



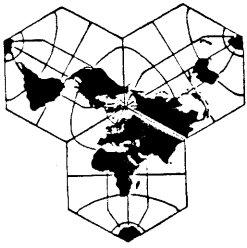
Eva Crane Trust

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Honeydew sources and their honeys

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HONEY SOURCES SATELLITE 5.

HONEYDEW SOURCES AND THEIR HONEYS

by Eva Crane and Penelope Walker

London 1986

International Bee Research Association

GENERAL INTRODUCTION TO HONEY SOURCES SATELLITES

The "Directory of important world honey sources" by Eva Crane, Penelope Walker and Rosemary Day was published by the International Bee Research Association in 1984, with financial support from the International Development Research Centre, Ottawa. This Directory, and the database from which it was produced, contain much concentrated information which will be of value to certain specialists. IBRA is therefore publishing a series of Honey Sources Satellites on topics of special interest, giving information extracted from the database.

Satellites 1 and 2 are relevant to the whole database. Satellite 1 will be especially useful to readers using Satellites 3-6 who do not have access to the 1984 Directory, and Satellite 2 also to botanists and others concerned with the plant origins of honeys.

Titles of the Honey Sources Satellites are:

1. Bibliography (with author reference codes); country codes; other abbreviations
2. Plants listed alphabetically and by family; common name index; pollen grain information
3. Chemical composition of some honeys
4. Physical properties, flavour and aroma of some honeys
5. Honeydew sources and their honeys
6. Drought-tolerant and salt-tolerant honey sources.

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1. INTRODUCTION

Section 2 gives printouts from the 1984 Directory for 15 important world sources of honey which is derived entirely from honeydew. Entries in the Directory for 23 of the sources of nectar honey show that these may also yield honeydew, and Section 3 here gives information on their honeydew production. Eight are considered to be important sources of honeydew honey (013, 014, 080, 354, 363, 364, 410, 415). Haragsim (1966) gave ratings to the importance of certain honeydew honey sources, and his highest rating is entered here as **D1**.

Section 4 provides an index to the 49 insects known to us as producing honeydew from the plants in Sections 2 and 3, together with some of their synonyms.

Section 5 discusses honeydew flows and honeydew honeys, with a useful summary Table.

The author reference codes in Sections 2 and 3 lead to the full references in the Bibliography, published in both the Directory and Satellite 1. Data for which no reference is given are from the last reference quoted. The 3-letter codes used for country names, e.g. FRA for France, and the 2-letter codes for languages, e.g. It for Italian, are also listed in the Directory and in Satellite 1.

2. COMPLETE PRINTOUTS FOR IMPORTANT PLANT SOURCES OF HONEYDEW HONEY

Old *Abies alba* Miller; Pinaceae

syn *Abies pectinata* (Lam.) DC.

silver fir; Edeltanne, Weisstanne (De); abete bianco (It)
Tree, <50 m, evergreen

Distribution temperate Europe. **Habitat** forests in mountainous areas of EUR; altitudes >500 m; widely planted in EUR; areas with atmospheric pollution not suitable

Soil deep moist soil preferred. **Rainfall** not drought tolerant

Economic and other uses

Timber. Land use amenity

Alert to beekeepers

Honey from *Cinara pectinatae* granulates v rapidly in combs, difficult to extract (FRA, Bab/56)

Honeydew

From *Cinara confinis* (Koch), previously *Todolachnus abieticola* (Cholodkovsky) and *T. confinis* (Koch), Lachnidae: flow viii-ix, "important to beekeepers" in parts of Black Forest, Alps, and on North Sea coast, honeydew analysis (mid EUR, Klo/65); flow (ROM, Cir/80); flow but not every yr (YUG, Rih/77)

From *Cinara pectinatae* (Nordlinger), previously *Buchneria pectinatae* Nordlinger, Lachnidae: rated D1, flow vii-ix (mid EUR, Hag/66); flow vii-x, very heavy in some yrs (mid Eur, Klo/65); yield "v important" (FRA, Bab/56); honey potential 40 kg/ha (ROM, Cir/80); yield 60-90 kg/colony/yr (SWI, Scd/50); flow vii-viii, yield 19 kg/colony/yr (YUG/Slovenia, Rih/77); honeydew analysis (Bab/56; Hag/66; Klo/65)

From *Cinara pilicornis* (Hartig), previously referred to as *Cinara piceicola* (Cholodkovsky), Lachnidae: rate of flow at 25° is twice that at 15°, but is reduced by direct sunlight and other factors (south-west GFR, Eck/72)

From *Mindarus abietinus* Koch, Thelaxidae: flow may be heavy, honeydew "thin", honey yield reported May 1957 (?GFR, Klo/65). Some records of honeydew "poisoning" of bees may relate to this insect

From *Physokermes piceae* (Schrank), Coccidae: flow mid-iv to early vii, coincides with heavy nectar flow from other plants, so not fully used by bees (mid EUR, Klo/65)

Insect not specified: mean honey yield 40-45 kg/colony/yr, mean honey potential 58.4, max 96 kg/ha (1968-1974, AUT, Peh/77); yield unspecified (GRE, Ric/80); "appreciable" (ITA/Apennines, Ric/78); honey potential 20 kg/ha (ROM, Apc/68); honey safe as winter food for bees (ROM/Muresh, Magyar, Fra/65); yield unspecified (TUQ, Ric/80); "much in some yrs" (YUG, Kul/59)

Honey: chemical composition

Water [low] 16.1%, 14.2% (insect not specified, AUT, GFR, Kir/61)
Sugars (insect not specified, ITA, Bat/73): **glucose** [medium] 36.90%; **fructose** [low] 33.86%; **sucrose** [low] 0.40%; **maltose** 9.05%; **isomaltose** 1.45%; **trehalose** 4.88%; **gentiobiose** 0.64%; **raffinose** 1.57%; **melezitose** 8.10%. **Dextrin** 2.98%, 4.45% dry wt (Kir/61)
Ash 1.14%, 1.01% dry wt (Kir/61)
pH 4.78, 4.96 (Kir/61)
Sucrase high (Vor/68)
Amino acid analysis (GFR, Kum/74). **Colloids** 0.31%, 0.24% dry wt (Kir/61)

Honey: physical and other properties

Colour, from *Cinara pectinatae*: black-brown with greenish tinge (mid EUR, Klo/65); white, yellow or brown (in combs, FRA, Bab/56); insect not specified: dark green (AUT, Kir/61; YUG, Kul/59); khaki green (GFR, Kir/61); v dark, often slightly greenish (ITA, Ric/78)
Optical rotation +2.89 deg (Bat/73); +9.55, +2.87 deg (insect not specified, AUT, GFR, Kir/61)
Granulation (alert to beekeepers) v rapid, in combs, difficult to extract (from *Cinara pectinatae*, FRA, Bab/56); rapid (YUG, Kul/59); none, or irregular (ITA, Ric/78); medium, becoming more green (GFR, Vor/68)
Flavour of treacle (AUT, Kir/61); v sweet (GFR, Kir/61); mild to resinous (aromatic) (GFR, Vor/68); "tonic" (ITA, Ric/78)

02D Abies borisii-regis Mattf.; Pinaceae

Tree, <60 m, evergreen; probably of hybrid origin, form variable
Distribution temperate (Med) Europe. **Habitat** mountains of Balkans

