

MONITORING OF GREENHOUSE PESTS IN BOTANICAL GARDENS OF KAZAKHSTAN AND CONTROL

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This article reflects the monitoring results of tropical and subtropical plant collection of on coccid damage (Coccoidae), *Tetranychus urticae* and *Trialeurodes vaporariorum*. Species constitution of pests and their feeding plants are revealed. Coccids, *Tetranychus urticae* and *Trialeurodes vaporariorum* have been considered to be permanent pests of greenhouse plants for ages (1970-2017). They are related to harmful species causing huge damage to lots of plant types in greenhouse. The consumption of insecticides temporarily stops their development, reduces the degree of damage and spread. Mechanical cleaning, usage of soap, strict culling, pruning of severely damaged plant parts (leaves, stems) and other hand tools are announced to be additional measures to combat them. The list of the most affected and more resistant plant species is given.

Keywords: greenhouse, tropical and subtropical plants, pests – Coccoidae, *Tetranychus urticae* and *Trialeurodes vaporariorum*. Stable and susceptible plant species, control

Concentration in a greenhouse on a limited area of large species diversity and a high number of plants creates certain prerequisites for emerging and spreading of various diseases and the propagation of harmful and dangerous pests [1]. The greenhouse complex of the Institute of Botany and Phytointroduction was established in 1969 and is introduced to be the only place in the Republic where a collection of unique tropical and subtropical plants is represented. The collection area consists of 940 sq.m. The Main Botanical Garden (Moscow), the Botanical Institute of Moscow V.L. Komarova (St. Petersburg), botanical institutions of the Caucasus and Crimea rendered an enormous contribution in the enrichment of the greenhouse collection [2]. For many years the department has been working to enrich the collection material with new species including forms of interest in botanical and decorative terms [5, 6]. For this purpose, on the subject-matter exchange, the Botanical Garden annually issues seeds from domestic and foreign botanical gardens. According to individual literary data [8], the most common dangerous species are known on the plants of the greenhouse in Moscow. In Lithuania, 30 species of coccid pests of decorative plants have been registered [11]. The first publications on pests and diseases of greenhouse plants in Main Botanical Garden (Almaty) have been known since 1970. According to greenhouse coccids, there is some information in the published article of 1978 [3]. The results of long period researches (1970-1984) were published in the reference book [4]. During this period, the most common species were established causing great damage to decorative introduced plants in all botanical gardens of Kazakhstan including

greenhouse plants. On the greenhouse plants, such pests as *Tetranychus urticae*, *Trialeurodes vaporariorum*, *Coccus hesperidum*, and *Pseudococcus maritimus* were found. Despite the small number of pest species, they are reported to be harmful species causing huge damage to plenty of plant types in the greenhouse. However, after the publication of the “Reference book” more than 30 years have passed. In this connection, it is time to carry out a complete inventory of the closed ground plants, analyze the pest species composition, the severity of the damage, the composition of the feeding plants that are prone to damage, assess the plant species resistance to pests, and apply protective control measures to reduce their severity and extension.

Materials and methods of research

The aim of the work was to identify the species composition of pests of tropical and subtropical greenhouse of the Main Botanical Garden (MBG) (Almaty city) and the Zhezkazgan Botanical Garden (ZBG) (Zhezkazgan city). Stationary observations were conducted in the MBG, as well as planned visits to the ZBG according to a pre-compiled schedule. To diagnose and determine the severity of the most dangerous pests, insect pests were collected, as well as herbarium materials, and the greenhouse plants damaged by them were noted. Determinants and monographic works were used to determine and refine the types of dangerous insect pests [8, 11]. Determination and refinement of plants are conducted according to generally accepted sources [7, 10]. Approved recommendations on plant protection have been used for the implementation of protective measures against pests [9].

