

PERSIMMONS FOR LOUISIANA'S CHILDREN - YOUNG AND OLD

III. ANNOTATED CHECKLIST OF INSECTS AND OTHER ZOOLOGICAL PROBLEMS OF PERSIMMONS, *Diospyros kaki* and *D. virginiana*.

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OBJECTIVE

There is a dearth of information about some of the pests and disease problems that have been noted on Oriental and American persimmons, and that which is available is usually minimal or fragmentary and widely scattered. The PRESENT OBJECTIVE is to assemble the fragments of information available into an ANNOTATED CHECKLIST of persimmon problems in the United States, and to include notes on the significant foreign pests and problems that could be of interest to us. The checklist will be submitted piecemeal: the zoological pests as number III, and later "God willing and the creek don't rise", the diseases and other problems as number IV. These will not be polished presentations. Later others may volunteer to update checklist III or to use it as an outline for their own compilation.

INTRODUCTION

When a new crop is introduced it is usually touted to be "pest free", since most of the pests were left behind. As time goes by – pests from the native home of the crop begin to catch-up with the outward spread. In addition, as the crop expands into new territories and climatic zones, local pests begin to expand their host range to include the new crop. Slowly this has been happening to persimmon, ---both Oriental and American and their scion/rootstock combinations.

Persimmon is still considered a low maintenance crop. When planted as a home orchard crop few pest control activities are required. Homeowners and hobbyists have two questions: "What is wrong?" and "What can be done about it?" Experience has taught that most will do nothing, but a few, bless them, will give it a try.

Unfortunately, in Louisiana there are few pesticides that have been registered for use on persimmon. To say it another way: There are few pesticides that can be lawfully used on persimmon in Louisiana. "All chemicals sold as pesticides in Louisiana must be registered with the Environmental Protection Agency and labeled for use in the state by the Louisiana Department of Agriculture and Forestry" (Bob Sylvestre 8/11/96, The Advocate, B.R. La.). Pesticides registered by Louisiana, as of October 1997, for use on persimmon are: fungicides – none; insecticides – the BT (bacterial) formulations (Biobit, Javelin, & Crymax); miticide – Omite; herbicides-Devrinol, Round-Up, Goal, and Touchdown. For an updated list contact your local county agent's office. Individual states vary in their pesticide recommendations and registrations. For persimmon both California and Florida have a longer list.

NOTES

Administrative law requires the presentation of data that will justify the registration of a pesticide for a specific crop. The pesticide must be effective, cause minimal danger to both the consumer and the environment.

When voter power shifted from rural to urban the philosophy of supporting agricultural research shifted from "use general fund money to support a basic industry" to "let the industry support its own research", the industry being primarily growers of a specific crop and the agricultural chemicals manufacturers. California with its Mediterranean climate, e.g., dry summers, has satisfied its needs for the production of the Oriental persimmon. Eastern problems, with rainy summers, are different from theirs. The persimmon industry, in the eastern states, combining both American and Oriental persimmons, neither provides enough crop income to enable research grants to the universities, nor does it offer enough potential for pesticide sales (e.g., cost/benefit) to interest the chemical companies to seek registration on persimmon. Thus, in most of the eastern U. S. the persimmon growers and hobbyists are on their own, to solve their problems, either individually or as a cooperative group.

ORGANIZATION OF PART III. The catalog of the insect parasites is based primarily on the feeding habit (i.e., borers, leaf eaters, sucking insects, etc.) of the attacking stage; secondarily on the taxonomic classification (i.e., insect order, family, down to the tribe where convenient). The amount of information included with each entry depends on what has been found in publications supplemented by personal knowledge or experiences of friends and self. *A computer search was not used.* Beyond the cataloging of insects there are notes on mites, nematodes, and vertebrate pests.

To aid the reader in validating entries the source is noted and a bibliography is included.

IDENTITY OF THE HOST SPECIES. Frequently, authors have recorded the host as **persimmon** without mentioning the common or scientific name of the species involved: **Oriental persimmon**, *Diospyros kaki* (D.k.); **American Persimmon**, *D. virginiana* (D.v.); or **Oriental date plum**, *D. lotus* (D.l.). One might assume that Craighead, writing about forest insects, was dealing with D.v., while in California and foreign countries the species was D.k. on either D.k. or D.l. rootstock. In the southeastern U. S. the host may either be D.v. or D.k., and probably but not always on D.v. rootstock. To avoid forced interpretation of the species involved when not clarified the host may be noted as 'persimmon'.

CHAPTER 1. THE WOOD-BORERS OF PERSIMMON

The borers that attack persimmon are members of two groups; moth larvae of the order Lepidoptera, and beetle adults and larvae of the order Coleoptera. Except for two lepidopterous borers and a twig girdling beetle most wood-borers found attacking persimmon are opportunists that attack sunburned, stressed, declining, dying, or dead trees; broken branches; or downed logs. Stress may be due to summer drought, winter drought, freeze damage, defoliation, or disease.

The avenues of attack vary with the species involved. Moths may lay eggs on bark surface. On hatching the moth larva penetrates the bark and tunnels down to the wood. Beetles fall into three groups based on placement of the egg: one may deposit the eggs under loose bark or in broken bark or wounds; a second may gnaw out brood chambers for eggs, either tunneling just under the bark or deep into the wood; a third may chew a hole in the bark of the twig and shove an egg under the bark. For beetles that penetrate to build a brood chamber the American persimmon has a defense mechanism, i.e., gumming; but the effectiveness of flooding the tunnel with gum is greatly reduced by the stress of drought. Comparatively, the Oriental persimmon produces a trace to very little gum.

A. WOOD-BORING MOTH LARVAE. Order LEPIDOPTERA (moths, butterflies) 27¹

Sesiidae – clear-winged moth family 27.47

Larvae bore into roots, stems, vines, tree branches and trunks of various plants and trees. Some species are serious pests of garden and orchard crops and forest trees. The moths of most species have transparent wings with scales confined to veins. Active during daylight. 115 spp (10 gen) in US/Can² (Arnett 2000 p. 963).³

Persimmon root borer, *Sannina uroceriformis* (Walker), Sesiidae, sf Sesiinae, tribe Synanthedonini, can be a serious problem on persimmon seedlings and grafted nursery stock in eastern U.S. In 1937 a Tennessee nurseryman estimated a 50% loss of his American persimmon stock. Damage appears more severe on grafted plants (Craighead 1950 p 464). *Persimmon is the only know host*. Native wild persimmon is preferred; introduced Japanese persimmon grafted onto native rootstock is sometimes attacked. Heaviest populations occur on trees ½” to 5” in diameter, moderate populations on trees up to 8”. Tunnels in the wood may be above ground as well as below. Small roots may be hollowed out; large roots may have 2 or more galleries (Solomon 1995 pp 56-59).

The adult, a blackish blue, wasp-like, clear winged moth about 1” long with yellow bands on the stomach, emerges in May to early July in the Gulf Coast Region (mostly June and July in the northern range). Moths emerge in the morning, mate between mid-morn and noon. Females deposit their eggs on the bark of the lower trunk, or sometimes drop their eggs on the ground at the base of the tree. Larvae bore through the bark, usually at the root collar, but sometimes 12” to 24” above the ground. Continually feeding on live tissue they may penetrate the soft root tissue to as much as 2’ below ground. A gummy sap combines with sawdust and excrement to fill the tunnel. Larvae overwinter in their galleries at or just below the soil line.

When ready to pupate a larva extends it’s gallery upward to ground line or just below; chews through the bark, constructing a tube-like case made of dark frass, bits of bark, and silk. Pupation, about 3 weeks duration, occurs in the spring. On becoming activated the pupa works it’s way through the “tube-like cocoon” until it is partially projecting out the end, enabling easy adult emergence. Life cycle takes 2 to 3 years. (Miller and Crocker 1992 p 14; Bullard 1995 p 2; Solomon 1995 pp 55-9)

Finding the extended escape tube with pupa skin still in place (Solomon fig 21-c) is an aid to field diagnosis.

Range: Atlantic Coast – NJ to FL; westward to IN, KS, and TX. [An earlier cataloging that listed *S. uroceriformis*, as present in Japan (Clausen 1931 p 8) is probably a case of mistaken identity. [See persimmon tree borer, below.]⁴

¹ Refers to computer scheme used by Arnett 1985 and 2000.

² Number of species and genera in North America north of Mexico.

³ Refers to the source of information. See bibliography at end of paper.

⁴ Brackets enclose comments, questions and personal opinion of the compiler or words added to quotations for clarity.

As of 1992 there were no pesticides registered for control of persimmon root borer in Florida (Miller and Crocker 1992 p 14). However, it was noted that Lorsband is a good preventative when used around April first and again August first (Bullard 1995 p 2). [PRB is closely related to the **peach tree borer**, *Synanthedon exitiosa* (Say).]

FOREIGN.⁵ The **persimmon tree borer**, *Synanthedon tenuis* Butler, Sesiidae, sf Sesiinae, tribe Synanthedonini, is listed as an important pest of Oriental persimmon in Japan. (Kitagawa & Glucina 1987 p 42). It is small and overwinters as a pupa in rough bark.

Cossidae – carpenter moth or goat moth family

27.53

Larvae are wood borers. Moths somewhat resemble sphinx moths. 45 spp (11 gen) in US/Can (Arnett 2000 p 698).

Pecan carpenterworm, *Cossula magnifica* (Strecker), Cossidae, sf Cossulinae, feeds on ‘persimmon’. It is a primary feeder on other woody plants including oak and pecan (Kimball 1965 p 272). Adults emerge late April through June. Eggs are deposited on bark of small branches in treetops. Larvae attack small twigs and branches tunneling in the pithy centers. When too large they exit and reenter larger branches, leaving an entrance hole, tunneling up to 4” in each direction. Tunnel can be revealed by splitting the branch. Apparently 1 generation per year. Distribution NC to FL, w to TX, Mexico and Guatemala (Solomon 1995 pp 121-6, figs 47-8).

FOREIGN. In Japan, **oriental leopard moth**, *Zeuzera leuconstum* Butler, Cossidae, is listed as an important pest (Kitagawa & Glucina 1987 p 42).

Tortricidae– tortricid moth family

27.57

Larvae bore into stems, leaves, and fruit. Some make webs on leaves, most are leaf rollers and leaf tiers (tying leaves together and feeding on the inside of the shelter). Separating the genera is based almost entirely on features of genitalia. Species may be identified by color patterns, yet male genitalia required for confirmation. 1065 spp (91 gen) in US/Can (Arnett 2000 pp 701-2; Borror & White 1970 p 218).

_____⁶, *Eumaroza malachitana* (Zeller), Tortricidae, sf Olethreutinae, tribe Olethreutini, feeds on persimmon (Kimball 1965 p 256; FlaDPI).

Oriental fruit moth, *Grapholita molesta* (Busch), Tortricidae, sf Olethreutinae, tribe Grapholitini, host range includes persimmon; stone fruit preferred. It was introduced on flowering cherry from Japan circa 1912 and has spread from coast to coast. Caterpillars bore into and enter twig tips soon after spring blossom and cause wilting and dieback. A small entrance hole is visible. When fruit begins to ripen, caterpillar frequently leaves twigs and enters fruit to complete development (Solomon 1995 pp 160-2). Six or seven broods in GA. Range: Ontario, e US and Pacific Northwest (Papp 2001 p 195).

FOREIGN. **Persimmon cochlid**, *Scopelodes contracta* Walker, Tortricidae, is listed as an important pest of persimmon in Japan (Kitagawa & Glucina 1987 p 42).

Pyralidae – snout moth family

27.45

A motley group. Larvae are stem borers, leaf skeletonizers, leaf rollers, and leaf tiers, but are rarely leaf miners. A few are aquatic to subaquatic, boring into stems and roots of submerged plants. A number are scavengers, including the wax moth. A few larvae feed on the leaves during early instars, and then bore into stems in later instars (Borror & White 1970 p 246). 1374 spp (423 gen) in US/Can (Arnett 2000 p 681)

American plum borer, *Euzophera semifuneralis* (Walker), Pyralidae, sf Phycitinae, an omnivorous feeder, listed on ‘persimmon’ in Florida (Kimball; 965 p 265), enters a break in the bark. Larvae injure weakened trees by feeding on inner bark and cambium. Hosts include deciduous fruits and nuts. Range: general throughout the U.S. and Canada and parts of Mexico (Solomon 1995 pp 169-72).

⁵ FOREIGN – indicates the problem and pest are unknown in the U.S., while FOREIGN/domestic – Indicates the pest is known in the US but reported only outside the U.S. as a pest of persimmons.

⁶ _____ (blank) indicates no common name, or common name unknown to compiler.

FOREIGN. **Persimmon bark borer**, *Euzophera batangensis* Cardaja, Pyralidae, is an important pest of D. k. in Japan (Kitagawa & Glucina 1987 p 45)

B. WOOD-BORING BEETLES Order COLEOPTERA (beetles, weevils, stylopids)

Cerambycidae – long-horned beetle family

24.129

The adults feed on flowers, pollen, leaves, wood and rarely other insects. Eggs of wood-boring species are laid under the bark or in bark crevasses. Larvae bore into solid tissue of live, dying, or dead trees. They also mine branches of fallen and cut trees and shrubs (Papp 1984 pp 198-9; Arnett 2000 p 477). 956 spp (303 gen) in US/Can (Arnett).