Honeydew

From ***Eulecanium sericeum*** (Lindinger), Coccidae: insect population small, so honey yield low; flow x-vii, but bees collect honeydew only v-vii (GRC/Tymphrystos, San/81)
 From ***Mindarus abietinus*** Koch, Thelaxidae: of minor importance, flow late spring to early summer (GRC/Iti, Tymphrystos, San/81). Some records of honeydew "poisoning" may relate to this insect
 From ***Physokermes hemicryphus*** Dalman, Coccidae: the main contributor, giving "abundant" secretion for which hives are migrated to forests; 5-10% of total honey production in Greece is from this insect on *Abies borisii-regis* and *A. cephalonica*(03D); flow late v to early vii (GRC/Eperos, Macedonia, Thessaly, San/81)

Honey no data

03D Abies cephalonica Loudon; Pinaceae

Greek fir

Tree, <30 m, evergreen

Distribution temperate (Med) Europe. **Habitat** mountainous areas of GRC; cultivated in ITA**Economic and other uses****Timber.** Land use afforestation**Honeydew****Honeydew** produced by the same insects as on *Abies borisii-regis* (02D). For *A. cephalonica*, insect distributions in Greece are: **Eulecanium sericeum** Parnis, Parnon; **Mindarus abietinus** central, Parnis, Iti, Tymphrystos; **Physokermes hemicryphus** central, Evia, Kephalaria, Peloponnessus (San/81)**Honey** no data**04D Calocedrus decurrens (Torr.) Florin; Cupressaceae**syn *Libocedrus decurrens* Torr.

California incense cedar, white cedar (En/USA)

Tree, 21-30 m, evergreen

Distribution subtropical N America; temperate N America, Europe.**Habitat** higher altitudes, mountains of USA/CA,OR; atmospheric pollution not tolerated**Soil** moist, well drained soil preferred. **Temperature** fully hardy**Economic and other uses****Timber.** Land use amenity**Honeydew**From **Xylococcus macrocarpi** (Coleman), Coccoidea: 45-136 kg/colony/yr; flow abundant at times, early summer onwards; honeydew v "gummy", colour amber but white in xi (USA/CA,OR, Pel/76)**Honey: chemical composition****Water** [low] 12.2, 15.2% (2 samples, age 9, 18 mths, insect not specified, USA/CA, Whi/62)**Glucose** [low] 23.34, 27.94%. **Fructose** [low] 23.91, 26.22%.**Sucrose** [low] 0.83, 0.74%. **Maltose** 5.85, 6.08%. **Higher sugars** 11.50, 8.70%**Ash** [high] 1.097, 1.047%**pH** 4.42, 4.71. **Total acid** 76.49, 56.08 meq/kg. **Free acid** [high] 66.02, 49.91 meq/kg. **Lactone** 10.47, 6.16 meq/kg**Nitrogen** 0.049, 0.047%

Honey: physical and other properties

Pfund 104 to >114 mm, amber to dark amber (insect not specified, USA/LA, Whi/62)

Viscosity "heavy body" (USA, Pel/76)

Granulation slow

Flavour bland

05D Fagus sylvatica L.; Fagaceae

beech, red beech; Rotbuche (De); faggio (It)

Tree, <30 m, deciduous; monoecious

Distribution temperate Europe; native to Europe. **Habitat** woodland; mountains; widely planted

Soil well drained; lime tolerated. **Temperature** hardy

Economic and other uses

Fodder - nuts for pigs. **Timber.** **Land use** amenity

Honeydew

From **Lachnus pallipes** (Hartig), previously *L. exsicicator* Altum, and *Schizodryobius pallipes* Hartig, Lachnidae: honeydew produced, amino acid analysis reported (assumed to be *F. sylvatica*, GFR, Kum/74); honeydew produced (ROM, Cir/80)

From **Phyllaxis fagi** (L.), Callaphididae: rated **D1**, flow v-vii (mid EUR, Hag/66); flow heaviest in v, early vi (mid EUR, Klo/65); also reported for ROM (Cir/80); honeydew v waxy, more attractive to bees after rain (mid EUR, especially AUT, Klo/65)

Insect not specified: "yield obtained from time to time" (ITA/- Central Apennines, Ric/78)

Honey no data

06D Larix decidua Miller; Pinaceae

syn *Larix europaea* DC.

larch; europäische Lärche (De); larice (It)

Tree, <35 m, deciduous

Distribution temperate Europe, Asia. **Habitat** mountainous areas of EUR, especially Alps and W Carpathians; widely planted

Soil well drained light or gravelly loam preferred; wet low-lying areas not tolerated

Economic and other uses

Timber. **Land use** afforestation, amenity. **Other uses** tannin from bark; medicinal; turpentine from resin

Alert to beekeepers

Honeydew and honey may granulate v rapidly, on tree or in combs (Klo/65; Mal/79; Ric/78)

Honeydew

From *Cinara cuneomaculata* (del Guercio), previously *C. boernerii* Hille Ris Lambers, and *C. laricicola* Börner, Lachnidae: rated **D1**, flow v-viii (mid EUR, Hag/66); "important", flow vi (or vii)-x, honeydew analysis (mid EUR, Klo/65)

From *Cinara kochiana* (Börner), previously *Laricaria kochiana* (Börner), Lachnidae: flow from late vi to autumn, visited by bees (mid EUR, Klo/65)

From *Cinara laricis* (Hartig), previously *Lachnus muravensis* Arnhart, and *Lachniella nigrotuberculata* del Guercio, Lachnidae: honeydew analysis (CZE, Hag/63); "probably main honeydew producer on larch", flow heavy vi, also late viii to x, honeydew may granulate on tree due to high melezitose content (mid EUR, Klo/65), then called manna; honey yield obtained, honeydew analysis (ITA, Mal/79)

Insect not specified: crystallized honeydew contained (% dry wt) - 53.36% melezitose, 53.36% [sic] sucrose, 13.94% invert sugar, 30.03% dextrin (AUT, Goa/52); honeydew produced (FRA, Lou/81); "a main honey source" (Germany, How/79); honey yield "rather scarce" (ITA/Alps, Apennines, Ric/78)

Honey: chemical composition

Glucose 15.94, 13.70% (dry wt, 2 samples, *Cinara laricis*, ITA/W Alps, Mal/79). **Fructose** 29.18, 24.33%. **Sucrose** 0.73, 4.16%. **Meso-inositol** 0.05, 0.06%. **Turanose** 2.49, 1.29%. **Raffinose** 2.13, 2.00%. **Melezitose** 44.47, 42.76%; "high" (*Cinara cuneomaculata*, mid EUR, Klo/65)

Honey: physical and other properties

Granulation (alert to beekeepers) v rapid, in combs (from *C. laricis*, Klo/65; Mal/79; Ric/78); colour then white (Mal/79)

07D *Nothofagus solandri* var. *cliffortioides* (Hook. f.) Poole;**Fagaceae**

mountain beech (En/NEZ)

Tree, <15 m, shrub in subalpine belt, monoecious

Distribution temperate Oceania; native to NEZ, South Island.

Habitat montane and subalpine forests, scrub (NEZ)

Economic and other uses

Timber

Honeydew

From **Ultracoelostoma assimile** (Maskell), Margarodidae: estimated honey yield 60 kg/colony/yr (Bet/79); abundant flow in late summer and autumn, honey safe (and often used as) winter food for bees (Coo/81).