When planning treatments against pests, the accounting for the severity threshold is found to be the main indicator. For comparative entomological assessment all the plants, depending on the extent of damage will be divided into 4 groups:

- 1) no damaged by the pests;
- 2) development of the damaged no more than 25% (the degree of damage is very weak);
- 3) development of the damaged within 26-50% (the degree of damage is average affected);
- 4) damaged up to 50% leaves (the degree of damage is very strong).

Results of research and their discussion

In the greenhouse approximately 450 species and forms of tropical and subtropical plants of the world have been growing. During the survey, pests, which annually cause damage in plants, have been identified. In the greenhouse and warm-houses, development of coccid occurs annually. When examining closed ground plants, 13 species of especially dangerous pests of plants were identified (the names are given in alphabetic order):

1. *Aspidiotus nerii* Bouche. It occurs on greenhouse and indoor plants. It is marked on next species: *Nerium oleander* L. (Apocinaceae), *Hedera helix* L. (Araliaceae), *Asparagus asparagoides* (L.) Wight. (Liliaceae), *Ficus retusa* L. (Moraceae), *Thrachycarpus fortunei* (Hook.) H. Wendl. (Palmae). The damage was – 3 points.

2. *Ceroplastes sinensis* Guer. Its damage was found on 3 plant families. *Laurus nobilis* (Lauraceae), *Myrtus communis* (Myrtaceae), *Cytrus meyeri* (Rutaceae). Its damage – 1 point.

3. *Coccus hesperidum* L. Larvae and females settle on shoots, petioles, leaves and trunks. It damages annually such plants as *Abutilon striatum thompsonii*, *Hibiscus cyriacus* L. (Malvaceae), *Adiantum formosum* R. Br. (Adiantaceae), *Aphelandra atrovirens* N.E.Br. (Acanthaceae), *Amaryllis belladonna* L., *Clivia gardenia* Hook. (Amaryllidaceae), *Asparagus asparagoides* (L.) Wight., *Chlorophytum comosum* (Thunb.) Baker (Liliaceae), *Aucuba japonica* Thunb. (Cornaceae), *Citrus reticulata* Mare hort. 'Clementin' (Rutaceae), *Laurus nobilis* L. (Lauraceae), *Monstera deliciosa* Liebm. (Araceae), *Nerium oleander* L. (Apocinaceae), *Philodendron scandens* C. Koch et Sello, *Scindapsus pictus* Hassk. (Araceae). Females and larvae damage sprouts, petioles, leaves, mainly from the upper side, causing discoloration, deformation of leaves and shoots. With a strong infection, plants are covered with a sooty fungus (niello), which retards the normal development of plants. Strongly damaged

shoots wither and leaves fall off. *Coccus hesperidum* refers to viviparous forms. The first age larvae of the stroller settle creeping on the plants. The damage sometimes forms 4 points.

4. *Diaspis boisduvalii* Sign. This species damages the leaves, petioles, unblown leaves. It covers completely the leaf blade more often on the underside of the sheet. Damaged leaves become brown, dry up. The female shield is white or grayish white, flat, round, translucent with light brown larval skin, 2 mm in diameter. Polyphage. The pest is able to cause serious damage to lots of plants: *Dracena fragrans* (Dracaeneae), *Eugenia brasiliensis* Lam. (Myrtaceae), *Ficus retusa* L. (Moraceae), *Livistonia australis* (Palmae), *Nerium oleander* L. (Apocinaceae), *Thrachycarpus fortunei* (Hook.) H. Wendl. (Polypodiophyta). Its damage is 3-4 points.

5. *Diaspis bromeliae* Kern. The pest was first recorded at *Cussonia spicata* in 2010. The pest damages leaves, stems and internodes. Nearby plants were also damaged by the pest *Abutilon hybridum* (Malvaceae), *Agave americana* L., *Agave sisalana* Perrine. (Agavaceae), *Cereus monstrosus* (DC.), *Citrus reticulata* Blanco var. *unchii* (Rutaceae). The damage was counted to be 2 points. Mechanical cleaning of plants, washing with a solution of soap, as well as additional treatment with pesticide led to the partial or complete disappearance of this pest. Currently it is marked on the *Abutilon hybridum* (Malvaceae).