Hickory twig girdler, *Oncideres cingulata* (Say), Cerambycidae, sf Lamiinae, tribe Onciderini. Damage is caused by the adult beetle. By girdling small limbs of American and Oriental persimmons the adult female induces winter pruning of 2 to 3 year old branches, 3/8” to 1/2” in diameter and 2 1/2’ to 4’ long. The girdled limbs are broken off by winter winds. As many as 12 branches may be found under a single wild tree.

The adult beetle emerges about mid-August and may be found in October. First, the female does a maturation feeding, eating the thin bark and often into the wood of young twigs. After sexual maturity and mating the female begins to lay, --- starting in late August and continuing into October. She carves a V-shaped groove around the branch leaving a wood attachment about 3/16” in diameter. She lays eggs during or after girdling, but never before. [Her legs are adapted to grasp firmly around the branch.]

Beyond the girdle she knaws a small hole in the bark, inserts a single egg underneath the bark or in the wood. In this manner several single eggs (usually 3 to 8, sometimes more) are deposited on one branch.

The attachment allows outward flow of water and dissolved nutrients to keep the branch alive while girdling prevents the return of carbohydrates via the phloem tissue, i.e., the inner bark, this saving the food for the larvae. During the winter the girdled limb, still alive,⁷ is broken off by the wind and falls to the ground. The SIGNATURE PATTERN enabling diagnosis is the smooth beveled edge at the end of the broken branch with a rough broken detachment area in the center. [Girdled D.k. limbs heavy with fruit break and fall in October]

The egg hatches in 7 to 9 days; larvae begin to feed on the inner bark and wood. Larvae remain dormant in the twig on the ground during cold weather. In the spring, feeding on wood in the direction of the severed end, and going deeper into the wood, the larvae grow rapidly.

By the time the larva is fully grown the following summer it has often hollowed out the limb for some distance from the point of entry. Larva transforms into a pupa during the period extending from about August until mid September. The pupal stage lasts 10 to 14 days, then the adult emerges (Fletcher 1915 p 20-1; Solomon 1995 pp 323-6, fig 324).

Hosts include 13 or more species of deciduous trees (Johnson & Lyon 1991 p 264) including hickory, elm, gum and persimmon (Fletcher 1915), both D.v. and D.k. Range: general, extending from New England to FL, w to KS and AZ (J&L). *Oncideres cingulata texana* Horn is limited to TX and ne Mexico (Solomon 1995 p 325).

In areas where the fungous disease, persimmon wilt, is present the maturation-feeding wounds plus the girdling wounds expose live wood to the spores of the wilt fungus. The pathogen has been isolated from insect wounds but not from adult beetles (Crandal & Baker 1950)

Twig pruner, *Elaphidionoides villosus* (Fabricius), Cerambycidae, sf Cerambycinae, tribe Elaphidioni. In the late spring the female chews a small niche in the bark of a twig and there lays an egg. After making its entrance hole the larvae begins to feed in the center of the small branch making a tunnel toward the base. “Twig remains alive all summer.” Autumn winds cause branch to break and fall. Twig pruner overwinters as a pupa; adult emerging from hollowed out branch. Hosts: a long list of deciduous hosts including ‘persimmon’. Range: New England to WS, s to

⁷ A branch from a 55’ American persimmon (30’ to lowest limb) picked off the forest floor, Jan 7, 1997, was used successfully as a source of scionwood (Q.L.H.)

Gulf States (Johnson & Lyon 1991 p 264).

Live oak root borer, *Archodontes melanopus* (L.), Cerambycidae, sf Prioninae, tribe Macrotomini. Hosts include 'persimmon', box elder and oaks. Small saplings preferred. Larvae burrow into root collar and down into root producing large flattened, oval galleries that become surrounded by gall-like growth. Larval growth apparently requires several years. Adults emerge May-June and are present until September. Range: VA to FL, w to AR & e TX (Solomon 1995 pp 396-8, fig 156).

Raspberry cane borer, *Oberea bimaculata*, (Olivier), Cerambycidae, sf Lamiinae, tribe Phytoecini. "On persimmon, black gummy exadute, mixed with frass can be found on infested [small] stems. Larvae tunnel downward in pith, periodically cutting small holes, often in straight rows in the surface of the bark to eject frass." One generation per year. Beetles emerge May-June, eggs inserted through thin bark. Hosts: raspberry is preferred, dogwood, elm, roses included. Range throughout U.S. & southern Canada east of the Rocky Mountains (Solomon 1995, pp 376-9, fig 148).

Redheaded ash borer, *Neoclytus acuminatus* (Fabricius), Cerambycidae, sf Cerambycinae, tribe Clytini, "feeds on the unseasoned wood [downed logs] of the numerous hardwood trees, completely honeycombing the sapwood. Attacks nearly all hardwoods but chiefly oak, hickory, persimmon and hackberry" (Craighead 1950 p 253). Beetles active March to mid-November in South. Eggs deposited in bark crevices, cracks, under bark scales and lichens, hatches in 6 days. Larva penetrating to sapwood by 20th day, feeds only in sapwood. Generation completed 60 to 90 days in southern Alabama. Overwintering generation pupating in late winter, in or close to the surface, boring through the surface to emerge. (Solomon 1995 p 464-6, fig 183).

FOREIGN. _____, *Clytus caprioides* (Bates), Cerambycidae, sf Cerambycinae, tribe Clytini, bores into the trunk and larger branches of D.k. in Japan. Adults appear in June and July. One generation per year (Clausen 1931 pp 9, 30).

FOREIGN. **Lemon tree borer**, *Oemona hirta* F., Cerambycidae, sometimes attacks persimmon trees in New Zealand and can cause major damage. The presence of tree borers in the branch is usually indicated by brown, withered foliage (Kitagawa & Glucina 1987 p 45) the borer does damage to many woody plants included the grape. Preferred hosts are lemon, grapefruit and orange (Peter Holder 2001 e-mail).

Bostrichidae – branch and twig borer family; horned powder-post beetle family; false powder-post beetle family 24.76

Minute to very large beetles; mainly wood borers, breed in dead trees, sometimes invade seasoned wood. Adults often bore into branches of live trees. The larvae of most species feed beneath the bark, in pith or in solid wood. A few leaf miners (Papp 1984; Frost 1942 p 383).

Red-shouldered bostrich, *Xylobiops basilaris* (Say), Bostrichidae, sf Bostrichinae, tribe Xyloperthini, normally inhabits dying or dead trees but will attack healthy trees when populations are heavy and favored host material is scarce. The adult beetles usually restrict their attacks to freeze injury and to stressed, dying, or dead persimmon trees and branches. The damage is started by the adult and, if successful, continued by her brood. The female burrows through the bark, tunneling a long brood chamber into the wood and across the grain laying eggs along the chamber. Larvae spread out from the chamber boring parallel to the grain.

The beetle will attack healthy American persimmon in the absence of weak and dying trees, but are counterattacked in their egg tunnels by a mass of gum. When the ground moisture is plentiful the sealing action of the gum is complete in 1 to 5 days. During drought the onset of gumming may be delayed 17 days or longer. In summer these unsuccessful attacks are seen as blobs of gum on the surface⁸ (Crandal & Baker 1950 p317). [D. kaki lacks the copious production of gum found in D.v.] Adults have been found attacking D.v. that have been weakened by persimmon wilt disease (Craighead 1949 pp 223, 227). The fungus casing wilt has not been recovered from adult beetles (C&B p 318).

Host range: very diverse including poison ivy, redbud, hickory, and occasionally a conifer. Distribution is eastern half of the U.S. plus se Can. (Solomon 1995 pp 286-8, fig 112)

⁸ Gum blobs – also see *Xylobrinus saxeseni*, Curculionidae, Scolytinae.

FOREIGN. _____, *Sinoxylon japonicum* Lessne is listed on D.k. in Japan (Clausen 1931 p 9).

Buprestidae – flathead borer family; metallic beetle family

24.45

Named for metallic luster of adult beetles and for the flat broad enlargement of larval thoracic segments. Adults feed on foliage, except a few species feeding on fungi. Many are pests of orchard and forest trees. Eggs are laid in bark of twigs and branches. Larvae mine under bark of conifers and deciduous trees and bushes (Papp 1984 p 113). 675 spp (40 gen) in US/Can (Arnett 2000 p 424). In Florida the flathead borers are common and appear to colonize persimmon tree wounds in July (Miller & Crocker 1992 p 14).

Persimmon agrilus, *Agrilus fucipennis* (Gory) Buprestidae, sf Acmaeoderinae, tribe Agrilini, is difficult to detect in persimmon, *the only larval host*. There is no tree mortality and as many as 15 tunnels have been observed in a trunk cross section. Tunnels reduce the commercial value of the wood for use in manufacture of specialty products.

Beetle life cycle is little known but probably takes more than 1 year. Adults emerge in spring (collected March to July). Larvae bore into wood in the lower trunk. Flattened-oval tunnels are most frequent near the root collar, extending a meter or more up the trunk and a half-meter or more into the roots. Pupation occurs in chambers in the lower trunk, Range: se U.S. mostly NC to TX, reported north to OH (Solomon 1995 pp 260-2, fig 102).

_____, *Chrysobothris chrysoela* (Illinger), Buprestidae, sf Buprestinae, tribe Chrysobothrini, breeds in wounds in persimmon. Attacks any tree that has been either injured or weakened by any factor that lowers vitality of the tree, e.g. defoliation, drought, sunscald (Craighead 1950 p 195).

Flathead apple tree borer, *Chrysobothris femorata* (Oliver), Buprestidae is a common pest of deciduous trees, particularly apple, but likely to attack persimmon, especially the young D.k. trees that are just planted. Transplants should be protected from sunburn (Quayle 1938 p 433). Range: throughout North American.

_____, *Dicerca obscura* (Fabricius), Buprestidae, sf Buprestinae, tribe Buprestini, “in dead persimmon and sumac” (Craighead 1950 p 195).

Curculionidae – snout beetle & weevil family

24.161

Subfamily **Scolytinae** – bark beetle⁹

A large **subfamily** of minute to small beetles, only 48 species in North American north of Mexico. Beetle is compact-formed and has a short snout. Most attack trees; few live in seeds, stems, or roots of herbaceous plants. Some will invade vigorous trees, but usually infest weakened, dying or dead trees and recently cut logs. They bore under the bark leaving distinctive engravings, or bore into the wood (Arnett 2000 p 524; Papp 1984 p 284).

Family Curculionidae has 2614 spp (401 gen) in US/Can (Arnett 2000 p 511).

Subfamily Scolytinae has 48 spp (67 gen) in US/Can (Arnett 1985 p 386).

Lesser shothole borer, *Xylobrinus saxeseni* (Ratzeburg), Curculionidae, sf Scolytinae, tribe Xyleborini (syn: *Xyleborus arbuti* Hopkins, *X. libocedri* Swaine, *X. pecanus* Hopkins, *X. quercus* Hopkins, *X. saxeseni* Ratzeburg, *X. tsugae* Swain) will attack healthy uninjured American persimmon resulting in the appearance of gum blobs¹⁰ on the bark surface. The adult can be extracted from the gum after the blob is soaked in water.

In Maryland (between July 1 & 31) it was observed that the attacking beetles, attempting to excavate brood chambers in the wood, were gummed out. Even if the eggs had been laid, no larvae developed. In the same orchard no signs of damage were observed on two D.k. cultivars, labeled ‘Hagakushi’ and ‘Tamopan Capless’ (Santamour & Batzli 1990).

In Japan *X. saxeseni* is listed as an important pest of D.k. (Kitagawa & Glucina 1987 p 42). It is present in New Zealand (K&G p 43).

Granulate ambrosia beetle, *Xylosandrus crassiusculus* (Motschulsky), Curculionidae, sf Scolytinae, tribe

⁹ Formerly family rank, Scolytidae, now reduced to subfamily.

¹⁰ Gum blobs also see *Xylobiops basilaris*, Bostrichidae.

Xyleborini (syn: *Xyleborus crassiusculus* (Motschulsky), *X. semipactus* Eichoff) was collected from trunk and main limbs of *D. kaki* (May 24, 1980) in Baton Rouge for the first time in Louisiana (Chapin & Oliver 1986 p 681), and again in New Roads (May 28, 2002) identified by Tessa Bauman. The beetles attack en masse a living tree under severe stress (e.g., weakened by a late hard freeze after leafing-out, or by severe drought accented by competition with roots of mature oaks). The attack further weakens the D.k. tree thus leading to further decline and in some cases death due to secondary borers and wood rotting fungi, D.k. trees that recover remain gnarled and stunted for several years (QLH). Hosts: wide range of trees including broadleaf and conifers. Range: Introduced from Europe; Ontario to B.C. in Canada, s to FL, CA and Mexico (Solomon 1995 p 575-7).

Oak-hickory ambrosia beetle, *Xylborus affinis* Eschoof, Curculionidae, sf Scolytinae, tribe Xyleborini, is one of the most destructive sawmill species in tropical lumber industry. Damage can be extensive in logs intended for wood products. Occasionally attacks weakened and dying trees; however the females prefer cut fermenting logs, green lumber, and stumps. Female initiates a brood chamber and may be joined by other females. Eggs are deposited in galleries cut deep into the wood, larvae feed and develop on an ambrosial fungus growing on gallery wall. They pupate within the gallery and upon hatching may leave or stay to enlarge the present gallery. Males are flightless. Hosts: Over 250 spp. of trees (deciduous, pines, palms) including persimmon are used for reproduction. Range: world-wide; throughout eastern U.S. - MA to FL w to MI & TX (Solomon 1995 pp 560-1).

