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3.9.8 Ornamental Plants

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INTRODUCTION

The plants that concern man can be divided into three general categories: (1) agricultural plants that are grown for food or fiber; (2) weedy plants that grow where they are not wanted; (3) ornamental, or amenity, plants. The latter group is grown mainly for its aesthetic qualities but may have certain secondary benefits such as providing shade, privacy, wind protection, etc. In general, the term "ornamental plant" or "ornamental" is used to describe those species primarily cultivated for their aesthetically-pleasing characteristics such as form, bark, leaves, flowers, fruit or some combination thereof. By definition this kind of plant must be appreciated by man to be considered an ornamental. A corollary to the definition is that ornamentals are abundant where people are concentrated. Use of the term "ornamental" in this way has some obvious problems since the appreciation that people have for such plants varies greatly among countries and cultures.

For the sake of simplicity, we use the term "urban" to denote places where ornamentals are grown. Thus, "urban" is broadly defined as those areas where most people live, work, recreate and commute. This definition encompasses a diversity of ornamental growing sites, e.g. the interior of homes and commercial buildings, private yards and institutional grounds, parks and along rights-of-way, and display gardens. Because of the proximity of these sites to man, ornamental plants share varying degrees of man-made stresses such as pollution, compaction, water loss and others.

Economic importance of ornamental plants

The sheer number and variety of ornamental plants is overwhelming. As an example of this diversity, Hortus Third (Bailey and Bailey, 1976) treats the cultivated plants of North America north of Mexico, Puerto Rico and Hawaii, and it contains 20 397 species. Most listed plants are strictly ornamental, but a few serve a dual role by being useful in both agricultural and ornamental systems, e.g. *Citrus*. When one extends these figures to the world flora, the number of ornamentals is staggering.

In the United States there is currently a growing interest in ornamentals. The expanded use of these plants has caused their cash value to rival, and in some instances exceed, the value of food and fiber crops. In 1984, nursery production in three north-eastern states (Maine, New York and Pennsylvania) accounted for more than $230 million (Morey and Gammel, 1984); the value of white potatoes in the same three states in 1982 was $188 million (USDC, 1984).

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According to C.S. Koehler (personal communication, 1985), the gate receipts for ornamental plant production in California exceed $1 billion each year.

The economic importance of ornamental plants extends past production industries. For example, the expenditures for gardening supplies and plants for each household in the United States ranged from $40 to $200 per year (Nursery Marketing Council, 1983). Therefore, the 18 million households in the north-eastern states alone spend an estimated $0.7 to $3.6 billion each year.

Pest status of armored scale insects on ornamentals

Armored scale insects seem to be especially well adapted to life on plants in urban situations. For example, large diaspidid populations frequently are found on plants growing along dusty roads, while scale insect parasites are scarce in such situations. Presumably, the constant contact with dust particles kills the delicate adult wasps as they search plants for their sedentary host. However, armored scale insects are afforded protection from many external hazards by the waxy cover.

It is difficult to estimate the impact of armored scale insects on the ornamental industry. W.F. Gimpel (personal communication, 1985) indicated that in Maryland 2 of the 10 most frequently reported pests that cause "stop sale" or "condemnation and seizure" proceedings of nursery ornamentals are armored scale insects. Neely and Himelick (1983) indicated that scale insects are one of three pest groups that are most commonly encountered by licensed tree experts in the state of Illinois. This situation probably is characteristic of most or all of the state agricultural systems in the United States and of similar divisions in other developed countries.

Limited information is available pertaining to losses caused by diaspidids. Realizing that armored scale insects constitute approximately one-third of the total number of all scale insects, it is possible to make rough estimates of losses caused by diaspidids alone. In the years 1975, 1976, 1977, 1980 and 1981 losses attributable to scale insects on ornamental plants in 9 south-eastern states were 51.40, 59.60, 39.55, 73.05 and 74.45 million dollars, respectively (Insect Detection, Evaluation and Prediction Committee 1977, 1978, 1979, 1982, 1983). Kosztarab (1977b) estimated that yearly losses caused by scale insects on all crops in the United States exceeded $500 million.

Control

Control of ornamental pests in urban situations is especially difficult since human contact with ornamental environments may be frequent and extensive. This situation precludes application of many of the toxic chemicals that commonly are used in food and fiber agro-ecosystems.

Horticultural spray oils are especially well suited for use around people because they have low mammalian toxicity. Traditionally, oils have been used in the dormant season to kill overwintering scale insect forms including crawlers, second instars, adult females and eggs. Recent refinements in the production of horticultural oil sprays in the United States allows them to be used during the growing season at approximately one-half the rate of dormant applications. While summer application of these oils can be effective against mites and other soft-bodied pests, our tests have shown that these sprays mainly are effective against crawlers. Timing for peak crawler emergence is important. Oils also can be combined with insecticides to give excellent control of crawlers and other stages in situations where adequate precautions can be exercised against excess human contact.

Although oils have been used for many years as scalicides, contact insec-

ticides directed against crawlers have been the predominant method of control of bark-infesting armored scale insects. When highly persistent pesticides were in common use, such methods were easily and effectively implemented. Timing of application was not critical since the chemicals remained effective during most of the crawler emergence period. In recent years most persistent insecticides have been replaced by short-lived chemicals. Use of these materials as scalicides requires precise timing of application coincident with emergence times of crawlers. In many instances, use of these pesticides requires application of 3 or 4 separate sprays, especially for diaspidid species that produce crawlers over a long period of time. The ideal contact scalicide is one that has sufficient residual activity to kill crawlers for about 1 month following application.

Systemic insecticides have been a valuable addition to the arsenal of armored scale insect control methods. These chemicals are especially effective on diaspidids that infest photosynthesizing areas of the plant. They are most useful on immature stages, and should be applied when crawlers appear. Obviously, they cannot be used for control of the egg stage or the third- through fifth-instar males, since none of these stages feeds. These chemicals work best on species that occur in northern areas where life cycles are closely synchronized and do not have overlapping generations.

It is difficult, if not impossible, to eradicate a population of armored scale insects from a large, woody ornamental without taking the extreme method of removing the host. For the past 14 years, we have observed continuous infestations of 7 species of diaspidids on the same plant specimens on the campus of the University of Maryland. These include *Lopholeucaspis japonica* and *Quadraspidiotus perniciosus* on *Pyracantha*, *Melanaspis obscura* on *Quercus*, *Melanaspis tenebricosa* on *Acer*, *Pseudaulacaspis pentagona* on *Morus*, *Pseudaulacaspis prunicola* on *Prunus* and *Unaspis euonymi* on *Euonymus*. When damage from these populations was obvious, they were treated with oils or contact insecticides. Post-spray evaluations usually showed a marked reduction in scale insect population size, but in no instance has a population been eliminated. In the case of *P. prunicola* and *U. euonymi*, some host specimens were killed despite control efforts.