6. *Myzodes persicae* Sulz. It is harmful to young shoots, leaves, flowers. The leaves turn yellow, the flowers fall and the buds do not open. *Myzodes persicae* are small insects, pale green, and 1.4-2.5 mm long. The pest damaged many plants: *Coleus hybridus* (Labiatae), *Chrysanthemum corea* Nakai (Compositae). The damage – 4 points.

7. *Pinnaspis aspidistrae* Sygn. Normal view of the leaves. The female's shield is brown, elongated, pear-shaped, 2-2.5 mm long. Polyphage. It forms dense colonies. The pest damages *Adiantum formosum* R. Br. (Adiantaceae), *Aspidistra elatior* Blume (Liliaceae.), *Dracaena draco*, *D. reflexa* Zacc. (Dracaeneae). The pest is introduced with planting material. The damage concludes 2 points.

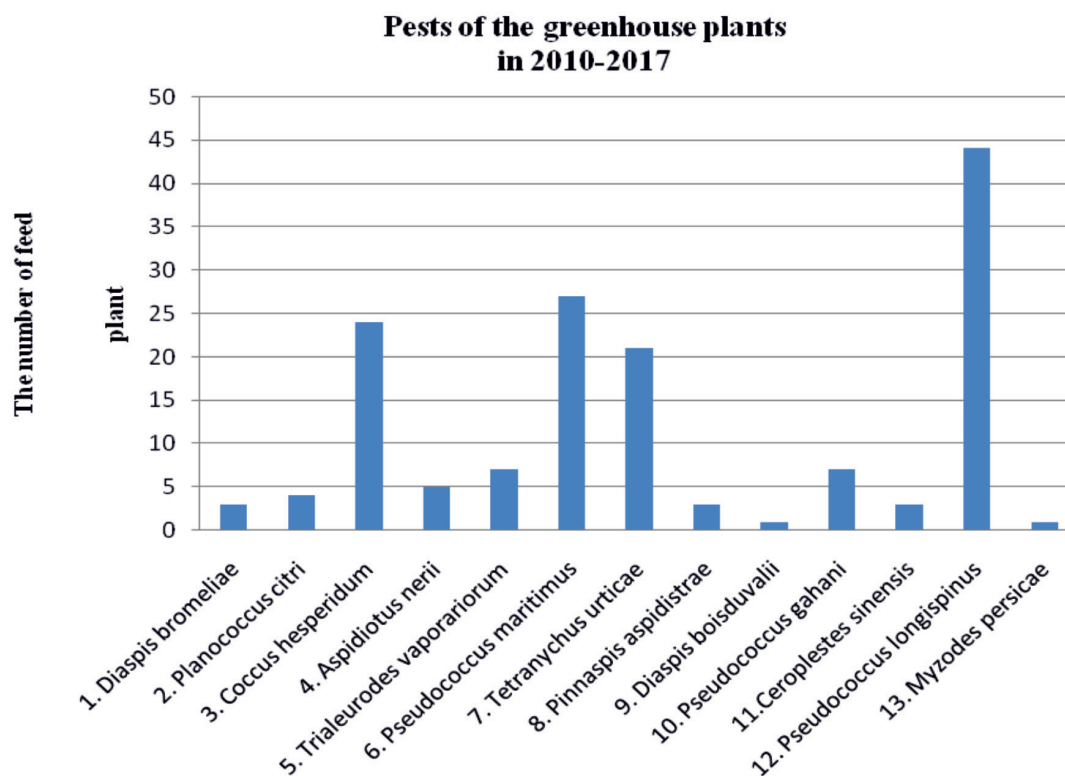
8. *Planococcus citri* Risso. It damages the above-ground part of the plant: stem leaves. With severe damage the plant dries. The pest is noted on four plant families: *Calanchoe blossfeldiana* Poln. (Grossulaceae), *Coleus pumilus* Blanco (Labiatae), *Euphorbia pulcherrima* (Willd) (Euphorbiaceae), *Nerium oleander* L. (Apocinaceae). The damage compiled 2 points.

