

# Studies on the insect pollination of fruit tree species and on closely related topics in Hungary: a bibliography of research publications

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**Summary:** In the past decades fruit production has become more and more intensive and so the interest towards the bee pollination of fruit trees has increased in Hungary. Thus insect pollination research has become more intensive in the eighties and in the nineties. Recently, high density fruit orchards are planted of dwarf trees at more and more farms in Hungary and these need highly controlled growing practices involving insect pollination, too. This is a new challenge of insect pollination research in Hungary. So it seems to be worth to compile a list on research publications having been appeared so far to create a basis to the ongoing new research. Besides papers strictly on the insect pollination of fruit trees publications on some closely related topics, first of all on the nectar production and on other flower characteristics of fruit tree cultivars that directly influence bee activity have also been included on the list.

## Introduction

Temperate zone fruit tree species require the contribution of pollinating insects to set fruit. Fruit trees, however, start to bloom early spring when no more than the pioneers of the early season solitary wild bees and the overwintered females of bumblebee species founding their colonies are on wing. Accordingly, in big commercial plantations where a great number of trees start to bloom simultaneously the density of wild pollinating insects is always inadequate. For this reason, commercial fruit production always needs the contribution of honeybees as pollinating agents.

This fact, however, has not been evident for a long time and there was a long dispute on this item for decades. Pollination problems arose in those regions of the world first where large commercial orchards were planted but not so much honeybee colonies were available.

In Hungary, this problem has been rather specific because traditionally there is extremely large number of honeybee colonies. The area of the country is some 93.000 square kilometres only and there are as much as some 670.000 honeybee colonies. The number of colonies varies somewhat year by year but it has not been less than 600 thousand and more than 725 thousand for a long time (*Figure 1*). The arable land in the country is some 5.7 million hectares and the total area of fruit orchards (commercial plantations plus large gardens) is some 100.000 ha. Thus

always great many honeybee foragers are available at the blooming fields or plantations of the entomophilous crop plants, however, usually no bee colonies are moved there for supplementary pollination.

The honeybees are usually kept in small apiaries well distributed in the settlements over the country. Since the villages and the small towns are fairly close to each other at most regions of Hungary the apiaries are fairly evenly distributed throughout the country and the honeybee foragers of their bee colonies usually densely populate the flowering entomophilous crop fields and plantations around and between the settlements. When the fruit trees are in bloom early spring not so much honey plants are available to honeybees and, therefore, great many honeybees are visiting blooming fruit trees in big plantations and in gardens, too. Thus the density of honeybees has usually been adequate for the pollination of fruit orchards and so the fruit growers have failed to recognise the role of honeybees in the fruit set of orchards for a long time. For this reason the presence of bees was a natural condition in fruit orchards and no fruit growers had to worry about it. Accordingly, research of the insect pollination of fruit trees in Hungary has not been encouraged by the growers and so it started in the seventies only.

In the past decades fruit production has become more and more intensive and so the interest towards the bee pollination of fruit trees has increased. Thus insect