Perhaps more than any other group of insect pest, armored scale insects lend themselves to a management strategy developed in recent years known as integrated pest management (IPM). The goal of an ornamentals IPM program is to reduce pest populations to levels that are aesthetically acceptable and that do not endanger the quality of the ornamental environment. Obviously, armored scale insects are not the only pests in most ornamental situations, and it is important when using IPM strategies to interrelate the management of all of the pests in the system. However, armored scale insects are particularly well suited for this type of strategy because they frequently can be suppressed using a diversity of relatively non-disruptive methods. They are exemplary targets for biological control; with appropriately timed applications of selective pesticides for other pests, many armored scale insects can be kept below aesthetic-threshold levels by natural enemies. Developing technologies in hormone and pheromone research show promise as minimally disruptive, control or monitoring methods that will be used in future IPM programs (Miller and Kosztarab, 1979). Use of resistant or tolerant plant materials is an often ignored but very effective method to reduce the importance of armored scale insects in ornamental systems. Because most ornamental environments are subject to frequent human contact, there is an increased interest in reducing pesticides in these situations. Since one of the goals of most IPM programs is decreased toxicant usage, it seems obvious that such strategies should become more and more common in ornamental environments.

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Damage

The impact of diaspidid infestations on ornamental plants depends on three interdependent variables: (1) the scale insect species; (2) the plant species, cultivar or variety; (3) environmental factors, including natural enemies.

Study of the species of armored scale insect pests reveals that if one member of a genus is a pest, it is likely that at least one other member of the same genus also will be a pest. In Beardsley and Gonzalez (1975), 36 of the 43 species listed as principal armored scale insect pests have a congener also on the list. Most of the scale insect species that are serious problems are adventives and are pests wherever suitable environments exist. Of the armored scale insects listed by Beardsley and Gonzalez, only 4 do not occur in the United States. A similar situation probably exists in nearly all countries of the world that have suitable environmental conditions. On the other hand, not all introduced species are economic problems; about 30 species of armored scale insects have been introduced into the United States and currently are not considered to be even minor pests. It appears that certain species of armored scale insects have inherent characteristics that cause them to be pests, but the nature of these characteristics is not obvious.

A few armored scale insects are ornamental pests within their indigenous ranges, but the circumstances surrounding their status are not very different from adventive species. For introduced species, it generally is assumed that a primary reason for their pestiferous characteristics is that they have been removed from their natural habitats where their hosts live under conditions for which they are well adapted and where they have a full complement of natural enemies. In the case of the indigenous species, the same circumstances occur. The host is in a situation different from its native habitat and many natural enemies do not occur in the ornamental ecosystem. An example of this sort of pest is observed in *Melanaspis obscura*, which is indigenous to the United States and is a serious pest of ornamental oaks in the east. In our examinations of populations of this scale insect in native forests, we have never found an infestation causing damage to the host. However, in ornamental situations this diaspidid is a common and severe pest of certain species of oaks.

The species, cultivar or variety of the host plant may have a dramatic effect on the damage sustained by diaspidid hosts. Resistance to diaspidids has not been examined in any detail, but available information suggests that there are major differences in tolerances among hosts to armored scale insect attack. Variable resistance to *Unaspis euonymi* is known in *Euonymus* (Williams et al., 1977; Gill et al., 1982). This scale insect is a serious pest of *Euonymus japonica* and will kill plants if left unchecked; modest infestations of the euonymus scale are sometimes reported on *Euonymus kiautshovica* but the infestations do not have obvious detrimental effects; *Euonymus alata* is nearly always free of infestation of the euonymus scale even in circumstances where heavy infestations are nearby. Similar host plant resistance was reported by Furuhashi (1974) in studies of *Unaspis yanonensis* on cultivars of *Citrus* species and by Oetting (1984) in studies of *Diaspis echinocacti* on various species of cactus.

The environment often has obvious effects on the extent of diaspidid damage. Abiotic factors such as winter temperatures, wind and humidity may have significant impact on armored scale insect population size and therefore on damage. Biotic factors such as the occurrence of natural enemies also can have major effects on the extent and severity of diaspidid damage.

Symptoms of armored scale insect damage are relatively consistent. Leaf-infesting species often produce chlorotic areas at feeding locations and usually cause premature leaf drop. In a few instances leaf distortion may be evident. Heavily infested plants sometimes become leggy, with the leaves restricted to

areas near the growing terminals. Bark-inhabiting species occasionally cause distortion of the stems and bark, e.g. *Melanaspis obscura* or *Quadraspidiotus perniciosus*, but generally the bark per se shows little damage from infestation. Large bark populations often result in hosts with many dead branches, particularly lower branches, and wilted leaves. In some instances populations of diaspidids can be so dense that the scale-covers themselves discolor the host, detracting from the ornamental value of the plant. This kind of aesthetic damage is particularly true of species that have males that produce white felted covers and concentrate on the undersides of branches, e.g. *Pseudaulacaspis prunicola*.

REPRESENTATIVE SPECIES

In this section we discuss certain critical aspects of the appearance, biology, distribution and hosts of armored scale insects that are ornamental plant pests. We have selected an example of a diaspidid species that occurs in each of 7 different ornamental situations and have discussed them in detail; 49 additional species are included in Table 3.9.8.1. We arbitrarily restricted the list to 56 species; undoubtedly, there are many more that could have been included. We have selected major ornamental pests but have not given detailed information on species, even major ornamental pests, that are treated elsewhere in this volume.

Pest of succulents

The cactus scale, *Diaspis echinocacti* (Bouché), is a common pest of cactus throughout the world in both indoor and exterior settings. The adult female cover is white, flat and circular; the exuviae are located in the central portion of the cover and are dark brown when rubbed but often are covered with a grayish powder. The male cover is white, elongate oval and has 3 longitudinal ridges; the exuviae are located at the anterior end of the cover and are white or yellow. Specimens usually are located on aerial portions of the host in areas that lack dense spination, particularly on the pads, stems and fruit. We have examined adult females collected on 57 genera of cactus hosts. Oetting (1984) tested the susceptibility of 13 cactus genera to infestation by the cactus scale and found that *Mammillaria* was the only genus that was completely unsuitable. A species of each of *Chamaecereus*, *Echinocactus*, *Hatiora* and *Pereskia* were only marginally acceptable. Genera such as *Astrophytum*, *Cereus*, *Epiphyllum*, *Hylocereus*, *Lemaireocereus*, *Opuntia*, *Rhipsalidopsis* and *Schlumbergera* were fully acceptable. Of the non-cactus succulents tested as host, only *Portulaca grandiflora* was found to be acceptable.