About 30 species of scale insects are found on *Nothofagus* spp, and many secrete honeydew which may contribute to beech honeydew honey (Wao/79)

Honey: chemical composition

Water [medium] 19% (beech honeydew honey, plant and insect not specified, NEZ, Dal/75)

Sugars, total 64%. **Fructose** [medium] 35.6%. **Sucrose** [medium] 1%. **Reducing sugars** [low] 63%

Ash [low] 0.79%

Free acid [medium] 32 meq/kg

Amylase 20. **HMF** 0 ppm

Honey: physical and other properties

Colour brown (beech honeydew honey, Dal/75)

Flavour distinctive (Coo/81). **Aroma** strong (Dal/75)

08D *Picea abies* (L.) Karsten; Pinaceae

syn *Picea excelsa* (Lam.) Link; *Picea vulgaris* Link

Norway spruce; Fichte, Rottanne (De); abete rosso (It)

Tree, <60 m, evergreen

Distribution temperate Europe; native to Europe. **Habitat** widely planted as forest tree in N, W and C Europe; often in mountainous districts

Economic and other uses

Food - alcoholic drink from fermented shoots, lvs. **Timber**.

Land use afforestation, amenity. **Other uses** resin purified for pitch; turpentine from shoots, lvs; tannin from bark; when young, sold for Christmas trees

Honeydew

From ***Cinara costata*** (Zetterstedt), previously *Lachniella costata* (Zetterstedt), Lachnidae: heavy flow in some yrs, but only one report of bees flying directly to this source (mid EUR, Klo/65)

From ***Cinara piceae*** (Panzer), previously *Mecynaria piceae* (Panzer), Lachnidae: up to 15 kg/colony/yr; with *Physokermes piceae* reported to be "most important source" on *P. abies* in Alps; flow 3-6 days in vii or viii, almost every yr (mid EUR, Klo/65)

From **Cinara pilicornis** (Hartig), previously referred to as *C. piceicola* (Cholodkovsky), Lachnidae: rated **D1**, flow vi-viii (mid EUR, Hag/66); "important" in S, mid and N GFR, flow from late v to vii, honeydew analysis (Klo/65); factors affecting secretion (Ecl/72)

From **Cinara pruinosa** (Hartig), previously *C. bogdanowi* (Mordvilko), Lachnidae: rated **D1**, flow vi-viii (mid EUR, Hag/66)

From **Physokermes hemicryphus** Dalman, Coccidae: honey yield 3.2-42.8 kg/colony/yr, "the most important honeydew producer of mid EUR", flow from early vi to early vii (AUT, Peh/76); rated **D1**, flow vi-vii (mid EUR, Hag/66); honey yield up to 39 kg/colony/yr, flow late v to mid vii, honeydew analysis (mid EUR, Klo/65); honeydew analysis (Hag/63)

From **Physokermes piceae** Schrank, Coccidae: flow mid-iv to mid-vi coincides with main nectar flow, so not fully used by bees; honeydew analysis (mid EUR, Klo/65); but important in Alps (see under *Cinara piceae*, Klo/65); heavy flow, collected by bees, gains of up to 4 kg/day per hive, water content of honeydew 14% (GFR, Got/51); honeydew analysis (Hag/63)

Insect not specified: honey potential 100-500 kg/ha (EUR, Nee/78); honeydew produced: (FRA, Lou/81); mean honey yield 40 kg/colony/yr (Germany, Pel/76); "rather scarce" (ITA/Alps, Ric/78); flow vii-viii (NOW, Lun/71); honey potential: 20 kg/ha (ROM, Apc/68); 50 kg/ha (ROM, Cir/80). Honey safe as winter food for bees (ROM, Fra/65)

Honey: chemical composition

Water [medium] 17.4% (insect not specified, AUT, Kir/61)

Reducing sugars 76.9% dry wt. **Dextrin** 3.57% dry wt

Ash 0.85% dry wt

pH 4.74

Colloids 0.24% dry wt. **Amino acid analysis** (insect not specified, GFR, Kum/74)

Honey: physical and other properties

Colour dark red brown (from *Cinara piceae*), reddish (from *C. pilicornis*), reddish brown (from *Physokermes hemicryphus*) (mid EUR, Klo/65); buff (insect not specified, AUT, Kir/61); greenish black (insect not specified) (SWI, Pel/76)

Optical rotation +3.48 deg (AUT, Kir/61)

Granulation slow (from *C. piceae*), slow (from *C. pilicornis*) (Klo/65)

Flavour fairly sweet (AUT, Kir/61)

09D Pinus halepensis Miller; Pinaceae

Aleppo pine, Jerusalem pine; pin d'Alep (Fr/ALG)

Tree, 20 m, evergreen

Distribution temperate (Med) Europe, Asia, Oceania; native to Med area

Soil shallow soil preferred; limestone; heavy clay better tolerated than by other *Pinus* spp; not waterlogged or saline soils. **Temperature** brief occasional cold spells -18° to -20° tolerated, also high temperatures. **Rainfall** 355-400 mm (native range); drought tolerant, 250-800 mm annually but young seedlings not drought tolerant

Economic and other uses

Fuel. Timber. Land use windbreak, shade, afforestation in poor dry conditions, amenity. **Other uses** resin

Honeydew

From *Marchalina hellenica* (Gennadius), previously *Monophlebus hellenicus* (Gennadius), Margarodidae: "high" honey yield, mainly in Chalkidiki (GRC, Mai/52); 5-10 kg/colony/yr, abundant flow in autumn (GRC/Chalkidiki, Thasos, Nic/55); heavy flow from late vi to following spring, bees collect honeydew viii-ix (GRC/Med basin, San/81); main source of pine honeydew at altitudes <900 m, 60% of Greek honey is from this insect on pine trees, mainly *P. halepensis* (San/81)

Insect not specified: much honeydew secreted, mainly in Oranie and southern mountains (ALG, Ske/77); main honey crop on Thasos and Ikaria (GRC, Adm/64); 60 000 colonies brought to forests by end vii for abundant flow viii (TUQ/west coast, Adm/77)

Honey: chemical composition

Nitrogen 14 mg/100 g dry wt (insect not specified, ?ITA, Bos/78).

Amino acids free 54, protein 64 mg/100 g dry wt (Bos/78)

Honey: physical and other properties

Colour dark (insect not specified, ALG, Ske/72). **Pfund** light amber (from *Marchalina hellenica*, GRC, Nic/55)

Viscosity "good body"

Granulation [slow] does not granulate

Flavour characteristic (Ske/72)

10D Pinus sylvestris L.; Pinaceae

Scotch fir, Scots pine; gemeine Kiefer, Rotkiefer (De); furu (No)
Tree, <40 m, evergreen

Distribution temperate Asia, Europe; native to Europe. **Habitat** open woodland; widely planted forest sp

Economic and other uses

Timber. Land use afforestation, amenity. **Other uses** rosin and turpentine from resin; tar, pitch and pine oil by distillation

Honeydew

From **Cinara cembrae** (Seitner), Lachnidae: rated D1, flow vii-ix (mid EUR, Hag/66)

From **Cinara nuda** (Mordvilko), Lachnidae: flow may be fairly heavy, honeydew collected by bees (mid EUR, Klo/65)

From **Cinara pinea** (Mordvilko), Lachnidae: flow vi-vii, honeydew collected by bees and in some areas hives are moved to forest for this flow, honeydew analysis (mid EUR, Klo/65); "good" flow vii-viii (NOW, Lun/71); honeydew honey potential on Pinus spp 10 kg/ha (ROM, Cir/80)

From **Marchalina hellenica** (Gennadius), Margarodidae: heavy flow late vi to following spring; 60% of Greek honey is from this insect on pine trees - *P. sylvestris* less important than *P. halepensis* (GRC, San/81)

From **Schizolachnus pineti** (Fabricius), Lachnidae: "considerable" flow visited by bees, but importance not known (EUR/Med, Klo/65)

Honey: chemical composition

Water [medium] 20.2, 20.5% (insect not specified, Dus/67)

Glucose [medium] 30.05% (presumed *P. sylvestris*, CZE, Svo/56).