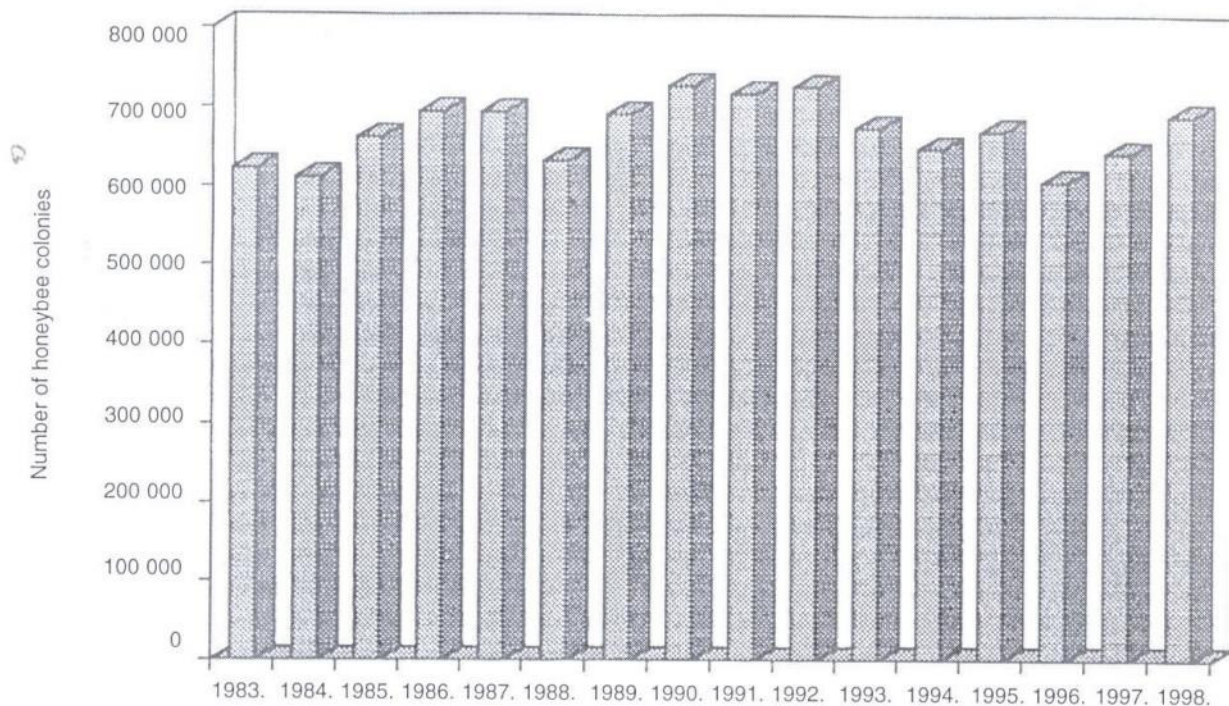


Figure 1 The number of honeybee colonies in Hungary during the past 15 years

pollination research has become more intensive in the eighties and in the nineties. Recently, high density orchards are planted of dwarf trees at more and more farms in Hungary and these need highly controlled growing practices involving insect pollination, too. This is a new challenge of insect pollination research in Hungary. So it seems to be worth to compile a list on research publications having appeared so far to create a basis to the ongoing new research.

Bee pollination of fruit trees is related to a number of research topics. Accordingly, beside papers dealing strictly with the insect pollination of fruit trees publications on some closely related topics, first of all papers on the nectar production and on other flower characteristics of fruit tree cultivars directly influencing bee activity have also been included in the list but other papers, namely publications on the structure of the flowers of fruit tree species in general, on the functioning of sexual organs of the flowers, on the fertility conditions and the compatibility of fruit tree cultivars as well as the papers on the blooming process of fruit tree species or cultivars have been excluded.

It is important to say that technical papers and abstracts of presentations have not been considered when compiling the list. Nothing else but the research papers and textbooks as well as chapters on insect pollination of scientific books have been included on the list below. Unfortunately, there is a large number of publications that appeared in Hungarian and so it is rather difficult to read them by others than Hungarians but fortunately almost all of the research papers in Hungarian have been completed with an enlarged abstract in English and also the tables and the figures have captions in English, too.

## I. Books and chapters in books

**Benedek P, Manninger S. & Virányi S. (1974):** Megporzás mézelő méhekkel (Pollination of crops by honeybees). Mezőgazd. Kiadó, Budapest, 194 pp. (In Hungarian) (*chapters on the bee pollination of apple, pear, sour cherry*)

**Benedek P. (1980):** A gyümölcsfák rovarmegporzása (Insect pollination of fruit trees). In: Nyéki J. szerk.: Gyümölcsfajták virágzásbiológiája és termékenyülése. Mezőgazd. Kiadó, Budapest:101–110. (In Hungarian) (*bee pollination of fruit trees in general*)

**Benedek P. (1983):** A méhészet és a mezőgazdasági növénytermesztés (Beekeeping and crop production in agriculture). In: Nikovitz A. szerk.: A méhészet kézikönyve. ÁTK-Hungaronektár, Budapest, 2: 577–662, 666–672. (In Hungarian) (*bee pollination of fruit trees in theory and practice*)

**Benedek P. (1996):** Insect pollination of fruit crops. In: Nyéki J.–Soltész M. szerk.: Floral biology of temperate-zone fruit trees and small fruits. Akad. Kiadó, Budapest: 287–340.