Oetting (1984) studied the biology of the species and found that development from newly-laid eggs to adults required about 23 days for females and 24 days for males when subjected to growth-chamber conditions of 27°C. Mating apparently is required and egg laying begins 8–13 days after copulation. The average number of eggs laid was about 150 for each female, with as many as 276 eggs being laid in one instance. Adult females could live for up to 230 days, but adult males persisted for no more than 2 days, usually less.

The cactus scale occurs throughout the world wherever cacti are grown. We have examined specimens from most areas of the New World, and from Africa, Asia, Australia, Europe and U.S.S.R. It can be a particularly serious pest on susceptible hosts in greenhouses. We have observed it to build to such heavy infestations on *Epiphyllum* spp. that whole pads, and occasionally entire plants, would wither and die. Several natural enemies are reported including

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9 species of *Aphytis* (Rosen and DeBach, 1979) and a nearly host-specific species, *Plagiomerus diaspidis* Crawford (Gordh and Lacey, 1976). It is entirely possible that one or a combination of parasites might effectively control this scale insect in greenhouses. Since the pest primarily is found on the photosynthesizing parts of the host, it is particularly susceptible to chemical control with systemic insecticides.

Pest of flowering fruit trees

The white prunicola scale, *Pseudaulacaspis prunicola* (Maskell), until recently was considered to be a junior synonym of the white peach scale, *P. pentagona* (Targioni Tozzetti). Kawai (1980) reinstated *P. prunicola* as a valid species and discussed it in his study on the scale insects of Japan. Since 1982, we have realized that the species also occurs in the United States and is a serious pest in the north-east (Davidson et al., 1983). The adult female cover is white, convex and circular; the exuviae are subcentral and light yellow. The male cover is white, felted and elongate oval with a faint medial carina. The male cover is composed of both a dorsal and ventral piece. The cover hangs from the host and is attached only at the anterior end, presumably by the mouthparts. Specimens usually occur on the bark and fruit of the host, but occasionally they are found on leaves. We have examined adult females collected on 21 genera in 16 families of host plants. In the United States this species is most commonly collected on *Prunus* spp., particularly flowering cherries, and often is found on *Ligustrum* and *Syringa*.

Because white prunicola scale and white peach scale have been confused, it is difficult to know what biological information pertains to the white prunicola scale. Based on voucher specimens, we know that Stimmel (1982) actually studied *P. prunicola* and not *P. pentagona* in his studies in Pennsylvania. We also have examined the white prunicola scale in Maryland. In Pennsylvania the species has 2 generations each year and the overwintering stage is the gravid adult female. Crawlers of each generation first appeared on 20 May and 28 July 1981. In Maryland there are 3 generations each year and the adult female again is the overwintering stage. Crawlers of each generation were found in early May, late June to early July and mid-August.

The white prunicola scale occurs primarily in cool temperate climates but occasionally has been collected in the southern United States. We have examined material from the U.S.A., Japan, China and Korea. This species has caused considerable dieback and even death to flowering cherries, *Prunus serrulata*, along the tidal basin in Washington, DC. Maskell (1895) reported that this pest caused significant damage to Japanese plum in Hawaii. Chemical control measures in Washington, DC, have not been entirely successful. Introduction of natural enemies might be the best method of control.

Pest of foliage plants

The fern scale, *Pinnaspis aspidistrae* (Signoret), is a common pest of foliage plants in greenhouses and outdoors in tropical and subtropical regions of the world. The adult female cover is light to dark brown and is oystershell shaped; the exuviae are terminal and yellow brown to brown. The male cover is white, felted, elongate oval and has 3 longitudinal ridges; the exuviae are located at the anterior end of the cover and are pale yellow. Specimens usually occur on the leaves of the host but occasionally are found on the bark or fruit. We have examined adult females collected on 40 genera in 26 families of host plants. It seems to be most common on monocotyledonous hosts such as members of the Liliaceae and Palmaceae, and on a wide range of ferns.

According to Werner (1931), a generation of the fern scale requires about 95 days for completion. Adult females survive for about 65 days. In bisexual populations, eggs appeared within the body of mated adult females about 8 days after mating and oviposition began about 4 days later. Females produced an average of 57 eggs (108 maximum) and laid about 6 eggs each day. Schmutterer (1952) indicated that eggs hatched about 10 days after being laid. Both bisexual (Werner, 1931; Brown, 1965) and parthenogenetic (Takahashi and Tachikawa, 1956) populations of this species are known. Saakian-Baranova (1954) indicated that there were 2 generations each year in a greenhouse population studied in Moscow, Russia.

The fern scale is a cosmopolitan pest in greenhouses and homes in cooler areas of the world and out-of-doors elsewhere. Beardsley and Gonzalez (1975) considered it to be one of the principal armored scale insect pests of the world. It frequently is a serious pest of foliage plants, particularly ferns, palms and certain liliaceous hosts; it sometimes is of economic importance on citrus, coconuts, bananas and ficus.

Pest of conifers

The juniper scale, *Carulaspis juniperi* (Bouché), is a pest of juniper and related plant genera. The adult female scale cover is white, convex and circular; the exuviae are located in the central portion of the cover and are yellow. The male cover is white, felted, elongate oval with 3 longitudinal ridges; the exuviae are located at the anterior end of the cover and are yellow. Specimens occur on the foliage of the host. We have examined adult females collected on *Chamaecyparis*, *Cupressus*, *Juniperus*, *Libocedrus*, *Pinus*, *Sequoia* and *Thuja*. It also is reported on *Cryptomeria* but is most frequently collected on *Juniperus*.

The juniper scale apparently has only 1 generation each year (Kosztarab, 1977a; Vinis, 1981) in most areas, but we suspect that it may have 2 in warm areas. The overwintering stage is mated adult females (Heller, 1977) and eggs are laid in the spring from March in warm areas to May in cooler regions (Johnson and Lyon, 1976). Crawlers appear soon after egg laying. Adult males occur over a long period of time from mid-July to August in Ohio (Neiswander, 1950). Winter mortality may be as high as 85% in some years in Ohio (Neiswander, 1950).