Fructose [medium] 38.25%. **Dextrin** 3.11%

Ash [medium] 0.44%

Invertase 46, 47.3. **Peroxide number** 418.7, 662.5 µg/g/h

Amino acid analysis (Kum/74)

Honey: physical properties

Optical rotation laevorotatory (presumed *P. sylvestris*, CZE, Svo/56). **Electrical conductivity** 0.00112, 0.0012/ohm cm (Dus/67)

11D Populus spp; Salicaceae

poplar; Pappel (De)

Tree, deciduous, usually dioecious

Distribution temperate Europe, Asia, N America, (Med) Africa; subtropical N America, Asia, C America

Economic and other uses

Timber - many hybrids planted for pulp-wood (EUR)

Honeydew

From **Chaitophorus populeti** (Panzer), Chaitophoridae, on *Populus alba*, *P. nigra* and *P. tremula*: heavy flow collected by bees (AUT, Klo/65)

From **Chaitophorus populeti**, together with **Pterocomma salicis** (L.), Aphididae: intense flow from late v to mid vi, colonies gained 10-20 kg/colony in 10 days, of which 60% attributed to poplar honeydew; honey potential for *P. alba* 20 kg/ha, for *P. nigra* 20 kg/ha (ROM, Cir/80)

From **Pachypappa vesicalis** Koch, Pemphigidae: flow v to early vi, honeydew analysis (URS/Ukraine, Blz/79)

Insect not specified: crystallized honeydew (manna) contained 40% melezitose (AUT, Goa/52); honeydew produced, NOW (Lun/71); USA (Pel/76); honeydew shortened life span of bees (URS/Voronezh, Orz/58)

Honey no data

12D Quercus robur L.; Fagaceae

syn *Quercus pedunculata* Ehrh.

common oak, English oak, pedunculate oak; farnia (It)

Tree, <45 m, deciduous, monoecious

Distribution temperate Europe, (Med) Africa, Asia; native to Europe. **Habitat** woodland, where it is often the dominant sp

Soil wide range but brown-earth soils preferred

Economic and other uses

Timber v hard, used for ship-building etc

Alert to beekeepers

Honey from *Quercus* spp not suitable as winter food for bees (ROM, Fra/65)

Pollen

P1 ITA. **P3** FRA. **P** URS. **Pollen value** 80% of spring harvest (Ric/78). **Colour** of load yellow green (Han/80)

Honeydew

From **Kermes quercus** (L.), Kermesidae: on *Quercus robur* and *Q. pubescens* - rated **D1**, flow ?iv-v (mid Eur, Hag/66); "considerable" flow from end iv to mid v or vi, honeydew tastes only slightly sweet (?to man) but bees collect it actively in the afternoon (mid EUR, Klo/65)

From **Lachnus ilicophilus** (del Guercio), previously *Schizodryobius longirostris* (Mordvilko), Lachnidae: collected by bees in vi (mid EUR, Klo/65)

From **Lachnus roboris** (L.), Lachnidae: rated **D1**, flow v-vii (mid EUR, Hag/66); importance to bees not certain (Klo/65)

From **Thelaxes dryophila** (Schrank), Thelaxidae: heavy flow with

peak v or vi, continuing till autumn, collected by bees (mid EUR, Klo/65)

From **Tuberculatus annulatus** (Hartig), previously *Tuberculoides annulatus* (Hartig), Calliphididae : flow peak mid vi to vii, "most important producer on oak", honeydew granulates rapidly, bees collect it while liquid in the morning (mid EUR, Klo/65)

Insect not specified: flow every 4 yrs (ITA/Umbria, Marche, Abruzzo, Ric/78); FRA (Lou/81); URS (Fed/55); honeydew honey potential from *Quercus* spp 20 kg/ha (ROM, Cir/80). **Alert to beekeepers** honey from *Quercus* spp not suitable as winter food for bees (ROM, Fra/65)

Honey: physical and other properties

Colour "less dark than other honeydew honeys" (insect not specified, ITA, Ric/78)

Flavour sweet, also slightly sharp. **Aroma** intense

13D *Quercus suber* L.; Fagaceae

cork oak; chêne liège (Fr)

Tree, <20 m, evergreen, monoecious

Distribution temperate (Med) Europe, (Med) Africa, Oceania

Temperature fairly hardy

Economic and other uses

Land use shade, amenity. **Other uses** cork from bark for making hives

Alert to beekeepers

Honey from *Quercus* spp not suitable as winter food for bees (ROM, Fra/65); honeydew shortened life span of bees (URS/Voronezh, Orz/58)

Pollen

P ALG

Honeydew

Insect not stated: flow sometimes abundant in Dellys forest (ALG, Ske/77); "important" honey source in Morocco (Cra/73). **Alert to beekeepers** honey from *Quercus* spp not suitable as winter food for bees (ROM, Fra/65); honeydew shortened life span of bees (URS/Voronezh, Orz/58)

Honey no data

14D Quercus virginiana Mill.; Fagaceae

live oak (En/USA)

Tree, <18 m, evergreen, monoecious

Distribution temperate N America; subtropical N America; tropical C America**Economic and other uses****Timber****Honeydew**

From "live oak gall" (specific name not stated): yield 11 kg/colony/yr, flow viii to late autumn, "v useful source during drought" (USA/TX, Pel/76)

Honey: chemical composition**Water** [medium] 18.2, 16.2% (2 samples, age 8,9 mths, USA/FL, Whi/62, who says "Quercus fagaceae", presumably Quercus (family Fagaceae) and we assume it to be Q. virginiana)**Glucose** [low] 29.51, 26.61%. **Fructose** [medium] 38.12, 34.59%.**Sucrose** [medium, also low] 1.14, 0.63%. **Maltose** 8.67, 10.59%.**Higher sugars** 1.28, 2.47%. **Melezitose** (1 sample) 0.38%**Ash** [medium] 0.212, 0.799%**pH** 3.90, 4.70. **Total acid** 50.71, 67.27 meq/kg. **Free acid** [medium, also high] 36.62, 64.57 meq/kg. **Lactone** 14.09, 2.58 meq/kg**Amylase** 6.7, 41.4**Nitrogen** 0.053, 0.223%**Honey: physical and other properties****Pfund** 85 to >114 mm, amber to dark amber (Whi/62, see note under **Water**). **Colour** dark (from live oak gall, USA/TX, Pel/76)**Viscosity** "heavy" (Pel/76)**15D Zea mays L.; Gramineae**

[see paragraph 6 on page 29]

maize, sweetcorn; Indian corn (En/USA)

Herb, 1-8 m, annual, monoecious

Distribution temperate N America, Asia, (Med) Africa, Europe and (Med) Europe; subtropical S America, N America, Asia, Africa; tropical S America, C America, Caribbean, Asia, Africa; native to N America. **Habitat** cultivated crop plant**Soil** deep well drained fertile soil preferred; waterlogging not tolerated. **Rainfall** - rain during growth essential

Economic and other uses

Food - fresh seeds as vegetables, dried for flour/oil. **Fodder** - lvs and seeds for forage, silage. **Fuel.** **Other uses** spathes for paper-making