**Benedek, P. (1997):** Rovarmegporzás (Insect pollination: fruit trees). In: Soltész, M. szerk.: Integrált gyümölcstermesztés, Mezőgazda Kiadó, Budapest: 359–364. (In Hungarian) (*background and techniques of supplementary bee pollination in fruit orchards*)

**Péter J. (1975):** (Fruit trees and shrubs). In: Halmágyi, L. & Keresztesi, B. editors: A méhlegelő (Honey plants). Akadémiai Kiadó, Budapest, 460–500. (In Hungarian) (In Hungarian) (*the nectar production of fruit trees and shrubs*)

## II. Research papers

### I. Nectar production of flowers

- Benedek P., Kocsisné Molnár G. & Nyéki, J. (2000):** Nectar production of pear (*Pyrus communis* L.) cultivars. *Internat. J. Horticultural Science*, 6 (3): 67–75.
- Benedek P., Szabó T. & Nyéki, J. (2000):** Nectar production of quince (*Cydonia oblonga* Mill.) cultivars. *Internat. J. Horticultural Science*, 6 (3): 87–94.
- Bordács M.M., Botz L., Orosz-Kovács Zs. & Kerek M.M. (1995):** The composition of nectar in apricot cultivars. *Acta Horticulture*, 384: 367–371.
- Farkas Á. & Orosz-Kovács Zs. (1992):** Continuous and discontinuous nectar secretion in some peach cultivars. *Internat. J. Horticultural Science*, 6 (3): 77–79.
- Nyéki J., Szabó Z., Benedek P. & Szalay L. (2000):** Nectar production and pollination in peach. *Internat. J. Horticultural Science*, 6 (3): 123–126. (See also the effect of honeybees on the fruit set and the yield)
- Orosz-Kovács Zs. (1990):** A nektártermelés periodicitása és a termékenyülés kapcsolata a Pándy-meggy klónoknál (Periodicity of nectar production and its relations to the fertilisation of the clones of sour cherry 'Pándy'). *Kertgazdaság*, 22(5): 24–31. (In Hungarian with English summary)
- Orosz-Kovács Zs. (1992):** A Pándy meggy 48-as klón virágainak nektárszekréciós ritmusa (Rhythm of nectar secretion in flowers of sour cherry cv. 'Pándy', clone No. 48). *Kertgazdaság*, 24 (In Hungarian with English summary)
- Orosz-Kovács Zs. (1992):** A florális szekréció endogén ritmusának funkciója a cseresznyefajták megporzásában (Role of endogenous rhythm of floral secretion in pollination of sweet cherry cultivars). *Kertgazdaság* 24(4): 47–54. (In Hungarian with English summary)
- Orosz-Kovács Zs. (1993):** Pollination strategies in sweet and sour cherry cultivars. *Acta Horticulturae*, 410: 455–462.
- Orosz-Kovács Zs. & Apostol, J. (1993):** Structure of the nectary and yield in sweet cherry cultivars. *Acta Horticulturae*, 410: 467–470.
- Orosz-Kovács Zs., Faust M., Nyujtó F. & Erdős Z. (1993):** New considerations for cultivar combinations in sour cherry. *Acta Horticulture*, 410: 527–535.
- Orosz-Kovács Zs. & Gulyás S. (1989):** Floral nectaries and nectar production of our cherry cv. "Pándy" clones. *Acta Bot. Hung.* 35 (1–2): 227–236.
- Orosz-Kovács Zs., Gulyás S. & Halászi Zs. (1989):** Periodicity of nectar production of sour cherry cv. "Pándy". *Acta Bot. Hung.* 35(1–2): 237–244.
- Orosz-Kovács Zs., Gulyás S. & Inhof L. (1987):** Regularities in nectar production of sour cherry cv. Pándy 31. Working Papers, 59–72.
- Orosz-Kovács Zs., Gulyás S., Sötét F. & Horváth Sz. (1988):** Periodicity of nectar production of sour cherry cv. "Pándy 114". Working Papers, 297–309.
- Orosz-Kovács Zs., Nagy Tóth E., Csatos A. & Szabó A. (1990):** A nektárium szerkezet és a nektártermelés összefüggése néhány almafajtánál (Relation between nectary structure and nectar production in some apple cultivars). *Bot. Közlem.*, 77(1–2): 127–132. (In Hungarian with English summary)

**Orosz-Kovács Zs., Nyujtó F. & Kerek M.M. (1995):** The role of floral nectar production in fertility of apricot cultivars. *Acta Horticulture*, 384: 361–366.