We have examined specimens of the juniper scale from Argentina, Australia, Canada, Chile, Europe, Iran, North Africa, Turkey and 29 states in the U.S.A. Beardsley and Gonzalez (1975) consider this species to be a principal armored scale insect pest. Heavy infestations can cause chlorosis of the foliage, needle drop and dieback. Severe damage may result in the death of entire trees under unusual circumstances. The species is considered to be a serious pest of junipers in the eastern United States (Johnson and Lyon, 1976). Chemical control would probably be best with systemic insecticides since the scale is located on the foliage of the host.

Pest of deciduous trees

The obscure scale, *Melanaspis obscura* (Comstock), is a serious pest of urban plantings of oaks in the eastern United States. The adult female cover is gray, slightly convex and circular; the exuviae are subcentral and shiny black when rubbed. The male cover is similar to that of the female in texture and color but is smaller and more elongate; the exuviae are subterminal and shiny black when rubbed. Specimens of the obscure scale are found on twigs, stems and trunks of the host. In heavy infestations the crawlers tend to settle under the scale covers of previous generations. After several years, this behavior may

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cause many layers of superimposed scale insect covers. We have examined specimens collected from *Acer*, *Carya*, *Fagus*, *Quercus*, and *Ulmus*. This scale insect has been reported from several additional hosts (Borchsenius, 1966), but we suspect that most, if not all, are erroneous. The specimens from maple, beech and elm probably also are incorrect host identifications or at best are incidental records.

Obscure scale has a single generation each year. Stoetzel and Davidson (1973) found major differences in the biology of the populations of this scale insect that occur on the red oaks and the white oaks in Maryland and suggested that these populations should be considered to be different species. The red oak form overwintered as second instars and reached maturity in May. Most eggs were laid in July and crawlers were present from July to September. In October the greatest part of the population was in the second instar. The white oak form overwintered as crawlers and lagged behind the red oak population by nearly a month.

The obscure scale is known only from Canada and the United States, but it could pose a serious threat to oaks in other areas of the world if introduced there. It is considered to be one of the most serious shade-tree pests throughout most of the eastern United States. This pest causes branch dieback on larger trees, and on highly susceptible species such as pin oak and willow oak it gives the bark a gnarled, distorted look at sites of heavy infestations. Small trees sometimes are killed. Scale insect infestations of low density are occasionally found in natural situations, but we have never observed it to cause damage under these circumstances. The obscure scale is an urban pest only. Control measures are particularly difficult: (1) because crawlers are produced over a long period of time, precluding the use of one or two applications of a non-persistent insecticide; (2) because many layers of scale covers protect the living insects from applications of contact insecticides. Although numerous and diverse natural enemies attack obscure scale in urban areas, they are unable to maintain the pest at subeconomic levels. A spray containing superior oil with an insecticide added, applied just before bud break in early spring, seems to be the most effective method of control.

Pest of shrubs

The euonymus scale, *Unaspis euonymi* (Comstock), is a major pest of euonymus. The adult female cover is dark brown, slightly convex and oystershell shaped; the exuviae are terminal and brownish yellow. The male cover is white, felted, elongate oval, with 3 longitudinal ridges; the exuviae are terminal and brownish yellow. Specimens occur on all above-ground parts of the host. Male scales are most abundant on the leaves, and females predominate on the stems and branches. We have examined adult females collected on 18 genera in 13 families of host plants. Although this pest is known to occur on a diversity of hosts, it is most commonly collected on *Euonymus* and is only rarely found on other hosts.

According to Gill et al. (1982), this species has 2 or 3 generations each year depending upon the climate. The species overwinters as adult females. In Maryland, where there are only 2 generations each year, eggs first appear in early May; crawlers are present in early May until early July and adults are first found in mid-June. Eggs of the second generation are present in late June and crawlers of this generation are first found in mid-July. The adults are found from early September and females occur throughout the winter. Adult males are required for reproduction.

The euonymus scale occurs in nearly all areas of the world where euonymus is grown. We have examined specimens from Argentina, Asia, Canada, Europe,

Honduras, Mexico and 27 states in the United States. It also is reported from the U.S.S.R. and North Africa. Damage symptoms include early leaf drop, leaving the foliage concentrated at the ends of the branches, chlorotic or spotted leaves and generally unhealthy looking plants. Certain species of euonymus are quite susceptible to attack, e.g. *E. japonica*, and may be killed within a few years of becoming infested. Other species of this host are quite resistant, e.g. *E. alata* and *E. kiautschovica* (Williams et al., 1977; Gill et al., 1982). Currently the most reasonable means for control of this pest is to avoid planting highly susceptible euonymus forms whenever possible. Since this scale insect usually is not a pest in areas where euonymus is indigenous, biological control agents may exist that could be introduced into countries where natural control is ineffectual. Perhaps the most effective method of chemical control is with dormant oil sprays.

Pest of tropical plants

The black thread scale, *Ischnaspis longirostris* (Signoret), occasionally is a serious pest in greenhouses and tropical gardens. The adult female cover is shiny black, sometimes covered with a light bloom, convex and unusually elongate, being about 8 times longer than broad; the exuviae are terminal and pale yellow. Males are unknown. We have examined adult females collected on 63 genera in 31 families of host plants. It is most commonly collected on palm hosts.

Little is known about the life history of this scale insect. It was studied briefly in the Seychelles by Vesey-Fitzgerald (1940). Development is continuous throughout the year. Twenty to 30 eggs are laid by each female. Hatching takes place soon after the eggs are laid, and crawlers settle within 24 h of eclosion. The crawler stage lasts about 3 days. Males have never been reported, and Brown's study (1965) of armored scale insect chromosome systems showed that the species is parthenogenetic.

The black thread scale occurs outdoors in nearly all tropical areas of the world and is occasionally found in greenhouses elsewhere. We have examined material from southern Africa, Asia, the Caribbean, Central America, Europe, Mexico, the Pacific islands, South America and 13 states in the United States. Beardsley and Gonzalez (1975) consider this species to be a principal armored scale insect pest. It is a pest on a wide range of tropical plants including palms (Dekle, 1977), *Jasminum* (Ballou, 1934), *Swietenia macrophylla* (Martorell, 1940), coffee (Bondar, 1924), mango (Swezey, 1936), *Annona, Musa*, cinnamon, litchi, oil palm, *Raphia* and *Zizyphus* (Vesey-Fitzgerald, 1940). The coccinellids *Chilocorus nigritus* (Fabricius) and *C. distigma* (Klug) were introduced to the Seychelles as biological control agents where they have achieved nearly complete control of this pest (Lionnet, 1959).