9. *Pseudococcus gahani* Green. It affects plants of the many family: *Citrus reticulata* Mare hort. 'Clementin', *Citrus limon* L. (Rutaceae), *Fatsia japonica* Decne. et Planch. (Araliaceae), *Laurus nobilis* L. (Lauraceae), *Monstera deliciosa* Liebm. (Araceae). The damage is 3-4 points.

10. *Pseudococcus longispinus* Targ. An adult female and larvae damage leaves and stems. The adult female is elongated oval, 17 pairs of thin white wax threads are located at the edge of the body, of which the back pair is the longest and often exceeds the body length of the female. The length of female body without wax threads is up to 3.5 mm. Its females are vivacious; they elaborate very thin white waxy thread, forming a cotton-like net, where the larvae are kept until the beginning of feeding. The damage from it is noted in the following types of closed ground plants: *Abutilon megapotamicum* St.Hil. et Nand. (Malvaceae), *Agave americana* L. (Agavaceae), *Achimenes candida* Lindl. (Gesneriaceae), *Adiantum formosum* R. Br. (Adiantaceae), *Anthurium andreanum* Lind. *Monstera deliciosa* Liebm., *Philodendron selloum* C.Koch., *Spathiphyllum wallisii* Regel (Araceae), *Aphelandra aurantiaca* var. *roezlii* Regel, *Sanchezia nobilis* Hook., *Jacobinia carnea* Nichols. (Acanthaceae), *Araucaria bidwillii* Hook. (Araucariaceae), *Aucuba japonica* Thunb. (Cornaceae), *Begonia rex* Putzeys (Begoniaceae), *Bougainvillea glabra* Choisy, *Bougainvillea sellowiana* (Berg) Burret. (Nyctaginaceae), *Boehmeria macrophylla* D.Don (Urticaceae), *Calathea lietzei* E.Morr. (Marantaceae), *Citrus reticulata* Mare hort. 'Clementin' (Rutaceae), *Cissus juttae* Dinter. (Vitaceae), *Clivia gardenia* Hook. (Amaryllidaceae), *Codiaeum variegatum* L. (Euphorbiaceae), *Cyperus alternifolius* L. (Cyperaceae), *Dracaena draco* L. (Dracaenaceae), *Feijoa sellowiana* (Myrtaceae), *Ficus auricularia* Lour., *Ficus carica* L., *Ficus bengalensis* (Moraceae), *Gardenia jasminoides* Ellis. (Rubiaceae), *Hibiscus cyriacus* L., *H. rosa-sinensis* (Malvaceae), *Kalanchoe pinnatum* S. Kurz. (Crassulaceae), *Maranta arundinacea* L. (Marantaceae), *Musa basjoo* Siebold et Zucc. (Musaceae), *Nerium oleander* L. (Apocynaceae), *Opuntia stricta* (Cactaceae), *Passiflora edulis* (Passifloraceae), *Peperonia caperata* (Piperaceae), *Plumbago capensis* Thunb. (Plumbaginaceae), *Portulaca grandiflora* Jacq. (Portulacaceae), *Rhoe sparganacanthae* (Swartz) Stearn (Commelinaceae). Its harm is 2-3 points. Examination of greenhouse plants in the Zhezkazgan Botanical Garden displayed that the most common species are: *Trialeurodes vaporariorum*, *Tetranychus urticae*, *Pseudococcus longispinus*.