FOREIGN/domestic. **Alnus ambrosia beetle**, black stem borer, *Xylosandrus germanus* (Blanford), Curculionidae, sf Scolytinae, tribe Xyleborini, (syn: *Xyleborus germanus* Blanford) is listed as a D.k. pest in Japan (Kitagawa & Glucina 1987 p 42). Range: Far East, Central Europe, eastern U.S. – NY, CT, s to GA & e TX (Solomon 1995 pp 572-4).

Curculionidae

24.161

Subfamily Platypodinae – ambrosia beetles

Distinguished from other ambrosia beetles by their large size, longer more slender body, prominent flat head. They bore into wood and cultivate ambrosial fungi on which adults and larvae feed. Burrows penetrate into heartwood. They attack weak, dying and recently felled trees, also wounds and dead areas of vigorous, healthy trees (Solomon 1995 p 578); and those injured by fire, lightning, or disease (Arnett 2000 p 527). 7 spp (Arnett 1985 p 385).

Hardwood platypus, *Platypus compositus* (Say), Curculionidae, sf Platypodinae, is listed on ‘persimmon’. Beetle prefers oak, hickory, maple or beech. Distribution is southern NY, southern MO, s to Gulf Coast states, on into Mex. and S. Amer. (Solomon 1995 pp 578-81, fig 579).

FOREIGN, **Mikado bark beetle**, *Scolytolpatypus mikado* Blanford, (? family, sf) is listed as a pest on persimmon in Japan (Kitagawa & Glucina 1987 p 42).

C. LOGS AND LUMBER

Once timber is cut many beetles will colonize unseasoned persimmon wood.

Tenebrionidae – darkening beetle family

24.87

Darkening beetles usually feed on fungi and decaying vegetable mater, but some are pests of stored products or feed on living plants. Generally nocturnal in habit (Papp 1984 p 161), 1008 spp (176 gen) in US/Can (Arnett 2000 p 465).

Craighead (1950 p 218) listed “tenebrionids which are commonly found in decaying hardwoods such as persimmon, hickory, oak and others: *Meracantha contracta* Beauv., *Scotables calcaratus* F., *Alobates pennsylvanica* Deg. [a predator], *Xylopinus saperdioides* Oliv., *X. aenescens* Lec., *Uloma imberbis* Lec., *Merinus laevis* Oliv., *Hoplandrus femoratus* F.”

CHAPTER 2. THE LEAF-EATERS OF PERSIMMON

The leaf eaters of *D. kaki* (D. k.) and *D. virginiana* (D.v.) are the larvae or caterpillars of moths and butterflies, Order Lepidoptera; and the adults of beetles, Order Coleoptera. Some are day feeders; some are night feeders. The food of each species may include either few or many plant species, with persimmon being either a major or minor food.

A. LEAF-EATING MOTH AND BUTTERFLY LARVAE Order LEPIDOPTERA 27

Arctiidae – tiger moth family 27.80

Moths small to medium size; most are light colored, often spotted or banded wings. Caterpillars covered with tufts of hair, often bright colored. Mostly feeding on grasses and a few trees and shrubs. 264 spp (89 gen) in US/Can. (Arnett 2000 p 785).

Fall webworm moth, *Hyphantria cunea* (Drury) Arctiidae, sf Arctiinae, tribe Arctiini, is the most conspicuous of the webbing species, and is the only arctiid that has this habit.

On Oriental and American persimmons the caterpillars feed in colonies, protected by an ever expanding web (tent) while progressively defoliating limbs, starting with an original little nest at the tip of a limb. Defoliation can take one-half or more of the foliage if the tree is small and the colonies are plentiful. *There are two races; redheaded and blackheaded.*

In Louisiana there may be as many as 4 generations starting about June first or earlier. Adult females, small white moths, lay eggs in masses of 400 to 500 on the undersides of leaves. Soon after hatching the caterpillars start spinning a web over the leaves on the terminal end of a single branch, continuing to expand the web as feeding progresses. The webworm pupates in the duff on the ground. (Craighead 1950 p 387-8).

Hosts: 88 tree species including black walnut, sweet gum, sycamore, cherry; feeding preferences vary from region to region, in West Feliciana Parish, Louisiana preference is mainly pecan and both persimmons.

Distribution: native to N. Amer., including Mex.; occurring throughout most of Can. & U.S.; accidentally introduced into Europe and Asia.

Control: There are 50 species of parasite and 36 species of predators known in the U.S. (Johnson & Lyon 1991 p 166). On small trees the webs within reach can be stripped or the limb pruned, then placed in a plastic bag and left in the sun. [In 1930 we used a torch to scorch webs, e.g., coal oil (kerosene) soaked rag encased in a hand-made wire basket attached to the end of a long pole. Today we would hear, "Fire hazard".]

Echo moth, *Seirarctia echo* (Abbot & Smith), Arctiidae, sf Arctiinae, tribe Arctiini, caterpillars become full grown in April, pupate in hairy cocoons, moths emerge in May. Food includes persimmon. MS, AL, GA, FL (Craighead 1950 p 388; Kimball 1965 p 80).

Notodontidae – prominent moth family

Larvae of this group usually gregarious. When disturbed they usually freeze with ends of body elevated. Most species feed on trees and shrubs. Classification of family, i.e., arrangement of genera into subfamilies and tribes, is confused. 136 spp (41 gen) in US/Can (Arnett 2000 p 779)

Red-humped caterpillar, *Schizura concinna* (J.E. Smith), Notodontidae, sf Notodontinae, tribe Heterocampini, is generally distributed in the U.S. and feeds on many plants. It occurs as sporadic infestations on, and can defoliate Oriental persimmon in CA (LaRue, et al 1982 p 9). Young larvae are gregarious, feed on lower surface, and as they become older feed on the edges of leaves (Quayle 1938 pp 386-7). Caterpillars spin loose silken cocoons on the ground among litter; 1 generation a year (Milne & Milne 1980 p785). FL (Kimball 1965 p 165).

Variable oak leaf caterpillar, *Heterocampa manteo* (Doubleday), Notodontidae, tribe Heterocampini, listed on *Diospyros* (Wescott 1956 p 489).

Tortricidae – tortricid moth, leaf roller moth family 27.57

Larvae bore into stems, leaves and fruit. Some make webs on leaves. Most are leaf rollers or leaf tiers, tying leaves together and feeding inside the shelter. Separating the genera is based entirely on features of genitalia. Species may be identified by color patterns, yet male genitalia required for confirmation. 1065 spp (91 gen) in US/Can. (Arnett 2000 p 524-5; Borror & White 1970 p 284).

Orange tortrix, *Argyrotaenia citrana* (Fernald), Tortricidae, sf Tortricinae, tribe Archipini. Caterpillar feeds on Oriental persimmon in southern California, occasionally attacking the fruit (LaRue, et al. 1982 p 9). Primarily feeds on buds, leaves and blossoms of citrus; attacks orchards and shrubbery Wyoming to California. Moth lays masses of pale yellow eggs, resembling overlapping shingles, on twigs and branches. Overwinters as caterpillar, pupating in the spring, 2 to 4 generations a year (Milne & Milne pp 713-4; picture of adult plate 535). 27.57

FOREIGN. **Leaf rollers**. The most serious pests in New Zealand are leaf roller caterpillars in the family Tortricidae; *Ctenopseustis obliquana* Walker, *Epiphyas postvittana* Walker, and *Planotortrix excessana* Walker, which damage foliage and fruit (Kitagawa & Glucina 1987 p 43).

Psychidae – bagworm moth family 27.54

Larva constructs a camouflaged protective bag (case) of tough silk covered with bits of twigs and leaves. Adults emerge within the bag in about 3 weeks. The winged male leaves the bag to find the females. The larva-like female remains in its bag leaving only after egg laying. Eggs overwinter in the bag, hatch in May. Larvae leave to start a new bag. Bag is open at ends, the top for feeding, the bottom (hanging downward) for a discharge of fecal waste and mating. 26 spp (12 gen) in US/Can (Arnett 2000 p 663).

Bagworm (unidentified), ?Psychidae. Solitary bagworms have been observed on both *D. virginiana* and *D. kaki*, West Feliciana Parish, Louisiana. Colonies of bagworms on persimmon not observed. [Persimmon is deciduous. In the spring how does the bagworm larva get to persimmon?]

FOREIGN. **Giant bagworm**, *Clania formosicola* Strand, Psychidae, and **mulberry bagworm** *Canephora asiatica* Staudinger, Psychidae, have been listed as significant pests of persimmon in Japan (Kitagawa & Glucina 1987 p 42).

Megalopygidae – flannel moth family 27.52

Larvae have stinging hairs mixed with soft hairs in diffused tufts. 11 spp (4 gen) in US/Can (Arnett 2000 p 697).

Puss caterpillar moth. *Megalopyge opercularis* (J.E. Smith), Megalopygidae, is native to eastern U.S. Food is orange, pecan, 'persimmon' (FlaDPI; Kimball 1965 p 196).

Geometridae – Geometrid moth family 27.61

Larvae are inchworms, measuring worms, spanworms, or loopers (name depending on local dialect). Walks with a looping motion (a feature shared by a few species in other families). Some are camouflaged as twigs. They may hibernate in ground debris. Difficult to identify; both male genitalia and details of wing venation must be correlated with color patterns of adults. 1404 spp (254 gen) in US/Can. (Arnett 2000 p 708).

_____, *Exelis pyrolaria* (Guenee), Geometridae, tribe Bearmiini, larvae become full grown in April; pupate in hairy cocoons. Moths emerge in May. Food: *Pyrola*, persimmon. MS AL GA FL (Kimball 1965 p 180).

Saturniidae – giant silkworm moth family 27.72

Largest moths in North America; most are bright colored. Short-lived adults do not feed. Some, not all, pupate in silk cocoon; overwinter in cocoon (Milne & Milne 1980 p 769). 69 spp (18 gen) in US/Can. (Arnett 2000 p 764). Rare on persimmon.

Hickory horned devil (regal moth, royal walnut moth), *Citheronia regalis* (Fabricius), Saturniidae, sf

Ceratocampinae. “Although it’s size and appearance attracts attention it is not important as a pest.” (Craighead 1950 p 383). Larva found July to September, feeds on foliage of hickory, walnut, sweet gum, and persimmon (both D.v. and D.k.). Caterpillar variably colored, with several paired long, curved black tipped orange horns on head-end of back. Pupates without a cocoon in the earthen cell. Overwinters in the ground. One generation per year. (Pictures: Milne & Milne 1980, adult plate 573, caterpillar plate 24).

Luna Moth, *Actias luna* (Linnaeus), Saturniidae, sf Saturniinae, tribe Saturniini (syn: *Tropaea luna* (L.)). Caterpillar about 3” long, eats foliage of hickory, walnut, sweet gum, ‘persimmon’ and sometimes other trees and shrubs (Milne & Milne 1980 p 768; Craighead 1950 p 379). Pupates in a cocoon usually loose on ground; 2 generations a year. Overwinters as pupa in cocoon. Adults short-lived, greenish with long tails on hind wings. Moths fly in April and June. Deciduous forest eastern U.S. and adjacent Canada. ENDANGERED. Insignificant on persimmon. (Pictures: Milne & Milne 1980, adult plate 573, caterpillar plate 24).

Lymantriidae – tussock moth family

27.79

Large family, about 2500 species, but only 32 spp (6 gen) native to U.S. and Canada; 3 additional genera, 4 species, have been introduced (Arnett 2000 p 783).

FOREIGN/domestic. **Gypsy moth**, *Lymantria dispar* (L.), Lymantriidae, sf Lymantriinae, tribe Lymantriini, (syn. *L. japonica* Motschulsky) is an important pest of Oriental persimmon in Japan (Kitagawa & Glucina 1987 p 42).

Males fly by day; the sluggish females do not fly at all and seldom move far from the place of emergence. They can crawl onto and deposit eggs in masses on solid objects, ---tree trunks, vehicles, other. The newly hatched larvae have hairs with small air pockets that make them buoyant, thus enabling dispersal up to 5 miles in strong winds. Larvae prefer oaks, but will eat the foliage of most trees and shrubs. There is one generation per year.

The gypsy moth, introduced from Europe, has become widespread in northeastern U.S. extending southward to Virginia. It has been found, but not yet established, as far south as Florida and Louisiana, and intercepted on RVs (recreational vehicles) entering California.

A subspecies from the Far East and Japan has recently become established in the Pacific Northwest (Arnett 2000 p 784).

Noctuidae – noctuid moth family

27.81

Most species are plant leaf feeders and stem borers (family of the army-worms and cutworms); a few mine leaves; others miscellaneous feeding. Most are nocturnal. The pupae of many species are formed in the soil at the base of the food plant. 2925 spp (615 gen) in US/Can. (Arnett 2000 p 795).

_____, *Alypia wittfieldii* Hy. Edwards, Noctuidae, sf Agaristinae, has been reported on *D. kaki* in Florida (Kimball 1965 p 81; FlaDPI).