CONCLUSIONS

Ornamental plants are playing an increasingly important role in urban habitats throughout the world. As common ornamental pests, diaspidids will become even more prevalent in the future. With public opinion becoming more sensitive to the hazards of human exposure to toxic chemicals, there is a very real need to conduct extensive research on methods of exploiting alternative control techniques and to use insecticides only when absolutely essential. This need is especially important in ornamental situations, since humans are in frequent contact with the plants in this habitat. The IPM approach is an obvious solution to the problem, but it requires detailed information on all

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Table 3.9.8.1

Representative diaspidid pests of ornamental plants

Scientific name	Description of female cover	Description of male cover	Host range	Major ornamental hosts	Position on host	Generations per year and location	Distribution
Abgrallaspis cyanophylli (Signoret)	Gray to white, flat, circular to oval; exuviae central, yellow	Similar to female but elongate oval; exuviae subterminal, yellow	44 fam. 75 gen.	Cacti, palms, *Pandanus*, many foliage plants	Fruit, stems, undersides of leaves	4 gen. Israel (Gerson and Zor, 1973); 5 gen. Taiwan (Shiao, 1979)	Tropics, greenhouses in cold areas
Aonidiella aurantii (Maskell)	Translucent, usually red-brown, circular; exuviae subcentral, red-brown	Similar to female but gray, oval; exuviae subterminal, red-brown	79 fam. 202 gen.	*Acacia*, *Chaenomeles*, *Citrus*, *Eucalyptus*, *Euonymus*, *Ficus*, *Gardenia*, *Ligustrum*, palms, *Rosa*	Fruit, stems, trunk, leaves on citrus; mostly on leaves on other hosts	2–3 gen. Calif. (Ebeling, 1959); 6 gen. Argentina (Costilla et al., 1970); 4 gen. Cyprus (Orphanides, 1982)	Tropics, greenhouses in cold areas
Aonidiella citrina (Coquillett)	Translucent, usually yellow, circular, flat; exuviae subcentral, transparent	Similar to female but oval; exuviae subcentral, transparent	18 fam. 28 gen.	*Acuba*, *Citrus*, *Daphne*, *Euonymus*, *Ficus*, *Hedera*, palms, *Pandanus*	Prefers leaves and fruit on citrus; mostly on leaves on other hosts	64 days per gen. in southern California (Nel, 1933)	Tropics, greenhouses in cold areas
Aonidiella orientalis (Newstead)	Yellow or yellow-brown, circular, flat; exuviae subcentral, transparent	Similar to female but oval; exuviae subterminal, transparent	25 fam. 36 gen.	*Cocos*, *Cycas*, *Hedera*, *Zizyphus*	Usually on leaves, sometimes on branches and trunks	3 gen. India (Glover, 1933)	Tropics, greenhouses in cold areas
Aonidiella taxus Leonardi	Translucent, red-brown, circular, flat; exuviae subcentral, translucent	Similar to female but oval; exuviae subcentral, translucent	2 fam. 3 gen.	*Podocarpus*	Undersides of leaves	2 gen. Crimea (U.S.S.R.) (Kuznetzov, 1971); 2–3 gen. Japan (Uematsu, 1978)	Argentina, Brazil, Italy, Japan, U.S.A., U.S.S.R.

Aspidiotus destructor Signoret	Translucent, yellow, circular, flat; exuviae subcentral, yellow	Similar to female but oval; exuviae subcentral, yellow	44 fam. 75 gen.	Palmaceae, *Pandanus*	Leaves, bark, fruit	1 gen. Japan (Murakami, 1970); continuous gen. Trinidad (Goberdhab, 1962)	Tropics, greenhouses in cold areas
Aspidiotus excisus Green	Translucent, white, circular to irregular, slightly convex; exuviae subcentral, yellow	Similar to female but oval; exuviae subcentral, yellow	9 fam. 10 gen.	*Aglaonema*, *Citrus*, *Hoya*, *Lonicera*	Leaves and stems	No information available	New World tropics, Asia, Pacific Islands, greenhouses in cold areas
Aspidiotus nerii Bouché	Translucent, white to tan, circular, convex; exuviae subcentral, yellow	Similar to female but oval; exuviae subcentral, yellow	88 fam. 236 gen.	*Cycas*, Leguminosae, *Nerium*, Palmaceae, Rosaceae, *Zamia*	Leaves, bark, fruit	Continuous gen. in most areas (Stoetzel and Davidson, 1974); 35 days from oviposition to last molt (Avidov and Harpaz, 1969)	Tropics, greenhouses in cold areas
Aulacaspis rosae (Bouché)	Dirty white, circular or oval, flat; exuviae submarginal, yellow	White, felted, elongate oval, 3 longitudinal ridges; exuviae terminal, yellow	Rosaceae 2 gen.	*Rosa*, *Rubus*	Stems and bark	1 gen. Oregon (Schuh and Mote, 1948), England (Boratynski, 1953); 2 gen. Ohio (Kosztarab, 1963), New York (Johnson and Lyon, 1976), Japan (Murakami, 1970); 3 gen. France (Bénassy, 1959)	Wherever *Rosa* or *Rubus* are grown
Carulaspis juniperi (Bouché)	White, circular, moderately convex; exuviae central, yellow	White, felted, elongate oval, 3 longitudinal ridges; exuviae terminal, yellow	3 fam. 11 gen.	*Juniperus*	Foliage	1 gen. Ohio (Kosztarab, 1977a), Hungary (Vinis, 1981); probably 2 gen. in warm areas	Australia, Canada, Europe, Iran, North Africa, South America, U.S.A.

