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United States Department of Agriculture,

BUREAU OF ENTOMOLOGY,

L. O. HOWARD, Entomologist and Chief of Bureau.

THE COMMON RED SPIDER.

(*Tetranychus bimaculatus* Harvey.)^a

By F. H. CHITTENDEN, SC. D.,

In Charge of Truck Crop and Special Insect Investigations.

INTRODUCTORY.

One of the most troublesome of greenhouse pests is a minute, red-dish, spiderlike creature, known popularly as "red spider." It does very considerable damage in flower and vegetable gardens, and in greenhouses attains its greatest destructiveness. It is particularly injurious to violets and roses, and attacks a great variety of other plants, including shade and fruit trees and some field crops. Beans, cowpeas, eggplant, cucumber, and tomato, especially when grown in hothouses, sustain much injury, while melons, squash, and berries are subject to destructive attack.

Red spiders are not true insects, in fact not even spiders, but are, more properly speaking, spinning mites. Since, however, they are almost universally known as "red spiders," this term is retained.

As the word "mite" indicates, these insects are extremely minute, and when they occur in ordinary numbers are not apt to be noticed unless the leaves are carefully scrutinized. Attention, however, is certain to be drawn to them when they become excessively numerous, as frequently happens in neglected greenhouses or out of doors during droughts in summer.

Red spiders spin threads, but do not, like true spiders, utilize them for climbing or for descending from a height. The threads spun are extremely fine and scarcely perceptible to the unaided eye, but a web

^a Until the year 1900 the common red spider, most often occurring in greenhouses, was technically designated as *Tetranychus telarius* L., a name which has been rather indiscriminately applied to all species of red spiders, both in America and abroad.

of threads is frequently so dense as to form a tissue plainly visible at a little distance. Webs are constructed upon the lower side of leaves, and attached here and there to projecting hairs, veins, or the edges of the leaves. Within the webs thus formed the mites feed in their different stages, and the eggs are laid from which the young develop.

DESCRIPTIVE.

The general appearance of this red spider as seen under a microscope is well shown in figure 1, *a*. At *b* a greatly enlarged palpus of the same species is illustrated, and *c* shows the claws, similarly enlarged.

The length of full-grown individuals, including the palpus, is about $\frac{1}{60}$ inch (0.4 to 0.6 mm), and the width about $\frac{1}{100}$ inch (0.25 to 0.30 mm), the thickness being 0.17 to 0.20 mm. The form is broadly oval, the

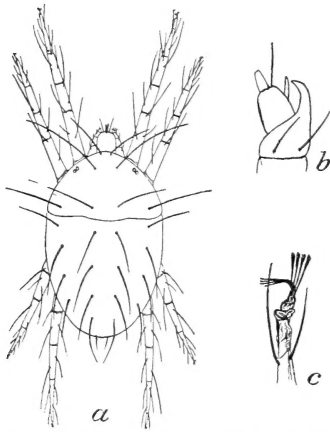


FIG. 1.—The common red spider (*Tetranychus bimaculatus*): *a*, Adult; *b*, palpus; *c*, claws. *a*, Greatly enlarged; *b*, *c*, still more enlarged. (After Banks.)

width greatest in the anterior third of the body, back of the eyes, where the sides are somewhat distended. The general color of the adult is reddish, usually more or less tinged with yellowish or orange, and most specimens have a dark spot on each side, due to the food contents of the body, from which the scientific name *bimaculatus* (two-spotted) has been derived.

Careful study of different individuals as they occur on garden vegetables and on horticultural and other plants growing in the field with those taken in greenhouses shows no appreciable differences. According to Mr. Nathan Banks, specimens taken in Florida on *Datura* and at Washington, D. C., on

violets are red, while those from Orono, Maine, and those from the District of Columbia on squash and peach, and on rose from Idaho, are greenish with more or less dark markings.

The eggs are extremely minute, spherical, of variable diameter, glassy, and are scattered and loosely attached about the webs.

The young are somewhat similar in appearance to the adults, but differ in having only three pairs of legs, while the adult has four pairs.

DISTRIBUTION.

This red spider is well distributed throughout the eastern United States, and was identified as occurring as far west as Idaho in 1900. In 1902 it was recognized from Brighton, Wash.; in 1907 from south-

ern California; and in 1908 at Brownsville, Tex., this last locality practically assuring its occurrence in Mexico.^a

NATURE OF INJURY.