Pollen

Pl ALG (Ske/72); URS/South (Glu/55); USA/TX (Pel/76)

Honeydew

Insect not specified: occasional flow (ALG, Ske/72); honey yield reported as 45 kg/colony/yr (USA/LA, Ord/83); honeydew honey also reported in USA/IA, TX (Pel/76); USA/MA (Shw/50); ZIM (Pap/73). Bees also collect sap from split stems (URS, Glu/55; USA, Pel/76)

Honey: physical and other properties

Colour yellow (USA/IA, Pel/76); dark (USA/TX, Pel/76)

Granulation v coarse (USA/IA, Pel/76)

Flavour "peculiar", like corn silk

3. PRINTOUTS OF HONEYDEW INFORMATION FOR IMPORTANT NECTAR SOURCES
WHICH CAN ALSO YIELD HONEYDEW

013 Acer platanoides L.; Aceraceae

Honeydew produced, and collected by bees: from **Periphyllus aceris** (L.), previously *Chaetophorella aceris*, Chaitophoridae - rated D1 (mid EUR, Hag/66; Klo/65); and from **Periphyllus caracinus** (Koch), previously *Chaitophorinus coracinus* (Koch), Chaitophoridae (mid EUR, Klo/65). Honeydew also produced by **Drepanosiphum platanoidis** (Schrank) Callaphididae (mid EUR, Klo/65); also in ALG (insect not specified, Ske/72); ROM (Cir/80)

014 Acer pseudoplatanus L.; Aceraceae

Honeydew produced, and collected by bees: from **Periphyllus aceris** (L.) Chaitophoridae - rated D1 (mid EUR, Hag/66); from **Periphyllus testudinaceus** (Ferne), previously *P. villosus* (Hartig), Chaitophoridae - honeydew collected from early or mid v in yrs when tree flowers (mid EUR, Klo/65). Honeydew also produced (insect not specified) in: ALG (Ske/72); ROM (Apc/68; Cir/80); UK (How/79)

015 Acer tataricum L.; Aceraceae

Honeydew produced ROM (Apc/68, Cir/80)

080 Castanea sativa Mill.; Fagaceae

Honeydew produced, and collected by bees: from **Lachnus roboris** (L.), previously *L. longipes* (Dufour), Lachnidae - flow 1-2 wks during flowering (S EUR, Klo/65); also from **Myzocallis castanicola** Baker, Callophididae - (S EUR, Klo/65); and **Parthenolecanium rufulum** (Cockerell), previously *Eulecanium rufulum* (Cockerell), Coccidae - bees can only use this flow early in morning and/or? at high RH (S EUR, Klo/65). Honeydew produced by *L. roboris* and *M. castanicola* (ROM (Cir/80). Also produced (insect not specified) in ITA (Ric/78); YUG (Kul/59)

209 Gossypium barbadense L.; Malvaceae

Honeydew produced (Mcg/76)

221 Helianthus annuus L.; Compositae

Honeydew produced ROM (Apc/68)

267 Liriodendron tulipifera L.; Magnoliaceae

Honeydew produced USA/MA (Cao/79)

282 Malus domestica Borkh.; Rosaceae

Honeydew produced, and collected by bees from **Aphis pomi** De Geer, Aphididae: flow 3-4 wks, honeydew analysis; honeydew produced by **Psylla mali** Schmidberger, Psyllidae: heavy flow, sometimes visited by bees; also produced by **Macrosiphum rosae** (L.), Aphididae: honeydew analysis (mid EUR, Klo/65)

283 Mangifera indica L.; Anacardiaceae

Honeydew produced INI (insect not specified, Sig/62); ?NEP (Cra/84)

290 Medicago sativa L.; Leguminosae

Honeydew produced, and collected by bees from **Therioaphis trifolii** form **maculata** (Buckton), Callaphididae; honey analysis (USA/CA, Whi/62)

354 Robinia pseudoacacia L.: Leguminosae

Honeydew produced in some yrs, eg during vi-vii in 1959 and 1960, when extra 10-12 kg honey/colony was attributed to secretion mainly from **Aphis medicaginis** Koch, Aphididae, also from **Parthenolecanium corni** (Bouché), previously **Eulecanium corni robinarium** (Douglas), Coccidae

357 Rubus spp [R. fruticosus L.]; Rosaceae

Honeydew produced NEZ (Wal/78)

359 Rubus ulmifolius Schott.; Rosaceae

Honeydew produced ALG (Ske/72)

362 Saccharum officinarum L.; Gramineae

[see paragraph 6 on page 29]

Honeydew produced, and collected by bees: from **Melanaphis sacchari** (Zehntner), previously *Aphis sacchari*, Aphididae (HAW, Ken/76); also ?from **Perkinsiella saccharicida** Kirkaldy, Delphacidae (used to be in HAW, ?now in S America, Ken/76). Honeydew also produced (insect not specified) in ANA (Por/74); ?COL (Ken/76)

363 Salix alba L.; Salicaceae

Honeydew produced, and collected by bees: from **Tuberolachnus salignus** (Gmelin), Lachnidae - flow may be v heavy (mid EUR, Klo/65); honey yield from *Salix* spp up to 20 kg/colony (ROM, Cir/80); also from **Pterocomma salicis** (L.), Aphididae - secretion "high", visited by bees (*Salix* spp, mid EUR, Klo/65). **Alert to beekeepers** *Salix* honeydew honey is not suitable as winter food for bees (ROM, Fra/65)

364 Salix caprea L.; Salicaceae

Honeydew produced, and collected by bees: from **Tuberolachnus salignus** (Gmelin), Lachnidae - honey yield from *Salix* spp up to 20 kg/colony (ROM, Cir/80); also from **Pterocomma salicis** (L.), Aphididae - secretion "high", visited by bees (*Salix* spp, mid EUR, Klo/65). Honeydew produced URS (insect not specified, Glu/55). **Alert to beekeepers** *Salix* honeydew honey not suitable as winter food for bees (ROM, Fra/65)

410 Tilia cordata Mill.; Tiliaceae

Honeydew produced, and collected by bees from **Eucallipterus tiliae** (L.) Callaphididae - rated D1, (mid EUR, Hag/66); flow may be intense in vi or vii, viii, possibly ix, but bees can collect honeydew only early and late in day ?and/or when RH is high, because it granulates rapidly on tree; honey data below (mid Eur, Klo/65); honeydew analysis (ITA, Lom/77). Honeydew produced in FRA (insect not specified, Lou/81). For *Tilia* spp: honeydew analysis (from *Eucallipterus tiliae*, Klo/65); flow vi-vii in some yrs, honey yield 6-12 kg/colony (ROM, Cir/80)

411 Tilia japonica (Miq.) Simonk.; Tiliaceae

Honeydew produced (ROM, Cir/80)

415 Tilia platyphyllos Scop.; Tiliaceae

Honeydew produced, and collected by bees from **Eucallipterus tiliae** (L.), Callaphididae - rated **D1** (mid EUR, Hag/66); flow may be intense vi or vii, viii, and possibly ix, but bees can collect honeydew only early and late in day ?and/or when RH is high because it granulates rapidly on tree; honeydew analysis for *Tilia* spp, also honey data below (S EUR, Klo/65). Honeydew produced (insect not specified): FRA (Lou/81); ITA (Ric/78); UK (How/79). **Alert to beekeepers** in 1928 honeydew reported toxic to bees in one area of GFR (Cra/77)

417 Tilia tomentosa Moench; Tiliaceae

Honeydew produced EUR (Maz/82); ROM (Cir/77; Cir/80)

418 Tilia x europaea L.; Tiliaceae

Honeydew produced UK (How/79)

430 Trifolium pratense L.; Leguminosae

Honeydew produced USA (Pel/76)

438 Vicia faba L.; Leguminosae

Honeydew produced EUR (Maz/82); ROM (Cir/80); analysis of honeydew from **Megoura viciae** Buckton, Aphididae (mid EUR, Klo/65)

4. INDEX TO HONEYDEW-PRODUCING INSECTS ON THE PLANTS

Plant entries 01D to 15D are in Section 2, and the others are in Section 3. In this index and in the entry, bold type indicates current names, others being synonyms. The authority and the family are given in the plant entry. Names were verified by the Commonwealth Institute of Entomology, London.