11. *Pseudococcus maritimus* Ehrh. It deteriorates leaves, stalks, internodes of plants from the following families: *Abutilon hybridum* (Malvaceae), *Adiantum formosum* R. Br. (Adiantaceae), *Amaryllis belladonna* L., *Clivia gardenia* Hook. (Amaryllidaceae), *Begonia sepmerflores* (Begoniaceae), *Camellia japonica* L. (Teaceae), *Cissus antarctica* Vent. (Vitaceae), *Dieffenbachia maculate* G.Don (Araceae), *Euphorbia pulcherrina* (Willd) (Euphorbiaceae), *Rhododendron indicum* (L.) Sweet (Ericaceae), *Fatsia japonica* Decne. et Planch., *F. japonica* var. *moseri* (Thunb.) Decne. et Planch. (Araliaceae), *Hibiscus cyriacus* L. (Malvaceae). In recent years (2012-2015) *Pseudococcus maritimus* widened the range of feeding plants and is currently marked on such plants as *Ctenanthe openheimiana*, *Marantha leuconeura* E.Morr. (Marantaceae), The damage sometimes compiles 3-4 points. The following species have been included to the most severely – and medium – damaged species with *Pseudococcus maritimus* for last years: *Bougainvillea glabra* (Choisy); *Bougainvillea spectabilis* Willd. (Nyctaginaceae), *Calathea crocata* (Marantaceae), *Callisia fragrans* (Lindl) Woods., *Comelina benghalensis* L. (Commelinaceae), *Coniogramme japonica* (Thunb.) Diels. (Heloniaceae), *Eucharis grandiflora* Planch. (Amaryllidaceae), *Erythrina corallodendron* L. (Fabaceae), *Eugenia brasiliensis* Lam. (Myrtaceae), *Passiflora quadrangularis* L. (Passifloraceae), *Petrea volubilis* L. (Verbenaceae), *Piper nigrum* L. (Piperaceae). Treatment with chemical means of protection practically does not lead to the complete eradication of this pest. Only additional pruning and mechanical cleaning make it possible to reduce temporarily the number and severity of the pest.

12. *Trialeurodes vaporariorum* Westw. It harms in the closed and opens (summer) ground, causing discoloration of the leaves and covers them with a sugary coating. The adult insect is 1.3-1.5 mm long, yellowish, with two pairs of wings pollinated by a waxy coating. The larvae are flat, oval, with spinules. Its eggs are greenish-yellow, deposited on the underside of the leaves. One generation is 30-40 days. Polyphage. Everywhere locally. The pest is marked on 7 families. Species that are severely damaged are: *Begonia rex* Putzeys (Begoniaceae), *Beloperone guttata* Brandegee (Acanthaceae), *Bignonia unguiscati* (L.) (Bignoniaceae), *Coleus blumei* Benth hybridus (Labiatae), *Fuchsia hybrida* (Onagraceae), *Gloxinia hybrida* (Gesneriaceae), *Lantana camara* L. (Verbenaceae). The occupancy of the *T. vaporariorum* was 3-4 points.



Pests of tropical and subtropical plants in greenhouse

13. *Tetranychus urticae* Koch. It is found on the following plant families of tropical and subtropical plants: *Ageratum mexicanum* Sims. (Asteraceae), *Amarillis belladonna* (Amaryllidaceae), *Asplenium* sp. (Polypodiophyta), *Calla aethiopica* (Araceae), *Cyclamen europaeum* C. Caswell (Primulaceae), *Cissus antarctica* Vent. (Vitaceae), *Citrus limon* (L.) Burm. (Rutaceae), *Feijoa sellowiana* (Myrtaceae), *Fuchsia gracilis* (Onagraceae), *Freesia hybrida* (Liliaceae), *Hedera helix* (Araliaceae), *Hibiscus rosa-sinensis* (Malvaceae), *Hydrangea paniculata* Sieb. (Hydrangeaceae), *Jacobinia cornea* Nichols., *J. pohliana* (Nees) Lindau (Acanthaceae), *Nerium oleander* L. (Apocynaceae), *Punica granatum nana* L. (Punicaceae), *Trachycarpus fortunei* (Hook.) H. Wendl. (Palmae). The plant leaves, which were damaged by mites, decolor, often dry out and fall off. This leads to a decrease in decorativeness, and sometimes to the death of plants. It harms also the families of *Moraceae* (*Ficus bengamina* L.), *Rutaceae* (*Citrus limon* (L.) Burm.), *Cactaceae* (Cactus spp.) and other greenhouse and flowering plants. The optimum temperature for a mite is 29-31 °C, the optimum humidity is