_____, *Catocala piatrix* Grote, Noctuidae, sf Catocalinae. Food: Hickory, pecan, ‘persimmon’, walnut (Kimball 1965 p 121)

_____, *Hypocala andremona* (Cramer), Noctuidae, sf Catocalinae. Food: ‘persimmon’ (Kimball 1965 p 131)

_____, *Hysorophra monilis* (F.) Noctuidae, “larvae feeding on persimmon at night, concealed on ground during daylight” in Florida (Kimball 1965 p 137) [Genus not in Arnett]

_____, *Renia adspersgillus* Bosc, Noctuidae, sf Hermininae, (syn: *R. larvalis* Grote) “Larva will eat persimmon” (Kimball 1965 p 148).

Limacodidae – slug caterpillar moth family

27.4

Stumpy winged moths. Caterpillar slug-like, rather fleshy with short thoracic legs and no prolegs. Move about like a slug. Some larvae have stinging hairs. (Borrow & White 1970 p 244; Arnett 2000 p 700). 52 spp (21 gen) in US/Can (Arnett).

FOREIGN. “An undetermined black limacodid is a serious pest of persimmon and *Aleurites* [tung oil] in central Japan, and the trees are often entirely defoliated by it.” Two broods a year, first adults in May, second in August. Eggs laid in masses of 700 or more upon leaves and lower branches. In early stages the larvae are gregarious, feeding on the undersurface of the leaf; later they separate. (Clausen 1931 pp 29-30).

FOREIGN/domestic. **Oriental moth**, *Cnidocampa flavescans* (Walker), Limacodidae, (syn: *Monema flavescans* Walker), is listed as “important” on D.k. in Japan (Kitagawa & Glucina 1981 p 42), a common pest in central Honshu and Kyusu (Clausen 1931 p 30). Also on D.k. in Korea and China (ibid. p 8). Overwinters as a mature larva in a cocoon. The oriental moth has been introduced into Massachusetts (Arnett 2000 p 700) and has spread outward.

FOREIGN. Other limacodids on persimmon (D.k.) in the Orient, presented as listed by Clausen (p8), are: *Microleon longipalpus* Butl., *Miresa inornata* Wlk., *Parasa consocia* Wlk., and *Scopenodes venosa* Wlk.

Lycaenidae – gossamer-winged butterfly family; 27.65
hairstreak, copper, and blue butterfly family

Adult butterfly rather small, 3/8” to 1-7/8”; most with blue, violet, or coppery wings; often with short curved narrow tails on hind wing. Wings held tightly together over back when at rest. Caterpillar stocky, slug-like; pupa in chrysalis suspended by silk thread, usually in leaf litter on ground, overwinter in egg or pupal stage. 136 spp (52 gen) in US/Can (Arnett 2000 p 735).

Cotton square borer (gray hairstreak, common hairstreak), *Strymon melinus* (Huebner), Lycaenidae, sf Theclinae, tribe Theclini, larvae eat buds, flowers, and fruit of many different plants. Listed on ‘persimmon’ (? source). Range: so. Can. to nw So. Amer. (Opler & Malikul 1992 p 12)

UNKNOWN. Listed on ‘persimmon’ by common name only.
penitent
southern flannel
small purplish gray
fine-lined gray

B. LEAF-EATING BEETLES. Order COLEOPTERA

Scarabaeidae – lamellicorn beetle family scarab beetle family

24.37

Adults of many species are leaf feeders on trees, crops, and ornamentals. Larva is a C-shaped white grub with sclerotized brown head equipped with prominent mandibles. The larvae of the different species, which includes dung beetles, have various feeding habits. Many live in soil and feed on roots. Except for a few large genera, e.g., the genus of the June bug, the species are rather easy to identify. 1295 spp (135 gen) in US/Can, (Arnett 2000 p 415).

June bugs, *Phyllophaga* spp., Scarabidae, sf Melolanthinae, also called May beetles, attack American and Oriental persimmons in April in southern Louisiana and Mississippi. *At night* the adult beetles devour leaves, --- veins and all; unopened flowers; tender bark and twigs. In a few nights' time these pests can seriously damage young trees (Brown & Brown 1994). More than one species is involved in Louisiana (Pollett 2000 pers com). Eggs are laid in soil among grass roots. The larvae, i.e., our grub worms, feed on roots in the soil; pupate in the soil in the spring; adults emerge in mass in the spring to feed on tender growth of forest trees.

The species that attack persimmon in Louisiana remain unlisted. Species recorded earlier on persimmons [D.v.] in the eastern forest are: *P. crenulata* (Froelich) [NY & SC, w. to IA; hickory, pecan flowers, black gun, persimmon and others]; *P. forsteri* (Brumeister) [NY & SC, w. to IA; oak, hickory, pecan, persimmon, others]; *P. ilicis* (Koch) [NY & SC, w. to MN & MS; oak, hickory, pecan, persimmon, others]; *P. tistis* (Fabricius) [NY & SC, w. to MN & MS; oak, , persimmon, others; not attracted to lights] (Craighead 1949 pp 177-9).

There are 217 species of Polyphaga (Arnett 2000 p 147). June bugs cannot be identified to species without aid of technical literature, which describes features of male and female genitalia. [If you must know, submit about 10 bugs of each look-alike observed feeding on *Diospyros*, naming host species, date, and collection locality.]

A daylight inspection is made searching for chewed leaves on D.k. and [possibly] “a few black splotches on leaves” [fecal stains] below the damage. To observe feeding, a night inspection aided by flashlight is made of persimmon, -- and also nearby oaks.

In Hazelhurst, Mississippi as many as 16 beetles were found on one persimmon tree. June bugs attack American and Oriental persimmon, blueberry bushes, and pecan. “A diazinon spray kills them...” (Brown & Brown 1994).

Chrysomelidae – leaf beetle family

24.153

Feeding habits vary. The beetle may feed on leaves and flowers; the larvae attack roots, devour leaves or tunnel within them. Host range may be restricted or broad. Some species can often be identified in the field because of their distinctive shape and color patterns; while many genera are difficult. The family includes some of our worst crop pests. 1481 spp (188 gen) in US/Can. (Arnett 2000 p 495).

Claycolored leaf beetle, *Anomoea laticlavata* (Froster), Chrysomelidae, sf Clytrinae, tribe Clytrini, are colored either tan or black or one of several patterns combining the two colors. They resemble a miniature June bug. They feed in the cool of day, and when disturbed the beetle either flies away or folds its legs and drops.

The beetles start feeding on tender leaves of the new growth in May and continue into late summer moving to new flushes of growth on D.v. The pattern of feeding starts at leaf edges. Occasionally a chewed out area extends from the edge to the central vein forming a SIGNATURE PATTERN that resembles a tube sock. (i.e., a sock woven without a heel) that has been used. Up to 75% of the individual leaf blade may be consumed leaving the area next to the coarse veins.

In South Carolina on young trees of native persimmon, “Early Golden and John Rick seedlings... Defoliation was not the problem, but destruction to the new growth was” (Lisenby 1993 p 72). The pest is insignificant on bearing trees since there is little new growth during the summer months.

Range of the leaf beetle: Quebec to FL & NM (Arnett 2000 p 497) Host range unknown. On American persimmon, St. Francisville, La. [Identified by Victoria Moseley, Louisiana State Arthropod Museum.]

Curculionidae – snout beetle or weevil family

24.161

Largest family of insects; estimates 40,000 and counting. Snout beetles and weevils used interchangeably. Adults 1 to 40 mm, well developed snout (actually drawn out head). Antennae inserted on snout, clubbed. Practically all are plant feeders; polyphagous except for a few species. Injury is from feeding of both larva and adult. Larva attacks all parts of host plant; adult may chew holes in fruit, nuts or other plant parts. 2614 spp (401 gen) in US/Can (Arnett 2000 p 511).

Fuller rose beetle, *Pantomorus cervinus* (Boheman), Curculionidae, sf Brachyderinae, tribe Naupactini, (syn: *Asynonychus cervinus* (Boheman); *A. goodmanni* Crotch adult feeds on many kinds of fruit trees including ‘persimmon’; devours leaves, buds, flowers. “Eggs are laid in batches around base of small plants or under bark of trees’ (Papp 2001 p 287). Larva lives underground, feeds on roots of almost any kind of plant, pupates in an earthen cell. Overwinters as an adult under plant debris, or as larva in the soil. Adult lacks the ability to fly. Males unknown. Range: much of N. Amer., common in CA (Johnson and Lyon 1991 p 230; Papp 1984 p 264). Two generations per year in Florida, adults peak in June and again in early September. (J&L p 230). *Adults feed at night.*

Asiatic tree weevil, *Cyrtopistomus castaneus* (Roelofs), Curculionidae, sf Eremninae, adults attacks leaves, feed on 36 or more woody species including ‘persimmon’ [D.v.] Native to northeastern Asia; range in U.S.: NJ, NY, west to MO and Ozark Mountains (Johnson and Lyon p 249)

C. MISCELLANEOUS LEAF-EATING INSECTS.

Order HYMENOPTERA Megachilidae – leaf-cutting and mason bees

25.68

Most are leaf cutters, a few parasitic. 682 species in US/Can (Arnett 2000 p 604).

Leaf-cutting bee (species not observed) activity on D.v. is rare but readily recognized by the perfect symmetry (the consistent radii) of the curve left behind as a piece of leaf is removed from the leaf edge. Leaf bits are used to line the tubular nest. Damage to D.v. is insignificant.

CHAPTER 3. THE SUCKING INSECTS

The sucking insects that feed on persimmon leaves, stems and/or fruits belong to 3 orders: A. HEMIPTERA (the true bugs); B. HOMOPTERA (cicadas, leafhoppers, aphids, scale insects); and C. THYSANOPTERA (thrips). Most sucking insects listed on persimmon are in the Homoptera.

A. SUCKING INSECTS. Order HEMIPTERA – true bugs

The group is equipped with strong piercing-sucking mouth parts. Most species feed on plant juices and feed on many plants, yet a few are host specific. A few feed on the blood of vertebrates (e.g., bedbugs), and others are predatory on other arthropods. There are terrestrial and aquatic forms. Life stages are egg; nymph, which resembles the adults; and adult. Most have wings. The covering wing (front wing) has a thickened basal portion and a membranous apical portion (thus hemi - half, pteron – wing). The second pair of wings is membranous. Wings are folded flat over the abdomen with membranous portion of forewing crossed when at rest.

Hemiptera suborder DISOCOROMORPHRA

Pentatomidae – stinkbug family

Large scutellum and broad body (shield-like); usually green or brown, sometimes marked with other colors. They may be plant feeders or predators. 260 spp (77 gen) in US/Can (Arnett 2000 p 259).

FOREIGN. In Japan three stinkbugs, family Pentatomidae, are listed as important pests: **brown-winged greenbug**, *Piautia stali* Scott; **brown marmorated stinkbug**, *Halyompha mista* Uhler; and a third stinkbug, *Glaucia subpunctatus* Walker. Their feeding causes deformities of fruit and fruit drop (Kitagawa & Glucina 1987 pp 42-3).

SPECIAL NOTE. In the local dialect “stinkbug” is applied to not only the Pentatomidae but to members of related families with well developed scent glands that produce a similar strong odor. In addition “stinkbugs”, plural, has a double meaning: A) several specimens of a single species; B) several species. The ambiguity becomes noticeable only when one is trying to catalogue the specific insects that are persimmon pests. However, instead of withholding information, waiting for purification, our friends have passed along their observations so that we also can be alert.

In Florida “of the insects associated with fruit stinkbugs [species not named] are the most significant. They are only a problem on non-astringent types and feed as the fruit colors in September and November. Damage will show up as off-white sections in the fruit just under the peel and are subject to decay.” (Miller & Crocker 1992 p 14).

In Louisiana, West Feliciana Parish, the non-astringent varieties are preferred. A single deformed fruit may show as many as 15 stings (feeding punctures). Astringent varieties in the same orchard also show stings, but to a lesser degree. On the surface the feeding wound, a small hole (usually detectable under magnification), is centered in a depression, the earlier the sting the deeper the dimple. Below the surface there is a whitish discoloration resembling dry rot. If secondary invaders enter through the wound subsurface area may have a dark discoloration, which remains firm in soft-ripe fruit. Species of Pentatomidae and Coreidae have been seen in the orchard, but none observed while feeding.

Coreidae – squashbug family

20.4

Large family, mainly tropical. Long body, length 10 to 20 mm. Body brown to dark; margin of abdomen raised in many species. Scent glands well developed, odor similar to stinkbug. All are plant feeders. 88 sp (33 gen) in US/Can (Arnett 2000 p 254).

Eastern leaf-footed bug, *Leptoglossus phyllopus* (Linnaeus), Coreidae, sf Coreinae, tribe Anisocelini, is listed as feeding on fruits and flowers of ‘persimmon’ and others (Johnson & Lyon 1991 pp 422-4). Range: primarily southern half of U.S.; reported NY to CA.

Tingidae – lacebug family

20.14

Lacebugs feed on the leaves of trees, shrubbery, and a few perennial plants, usually hiding on the underside of the leaf. Adults are small, usually 5 mm or less, grayish, flattened with somewhat rectangular outline, with lace-like sculpturing on the semitransparent wings and extensions around the head (Arnett 2000 p 263; Borror & White 1970 p 120). Eggs are inserted in plant tissues on underside of leaves, in groups, generally along the midrib (Papp 2001 p 103). 154 spp (22 gen) in US/Can. (Arnett).