<i>Aphis medicaginis</i>	354	<i>Laricaria kochiana</i>	05D
<i>Aphis pomi</i>	282	"live oak gall"	14D
<i>Aphis sacchari</i>	362	<i>Macrosiphum rosae</i>	282
<i>Buchneria pectinatae</i>	01D	<i>Marchalina hellenica</i>	09D, 10D
<i>Chaitophorus coracinus</i>	013	<i>Mecynaria piceae</i>	08D
<i>Chaitophorus populeti</i>	11D	<i>Megoura viciae</i>	438
<i>Cinara boernerii</i>	05D	<i>Melanaphis sacchari</i>	362
<i>Cinara bogdanowi</i>	08D	<i>Mindarus abietinus</i>	01D, 02D, 03D
<i>Cinara cembrae</i>	10D	<i>Monophlebus hellenicus</i>	09D
<i>Cinara confinis</i>	01D	<i>Myzocallis castanicola</i>	080
<i>Cinara costata</i>	08D	<i>Pachypappa vesicalis</i>	11D
<i>Cinara cuneomaculata</i>	05D	<i>Parthenolecanium corni</i>	354
<i>Cinara kochiana</i>	05D	<i>Parthenolecanium rufulum</i>	080
<i>Cinara laricicola</i>	05D	<i>Periphyllus aceris</i>	013, 014
<i>Cinara laricis</i>	05D	<i>Periphyllus coracinus</i>	013
<i>Cinara nuda</i>	10D	<i>Periphyllus testudinaceus</i>	014
<i>Cinara pectinatae</i>	01D	<i>Periphyllus villosus</i>	014
<i>Cinara piceae</i>	08D	<i>Perkinsiella saccharicida</i>	362
<i>Cinara piceicola</i>	01D, 08D	<i>Phyllaxis fagi</i>	04D
<i>Cinara pilicornis</i>	01D, 08D	<i>Physokermes</i>	
<i>Cinara pinea</i>	10D	<i>hermicryphus</i>	02D, 03D, 08D
<i>Cinara pruinosa</i>	08D	<i>Physokermes piceae</i>	01D, 08D
<i>Drepanosiphum platanoidis</i>	013	<i>Psylla mali</i>	282
<i>Eucallipterus tiliae</i>	410	<i>Pterocomma salicis</i>	363, 364, 11D
<i>Eulecanium corni</i>		<i>Schizodryobius longirostris</i>	12D
<i>robiniarum</i>	354	<i>Schizodryobius pallipes</i>	04D
<i>Eulecanium rufulum</i>	080	<i>Schizolachnus pineti</i>	10D
<i>Eulecanium sericeum</i>	02D, 03D	<i>Thelaxes dryophila</i>	12D
<i>Kermes quercus</i>	12D	<i>Therioaphis trifolii</i>	
<i>Lachniella costata</i>	08D	form <i>maculata</i>	290
<i>Lachniella nigrotuberculata</i>	05D	<i>Todolachnus abieticola</i>	01D
<i>Lachnus exsiccator</i>	04D	<i>Todolachnus confinis</i>	01D
<i>Lachnus iliciphilus</i>	12D	<i>Tuberolachnus salignus</i>	363, 364
<i>Lachnus longipes</i>	080	<i>Tuberculatus annulatus</i>	12D
<i>Lachnus muravensis</i>	05D	<i>Tuberculoides annulatus</i>	12D
<i>Lachnus pallipes</i>	04D	<i>Ultracoelostoma assimile</i>	07D
<i>Lachnus roboris</i>	080, 12D	<i>Xylococcus macrocarpi</i>	06D

5. DISCUSSION PAPER†

IMPORTANT HONEYDEW SOURCES AND THEIR HONEYS

by EVA CRANE AND PENELOPE WALKER

Honeydew flows

Honeydew flows are the main source of honey in some parts of the world, but they are comparatively localized, and many beekeepers have no experience of them. Most honeydew flows are from trees in temperate-zone forests. They are especially important in parts of Europe, and are also used by beekeepers in New Zealand and North America. The famous Black Forest honey in Germany is from honeydew. In the eastern Mediterranean the flow from pines can give high honey yields, and in Greece 60% of the honey produced is from these trees. On the south-west coast of Turkey, 500 000 hives are moved to work the honeydew flow from Aleppo pine.

Honeydew is produced by different species of plant-sucking insects (Hemiptera), which have mouthparts capable of piercing the foliage or some other part of the host tree¹ (Fig. 1). The insect ingests the plant sap, and much of this is not digested but passes through special filter chambers in the insect and reappears as honeydew^{8, 11, 13, 14} (Fig. 2), which bees collect. Research work during the last thirty years has shown that a specific honeydew flow is produced on one tree species by one insect species that feeds on a certain part of the tree—usually leaves, stalks, stem or shoots. A prolific honeydew flow depends on the development of a large population of the insect concerned. Some tree species are host to half a dozen or more insect species, and some to only one. No honeydew is produced on the trees growing in areas where the appropriate insect is absent. In parts of Turkey, and of Greece (including Crete), beekeepers extend the area of honeydew flow by introducing *Marchalina hellenica* into areas of *Pinus halepensis* without it. In late summer, when the adult insects appear in good numbers, branches carrying them are removed and taken to an area where they do not occur. The branches are tied into a few trees, and if conditions are suitable the insects will multiply and spread.

Much of the research work on honeydew-producing insects and honeydew flows is published in German, or in languages less widely read by English-speaking peoples. One of the few books to give ratings to plants as producers of honeydew honey (see Table 1), by Haragsim, has been published in Czech and in Polish; a summary paper is available in French^{9, 10}; Cirnu's book on bee plants², which includes many honeydew sources, is in Romanian. Rihar has done much work on forecasting honeydew flows in Yugoslavia, and his reports are in Croatian and Slovenian^{17, 18}; there can be great economic value in a reliable method for such forecasting.

An important honeydew source which has only recently been exploited for honey production is the beech *Nothofagus solandri* var. *cliffortioides*^{4, 16}. The tree grows on certain mountain slopes of South Island, New Zealand, and honeydew is produced in areas where the soft scale insect *Ultracoelostoma assimile* also occurs. The honeydew is entirely suitable as a source of winter food for bees (although some honeydews are not)*,

*Honeydew sources do not, however, provide the pollen required for brood rearing.