**Orosz-Kovács Zs., Szabó L. Gy., Bubán T., Farkas Á. & Bukovics P. (2000):** Sugar composition of floral nectar in sour cherry. *Internat. J. Horticultural Science*, 6 (3): 109–113.

**Orosz-Kovács Zs., Szabó L. Gy., Szabó T., Botz L., Bubán T., Majer-Bordács M. & Nagy-Tóth E. (1997):** Sugar components and refraction of the floral nectar in apple cultivars. *Horticultural Science*, 29.(3–4): 123–128.

**Péter J. (1972):** A gyümölcsfák mézelési értékelése nektártermelésük alapján (The value of fruit trees as honey plants). *Agrártud. Egyetem Keszthely, Mosonmagyaróvári Mg. Kar Növénytan és Növényélettani Tanszék Közl.*, 8: 5–35. (In Hungarian with German summary)

### 2. Flower characters of cultivars affecting bee pollination

- Benedek P. & Nyéki J. (1994):** A comparison of flower characters affecting bee pollination of temperate zone fruit trees. *Horticultural Science*, 26(2): 32–37. (See also for nectar production!)
- Benedek P. & Nyéki J. (1996):** Pollinating efficiency of honeybees on apple cultivars as affected by their flower characteristics. *Horticultural Science*, 28: (1–2): 40–47. (See also for nectar production!)
- Benedek P. & Nyéki J. (1996):** Studies on the bee pollination of peach and nectarine. *Acta Horticulturae*, No. 374: 169–176. (See also for nectar production!)
- Benedek P., Nyéki J. & Szabó Z. (1990):** Cseresznye és meggyfajták méhmegporzást befolyásoló tulajdonságai (Variety features affecting bee pollination of sweet and sour cherries). *Kertgazdaság*, 22(5): 1–23. (In Hungarian with English Summary) (See also for nectar production!)
- Benedek P., Nyéki J. & Szabó Z. (1991):** őszibarack fajták méhmegporzást befolyásoló tulajdonságai (Variety features affecting bee pollination of peach and nectarine). *Kertgazdaság*, 23(1): 40–58. (In Hungarian with English Summary) (See also for nectar production!)
- Benedek P., Nyéki J. & Szabó Z. (1991):** Kajszi fajták méhmegporzást befolyásoló tulajdonságai. *Kertgazdaság*, 23(2): 27–39. (Variety features affecting bee pollination of apricot trees) (In Hungarian with English Summary) (See also for nectar production!)
- Benedek P., Nyéki J. & Szabó Z. (1995):** Bee pollination of apricot: variety features affecting bee activity. *Acta Horticulturae*, No. 384: 329–332. (See also for nectar production!)
- Benedek P., Nyéki J. & Szabó Z. (1996):** Features affecting bee pollination of sweet and sour cherry varieties. *Acta Horticulturae* 410: 121–126.
- Benedek P., Soltész M., Nyéki J. & Szabó Z. (1989):** Almafajták virágainak rovarmegporzást befolyásoló tulajdonságai (Variety features affecting insect pollination of apple flowers). *Kertgazdaság*, 21(6): 41–64. (In Hungarian with English Summary) (See also for nectar production!)
- Benedek P., Szabó Z. & Nyéki J. (1994):** The activity of honeybees in plum orchards, their role in pollination and fruit set. *Horticultural Science*, 26(1): 20–22. (See also for nectar production!)