The red spider occurs in greenhouses throughout the year, and appears to be at all times destructive if permitted to propagate. Few plants are, in fact, free from its attack, and it is found in most greenhouses. When only a few mites are present the plants seldom show any external evidences of injury, but as they increase in number the leaves gradually turn paler and become yellowish and stunted, and soon the whole plant succumbs unless the proper remedies are applied. Cuttings or young rooted plants are particularly subject to serious injury, and this is especially true in the spring. At this time the mites multiply rapidly, and unless plants are carefully watched they are apt to become so badly infested that it is only with extreme difficulty that they can be restored to their normal growing condition.

The mites injure plants by suction, and when they occur in numbers, which they almost assuredly do when plants are neglected, the vitality of the plants is slowly but surely reduced by the loss of the juices, and in time all of the plants' functions are more or less deranged. In cases of severe attack, millions of red spiders can be found upon the foliage, and the webs, rarely observable at ordinary times, sometimes stretch from plant to plant, the mites passing rapidly over them and congregating in swarms.

FOOD PLANTS.

The red spider is nearly omnivorous, attacking a wide range of both glabrous and hirsute plants belonging to many families. It has been observed on plants of the following list: Among greenhouse and other ornamental plants, roses, violets, carnations or pinks, mignonette, clematis, pelargonium, abutilon, fuschia, passiflora, manettia, bouvardia, feverfew, verbena, heliotrope, salvia or sage, morning-glory, moonflower, cypress-vine, phlox, chrysanthemum, calla, Easter lily, Boston smilax, mimulus, slipper flower (*Calceolaria*), canary bird (*Tropæolum peregrinum*), thunbergia, wedding bells (*Brugmansia arborea*), castor-oil plant, *Asparagoides plumosa*, cuphea, godelia, sunflower, and aster. Of the plants listed, violets and roses are very susceptible to damage by the red spider, more especially when the plants are growing under glass.

^a If, as seems probable, *Tetranychus cucumeris* or some other species described by Boisduval (*Entom. Horticole*) is identical with *T. bimaculatus*, it is quite likely that this red spider is of foreign origin and introduced into the United States, which is true of a very large proportion of greenhouse and other indoor insects.

Among truck and vegetable crops, leguminous plants are greatly injured, more especially beans, including Lima beans. Cucumbers and tomatoes grown in hothouses, cantaloupes or muskmelons, watermelons, and squash are also badly damaged. Eggplant, pepper, pepino (*Solanum muricatum*), corn, cowpeas, raspberry, strawberry, beets, and celery are also subject to attack, but are not as a general rule very seriously injured.

Of field crops infested other than those which have been mentioned are hops, hemp, peanut, and the groundnut or wild bean (*Apios epios*).

Trees grown for shade and for fruit are subject to attack and considerable injury is effected at times. The list of trees that have come under observation as subject to the greatest injury includes the Kentucky coffee tree (*Gymnocladus canadensis*), the hop tree (*Ptelea trifoliata*), pecan, ornamental sassafras, arborvitæ, maple, horsechestnut, and birch.

INJURY TO TRUCK CROPS.

Every year this species is noted in considerable numbers on the underside of leaves of bean in and about the District of Columbia, frequently causing great blotches and the withering of a large portion of the leaf. When the mites occur in such abundance it necessarily causes a drain on the vitality of the plant and a decrease in the productiveness of seed-pods if not of the seeds themselves. Still, as a rule, such injury is rarely noticed until comparatively late in the season, in September and October.

Similar injury has been reported in Georgia and South Carolina to all forms of beans—snap, butter, and Lima—as well as to cowpeas. In the same States injury has been reported to a variety of other truck crops. Writing in June, one of our correspondents stated that his cucumbers looked as if a blight were on them; another wrote: "A fine garden three weeks ago now looks as if a fire had struck it."

INJURY TO TREES.

Injury by the red spider to shade and fruit trees is insignificant, as a rule, compared with that which is accomplished by leaf-feeders such as caterpillars. Sometimes, however, very considerable defoliation is caused by the attack of this species. This was very noticeable during the summer of 1906, when the foliage of various shade trees in the city of Washington was injured. Attack was first observed during the third week in July and was manifested by the leaves having turned yellow on the upper surface. The leaves on the lower branches showed the presence of numerous feeding colonies. The Kentucky coffee tree suffered most of all of our city trees. On one of these trees the leaves continued to drop throughout the remainder of July and August, but by September, partly owing to an unprecedented rainfall of three weeks' duration, the mites were less in evi-

dence and many branches from which the leaves had fallen developed new clusters of fresh leaves.