FOREIGN. A Japanese lacebug, *Stephanitis takeyai* Drake and Maa, Tingidae, tribe Trigini, is listed as an important pest of Oriental persimmon in some regions of Japan (Kitagawa & Glucina 1987 p 42).

Note. For those not familiar with lacebugs and their damage there are two American species, same genus, that may be observed during the summer; azalea lacebug, *S. pyrioides* Scott and rhododendron lacebugs, *S. rhododendri* Hovarth.

B. Sucking Insects. Order HOMOPTERA – cicadas, leafhoppers, aphids, scale insects and allies
21

All Homoptera are plant juice eaters equipped with piercing-sucking mouthparts enabling them to penetrate into the phloem and xylem, ---the food and water conducting tissues respectively. This large diverse group of active and sedentary forms is broken into 2 suborders and further into 9 superfamilies.

Homoptera suborder AUCHENORRYNCHA – cicadas, hoppers, and allies

Cicadidae – Cicadas

21.13

Large insects, mostly 1” to 2”; head wide, blunt; short antennae inserted on flat front of head between large compound eyes; ocelli 3 spaced in a triangle; wings membraneous, transparent, large, and held roof-like over body. Feeds on plant juices. Long life cycle, 4 years or more. Nymphs feed under the soil; crawl out of a hole and climb any structure to emerge as a one-season adult. 166 spp (22 gen) in US/Can Arnett 1985 p 217).

Cicada (sp not identified) cause mechanical damage during egg-laying activities resulting in the production of cankers on the underside of twigs and small branches. The SIGNATURE PATTERN is a slight swelling along the twig, bark removed from bottom side, plus short tufts of splinters (one to seven tufts) projecting outward from bare surface at an acute angle. Damage to D.v. and D.k. insignificant; species of *Prunus* preferred. The bark rolls in from sides canker covering the wound at the end of 2 years.

Flatidae – flatid planthopper family

21.8

Group feeds on sap of shrubs, trees and vines. About 8 to 15 mm, moth-like, somewhat wedge-shaped forewing held almost vertical at rest; elongated-triangular wing with coastal and/or apical cross veins. Most are brownish or greenish. Nymphs have long waxy filament on body. Adults and nymphs are gregarious. 33 spp (14 gen) in US/Can (Arnett 1985 p 214; Borror & White 1970 p 132).

_____, *Ormenoides venusta*, (Melichar), sf Flatinae, tribe Nephesine. Early nymphs (size and color suggesting a white fly adult) feed on the veinlets on the underside of D.k. and D.v. leaves, last stage of nymph and adults observed feeding on succulent twigs. Adults white with yellowish and greenish tinge. Nymphs hop off if disturbed. [Identified by Victoria Moseley.]

Sweep-netting of foliage yields several species of plant hoppers, including *Metcalfa pruinosa* (Say). [Identified by Victoria Moseley.]

Cercopidae – spittle bug family

21.12

Nymphs appear in spring and while feeding secrete a froth in which they hide for protection. Most species feed on herbaceous plants, some on trees. Overwinter as eggs laid on host. 54 spp (7 gen) in US/Can. (Arnett 1985 p 215).

FOREIGN. A Japanese spittlebug, *Eoscartopsis assimilis* Uhler, is listed as an important pest of persimmon in Japan (Kitagawa & Glucina 1987 p 42).

Cicadellidae – leafhopper family

21.14

Also known as dodgers or sharpshooters. A very large group difficult to identify. Body elongated, tapers posteriorly or parallel-sided; some 22 mm, most less than 10 mm; front wings thickened and colored. Overwinters as egg or adult. Eggs inserted into plant tissue. Most have 5 nymphal stages. Often discharges honeydew while feeding. 2507 spp (225 gen) in US/Can. (Arnett 2000 p 299; Borror & White 1970 p 130).

Glassy-winged sharpshooter, *Homalodisca coagulata* (Say), Cicadellidae, sf Tettigellinae, tribe Proconiini attacks many host plants. It feeds singly or in a dispersed group on succulent stems of D.v. and D.k. They shift to the other side of the stem to hide. [Identified by Victoria Moseley.]

Homoptera suborder STERNORRHYNCHA – jumping plant lice, aphids, whiteflies and scale insects

Psyllidae – jumping plantlice family

21.17

Adults small 2 to 5 mm, some resembling cicadas; 4 wings transparent, held roof-like over body. Eggs stalked, some laid in plant surface, a few species laid in plant tissue. Nymphs not resembling adult. 5 instars, many species producing waxy filaments, which protect their body, some secrete honeydew and are attended by ants. Most are free living; some produce galls. 257 spp (28 gen) in US/Can (Arnett 1985 p 224; Borror & White 1970 p 134).

Persimmon psylla, *Trioza diospyri* (Ashmead), Psyllidae. The nymphs colonize developing leaves causing the edge to roll either upward or downward to cover the louse colony, resulting in severe persimmon leaf distortion (sometimes resembling herbicide injury) and 50% or more reduction in internode length. Heavy infestation can severely stunt the new growth made during late spring and into the summer by seedlings, grafts and late pushing transplants. Damage to bearing trees is insignificant due to shortage of new growth during the summer months. Infestation starts in early spring, about flowering time for Oriental persimmon and before flowering of American Persimmon. Adults are present and mating by May first in south Louisiana. Reproduction continues throughout the summer as long as new growth continues.

Tiny knat-like cicada-shaped clear-winged black-bodied adults are attracted to the leaves emerging from active buds, --- where they rest, court, and mate. The female deposits her eggs along the edges of the developing leaf. Eggs hatch in 5 to 6 days. The sucking nymphs stimulate the leaf edge to roll (up or down) producing a protective cover over the louse colony. A white powder produced by the plump pink nymphs protects them against wetting. [These are not mealybugs, although under some situations mealybugs might also be present. (Miller & Crocker 1992 pp 13-14).] From egg to flying adult takes 4 to 6 weeks. The species overwinters as eggs in crevasses in the bark (Mead 1966).

The insect seems to be host specific for *Diospyros*, completing its life cycle in Louisiana on *D. kaki*, *D. lotus*, and *D. virginiana*, but not on *D. texana*. Nymphs hatch on Texas persimmon but the leaves are too small for colony protection.

No pesticide is registered in Louisiana for psyllid control on persimmon. When adults are observed a malathion spray directed toward emerging new growth is effective. Established colonies are difficult to kill due to the problem of wetting the protected colony.

Aleyrodidae – white fly family

21.18

Minute 4-winged moth-like white insects, 2 to 3 mm, resting and breeding on underside of host leaf, unnoticed until white-fly adults are disturbed and take flight. Wings and body with white powder coating. Wings disproportionately large, folded flat over body when at rest. Eggs produced with or without benefit of male; first instar active, subsequent instars sedentary, protected by oval, flat, scale-like covering, which is *attached to underside*

of leaf. Classification of genera based on 4th instar (which becomes pupa). 99 spp (19 gen) in US/Can (Arnett 2000 p 308; Borror & White 1970 p 134). For identification the instars attached to the leaf are submitted to the specialist.

Citrus whitefly, *Dialeurodes citri* (Ashmead), Aleyroidae, sf Aleyrodinae, is present on D.k. and to a lesser amount to trace on D.v. in West Feliciana Parish, LA on trees growing in full sun. Moderately infested D.k. trees are noticeable due to their blackish-green cast. The nymph, closely appressed to the leaf surface, produces honeydew as a byproduct while feeding. The honeydew settles on the tops of leaves. A sooty mold, a black fungus of the genus *Capnodium* grows on honeydew producing a black layer and thus reduces the light needed for photosynthesis, i.e., the use of energy from the sun to combine carbon dioxide from the air with water from the soil to produce carbohydrates (sugars). The insect is the parasite; the fungus is not. The white fly does not overwinter on the deciduous host. It overwinters on broad-leaf evergreens, e.g., citrus and gardenia (QLH).

In some areas natural enemies have given satisfactory control of the citrus white fly (Gill 2002, pc).

Barberry whitefly, *Aleuroplatus berbericolus* Quaintance & Baker, Aleyrodidae, sf Aleyrodinae, is listed on 'persimmon' (Johnson & Lyon 1991 p 322).

Other whiteflies. Mound and Halsey (1978) catalogued whiteflies, worldwide, listing 14 species plus one questionable on the genus *Diospyros*. Below are whiteflies reported somewhere in the world as parasites of either *D. kaki* or *D. virginiana*, or as *D.sp.* that by geographical location were interpreted by this compiler as being either *D.k.* or *D.v.*

Orange spiny whitefly, *Aleurocanthus spiniferus* (Quaintance) on *D. k.* reported by Kawana 1928:46. Whitefly range includes Hawaii. (M&H p 21-22)

Woolly whitefly, *Aleurothrixus floccosus* (Maskell) on *D. k.* reported by Biezanko & Freitas 1939:6 Whitefly range includes Florida. (M&H p 63-64)

_____, *Aleurotrachelus turpiniae* Takahashi on *D. k.* reported on Takahashi 1935b:40. Whitefly range is Taiwan. (M&H p 78)

_____, *Parabemisia myriceae* (Kuwana) on *D. k.* reported by Kuwana 1928:64. Whitefly range is Japan, Taiwan, Malay. (M&H p 177).

Mulberry whitefly, *Tetraleurodes mori* (Quaintance) on *D. sp.* reported by Quaintance & Baker 1916. Whitefly range in North America and Antilles (M&H p 199-200)

_____, *Trialeurodes packardi* (Morrill) on *D. v.* reported on Russell 1963:151. Whitefly range in U.S. and Canada (M&H p 214-215).

Greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood) on "Diospyros" reported by Russell 1963:152. Whitefly has large host range and occurs practically world wide, including U.S. (M&H p 219-221).

The presence of **plumeria whitefly**, *Paraleyrodes perseae* (Quaintance) on *D. spp* is questioned (M&H p 248). Reported species distribution was Florida, Cuba, Mexico.

Aphidae – aphid, plant lice family

21.19

Colonies of aphids have not been observed on either *D.k.* or *D.v.*

Giant black aphid, *Longistigma caryae* (Harris), Aphidae, feeds on bark of hickory, maple and other forest trees (Arnett 2000 p 312). During spring migration large, single, black, smoky-winged aphids may be seen scattered on surfaces of *D. k.* and *D.v.* branches. The aphids occasionally probe the bark of persimmon in search of liquids before moving on. [Identified by Victoria Moseley]

Superfamily COCCOIDEA of suborder Stenorrhyncha

Collectively, 17 families are called scale insects. Females are wingless, sometimes legless. Body regions fused, usually covered with waxy secretion that forms either a scale, felt-like sac, cottony wax threads, or similar cover. Most males are winged; some are not, yet they crawl. The first instar, the newly hatched crawler, has legs. Legs are lost if nymph becomes sedentary (Arnett 2000 p 315)

Mealybugs, soft scales, and armored scales are recorded on persimmon. “Of the insects that are associated with persimmon those that attack the tree [in Florida] are more devastating than those that attack the fruit. The most devastating insects are the scales found on the bark, and the white peach scale is the most common” (Miller & Crocker 1992 p 13).

Pseudococcidae – mealybug family

21.25

These scale insects (mealybugs) secrete a cottony covering of waxy material that gives them the impression of being mealy. Female body is more or less elongated. 280 spp (45 gen) in US/Can (Arnett 2000 p 318).

Mealybugs may hide under the large calyx lobes of fruit (Kitagawa & Glucina 1987 pp 43-4, fig 48).

Apple mealybug, *Phenacoccus aceris* (Signoret), Pseudococcidae, (of European origin) is listed on ‘persimmon’ (Johnson & Lyon 1991 p 324).

Citrus Mealybug, *Planococcus citri* Risso, Pseudococcidae, on D.k. are found on trees and fruit, especially under the calyx. Ants transport and nurse mealybugs (Tsuda 1956). In California mealybugs are largely controlled by natural enemies (LaRue, et al. 1982 p 9). And outside pest in subtropical climate; greenhouse pest in temperate regions (Arnett 1985 p 236).

Comstock mealybug, *Pseudococcus comstocki* (Kuwana), Pseudococcidae, is listed on ‘persimmon’ (Johnson & Lyon 1991 p 236). Range: eastern U.S. & Can.

Japanese mealybug (wisteria cottony mealybug), *Planococcus kraunkiae* (Kuwana), Pseudococcidae, was collected on *Wisteria sp.* and *Diospyros sp.* in Ventura Co., CA Sept 1917 (McKenzie 1967 p 285). It is listed as a significant pest of D.k. in Japan (Kajiuira 1882 p 132; Kitagawa & Glucina 1987 p 42).

Long tailed mealybug *Pseudococcus longispinus* (Targioni-Tozzetti), Pseudococcidae, (Syn: *P. adonidum* (Linnaeus)) may sometimes be seen on D.k. in California (Ebeling 1959 p 384). Also listed on D.v. (McKenzie 1967 p 303). In New Zealand the LTMB under the large lobes of the fruit calyx are often difficult to control once the fruit sets and begins to expand (Kitagawa & Glucina 1987 pp 43-44, pig 48). And outside pest in southern states; a greenhouse pest in northern states (Milne & Milne 1980 p 511). Spread throughout the world (McKenzie).