- Davary-Nejad, G.H., Szabó Z., Nyéki J. & Benedek P. (1993):** Almafajták virág-tulajdonságai és méhmegporzása (Flower characteristics and bee-pollination of some apple varieties). *Kertgazdaság*, 25 (2): 72–88. (In Hungarian with English Summary) (*See also for nectar production!*)
- Dibuz E., Benedek P., Soltész M. & Nyéki J. (1997):** Bee visitation and fruit set of pear as affected by the opening sequence of flowers in the inflorescence. *Horticultural Science*, 29 (3–4): 129–136.
- Dibuz E., Benedek P., Soltész M. & Nyéki J. (1998):** Relationship between the type of inflorescence and the bee pollination of pear cultivars. *Acta Horticulturae*, 475: 223–229.
- Kocsis M.G., Nyéki J. & Szabó Z. (1994):** Pollen production of apple and stone fruit varieties. *Horticultural Science* 26/2:16–32.
- Surányi, D. (1977):** Cseresznye- és meggyfajták virágszerveződése (Flower organisation of sweet and sour cherry varieties). *Bot. Közlem.*, 64: 259–265. (In Hungarian with English Summary)
- Surányi, D. (1992):** Floral morphological characteristics of Hungarian apricot varieties. *Acta Horticulturae*, 293: 303–309.
- Surányi, D. (1992):** Újabb eredmények a kajszibarack fajták virágmorfológiai kutatásaiban (New results in flower morphologic researches of apricot varieties). *Kertgazdaság* 24 (4): 36–46. (In Hungarian with English Summary)
- Surányi, D. & Tóth, E. (1977):** Szilvafajták porzószámának vizsgálata (Investigation of stamen number in some plum varieties). *Kertgazdaság*, 9: 41–51. (In Hungarian with English Summary)
- Szabó Z., Nyéki J. & Benedek P. (1989):** A mézelő méhek tevékenysége szilvafákon, szerepük a megporzásban és a gyümölcskötődésben (The activity of honey bees in plum trees, their role in pollination and fruit set). *Kertgazdaság*, 21 (1): 53–70. (In Hungarian with English Summary) (*See also for nectar production!*)
- Benedek P., Ruff J. & Nyéki J. (1997):** Honeybee visitation of pear cultivars. *Horticultural Science*, 29 (1–2): 98–102.
- Benedek P. & Nyéki J. (1997):** Considerations on the nectar production and the honeybee visitation of fruit tree flowers. *Horticultural Science*, 29 (3–4): 117–122. (*See also for nectar production!*)
- Benedek P., Ruff J. & Nyéki J. (1998):** Comparison of honeybee visitation of pear cultivars. *Acta Horticulturae*, 475: 429. (*See also for nectar production!*)
- Benedek P., Szabó T. & Nyéki, J. (2000):** Honeybee (*Apis mellifera L.*) visitation at the flowers of quince cultivars (*Cydonia oblonga Mill.*). *Internat. J. Horticultural Science*, 6 (3): 95–102.
- 3. Honeybee activity at the flowers**
- Benedek P. (1977):** Bestäubung der Pflanzen durch Insekten: Überblick der Untersuchungen in Ungarn. In: Harnaj, V. – Keresztesi B. – Rupp K. editors: *Nektarflora – Grundlage der Bienenzucht*. Apimondia Verlag, Bukarest: 61–66. (apple and sour cherry pollination by bees)
- Benedek P. & Martinovich V. (1971):** A meggy rovarmegporzásának néhány kérdése (Some questions of insect pollination in sour-cherry). *Kertgazdaság*, 3: 37–42. (In Hungarian with English Summary)
- Benedek P. & Nyéki J. (1995):** Role of bee pollination in the fruit set and yield of self-fertile and self-sterile apple, sour cherry and plum cultivars. *Horticultural Science*, 27: (3–4): 34–37.
- Benedek P. & Nyéki J. (1996):** Relationship between the duration of insect pollination and the yield of some apple cultivars. *Horticultural Science*, 2(3–4): 93–96.
- Benedek P. & Nyéki J. (1996):** Fruit set of selected self-sterile and self-fertile fruit cultivars as affected by the duration of insect pollination. *Acta Horticulturae*, No. 423: 57–63.
- Benedek P. & Nyéki J. (1997):** Yield of selected apple cultivars as affected by the duration of bee pollination. *Acta Horticulturae*, No. 437: 207–211.
- Benedek P., Nyéki J., Soltész M., Erdős Z., Skola I., Szabó T., Amtmann I., Bakcsa F., Kocsisné Molnár G., Vadas Z. & Szabó Z. (2000):** The effect of the limitation of insect pollination period on the fruit set and yield of temperate-zone fruit tree species. *Internat. J. Horticult. Science*, 6(1): 91–95.
- Benedek P., Nyéki J., Amtmann I., Bakcsa F., Iváncsics J., Erdős Z. & Skola I. (2000):** The effect of spring frosts on the nectar production and the bee visitation of fruit trees. *Internat. J. Horticult. Science*, 6 (1): 86–89.
- Benedek P., Martinovich V. & Dévai Gy. (1972):** Megporzási kísérletek háziméhekkel almagyümölcsösökben. *Kertgazdaság*, 4(4): 51–58. (In Hungarian with English Summary)
- Benedek P., Nyéki J. & Lukács Gy. (1989):** A méhmegporzás intenzitásának hatása az alma kötődésére és termésére (Effect of intensity of bee pollination on the fruit set and yield of apple trees). *Kertgazdaság*, 21 (3): 8–26. (In Hungarian with English Summary)
- Farkas J. (1981):** Méhes megporzás meggyültetvényben (Pollination of sour cherry by honey-bees). *Kertgazdaság*, 12(5): 15–29. (In Hungarian with English Summary)
- Soltész M., Nyéki J. & Benedek P. (1998):** The selection and the arrangement of pollinizer cultivars in pear plantations. *Acta Horticulturae*, 475: 431.
- 5. Flower constancy of honeybees to fruit tree flowers and the effect of competing plants on their activity**
- Benedek P., Béres I. & Nyéki J. (1998):** Competition between pear flowers, flowering weeds and other fruit trees for honeybee pollination. *Acta Horticulturae*, 475: 417–426.
- Benedek P. & Nagy Cs. (1996):** Flower constancy of pollinating honeybees on some fruit tree species. *Acta Horticulturae*, No. 423: 65–71.
- Benedek P., Ruff J., Nagy Cs. & Nyéki J. (2000):** Flower constancy of honeybees (*Apis mellifera L.*) to blooming pear plantations. *Internat. J. Horticultural Science*, 6 (3): 81–85.
- 6. Supplementary bee pollination techniques**
- Benedek P., Soltész M. & Nyéki J. (1990):** Az alma irányított méhmegporzásának alapjai és üzemi technológiája (Technology for honeybee pollination to apple orchards). *Kertgazdaság*, 22(1): 1–19. (In Hungarian with English Summary)
- Benedek P., Soltész M. & Nyéki, J. (1997):** The effect of the distance of the pollinizer variety and the size of single cultivar blocks on the yield of the main cultivar in pear plantations. *Horticultural Science*, 29 (3–4): 141–143.

