitania pąków. Jedynie w obrębie trzech gatunków rodzaju *Agastache* wystąpiło pewne zróżnicowanie przebiegu tego procesu.

BOŻENNA JASKIEWICZ

The Number and Growth Dynamics of Aphids on the Bushes of *Chaenomeles japonica* Lindl. in Lublin

Liczba i dynamika rozwoju mszyc na krzewach *Chaenomeles japonica* Lindl. w Lublinie

Abstract. The area under observation was the Academic Park in Lublin (former Botanical Garden), in the years 1994-1996, on the shrubs of *Chaenomeles japonica* Lindl. During the observations three aphid species from the family of Aphididae were found on the shrubs of *Chaenomeles japonica* Lindl: *Aphis penn* De Geer, *A. fabae* Scop. and *Brachycaudus helichrysi* Kalt. Also in June species of *Auracanthia* F. and *Aphis spiraephaga* Müll were found, but only single winged form (then accidental finds). *A. penn* De Geer was the dominating species in the examined years. *A. fabae* Scop. and *B. helichrysi* Kalt were observed in small numbers. Singular aphidophagous could not have had any influence on the population reduction in aphid colonies. The reduced or increased numbers and growth of all aphid species were influenced by the weather conditions (high temperatures 30-35°C, drought and heavy stormy rainfalls). Aphids living on the shrubs of *Chaenomeles japonica* Lindl. caused insignificant damage, which was of no practical importance.