FIG. 1. A group of the greater black spruce bark aphid, *Cinara piceae* (Panzer), producing honeydew on the terminal shoot of spruce (*Picea abies*). This aphid is an important producer of honeydew flows in the higher Alpine forests. Photo Dr A. Fossel



FIG. 2. Production of honeydew by a small spruce scale insect (*Physokermes hemicryphus* Dalman) on a spruce stem. The insect is well camouflaged by its habit of attaching itself to the stem between bud scales. It is covered with wax threads and hardly looks like an insect at all. Here a young female is shown with the drop of honeydew she has excreted: the bees collect these drops directly from the insect. Photo Dr A. Fossel

and it has been used for that purpose for many years. Since about 1970, a large number of colonies have been moved to the beech forests—about 10 000 in 1981, giving 400 tonnes of honey. One estimate⁴ suggests that a further 3000 tonnes of honey could be produced each year.

The 1984 *Directory of important world honey sources*⁶ includes 14 trees solely because of their importance as sources of honeydew honey; this compares with 452 important plant sources of honey from nectar. Table 1 gives information from the *Directory* on each of these trees. It includes the honey potential available in terms of yield per hectare, and honey yields actually obtained from the trees, with the names of the most important insects involved. Yields of 40 to 100 kg per colony per season are reported from several sources. Most of the identification and taxonomic work on honeydew-producing insects has been done within the last few decades, much of it in central Europe where honeydew is of special economic importance. Further insect species will certainly be identified in the future.

None of the above 14 trees have flowers that produce nectar, but there are 23 other plants listed in the 1984 *Directory*⁶ as important sources of honey from nectar, which also yield honey from honeydew. Eight of them are *important* sources of honeydew honey, and they are listed at the end of Table 1, with their honeydew-producing insects and corresponding honey yields.

The intensity of honeydew flows varies greatly from year to year according to the annual population growth of honeydew-producing insects, which is very sensitive to environmental factors. It has been shown repeatedly that the presence of a nest of ants, especially the red wood ant, *Formica polyctena* Först., actively increases honeydew production in its immediate neighbourhood¹⁹. In one set of records²¹ average honey yields for the years 1957-1965 were 43% higher in a forest area with ants than in a comparable area without them. The ants feed on honeydew, and are reported to protect honeydew-producing insects from predation.

Many forest areas have been felled, and honeydew production ceases if the host plants are killed in this way, or by atmospheric pollution. Certain areas that have been excellent for honeydew production are now endangered through 'acid rain'.

Some honeydew-producing insects are pests of crop plants. Maize (*Zea mays*) has been referred to in the literature as a source of large yields of honeydew honey, and is included in the 1984 *Directory*⁶. However, the pest insects are the target of pesticide applications, and they no longer give honeydew flows where pest management is effective¹². French law prohibits the use of pesticides dangerous to bees during the period of honeydew production resulting from aphid attack on cereal crops and on trees in forest plantations⁵.

Honeydew honeys

The main sugars in honey derived from either nectar or honeydew are almost always glucose and fructose, and some sucrose is usually also present. Honeydew honey (but not honey from nectar) characteristically contains appreciable amounts of trisaccharide sugars (such as melezitose, raffinose, fructomaltose), some higher saccharides, and also dextrin, and certain enzymes and amino acids not normally found in honey from nectar.

TABLE 1. Important sources of honeydew honey, with indications of honey yields. Information extracted from the 1984 *Directory*⁶, which cites the publications on which the entries are based. Insect names were verified by the Commonwealth Institute of Entomology, London. In column 2 'mid Europe, major source' indicates a rating by Haragsim⁹, ¹⁰.

<i>Plant and honeydew-producing insects</i>	<i>Honey production and flow period</i>
CUPRESSACEAE	
<i>Calocedrus decurrens</i> (Torr.) Florin: incense cedar	
<i>Xylococcus macrocarpi</i> (Coleman), Coccoidea	— California and Oregon, USA, 45-136 kg honey/colony, from early summer onwards
FAGACEAE	
<i>Fagus sylvatica</i> L.: beech	
<i>Phyllaxis fagi</i> (L.), Callaphididae	— mid Europe, major source, v-vii
<i>Nothofagus solandri</i> var. <i>cliffortioides</i> (Hook. f.) Poole: mountain beech	
<i>Ultracoelostoma assimile</i> (Maskell), Magarodidae	— New Zealand, estimated 60 kg honey/colony, late summer to autumn
<i>Quercus robur</i> L.: English oak	
<i>Kermes quercus</i> (L.), Kermesidae	— mid Europe, major source, ?iv-v or vi
<i>Lachnus roboris</i> (L.), Lachnidae	— mid Europe, major source, v-vii
<i>L. iliciphilus</i> (del Guercio)	— mid Europe, 'most important producer on oak', mid vi to vii
<i>Thelaxes dryophila</i> (Schrank), Thelaxidae	— mid Europe, heavy flow, peak v or vi
insect not specified	— Romania, honey potential 20 kg/ha from <i>Quercus</i> spp
	— France, USSR and (every 4 years) Italy, flows reported
<i>Quercus suber</i> L.: cork oak	
insect not specified	— Morocco, 'important' source
	— Algeria, flow sometimes abundant
<i>Quercus virginiana</i> Mill.: live oak	
'live oak gall'	— Texas, USA, 11 kg honey/colony, viii to late autumn
PINACEAE	
<i>Abies alba</i> Miller: silver fir	
<i>Cinara pectinatae</i> (Nördlinger), Lachnidae	— mid Europe, major source, vii-ix
	— Switzerland, 60-90 kg honey/colony
	— Yugoslavia, 19 kg honey/colony
	— Romania, honey potential 40 kg/ha
<i>C. confinis</i> (Koch)	— Black Forest, Alps, N Sea coast, flow may be important, viii-ix
	— Romania, Yugoslavia, flows reported
insect not specified	— Austria, 40-45 kg honey/colony (honey potential 96 kg/ha)
	— Romania, honey potential 20 kg/ha

<i>Plant and honeydew-producing insects</i>	<i>Honey production and flow period</i>
<i>Abies borisii-regis</i> Mattf.; <i>Abies cephalonica</i> Loudon: Greek fir <i>Physokermes hemicyphus</i> Dalman, Coccidae	— Greece, 5-10% of honey is from this flow, v-vii
<i>Larix decidua</i> Miller: larch <i>Cinara cuneomaculata</i> (del Guercio), Lachnidae <i>C. laricis</i> (Hartig)	— mid Europe, major source, v-viii or vi-x — mid Europe, major source, flow heavy in vi, also late viii to x; honeydew may crystallize on tree — Italy, honey yield obtained
<i>Picea abies</i> (L.) Karsten: Norway spruce <i>Cinara pilicornis</i> (Hartig), Lachnidae <i>C. pruinosa</i> (Hartig) <i>C. piceae</i> (Panzer); see Fig. 1 <i>Physokermes hemicyphus</i> Dalman, Coccidae; see Fig. 2 <i>P. piceae</i> Schrank insect not specified	— mid Europe, major source, vi-viii — GFR, important source, flow late v-vii — mid Europe, major source, vi-viii — mid Europe, up to 15 kg honey/colony, flow 3-6 days in vii or viii; honeydew may crystallize on tree (Fig. 3) — mid Europe, up to 39 kg honey/colony, late v to mid vii — GFR heavy flow, gains up to 4 kg/colony/day — Germany, mean 40 kg honey/colony — Europe, honey potential 100-500 kg/ha — Romania, honey potential 20, 50 kg/ha — Norway, flow vii-viii
<i>Pinus halepensis</i> Miller: Aleppo pine <i>Marchalina hellenica</i> (Gennadius), Margarodidae insect not specified	— Greece, main source of pine honeydew below 900 m, 60% of Greek honey from this insect on pine; bees collect honeydew viii-ix — Chalkidiki and Thasos, Greece, 5-10 kg honey/colony in autumn — Thasos and Ikaria, Greece, main honey crop — Turkey (S & W coast), abundant flow, viii — Algeria, flow reported
<i>Pinus sylvestris</i> L.: Scots pine <i>Cinara cembrae</i> (Seitner), Lachnidae <i>C. pinea</i> (Mordvilko) <i>Marchalina hellenica</i> (Gennadius), Margarodidae	— mid Europe, major source, vii-ix — mid Europe, hives brought for flow vi-vii — Norway, 'good flow', vii-viii — Romania, honey potential on <i>Pinus</i> spp 10 kg/ha — Greece, heavy flow late vi to spring (see <i>Pinus halepensis</i>)