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Table 3.9.8.1 (*continued*)

Scientific name	Description of female cover	Description of male cover	Host range	Major ornamental hosts	Position on host	Generations year^{-1} and location	Distribution
Carulaspis minima(Targioni Tozzetti)	Same as *C. juniperi*	Same as *C. juniperi*	3 fam. 7 gen.	*Juniperus*	Foliage	1 gen. England (Boratynski, 1957); 2 gen. Italy (Baccetti, 1960)	Widely distributed, not in Australia
Chionaspis heterophyllae Cooley	White, oystershell shaped, slightly convex; exuviae terminal, yellow-brown or translucent	White, felted, elongate oval, 3 longitudinal ridges; exuviae light yellow or translucent	Pinaceae *Pinus*	*Pinus*	Needles	2 gen. Maryland (unpublished data, 1983)	Bahamas, Mexico, U.S.A.
Chionaspis pinifoliae (Fitch)	Same as *C. heterophyllae*	Same as *C. heterophyllae*	2 fam. 6 gen.	*Abies*, *Picea*, *Pinus*	Needles	1 gen. California (Luck and Dahlsten, 1974); 2 gen. New York (Nielsen and Johnson, 1973)	Canada, Central America, England, Germany, U.S.A.
Chrysomphalus aonidum (Linnaeus)	Dark brown or black, circular, slightly convex; exuviae central, red-yellow	Similar to female but elongate; exuviae red-yellow	74 fam. 200 gen.	*Citrus*	Leaves and fruit, rarely on branches	Continuous gen.; 3–6 gen. depending on climate (Bodenheimer, 1951); 40–55 days from egg hatch to last molt in summer (Avidov and Harpaz, 1969)	Tropics, greenhouses in cold areas
Chrysomphalus bifasciculatus Ferris	Same as *C. aonidum* except cover lighter colored	Same as *C. aonidum* except cover light colored	26 fam. 40 gen.	*Camellia*, *Euonymus*, *Hedera*	Leaves	2 gen. Japan (Murakami, 1970)	China, Hawaii, Japan, Korea, Mexico, Taiwan, U.S.A.

Chrysomphalus dictyospermi (Morgan)	Red-brown or gray, circular, flat; exuviae central, yellow or white	Similar to female but elongate; exuviae subterminal, yellow	71 fam. 187 gen.	*Citrus*, *Ficus*, *Persea*	Upper surface of leaves, sometimes on undersides of leaves, fruit, branches	Continuous gen. warm areas; 2 gen. Egypt (Salama, 1970); 3–4 gen. California (Quayle, 1938); 5–6 gen. greenhouse (Quayle, 1938)	Tropics and subtropics, greenhouses in cold areas
Diaspis boisduvalii Signoret	Translucent, white, circular, flat; exuviae subcentral, light yellow	White, felted, elongate, 3 longitudinal ridges; exuviae terminal, yellow	15 fam. 44 gen.	Bananas, bromeliads, orchids, palms	Leaves and pseudobulbs	Continuous gen.; 50 days from egg to egg-laying female (Bohart, 1942)	Tropics, greenhouses in cold areas
Diaspis bromeliae (Kerner)	Semitransparent, white, circular, flat; exuviae subcentral, light brown or yellow	Same as *D. boisduvalii*	2 fam. 10 gen. (we suspect that many host records are errors)	Bromeliads	Leaves, sometimes on fruit	Continuous gen.; 2 months from egg to adult in Australia (Jarvis, 1944)	Tropics, greenhouses in cold areas
Diaspis echinocacti (Bouché)	White, circular, flat; exuviae subcentral, dark brown, covered with gray powder	White, felted, elongate, 3 longitudinal ridges; exuviae terminal, white	2 fam. 57 cactus genera	Cactus	Pads, stems, fruit	23 or 24 days from egg to adult at 27°C (Oetting, 1984)	Wherever cacti are grown
Duplaspidiotus claviger (Cockerell)	Gray, embedded in epidermis, circular, convex; exuviae subcentral, yellow-orange	Unknown	24 fam. 40 gen.	*Camellia*, *Ligustrum*, *Viburnum*	Under epidermis of twigs and branches	No information	Asia, Pacific Islands, Panama, South Africa, U.S.A. (Florida, Hawaii)
Dynaspidiotus britannicus (Newstead)	Gray, circular, flat; exuviae subcentral, yellow	Similar to female but elongate oval; exuviae subterminal, yellow	18 fam. 23 gen.	*Buxus*, *Hedera*, *Ilex*, *Lonicera*, palms	Leaves, fruit, twigs	Probably 1 gen. Oregon (Roaf and Mote, 1935)	Africa, Bermuda, Brazil, Canada, Europe, Israel, Turkey, U.S.A., U.S.S.R.

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Table 3.9.8.1 (*continued*)

Scientific name	Description of female cover	Description of male cover	Host range	Major ornamental hosts	Position on host	Generations year^{-1} and location	Distribution
Fiorinia externa Ferris	Pupillarial, second exuviae red-brown, covered with translucent wax; exuviae terminal, transparent	White, felted, elongate oval; exuviae terminal, transparent	2 fam. 7 gen.	*Tsuga*	Undersides of needles	1 gen. Connecticut (McClure, 1978); 2 gen. Maryland (Davidson and McComb, 1958)	Japan, U.S.A.
Fiorinia fioriniae (Targioni Tozzetti)	Pupillarial, second exuviae brown-yellow, median ridge; exuviae terminal, transparent	Same as *F. externa*	23 fam. 45 gen.	*Persea*, palms	Leaves	3 gen. Japan (Murakami, 1970); continuous gen. southern U.S.A. (Johnson and Lyon, 1976)	Tropics, greenhouses in cold areas
Fiorinia theae Green	Pupillarial, second exuviae gray or black, median ridge; exuviae terminal, transparent	White, felted, elongate, 3 faint longitudinal ridges; exuviae terminal, transparent	9 fam. 24 gen.	*Camellia*, *Ilex*	Leaves	22–24 days from egg to adult in India (Das and Das, 1962); 60–70 days from egg to egg-laying female in Alabama in summer (English and Turnipseed, 1940)	Asia, Bahamas, Honduras, Mexico, U.S.A.
Hemiberlesia lataniae (Signoret)	Variable; on leaves gray to white, circular, convex; on stems brown, slightly convex; exuviae	Similar to female but elongate oval; exuviae subterminal, yellow	78 fam. 278 gen.	Most woody ornamentals, e.g. *Ilex*, palms, *Rosa*	Leaves, bark	2 gen. Maryland bisexual (Stoetzel and Davidson, 1974); 3 gen. Egypt (El-Minshawy et	Tropics and subtropics, greenhouses in cold areas