FOREIGN/domestic. **Citrophillus mealybug**, *Planococcus calceolariae* (Maskell). Pseudococcidae, (syn: *Pseudococcus caceolariae* Maskell) hides under the calyx lobes of persimmon in New Zealand (Kitagawa & Glucina 1987 pp 43, 44).

FOREIGN. **Elongated cottony scale**, *Phenacoccus pergandei* Cockell, Pseudococcidae, attacks D.k. in Japan (Kajiuira 1982; Clausen 1931 pp 10, 30; K. & G. 1987 p 42)

Coccidae – soft scale insect family

21.26

These insects are pests of fruit and ornamental trees. Frequently found in greenhouses and on houseplants. 92 spp (22 gen) in US/Can (Arnett 2000 p 319).

Barnacle scale, *Ceroplastes cirripediformis* Comstock, Coccidae. Occasional infestations on D.K. in California (Quayle 1938 p 434).

Duges wax scale, *Ceroplastes dugesii* Litchenstein, Coccidae, occurs in southern Florida and Hawaii. It has a broad host range including ‘persimmon’ (Johnson & Lyon 1991 p 358)

Florida wax scale, *Ceroplastes floridensis* Comstock, Coccidae. Solitary individuals were observed on D.v. and D.k. in Louisiana. Infestations were short lived (QLH). Noted on D.k. in Japan (Clausen 1931 pp 10,30).

Brown soft scale, *Coccus hesperidum* Linnaeus, Coccidae, occasionally attacks D.k. in California (Quayle 1938 pp 433-4).

European fruit lecanium, *Parthenolecanium corni* (Bouche'), Coccidae, occasionally attacks D.k. in California (Quayle 1938 p 434). It is widely distributed and has a large host list (Johnson & Lyon 1991 p 362).

Green shield scale, *Pulvinaria psidii* Maskell, Coccidae, occasionally infests the 'persimmon' (Ebeling 1959 p 384).

Black scale, *Saissetia oleae* (Olivier), Coccidae, occasionally infests D.k. in California (Quayle 1938 p 434). Extensive host range; distributed in the Gulf States and the Southwest (Johnson & Lyon 1991 p 538).

FOREIGN. **Japanese wax scale**, *Ceroplastes japonicus* Green, Coccidae, is listed as an important pest on 'persimmon' [D.k.] in Japan (Kitagawa & Glucina 1987 p 43).

FOREIGN/domestic. **Indian wax scale**, *Ceroplastes ceriferus* Fabricius, Coccidae, is listed as an important pest on D.k. in Japan (Kitagawa & Glucina 1987 p 42); listed by Clausen (1931 pp 10, 30) as present on D.k. in Japan Korea, and China. Found on holly in U.S. (Arnett 2000 p 319).

FOREIGN/domestic. **Red wax scale**, *Ceroplastes rubens* Maskell, Coccidae, is listed as important on D.k. in Japan (Kitagawa & Glucina 1897 p 42); also occurs in China and Formosa (Clausen 1931 p 10). Listed in the U.S. on other host plants (Arnett 2000 p 319).

Diaspididae – Armored scale insect family

21.23

Adult females are covered with a wax test (a hard external covering) that rests tent-like over the body, but not attached. Test is composed of molted skins, excretions, and wax. 194 spp (85 gen) in US/Can (Arnett 2000 p 324).

Putnam scale, *Diaspidiotus ancyclus* (Putnam) Diaspididae, listed on Diospyrus (Wescott 1956 p 489).

Greedy scale, *Hemiberlesia rapax* (Comstock), Diaspididae, is listed on 'persimmon' (Johnson & Lyon 1991 p 372). This insect is widely distributed in the U.S. and closely related to the latania scale.

Latania scale, *Hemiberlesia lataniae* (Signoret), Diaspididae, may sometimes be seen on D.k. in California, especially under sepals of fruits (Ebeling 1959 p 384). Latania scale is found in the costal states as far north as Maryland, and in California.

Oyster shell scale, *Lepidosaphes ulmi* (Linnaeus), Diaspididae, is listed on 'persimmon' (Quayle 1938 p 393). It is recognized by its oyster shell shape. Attacks many ornamental and fruit trees.

Olive scale, *Parlatoria oleae* (Colvee), Diaspididae, is found on D.k. in California. Normally controlled by wasps (LaRue, et al. 1982 p 9).

Camphor scale, *Pseudaonidia duplex* (Cockerell), Diaspididae, listed on Diospyrus (Wescott 1956 p 489)

White peach scale (syn; West Indian peach scale), *Pseudaulacaspis pentagona* (Targioni-Tozzetti), Diaspididae, (syn: *Aulacaspis pentagona* (Targioni-Tozzetti)) causes limb girdling and sometimes death of the persimmon tree (Miller 1984 p 341). Infestations become highly visible when males emerge in warm weather and produce a snowy-white appearance on limbs and trunks. Slicing the bark down into green cambial layer with a knife will reveal reddish purple dots where the insect has probed and is feeding on the tree (Miller & Crocker 1992 p 13). White peach scale is listed on D.k. in Japan, Korea, China and Formosa (Clausen 1931 p 10), and in Florida, USA. The host list includes as many as 97 plant species. The scale is reported as common on the east coast from Maryland southward (Johnson & Lyon 1991 p 392), including Louisiana. There are many generations for each year.

For control on persimmon in Florida, oil emulsion is applied during the dormant season, i.e., mid-January (Crocker & Andrews 1982 p4). An infestation in West Feliciana Parish spread rapidly from peach to peach but did not attack D.k. or D.v. (QLH).

San Jose Scale, *Quadraspidotus perniciosus* Comstock, Diaspididae, is listed on Diospyros (Wescott 1956 p 489).

FOREIGN/domestic. **Oleander scale**, *Aspidiotus nerii* Bouche', Diaspididae, observed on D.k. in New Zealand (Kitagawa and Glucina 1987 p 44) is present in the U.S. on other hosts.

FOREIGN. _____ *Droscha corpulenta* Kuw., is listed on D.k. in Japan (Clausen 1931 p 10).

FOREIGN. _____ *Lepidosaphes kuwacola* Kuw., Diaspididae, is listed on D.k. in Japan (Clausen 1931 p 11).

FOREIGN. _____ *Lepidosaphes tubulorum* Ferris, Diaspididae, is "one of the important pests of persimmon" in Japan. Hosts include pear, grape and various species of *Prunus* (Clausen 1931 p 30).

C. SUCKING INSECTS. Order THYSANOPTERA – thrips

22

Collectively called thrips. Slender insects, 0.5 to 14mm; wings if present two pairs, fringed with long hairs. Usually concealed; living in flowers, under leaves, or under bark; feeding on plant tissues, fungous spores, or other arthropods. Stages are egg, 2 active nymph stages, 1 inactive, then pupal stage, finally adult, winged or wingless. Males unknown or rare in some species. Reproduction without sex common.

Thripidae – thrips family

22.4

Body slender and somewhat flattened, 0.5 to 2 mm long, commonly collected on flowers and leaves. Almost any flower thumped against a white cloth will expose tiny, pale to blackish specks that crawl. Nearly all species are plant feeders. Mouthparts combine piercing and rasping elements that enable thrips to saw through plant tissues and suck juices. For identification high magnification is required. Permanent mounts are made on microscope slides. 264 spp (50 gen) in US/Can (Arnett 2000 p 334).

"Various species of thrips can be seen on the flowers and around newly developing fruit" in Florida, but their impact is not known (Miller & Crocker 1992 p 14). In California thrips discolor fruit, usually in thick foliated areas. Damage is first noticed on leaves, --- silvery in appearance (Tsuda 1986). In Japan "thrips injure the flowers." On 'Jiro', an old cultivar native to Shizuoka prefecture, damage "is remarkable due to late petal fall" (Kajiura 1982 pp 128, 132).

Greenhouse thrip, *Heliothrips haemorrhoidalis* (Bouche), Thripidae, sf Panchaethripinae, has been listed on *Diospyros* in the U.S. (Wescott 1956 p 579) and in New Zealand (Kitagawa & Glucina 1987 p 44).

Redbanded thrip, *Selenothrips rubrocinctus* (Giard), Thripidae, sf Panchaethripinae, is listed on "persimmon". Only immature thrips have the red band across the abdomen. It is a tropical species, present in Florida, that may be able to survive along the Gulf Coast (Johnson & Lyon 1991 p 432).

FOREIGN. Two thrips listed as significant pests of D.k. in Japan are: **Yellow tea thrip**, *Scirtothrips dorsalis* Hood, Thripidae, tribe Sericothripini, which injures flowers and blemishes fruit beneath the calyx; and **Persimmon thrip**, *Ponticulothrips diospyori* Haga & Okajima (Kitagawa & Glucina 1982 pp 42,43)

CHAPTER 4. THE FRUIT DAMAGING INSECTS OF PERSIMMON

There are several insects that destroy or reduce the quality or commercial value of fruit, --- some domestic, others foreign. Damage includes surface blemishes and distortions, destruction of the flesh, and including fruit drop. Some insects make slight penetration resulting in a wound that offers entryway for secondary organisms (namely, fungi) to either discolor or rot the flesh.

The various species are scattered among several insect orders. *Species mentioned in previous chapters will be listed again and briefly noted.*

A. FRUIT DAMAGING INSECTS – LEPIDOPTERA

27

Family **Lycaenidae** – gossamer-winged butterflies

Subfamily **Theclinae** – hairstreaks

Belonging to the true butterflies. Adults small delicate, often brightly colored, frequently a thread-like tail on hind wing. Most species local in occurrence; migration rare. Caterpillars feed on wide variety of hosts, usually woody trees and shrubs. Overwinter in either egg or pupal stage.

Henry's elfin, *Incisalia henrici* (Grote & Robinson), Lycaenidae, sf Theclinae, “eats flowers and bores into the fruit of blueberries, redbud, huckleberry, wild plum, and **Texas persimmon** (*Diospyros texana*)” (Pyle 1981 p 429). Larva feeds on “usually one host in my area, but several used in central Texas”. Distribution: e. N. Amer – from se Man. To N.S. s to FL & TX. ‘Persimmon’ among food hosts (Opler & Maikilul 1992 p 113). Subspecies larvae of *I. h. solata* Cooke & Watson (distribution range Texas) feeds on Texas persimmon (Tilden & Smith 1986 p 173).

FOREIGN. **Persimmon fruit moth**. *Stathmopoda masinissa* Meyrick, Oecophoridae (syn: *Kakivora flavofasciata* Nagano) is a serious pest of D.k. in Japan. The larvae attacks buds, shoots and fruit (Kajiura 1986 p 132). The caterpillar pierces the fruit and causes it to mature prematurely and to drop (Kitagawa & Glucina 1987 p 43), ---“the damage at times being so extensive as to prevent the ripening of a single fruit upon the trees” (Clausen 1931 p 29).

There are two broods a year, first appearing in May and June and second in July and August. Eggs are deposited on the bud at the base of leaf petiole, or between them. Upon hatching the young larva may attack several fruit (Clausen 1931 p 29). “the moth lays its eggs on the calyx and stem of the fruit in early summer. The caterpillar pierces the fruit and causes it to mature prematurely and drop” (K & G p 43). The fruit moth overwinters as: a mature larval stage in a cocoon beneath a strip of bark; a pupa in rough bark (K & G p 46).

FOREIGN. **Reddish oraesia**, *Oraesia excavata* Butler, Noctuidae, is considered a most important pest in Japan on D.k. Fruit piercing larvae cause damage, “which allows infection to invade the fruit” (Kitagawa & Glucina 1987 pp 42, 43).

B. FRUIT DAMAGING INSECTS - DIPTERA

29

The Diptera have one pair of membranous wings, the hind wings are either reduced to balancing organs or entirely absent. Soft bodied, with surface spines and setae, sometimes scales. Head globular, thorax oval and humpbacked, abdomen elongated, cylindrical or oval. Mouthparts sucking, vestigial. Life sages: eggs, legless larvae or maggots, pupa, adult.

Tephritidae – fruit fly family

29.61

Fly, 2 – 12 mm (rarely 25 mm including long ovipositor). Most species with transparent, characteristically pictured wings. Larvae of many species live in fruit; others either developing in seeds of Compositae, are leaf miners, or cause galls. True fruit flies are among the most destructive pests. 300 spp in US/Can (Arnett 200 p 892).

“In other countries fruit flies (e.g., Mediterranean fruit fly, Queensland fruit fly) are important pests of persimmon” (Kitagawa & Glucina 1987 p 43).

Western Hemisphere fruit flies

Anastrepha Schiner, Tephritidae, sf Trypetine, tribe Toxotrypanini, is a genus of relatively large fruit flies confined to the Western Hemisphere, --- the Bahamas, Florida, south Texas, most Caribbean islands, extending south to Uruguay and Argentina (occasionally trapped in California). "*Diospyros*" is noted among the host plants listed under 5 species of 20 encountered in the U.S. (Foote, et al. 1993 pp 83-111, maps 4-7).

South American fruit fly, *A. fraterculus* (Wiedemann) occurs from south TX to Argentina. Large host range includes *Diospyros* (ibid. pp 95-7, map 5).