Two years later it was noticed that many of the lower branches which had suffered most from defoliation by the red spider were dead,

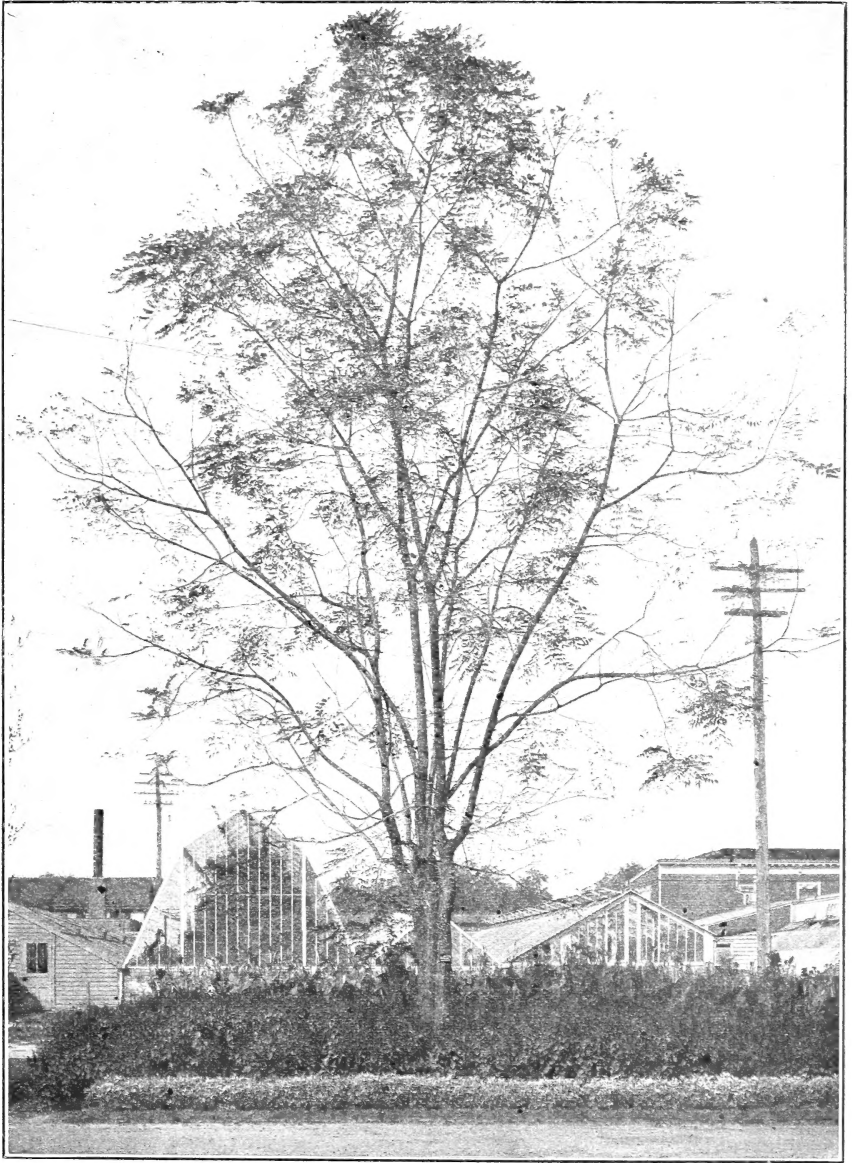


FIG. 2.—Kentucky coffee tree, showing partial defoliation by the red spider on lower branches; upper branches have put out new leaves. (Original.)

without doubt owing to the attack of this insect. The accompanying illustration (fig. 2) was taken after the new leaves had become well

developed. Two or three weeks before that time the lower half of the tree bore only a few leaves.

This same form of injury was repeated in 1908, the tree looking considerably worse than shown in figure 2.

NATURAL ENEMIES.

The predaceous and parasitic insect enemies of the red spider, mentioned below, were observed by the writer on the Kentucky coffee tree at Washington, D. C., during July and early August, 1906.

Scymnus punctum Lec., a very small black ladybird, was observed July 21, chiefly as a nearly full-grown larva, and was the most active natural enemy. At that time it was for the most part attached to the leaves for pupation, and a single pupa was found then and many a few days later. Nearly all the larvæ had transformed and the beetles had begun to issue by the 1st of September. An illustrated account of this species was given by J. C. Duffey in 1891.^a

Cecidomyia coccidarum Ckll. (?).—The larva of this small cecidomyiid fly was reared at Washington, where it was fairly abundant. It was secondary in importance only to the ladybird mentioned, as a destroyer of its red-spider host.