**Farkas J. & Szalai Z. (1980):** Méhes megporzás a kertészeti termelésben (Bee pollination in the horticultural production) *Kertgazdaság*, 12 (6): 53–62. (In Hungarian with English Summary)

**Ludányi I. (2000):** Overwintering capability and spring population size of honeybee (*Apis mellifera L.*) in Hungary. *Internat. J. Horticultural Science*, 6 (3): 153–156.

**Szalai Z. (1990):** A pollenkitt szerepe a megporzásban (The role of pollenkitt in pollination). *Bot. Közlem.*, 77 (1–2): 59–73. (In Hungarian with English Summary)

**Szalai Z. (1990):** Pollen és pollenkitt extraktumok attraktivitási vizsgálata mézelő méhekkel (Examination the attractiveness of extract from pollen and pollenkitt with honeybees). *ATK ÁKI*

*Közleményei (Gödöllő)*: 234–238. (In Hungarian with English Summary)

**Szalai Z. (2000):** Application of pollen mixing device in front of the hive entrance. *Internat. J. Horticultural Science*, 6 (3): 151–152.

**Szalai Z. (2000):** Differences of pollen and pollenkitt attractiveness of some cultivated and ornamental apples for honeybees. *Internat. J. Horticultural Science*, 6 (3): 145–150.

**Szalai Z., Farkas J. & Barnabás B. (1983):** Egyes almafajták pollenjének tárolása mélyhűtéssel, termékenyítő képességük megőrzésével (Storage of pollen of some apple varieties by deep freezing). *ATK ÁKI Közleményei (Gödöllő)*, 1983: 371–374. (In Hungarian with English Summary)