SALICACEAE

<i>Populus</i> spp: poplar <i>Chaitophorus populeti</i> (Panzer), Chaitophoridae <i>Pterocomma salicis</i> (L.), Aphididae	{ Romania, 10-20 kg gain/colony in 10 days (60% from this source), late v to mid vi; honey potential 20 kg/ha of <i>P. alba</i> or of <i>P. nigra</i>
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Important sources of nectar honey also reported as important sources of honeydew honey

ACERACEAE

Acer platanoides L.: Norway maple; *Acer pseudoplatanus* L.: sycamore
Periphyllus aceris (L.), Chaitophoridae — mid Europe, major source

FAGACEAE

Castanea sativa Mill.: sweet or Spanish chestnut
Lachnus roboris (L.), Lachnidae — southern Europe, flow 1-2 weeks during
 flowering, honeydew collected by bees
 — Romania, flow reported
Myzocallis castanicola Baker, Callophidi- — southern Europe, flow reported, honeydew
 didae collected by bees
 — Romania, flow reported
Parthenolecanium rufulum (Cockerell), — southern Europe, flow reported, honeydew
 Coccidae collected by bees before it crystallizes on
 tree

LEGUMINOSAE

Robinia pseudoacacia L.: false acacia
Aphis medicaginis Koch, Aphididae } Romania, up to 10-12 kg honey/colony in
Parthenolecanium corni (Bouché), } some years
 Coccidae

SALICACEAE

Salix alba L.: white willow; *Salix caprea* L.: goat willow
Tuberalachnus salignus (Gmelin), — Romania, up to 20 kg honey/colony from
 Lachnidae *Salix* spp
 — mid Europe, flow may be very heavy
Pterocomma salicis (L.), Aphididae — mid Europe, strong flow

TILIACEAE

Tilia cordata Mill.: small-leaved lime; *Tilia platyphyllos* Scop.: large-leaved lime
Eucallipterus tiliae (L.), Callaphididae — mid Europe, major source vi or vii to viii or
 ix; honeydew crystallizes on tree
 — Romania, 6-12 kg honey/colony from *Tilia*
 spp in some years

The total mineral content, and the amounts of potassium, phosphorus and iron, are higher in honeydew honeys than in nectar honeys³.

Other constituents present in very small amounts are used as 'honeydew indicators' in the microscopic examination of honey, as pollen grains are indicators of the plant origin of honey from nectar. Of these indicators, algae and sooty moulds (*fumago*) are

particularly important¹⁵. The presence of algae may impart a greenish tinge to some honeydew honeys; for example samples of honey from the honeydew of *Cinara pectinatae* on *Abies alba* have been described as 'black-brown with a greenish tinge', and 'dark green'. Not all honeydew honeys are dark, and even white honey has been obtained from *Abies alba*. Many honeydew honeys have a characteristic flavour, much liked by people accustomed to them but not by everyone.

Melezitose is one of the less soluble sugars in honey, and the large amounts of it in some honeydews can cause them to crystallize, even on the tree (Fig. 3). Bees collect such honeydew when it is liquid in the morning, or when atmospheric humidity is high. The resulting honey also crystallizes very rapidly, particularly honeydew honey from *Cinara laricis* feeding on larch (*Larix decidua*); it contains about 42% melezitose. Melezitose was named by Berthelot in 1859 from *mêlèze*, the French word for larch, when he found this sugar in crystallized honeydew (known as Briançon manna) on young larch shoots. Honey from some other honeydews crystallizes slowly or not at all.

Honeydew honey has a higher electrical conductivity ($6.3\text{--}16.41 \times 10^{-4}/\text{ohm cm}$) than honey from most nectars ($0.6\text{--}1.46 \times 10^{-4}/\text{ohm cm}$), although nectar honey from heather (*Calluna vulgaris*) is an exception ($7.7 \times 10^{-4}/\text{ohm cm}$)²⁰. The optical rotation of honeydew honeys is also different from that of nectar honeys; the former are usually dextrorotatory—largely due to the presence of melezitose or erlose, as well as glucose—and the latter laevorotatory, because of their relatively high fructose content. Both the above properties are used in tests to establish whether a honey sample is entirely from nectar, or mostly or entirely from honeydew.

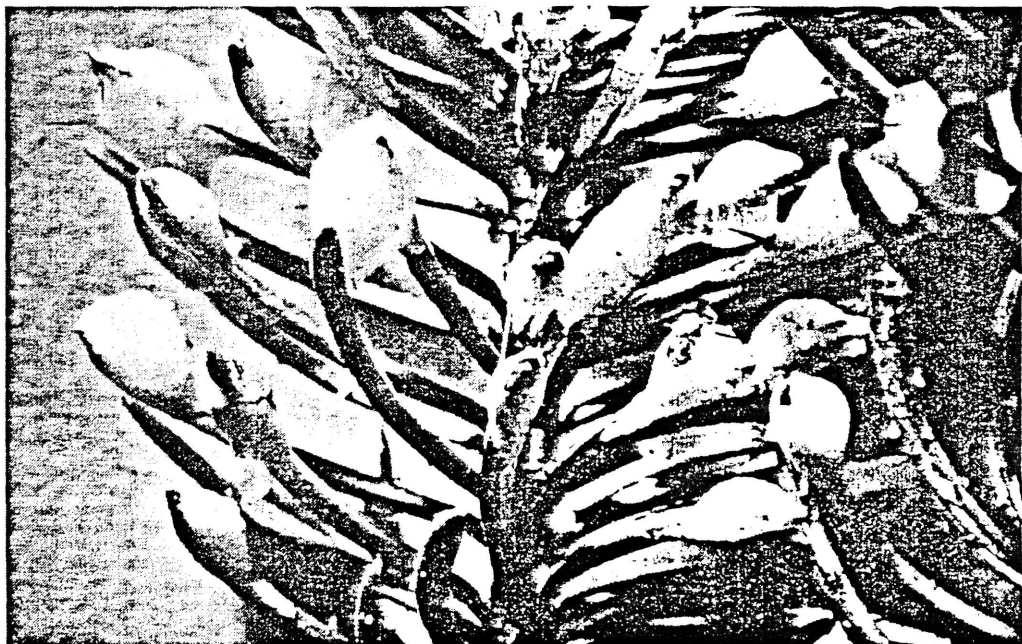


FIG. 3. Part of a branch of spruce covered with crystallized honeydew, from the greater black spruce bark aphid shown in Fig. 1. Photo Dr A. Fossel

Honey sources Satellite

One of several *Satellites* to the *Directory of important world honey sources* to be published in 1985 is *Honeydew sources and their honeys*⁷. This gives entries extracted from the 1984 *Directory*⁶ for the sources of honeydew honey listed in Table 1, including data on the chemical composition and physical properties of the honeys. It also gives information on 15 other important nectar sources that produce some honeydew.

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