Mexican fruit fly, *A. ludens* (Loew) occurs south TX to Costa Rica, annually migrates across the Rio Grande from Mex. to TX. Introduced into CA but eradicated. 22 plant genera listed on hosts; commonly encountered on citrus (ibid. pp 98-100, map 7).

West Indian fruit fly, *A. oblique* (Macquart) (syn: *A. mombinpraeoptans* Sein) occurs throughout Greater and Lesser Antilles, recorded Mex. to Brazil. It has been trapped in the Florida Keys, Rio Grand Valley in TX, and 3 counties in southern CA. More than 60 host plants (ibid. pp 101-2, map 6).

Black fruit fly, *A. serpentina* (Wiedemann) occurs in Mex., Cent. America, and much of S. America. Trapped once in McAllen TX, twice in s. CA. Hosts include 21 plants. Preferred host is Guava (ibid. p 105-7, map 7).

_____, *A. striata* Schiner occurs in Mex., Cent. Amer., and much of S. Amer. Trapped once in McAllen, TX; twice in s. CA. Host: includes 21 plants. Preferred host is Guava (ibid. p 108, map 7).

Overseas fruit flies

FOREIGN. **Mediterranean fruit fly**, medfly, *Ceratitis capitata* (Wiedemann), Tephritidae, sf Dacinae, tribe Ceratitini, attacks approximately 260 different kinds of fruits, vegetables and nuts, including *Diospyros decandra*, Lour., *D. kaki*, and *D. virginiana* (Weems 1981). It is an economic threat to citrus and other fruit crops that enter the world trade.

Medfly is native to the Mediterranean region of Europe and North Africa. It has been established in Hawaii since 1910, but not established in the contiguous 48. In the past it has been introduced in TX once, and several times into FL & CA, and eradicated each time after costly detection and eradication efforts (Foote, et al. 1993 pp 124-6, map 9).

FOREIGN. **Queensland fruit fly**, *Bactrocera tryoni* (Froggatt), Tephritidae, sf Dacinae, tribe Dacini, is considered the most destructive fruit and vegetable pest in Australia, where it is found on more than 100 host plants. It is endemic in the western third of Queensland and New South Wales, and the western tip of Victoria. Since circa 1977 it has invaded New Guinea, New Caledonia, Austral Islands, and many of the Society Islands. An adult female was trapped at La Mesa, California in 1985, but no infestation was found. (Foote, et al. 1993 pp 118-9, map 8).

C. FRUIT DAMAGING INSECTS - COLEOPTERA

24

Curculionidae – snout beetle or weevil family

24.161

Largest family of insects; estimated 40,000 and counting. **Snout beetle** and **weevil** used interchangeably. Adult 1 to 40 mm, with well-developed snout (actually drawn out head). Antennae inserted on snout, clubbed. Practically all are plant feeders; polyphagous except for a few species. Injury is from feeding of both larva and adult. Larva attacks all parts of host plant; adults may chew holes in fruit, nuts or other plant parts.

Plum curculio, *Conotrachelus nenuphar* (Herbst), Curculionidae, sf Cryptorhynchinae, tribe Ityporini, attacks young persimmon fruit (Woodward 1978 pp 337, 342). Plum curculio attacks only the fruit. Host plants include stone fruits, pear, apple, blueberry. Stone fruit usually drops; pome fruit usually remains on tree but are deformed. One brood in North; two broods in South. Adults hibernate under litter, emerges about the time peaches bloom in South. Female cuts a crescent-shaped flap in the fruit skin, --- the SIGNATURE PATTERN, and inserts an elliptical egg.

C-shaped larva feeds inside fruit for about 2 to 4 weeks; leaves fruit to pupate in the soil. Adult emerges in 30 to 35 days (Papp 1984 p 280) and feeds on dropped fruit until cold weather. Range: east of Rocky Mountains.

D. FRUIT DAMAGING INSECTS Order DERMOPTERA - earwigs

Earwigs have short wing covers and *a well-developed, usable forceps at their tail end*. The latter appendage serves as an easy feature to distinguish them from short winged beetles. Life stages are egg, nymphs and adults. They hide in daytime, and *feed at night*. They live in damp places: under bark or in the soil; in cracks or similar locations. The species in U.S. and Canada are omnivorous. 20 species (12 gen) represented in 5 families in US/Can (Arnett 2000 p 185).

Earwigs (species not named) have been reported as a pest of Oriental persimmon trees and fruit in California's Sacramento Valley near Orland (Sheley, 1990 p 59): "...earwigs...eat the flowers and chew the stems. They also bore into the Giants [Giant Fuyu] just under the calyx and form little burrows which provide hiding places and convenient food source" but not into standard Fuyu that bears smaller fruit.

NOTE. Damage by earwigs to the flowers and tender stems is acceptable. However, are the earwigs boring into the fruit? Or just taking advantage of a varietal weakness, which is occurring only on the "Giants", i.e. a possible tendency of big fruited cultivars to develop separation of the calyx? For example, cultivar 'Hanagoshi' tends to have a "high dehiscence between calyx and fruit" (Kajiura 1982 p 132). Also it was postulated that *Eriophyes diospyri* caused partial separation of the fruit from the calyx [See in chapter 6 under eriophyid mites.]

E. FRUIT DAMAGING INSECTS. Order unknown (leaf miner)

Leafminer tunnels have been observed on D.v. fruit. [See chapter 5, p 25]

F. FRUIT DAMAGING INSECTS noted earlier:

LEPEDOPTERA

Orange tortrix in California may occasionally feed on fruit of D.k. [Chapter 2, p 10]

Oriental fruit moth introduced from Japan has spread coast to coast. [Chapter 1, p 4]

FOREIGN. Three **leaf rollers** in New Zealand may damage fruit of D.k. [Chapter 2, p 10]

HEMIPTERA

Stinkbugs in Florida cause a blemish in fruits of D.k. [Chapter 3, p 15]

FOREIGN. **Stinkbugs** in Japan may cause fruit deformities and fruit drop. [Chapter 3, p 15]

THYSANOPTERA

Thrips in California discolor fruit and foliage of D.k. [Chapter 3, p 21]

FOREIGN. **Yellow tea thrips** in Japan blemish fruit. [Chapter 3, p 21]

CHAPTER 5. MISCELLANEOUS AND LEFT-OVERS

A. LEAF MINERS AND OTHER MINING INSECTS.

Depending upon the species of insects, a miner larva lives and feeds part or all of its existence in a special environment, semi-aquatic, tunneling and feeding in succulent plant tissue (as opposed to woody tissue) either between two epidermal layers (top and bottom surfaces) of a leaf; just under the surface of the leaf petiole; in a stem under the surface to as deep as the cambium; or under the skin of the fruit. *Leaf miners form a habitat group rather than a related taxonomic group.* “Each species makes a characteristic type of mine. They write their signatures in the leaves, a habit which greatly assists in determining species.” (Forest 1942 p 334). “There is little difference between a borer and a miner except that a boring insect feeds deep in the tissue and a miner feeds just below the surface of the portion of the plant attacked” (ibid p 319).

A LEAF MINER STAGE has been noted in several families distributed among four orders: COLEOPTERA – Buprestidae, Chrysomelidae, Curculionidae; DIPTERA – Agromyzidae, Anthomyiidae, Cecidomyiidae, Tipulidae, Trupanelidae; HYMONOPTERA – Tenthredinidae; and LEPIDOPTERA – “about 400 North American species scattered in about 20 families”, the majority in Galichiidae, Gracillariidae, Nepticulidae and Tischeriidae (Frost 1942 chapter 16).

Leafminer symptoms on *D. virginiana* fruit, insect unknown. Trumphet mines¹¹, i.e., tunneling just below the fruit skin, starting small and enlarging as it progresses, have been observed on rare occasions on green fruit in West Feliciana Parish, Louisiana in years 1999 and 2000, ---an insignificant curiosity (QLH).

FORIEGN. **Persimmon leafminer**, *Cuphodes diospyrosella* Issiki, Lepedoptera, Gracillariidae, is listed as a minor pest of persimmon in Japan (Kitagawa & Glucina 1987 p 42).

B. LEFTOVERS

Order LEPIDOPTERA

FOREIGN. Recorded as “most important pests” (Kitagawa & Glucina 1987 p 42) on persimmon in Japan are:

Akebia leaf-like moth, *Adris amurensis* Staudinger, Noctuidae;
Small oraesia, *Oraesia emarginata* Fabricius, Noctuidae.

Recorded as “important:” is:

Persimmon cochlid, *Scopelodes contracta* Walker

Order HYMENOPTERA Formicidae

Ants (species not mentioned) transport and nurse mealybugs on trees and fruit (Tsuda p 8) and transport aphids (Bathgate 1986) on persimmon in California in order to harvest honeydew produced by these juice sucking insects. [Aphids? Literature dealing with aphid colonies on persimmon was not encountered.]

Red imported fire ant, *Solenopsis invicta* Buren, Formicidae, sf Myrmicinae, will infest open areas, which includes orchards and lined-out nursery stock when cultivation is minimal. They are harmless to the persimmon; however, on the unwary worker they can inflict painful bites and stings (especially during grafting season) that cause red bumps on the skin. Their presence in the orchard can be recognized by the mounds they build during wet weather (to keep their brood from drowning in underground chambers). During drought there is no need for mound building. Food includes intermediate stages of insects (e.g., larvae, grubs) and some plant products (e.g., seeds, okra pods). It may be that the imported fire ant contributes to biological control in persimmon orchards. Range; southeastern U.S. :SC to FL, westward to AK and TX, and recently introduced into CA.

Stinging Insects. Flowers are visited by several (unidentified) species of native black bees (small, medium and large

¹¹ The trumphet mine observed is similar to that produced by *Marmara pomonella* Busck, Lepedoptera, Gracillariidae, subfamily Gracillariine, on apple fruit (Frost 1942 p 320, Fig 266).

sizes) and an occasional honeybee. Damaged fruit are visited by yellow jackets and at least two (unidentified) native black bees (large and medium sized). *The medium sized black native is aggressive and will attack and sting if disturbed.*

FOREIGN. _____, *Eriocampoides limacine* Retz is listed on D.k. in Japan (Clausen 1931 p 7).

Order ODANATA - dragonfly & damselfly
Sub-order Zygoptera – damselfly

Resembles dragonfly, but when at rest the wings are together above the body. Head mostly eyes; thorax with 2 pairs of elongated, membraneous wings similar in size; abdomen long and slender. Adults feed on insects they catch in flight. Immature stage (nymph) is aquatic and predatory on aquatic insects and tiny crustaceans. The 161 spp in US/Can in sub-order are assigned to 8 families (Arnett 2000 p 129).

FOREIGN. In Japan on persimmon trees planted along rice paddies the female damselfly inserts her eggs into the bark of twigs. When the nymph hatches it drops into the water (Public Television, NOVA, “Japan’s Secret Garden”).

CHAPTER 6. MISCELLANEOUS NON-VERTEBRATE PESTS, OTHER THAN INSECTS

This is a grouping for convenience, of other non-vertebrate pests other than the 6-legged arthropods, the insects. Included are spider mites, eriophyid mites, and soil inhibiting plant-parasitic nematodes. The only significant American pest is the gall-forming eriophyid mite on *D. v.* The other pest species are named for record.

Order ACERINA – mites and ticks

FOREIGN. **Mites** of the family Tydeidae have been observed on *D.k.* in New Zealand (Kitagawa and Glucina 1987 p 44).

FOREIGN. **Persimmon false spider mite**, *Tenuipalpus zhizhilashviliae* Reck, is recorded as an occasional important pest (in some areas or some varieties) in Japan (Kitagawa & Glucina 1987 p 42).

Superfamily ERIOPHYOIDEA – eriophyid mites

There are over 1,250 species in the Superfamily; the majority belonging to the family Eriophyidae. They are commonly known as gall, rust, bud, and blister mites, or simply eriophyids. A large number are confined to a single host species. Other eriophyids feed on a few closely related species or genera of plants. The eriophyids are tiny, wingless, soft-bodied, white to red, worm-like to spindle shaped with *only 4 legs* (2 pairs at the front end); less than 0.5 millimeters long and 0.05 mm thick, --- almost invisible to the naked eye (Keifer, et al. 1982 pp 5-10). [Under magnification they suggest a microscopic squid (QLH)].

To move short distances they crawl on the plant surface or ride out on new growth; long distances by drifting on air currents. To take-off on a random free flight one mite does a “handstand” by holding onto the plant surface and raising its tail end up and away from the surface. The second mite climbs up the body of the first mite and does a handstand on the tail of the first; then the third on the tail of the second, continuing thus until a chain extends outward into the gentle breeze. Then, one lets go and away the chain floats in wingless flight on the air currents, to land by chance on another host plant. However, if the breeze increases to 20 miles per hour the first mite lowers its body returning the chain to the plant surface.

Life cycle of most eriophyids is relatively simple: egg, juvenile, male and female adults. But certain species, especially those on deciduous plants, may develop a more complicated cycle, i.e., an overwintering females-only stage, deutogynes; and a summer stage, protogynes, with male present. The deutogynes overwinter in colonies under the bud scales or in cracks in the bark. The two forms, deutogynes and protogynes, are morphologically different and have been named and described, mistakenly, as separate species, --- until the “Aha!” stage of enlightenment.

There are two species of eriophyids reported on *Diospyros* in the U.S., one on American persimmon, the other on Oriental persimmon.