	subcentral, yellow-brown					al., 1971); 4 gen. Israel unisexual (Gerson and Zor, 1973); 56–65 days from egg to egg-laying female southern California unisexual (McKenzie, 1935)	
Hemiberlesia rapax (Comstock)	Gray to white, circular, convex; exuviae subcentral, yellow-brown	Similar to female but oval; exuviae subterminal, yellow	60 fam. 117 gen.	Most woody ornamentals	Leaves, bark	Continuous gen. in greenhouse (Schuh and Mote, 1948); at least 2 gen. New Zealand (Dale, 1981); unisexual (Schmutterer, 1952; Nur, 1971)	Tropics and subtropics
Howardia biclavis (Comstock)	Usually concealed by epidermis, white or yellow, circular, convex; exuviae submarginal, light brown	Unknown	41 fam. 99 gen.	*Acharas*, *Ixora*, *Jasminum*, etc.	Under epidermis of stems and bark	No available information; parthenogenetic (Brown, 1965)	Tropics, greenhouses in cold areas
Ischnaspis longirostris (Signoret)	Black, sometimes covered with white bloom, very elongate, convex; exuviae terminal, pale yellow	Unknown	31 fam. 63 gen.	*Jasminum*, *Mangifera*, palms	Usually on leaves, also bark, fruit	Continuous gen. Seychelles (Vesey-Fitzgerald, 1940)	Tropics, greenhouses in cold areas
Lepidosaphes beckii (Newman)	Purple-brown or yellow-brown, oystershell shaped, convex;	Similar to female but shorter, narrower; exuviae terminal, brown	11 fam. 45 gen.	*Citrus*	Leaves, bark, fruit	1 gen. southern Chile (Zuniga, 1971); 2 gen. France (Bénassy	Tropics and subtropics

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Table 3.9.8.1. (*continued*)

Scientific name	Description of female cover	Description of male cover	Host range	Major ornamental hosts	Position on host	Generations year^{-1} and location	Distribution
Melanaspis obscura (Comstock)	Gray, circular, slightly convex; exuviae subcentral, black	Similar to female but elongate, smaller; exuviae subterminal, black	3 fam. 5 gen. (we believe others are probably errors)	*Carya*, *Quercus*	Bark	1 gen. Maryland (Stoetzel and Davidson, 1971), Louisiana (Baker, 1933)	Canada, U.S.A.
Melanaspis tenebricosa (Comstock)	Brown to gray, circular, very convex; exuviae subcentral, black	Similar to female but elongate, smaller; exuviae subterminal, black	18 fam. 22 gen.	*Acer*	Bark	1 gen. Maryland (Stoetzel, 1975), south Carolina (Metcalf, 1922)	U.S.A.
Parlatoria pergandii Comstock	Translucent, brown to gray, circular or oval, flat; exuviae terminal, yellow-brown, longitudinal medial stripe	Similar to female but elongate, smaller; exuviae terminal, yellow-brown, longitudinal medial stripe	17 fam. 72 gen.	*Citrus*	Leaves, twigs, fruit	3 gen. Alabama (English, 1933); 3–4 gen. Israel (Gerson, 1967); 4 gen. Florida (Watson, 1926)	Tropics and subtropics, greenhouses in cold areas
Parlatoria proteus (Curtis)	Translucent, yellow or brown, oval, flat; exuviae terminal, yellow or brown, longitudinal medial stripe	White, elongate, flat; exuviae terminal, yellow-brown, longitudinal medial stripe	22 fam. 122 gen.	Orchids	Leaves, bark, fruit	No available information; sexual (Schmutterer, 1952) and parthenogenetic (Nur, 1971) populations	Tropics and subtropics, greenhouses in cold areas
Pinnaspis aspidistrae (Signoret)	Light to dark brown, oystershell shaped, flat;	White, felted, elongate, 3 longitudinal	27 fam. 60 gen.	Ferns, *Liriope*, *Ophiopogon*, palms	Leaves, rarely bark or fruit	2 gen. greenhouse (Saakian-Baranova, 1954); 95 days	Tropics, greenhouses in cold areas

	exuviae terminal, brown to yellow-brown	ridges; exuviae terminal, pale yellow				from egg to egg-laying female (Weiss, 1953); sexual (Weiss, 1953) and parthenogenetic (Takahashi and Tachikawa, 1956) populations	
Pinnaspis buxi (Bouché)	Pale brown, yellow or white, oystershell shaped, flat; exuviae terminal, yellow	Unknown except 1 population (Mamet, 1959)	21 fam. 42 gen.	Araceae, palms, many foliage plants	Foliage	1 month from crawler to egg-laying female (Vesey-Fitzgerald, 1940); most report parthenogenesis (Ferris and Rao, 1947; Brown, 1965); males reported Reunion Island (Mamet, 1959)	Tropics, greenhouses in cold areas
Pinnaspis strachani (Cooley)	White to gray, oystershell shaped, slightly convex; exuviae terminal, yellow-brown	White, felted, elongate, 3 longitudinal ridges; exuviae terminal, yellow-brown	27 fam. 170 gen.	*Citrus*, *Hibiscus*, palms	Leaves, bark, fruit	Continuous gen. (Johnson and Lyon, 1976)	Tropics, greenhouses in cold areas
Pseudaonidia duplex (Cockerell)	Brown, oval or circular, convex; exuviae submarginal or subcentral, orange-yellow	Similar to female but elongate oval, smaller; exuviae submarginal, orange-yellow	10 fam. 57 gen.	*Camellia*, *Cinnamomum*	Leaves, bark	3–3.5 gen. Louisiana, 51 days from egg to egg-laying female (Cressman et al., 1935)	China, India, Japan, Korea, Sri Lanka, Taiwan, U.S.A., U.S.S.R.
Pseudaonidia paeoniae (Cockerell)	Usually embedded in epidermis, brown, oval or	Same as *P. duplex*	4 fam. 15 gen.	Azalea, *Camellia*, *Ilex*, rhododendron	Covered by bark flakes	1 gen. Georgia (U.S.A.) (Tippins et al., 1977),	China, Japan, Italy, U.S.A., U.S.S.R.