35-55%. The increase in humidity adversely affects the development of the mite. A variety of pesticides and acaricides are used in order to suppress the pest development. However, because of the widespread usage of pesticides, the difficulties of fighting *Tetranychus urticae* are increasing, as a result, in recent years it has acquired considerable resistance to acaricides. The occupancy is 3-4 points per year.

As a result of the last year research (2010-2017), resistant plant species that were not damaged by the aforementioned pests were identified. These include the following plants from the family: *Acorus gramineus* Varietgus, *Alocasia odora* C., *Anthurium andreaeanum* Lind. (Araceae). Thus, the results of multi-year (2010-2017) surveys of tropical and subtropical plants, a quantitative analysis of pests found on closed ground plants are shown in Figure.

According to the quantitative ratio *Pseudococcus longispinus* and *Pseudococcus maritimus* are the most abundant species in a closed ground. The range of damaged plants is extensive and they were identified respectively on 44 and 27 types of feeding plants. *Coccus hesperidum* is a polyphage and has been identified

in 20 families and 24 plant species. *Tetranychus urticae* is identified in 21 families and 22 plant species. *Trialeurodes vaporariorum* is also one of the harmful pests of the enclosed ground. It damages many types of potted plants that grow in a closed ground. It should also be noted that the small number of pests and plant species, which were damaged by them, is not the criterion of their low degree harmfulness. All identified pests are classified as harmful and dangerous plant species of enclosed soil. Control measures include the following activities: Agrotechnical measures that ensure the normal development of plants, in autumn the removal and burning of affected leaves and shoots, on which the pest is overwintered; consumption of chemical control tools to reduce their numbers, severity and spread to other nearby plants. All of the drugs listed below are permitted for usage against plant pests.

1. BI-58, 40% c.e (dimethoate) BASF, Germany. Spraying during the vegetative season (summer) (aphis, thrips, ticks, coccids and others); Carate, 5% c.e. (lambda – cyhalothrin). Zeneca, England. Spraying during the vegetative season (aphis, thrips, ticks, coccids, fall webworm and others); Kel'tan, purified, 18 c.e. (dicofol), Rhom and Haas, USA. Spraying in the vegetation period (ticks, whitefly); Omait, 30% s.p.; 57% c.t. Junirojal, USA. Spraying (ticks, arachnoidal ticks).

2. A necessary condition for effective action of drugs is their alternation and their usage in combination with other drugs. Such mixtures reduce the number of treatments, and the effectiveness of the drugs increases. Particular attention should be paid to combating sucking pests (aphids and spider mites), which sucking out the juices, greatly weaken the plants.

3. Almost all chemical means of controlling pests and plant diseases are poisonous to humans and warm-blooded animals. Work related to the chemical consumption should be carried out under the direct supervision of agronomists and other professionals who are well versed in the pesticide handling and who are responsible for the implementation of necessary measures to prevent accidents.

Conclusions

In the greenhouse the development of pests is observed annually. During the survey,

13 pest species were found out and identified, damaging 51 genes from 43 families consisting of tropical, subtropical and potted plants. Relatively stable (18 species) and highly damaged plant species (20 species) are defined. Control measures are reduced in the timely usage of chemical agents (systemic or contact action), as well as improving the agrotechnical conditions of cultivation. During this period, plant pests such as bromeliad shield, citrus wax shield, black convex scutellum were brought. Identification of these pests has made it possible to reduce their numbers, spread to other plants and practically destroy some species (black convex scutellum). It should be noted that the same plant species of the same family can be damaged by several pest types.

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