Eriophyidae

Eriophyes theospyri (Keifer), Eriophyidae, (syn: *Aceria theospyri* Keifer) was collected August 2, 1960 on *D. virginiana* at Greenbelt, Maryland (Keifer 1960 pp 7,8; plate 6). It is host specific and native to the home range of American persimmon. The mite causes small bead-galls that protrude wart-like on the leaf upper surface and are open on the lower surface. Heavy infestations result in stunted growth showing rough, twisted chlorotic leaves and shortened stem internodes. Severe infestations have been observed in rootstock nurseries. Since *D. kaki* is immune the use of graft-size virginiana rootstock presents no problem in the propagation of Oriental cultivars.

Earliest symptoms appear before flowering as widely scattered tiny chlorotic pimples on the upper leaf surface. The density of gall occurrence increases as new growth continues to form throughout the summer. The mite is a minor problem on bearing trees since little new growth occurs after the spring flush. The mite probably overwinters under the bud scales then crawls to infest the emerging leaflet. Introduction of the mite on *D.v.* scionwood is a possibility. Infestation by wind-blown mites is a probability.

Control. In Louisiana the miticide, Omite, is registered for persimmon. [I have not tried it on gall mite.] No systemic pesticides are registered for persimmon. Academic research on control in the nursery should be directed toward protecting the new flushes of growth, and toward testing of systemic insecticides to eradicate infestations in isolated nursery stock. Research with a successful systemic should include tests to determine its influence on graft and budding takes on treated stock.

Eriophyes diospyri (Keifer), Eriophyidae, (syn: *Aceria diospyri* Keifer) was encountered on *D. kaki* (cultivar not listed) near Garden Grove, California in October 1943. Populations developed under bud scales¹² and under fruit buttons [the calyx] (Keifer 1944 pp 23,24; plate 185).

It was postulated that the mites caused partial separation of the fruit from the calyx and aided in premature dropping. Partial calyx separation on large fruit has been reported elsewhere as a varietal characteristic of 'Fuyu'. [Which "fuyu"?)

Note 1. Eriophid mite on Texas persimmon? Observed in 1995 at flowering time, on leaves of *D. texana* shrubs used in landscaping around the Alamo, San Antonio, TX, were leaf blade distortions, i.e., hemispherical bulges in top of leaves with corresponding concave depressions on the bottom. These depressions suggested an early erineum (QLH). No mites found on material collected at that time (T.Kono – CaDPI) [Perhaps a collection made at a later date?]

Note 2. Eriophyids as vectors of viruses. The **peach mosaic virus**, vectored by *Phytoptus insidiosus* (Keifer & Wilson) – syn: *Eriophyes insidiosus* Keifer & Wilson, can be transmitted by a single mite. The geographic range of the mite exceeds that of the disease (USDA ARS 1976 pp 66-67).

Phylum NEMATODA – nematodes

A nematode is an elongated, cylindrical, non-segmented worm with a non-cellular protective outer covering, --- a cuticle. They vary in size from microscopic to as large as earthworms, --- and a few still larger. The life cycle includes egg, juvenile, adults; males may or may not be needed or even present. Plant parasites, after they are extracted from soil or roots, are barely visible to the naked eye. A microscope is needed to identify plant parasites to genus and species.

The plant parasites are equipped with a buccal [mouth cavity] stylet that enables them to puncture the wall of a plant cell and to suck in the cell contents. Most feed on the roots in the soil, either completely penetrating the plant tissue (endoparasitic), or partially penetrating the tissue leaving their tail-end outside (semiendoparasitic), or live outside free to move around probing the roots with their stylets (ectoparasitic). The most serious are the species that devitalize the root tips.

Damage caused by feeding can be either mild or devastating, dependent on the nematode species, the host species and variety, and several environmental factors, especially soil texture and soil structure. In the U.S. no serious study of the damage to persimmon caused by nematodes had been made. Information available is based on field observation tied with the identity of the nematode extracted plus speculation.

In the southeastern states root-knot nematodes can attack the fine roots system in sandy solid but harm only seedlings (Hepting 1971 p 157). In Florida "some seedling susceptibility to nematode has been observed" (Miller & Crocker 1992 p 7).

In Florida the list of nematodes found associated with roots of [unidentified] rootstock under Oriental cultivars include some serious pests of other plant species. Without evaluation on persimmon and in alphabetic order: *Belonoliamus longicaudata*, *Cacopaurus sp.*, *Cricronemoides curvatum*, *C. spp.*, *Helicotylenchus sp.*, *Hemicycliophora sp.*, *Hemicricronemoides wessoni*, *Hoploliamus galeatus*, *H. tylenchiformis*, *H. sp.*, *Scutellonema sp.*, *Trichodorus spp.* *Tylenchulus graminis*, *T. semipenetrans*, *Xenocriconemella macrodora*, and *Xiphenema americana* (FlaDPI via Esser 1992, pc). Rootstocks in Florida are mostly *D. virginiana* with a few *D. kaki*.

¹² Thus introduction into new areas on scionwood and nursery stock is highly probable.

In California where rootstocks are either *D. kaki* or *D. lotus* the **rootknot nematode**, *Meloidogyne sp.*, is not a serious pest of persimmon. **Citrus nematode**, *Tylenchulus semipenetrans*, and other species have been found on persimmon but apparently cause little damage (LaRue, et al. 1982 p 9).

From California Division of Plant Industry the following are listed without evaluation or comment: *Cacopaurus sp.*, *Criconemoides sp.*, *Helicotylenchus wessoni*, *Pratylenchus sp.*, *Scutellonema sp.*, *Trichodorus sp.*, and *Xiphenema americana* (CalDPI via Weiner 1992).

Note: Nematodes as Vectors of Viruses. There are several virus¹³ diseases trees, shrubs, brambles, and herbaceous plants that are transmitted by ectoparasitic nematode species belonging to the genera *Longidorus* (needle nematodes), *Xiphenema* (dagger nematodes), and *Trichodorus* (stubby root nematodes).

Also, a few of these nematode-transmitted viruses can be transmitted to a healthy plant via pollen from an infected plant of the same plant species. Also, there can be a small amount of transmission through the seed to the seedling of a crop plant or weed host. These “soil-borne” viruses usually have an extensive list of host plants (involving several plant families) some in which the symptoms are not obvious to the casual observer.

¹³ Words ending in –us commonly require an o before the u (i.e., -ous) when used as an adjective. This is an exception.

CHAPTER 7. THE VERTEBRATE PESTS OF PERSIMMON

Losses caused by wild and domestic vertebrates include: sharing the harvest to complete loss of fruit on non-astringent cultivars, damage to fruit ripening on trees, broken limbs, and browsing of foliage and limb-tips within reach. Only a few hobbyists in Louisiana propagate selected native trees for personal use of fruit. The main concern is nursery tree production and Oriental fruit production in the commercial and home orchards.

Whitetail deer, *Odocoileus virginianus*, damage young trees, both D.v. seedlings and D.k. cultivars, by browsing, -- nipping the ends of twigs and removing foliage up to 4½ feet. In 1998 a male deer (in establishing his territory) scared, debarked and delimbed several young orchard trees and destroyed 2 transplants.

The fruit of wild persimmon on the ground is a natural food of deer. Due to continued forage shortage, 1999 and 2000, deer began to eat the fruit of Oriental persimmon, both astringent and non-astringent, as it began to color. Fruit was broken off and eaten on the ground. All fruit up to four feet was stripped from the tree. Those remaining above four feet and up to five feet frequently had tooth marks. The SIGNATURE PATTERN was the imprint of teeth of the lower jaw, --- a deep crescent about one inch across. Range; southern California to South America, except for parts of the U.S. southwest (Nowak & Paradiso 1983 p 1213).

In California the deer [species not named] “will take a bite of the fruit at about three to four feet off the ground. Usually eats the entire fruit leaving the calyx on the branch. Eats about six to 10 fruit throughout the orchard” (Tsuda 1986 pp 8,9).

The impact of **cattle** in the absence of deer has not been witnessed.

Eastern grey squirrel, *Sciurus carolinensis*, spends most of its time in trees, comes down to ground to bury nuts and acorns. It forages in forest and suburbia. Protected in residential areas by hunting restrictions and sentiment, squirrels overpopulate. Overpopulation plus drought forces the squirrel to explore other food sources.

For two consecutive drought years, 1999 and 2000, shortage of squirrel food (acorns and pine cones) caused a food shift resulting in the complete stripping of non-astringent fruit in two trees (one PCNA and one seeded PVNA) in a landscape planting in St. Francisville, LA. Astringent fruit on a third Oriental persimmon cultivar was sampled then avoided. The following year (2001) with the return of good rainfall plus a good acorn crop there was no fruit loss on the same trees that had been stripped the previous year. Total fruit loss returned in 2002. Range: se Canada and e. U.S. (Nowak & Paradiso 1983 p 510).

Ground squirrels (species not named) in California “have a bad habit of taking a bite out of each fruit as it starts to color out” (Tsuda 1986 p 510).

Rabbits (species not named) in California “take their toll” (Bathgate 1986).

Raccoon, *Prycyon lotor*, and **Virginia opossum** (possum in local dialect), *Didelphis virginiana*, both night providers that forage rural and forested areas have invaded suburbia (or rather, have stayed on while suburbia invaded their area). Their weight breaks the branches of *D. virginiana*. In California each “climbs *D. kaki*” and breaks branches as it reaches for fruit. ... Usually eats about half to three-fourths of two or three fruit at a time (Tsuda 1986 p 8). In limb breakage the raccoon is the most destructive; the possum is more cautious and backs away. The diagnostic teeth marks [look above 6 foot level] if present are found on partially eaten Oriental fruit. For the raccoon the apex of the teeth print is truncate (squared across the end); while for the possum it is rounded, and if she brought along her brood there will be miniature versions (Guidry, p.c.). Possum range: natural from New Hampshire to Colorado and from southern Ontario to Costa Rica (Nowak & Paradiso 1983 p 18). Raccoon range: southern Canada to Panama (Ibid. p 980).

Dog, *Canis familiaris*, will consume any ripe fruit within reach. Young dogs with retriever instinct create a problem during grafting season, --- especially the young ones. They remove ground-level articles touched by human hands either during (low level) grafting or later when examining the grafted seedling, --- articles such as plastic bags, milk jug cloches, paper bags, and aluminum labels. Range: worldwide, with feral populations in Australia and New Guinea (Nowak & Paradiso 1983 p 948).

BIRDS. Birds become more active when the fruit of the Oriental persimmon begins to color and shows the first indication of red coming through the yellow.

In Louisiana two frequent visitors are the **Blue Jay**, *Cyanocitta cristata* and the **Northern Mockingbird**, *Mimus polyglottos* [In local dialect – the mockingbird]. The Blue jay moves around pecking several fruits, while the Northern Mockingbird continues to feed on the same fruit (Guidry 1993 pers. com.). The same habits have been noted in California (Shelley 1990 p 59) for jays and mockingbirds. Most small birds have difficulty breaking into the soft meat of the fruit (Tsuda 1986 p 9).

FOREIGN. **Japanese macaque**, *Macaca fasciata*. “In parts of rural Japan monkeys are stripping persimmon trees.” A farmer reported, “If you do nothing, you’ll lose your whole crop to them.” Monkeys “are no longer afraid...the monkey feels hostility when you look into its eyes. He might attack you.” Japan’s monkey population, roughly estimated at 15,000 in 1953 reached an estimated 114,000 by 1990 while rural population decreased (Doug Struck 2002). The wild Japanese macaque is endemic to several Japanese islands: Honshu, Shikoku, Kyushu, and Yaku Jima (Norwalk & Paradiso 1983 p 415).

THOUGHTS AND THANKS; My objective in gathering, reviewing, and interpreting information about persimmons was to keep my mind active during the sunset years. I have observed both native and Oriental persimmons under local conditions. I have listened, read, experimented and improvised. And, based on my professional background I have interpreted, -- at least to my satisfaction. The mind is genetic plus bias inserted by culture, teachers, and experience. By writing down my experiences and interpretations I not only organized the information in my mind but also produce a stable memory that can be shared, --- albeit my bias. By compiling the widely scattered bits of information into one article I can leave behind a thank-you legacy.

I owe thanks to many, near and far, who in visits, phone conversations, and letters have shared bits and pieces of information during the years of study, --- starting in 1992 with hands-on instructions from Melvin Guidry, and continuing into 2002 with a newspaper clipping from Don Shaw. Precious are those friends, acquaintances, and family who encouraged and aided me in getting the previous reviews organized and photocopied.

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Please consider this compilation to be YOUR reference material. Reorganize if you wish; correct synonymy if you have the facilities. In this presentation I have departed from the professional style, --- much would have been trimmed by a science editor to reduce costly journal space. The style was my choice (my reference material). This presentation is a gift in memory of my life’s companion, Beverly Hadden Hammer Holdeman.

I am beholden unto Claire Mott for her assistance and patience in the final preparation of this manuscript.

Future? There is no guarantee that article IV, the diseases, will be finished. The sun is setting. Quintin L. Holdeman, St. Francisville, LA .70775-0321

Three days after his final editing and printing of this manuscript the sun did indeed set for the last time for Dr. Quintin Lee Holdeman, Ph.D., November 12, 1921 – March 26, 2003. His incredible knowledge, joyous wit and loving spirit will be greatly missed.

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