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Table 3.9.8.1 (*continued*)

Scientific name	Description of female cover	Description of male cover	Host range	Major ornamental hosts	Position on Host	Generations year^{-1} and location	Distribution
	circular, convex; exuviae submarginal or subcentral, orange-yellow					southern U.S.A. (Westcott, 1973), Alabama (English and Turnipseed, 1940), Maryland (McComb and Davidson, 1969), Japan (Murakami, 1970), U.S.S.R. (Tikhonov, 1966; Kunincka, 1970)	
Pseudaulacaspis cockerelli (Cooley)	White, broadly oystershell shaped, flat; exuviae terminal, yellow-brown	White, felted, elongate, sometimes with 3 longitudinal ridges; exuviae terminal, light brown	21 fam. 84 gen.	*Acuba*, *Hedera*, *Magnolia*, *Mangifera*, *Nerium*	Leaves, rarely stems	2 gen. southeastern U.S.S.R. (Danzig, 1980); 50–60 days from egg to egg-laying female (Tippins, 1968)	Africa, Asia, Australia, Caribbean, Central America, Pacific Islands, U.S.A.
Pseudaulacaspis pentagona (Targioni Tozzetti)	White or yellow-white, circular, convex; exuviae subcentral, yellow-orange	White, felted, elongate, sometimes with 1 longitudinal ridge; exuviae terminal, white or yellow	55 fam. 115 gen.	*Callicarpa*, *Diospyros*, *Melia*, mulberry, peach	Bark, fruit, rarely leaves	3 gen. North Carolina (Smith, 1969), Virginia (Bobb et al., 1973), Maryland (Davidson et al., 1983), France (Bénassy, 1958), Italy (Monti, 1955), Turkey (Bodenheimer,	Africa, Asia, Australia, Caribbean, Central America, Europe, Pacific Islands, South America, U.S.A., U.S.S.R.

						1953), U.S.S.R. (Kunincka, 1970), Japan (Murakami, 1970);3.5–4 gen. north Florida (Van Duyn and Murphey, 1971); 4 gen. central Florida (Kuitert, 1967)	
Pseudaulacaspis prunicola (Maskell)	White, circular, convex; exuviae subcentral, light yellow	Same as *P. pentagona*	16 fam. 21 gen.	Flowering cherry, *Ligustrum, Syringa*	Bark, fruit, rarely leaves	2 gen. Pennsylvania (Stimmel, 1982); 3 gen. Maryland (Davidson et al., 1983)	China, Japan, Korea, U.S.A.
Quadraspidiotus forbesi (Johnson)	Dirty gray, circular, flat or slightly convex; exuviae marginal to subcentral, orange	Similar to female but dark gray, margin lighter, elongate oval, smaller; exuviae subterminal, orange	11 fam. 22 gen.	*Carya, Cornus, Fraxinus, Prunus, Pyrus*	Bark	2 gen. Ohio (Johnson, 1898), Illinois (Felt, 1901), North Carolina (Turnipseed and Smith, 1953)	Canada, Mexico, South Africa, U.S.A.
Quadraspidiotus gigas (Thiem and Gerneck)	Gray, circular, convex; exuviae subcentral, orange-yellow	Similar to female but elongate oval, smaller; exuviae subterminal, orange-yellow	4 fam. 5 gen.	*Populus, Salix*	Bark	1 gen. Czechoslovakia (Lellakova-Duskova, 1963), Hungary (Kosztarab and Kozar, 1978)	Algeria, Canada, Europe, Turkey, U.S.A., U.S.S.R.
Quadraspidiotus juglansregiae (Comstock)	Variable, gray to red-brown, circular, flat; exuviae subcentral, yellow to orange	Similar to female but gray-brown, elongate oval, smaller; exuviae subterminal, yellow to orange	10 fam. 40 gen.	*Juglans*	Often under epidermis of bark and stems	1 gen. Maryland (Stoetzel, 1975); 2 gen. Ohio (Houser, 1918)	Canada, Mexico, U.S.A.

Table 3.9.8.1 (*Continued*)

Scientific name	Description of female cover	Description of male cover	Host range	Major ornamental hosts	Position on host	Generations year^{-1} and location	Distribution
Quadraspidiotus ostreaeformis (Curtis)	Gray, circular, convex; exuviae subcentral, orange or yellow	Similar to female but elongate oval, smaller; exuviae subterminal, yellow	18 fam. 41 gen. (we suspect many hosts are errors)	*Malus*	Bark, fruit	1 gen. New Zealand (Richards, 1962), England (Anon., 1977), Germany (Schmutterer, 1952), British Columbia (Madsen and Arrand, 1971)	Argentina, Asia, Australia, Canada, Europe, U.S.A., U.S.S.R.
Quadraspidiotus perniciosus (Comstock)	Gray to light brown, circular, flat; exuviae subcentral, yellow	Similar to female but elongate oval, smaller; exuviae subterminal, yellow	81 fam. 240 gen.	Rosaceae, e.g. *Malus*, *Prunus*, *Pyracantha*, *Pyrus*	Bark, sometimes fruit, leaves	1 gen. cold U.S.S.R. (Chumakova, 1969); 2 gen. central Europe (Kr'steva, 1977; Balàs and Sàringer, 1982), Oregon (Westigard et al., 1979); 3 gen. Mediterranean area (Zocchi, 1960; Loucif and Bonafonte, 1977), New Zealand (Wearing, 1976), Japan (Murakami, 1970), India	Temperate

						(Dinabandhoo and Bhalla, 1980), Chile (Gonzalez, 1981), Maryland (Stoetzel, 1975); 2–4 gen. warm U.S.S.R. (Smol'yannikov, 1980)	
Selenaspidus articulatus (Morgan)	Semitransparent, gray to light brown, margin lighter, circular, flat; exuviae subcentral, yellow	Similar to female but lighter in color, elongate oval, smaller; exuviae submarginal, dark yellow	31 fam. 60 gen.	*Citrus, Codiaeum, Tamarindus*	Leaves, fruit, rarely bark	45 days from egg to adult (Beingolea, 1969)	Africa, Caribbean, Central America, Fiji, Mexico, Philippines, South America, Turkey, U.S.A.
Unaspis citri (Comstock)	Brown or brown-black, oystershell shaped, slightly convex; exuviae terminal, brown-yellow	White, felted, elongate oval, 3 longitudinal ridges; exuviae terminal, brown-yellow	7 fam. 9 gen.	*Citrus*	Bark, occasionally leaves, fruit	2–3 gen. U.S.S.R. (Tikhonov, 1966), Japan (Borchsenius, 1950); 4 gen. in typical citrus-growing areas (Brooks, 1977)	Africa, Asia, Australia, Central America, Europe, Mexico, Pacific Islands, South America, U.S.A.
Unaspis euonymi (Comstock)	Dark brown, broadly oystershell shaped, slightly convex; exuviae terminal, brown-yellow	Same as *U. citri*	7 fam. 18 gen.	*Euonymus*	Leaves, bark, fruit	2 gen. northern U.S.A. (Gill et al., 1982), Japan (Murakami, 1970), Hungary (Vinis, 1977); 3 gen. southern U.S.A. (Gill et al., 1982), except 3 gen. Connecticut (Felt, 1933), New Jersey (Weiss, 1953), New	Argentina, Asia, Canada, Europe, Honduras, Mexico, North Africa, U.S.A., U.S.S.R.

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