With the latter was reared a minute chalcis fly, *Aphanogmus varipes* Ashm., a species recorded as parasitic on cecidomyiids.

Chrysopa rufilabris Burm., a lacewing fly, was also reared and the larva was observed in numbers attacking the red spider.

Thrips sexmaculata Perg. has been recorded as an enemy of the red spider by Pergande^b and by Duffey.

METHODS OF CONTROL.

DIRECT REMEDIES.

Red spiders are more resistant to fumigation, either with tobacco or hydrocyanic-acid gas, than are aphides, thrips, and small forms of insects generally. Only a portion of these creatures are usually killed by the ordinary use of the gas in greenhouses—never more than 80 per cent, so far as our records go. The remainder may be stupefied for a time, but eventually recover. They are, however, extremely sensitive to sulphur, applied either dry or as a wash, or in connection with other poisons. Soap is also a good remedy.

Sulphur.—Flowers of sulphur, mixed with water at the rate of an ounce to a gallon, and sprayed over infested plants, is of great value in the eradication of this pest; or the sulphur may be combined with strong soapsuds. For the application of this spray a force pump with spraying nozzle is a necessity and *the current should always be directed to the lower surface of the leaves*.

Soap solutions.—Potash, fish-oil, whale-oil, and other soap solutions are valuable against the red spider, and the addition of sulphur in-

^a Trans. St. Louis Acad. Sci., Vol. V, pp. 540-542.

^b Psyche, Vol. III, p. 381, 1882.

creases their effectiveness; but these washes will injure some delicate plants. Moreover, they have no more value as insecticides than neutral soaps of the castile and Ivory type, or such as are used by physicians and surgeons.

For the red spider, as it occurs in greenhouses, particularly on plants, such as violets, that are liable to injury from sulphur, no other remedy is employed by florists generally than frequent syringing or spraying with water or with a soap solution. Neutral soaps are valuable, particularly upon cuttings affected with the red spider, and the best results have been obtained in the proportion of a 5-cent cake to 6 or 7 gallons of water. The soap is shaved with a small plane, dissolved in about a gallon of hot water, and then sufficient cold water is added to make the quantity desired. Five gallons are sufficient for the treatment of three or four thousand cuttings of violets. It is customary to allow the soap to remain on the plants two or three hours and then to syringe thoroughly with clear water, repeating this treatment two or three times, until the "spiders" and their eggs have been destroyed. Used thus, the soap has little if any deleterious effect upon most plants.

Kerosene-soap emulsion.—An emulsion may be prepared by combining 2 gallons of kerosene and one-half pound of whale-oil soap (or 1 quart of soft soap) with 1 gallon of water. The soap is dissolved in boiling water and then poured while still boiling hot (away from the fire) into the kerosene. The mixture is churned rapidly for five or ten minutes, pumping the liquid back upon itself by means of a force pump and direct-discharge nozzle throwing a strong stream. At the end of this time the mixture will have the consistency of thick cream.

Properly prepared, an emulsion will keep almost indefinitely, and should be diluted as needed for use. For the red spider the staple emulsion should be diluted with about 10 parts of water. In the preparation of kerosene emulsion a force pump is required, since if not made according to directions a perfect emulsion is not formed and there is then danger of injury to the plants or useless waste. There is danger and waste, too, if the insecticide is not applied by means of a fine nozzle in the form of a *spray*, which should be fine and mist-like. It should be sprayed only for a sufficient time to cover the plants; otherwise the liquid forms into globules and runs off. An elbow attachment for underspraying is shown in figure 3.

Lye-sulphur.—The lye-sulphur remedy was given a thorough test against the red spider in its occurrence on beans in Florida, having been applied May 28, 1908, with the result that 98 per cent of the red spiders were killed without in the least affecting the plants treated.

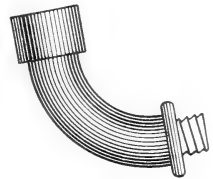


FIG. 3.—Elbow attachment for underspraying. Reduced.

This shows better results than with any of the four insecticides which were tested in that locality by Mr. H. M. Russell,^a 3 per cent more of the mites being destroyed than by the use of kerosene emulsion, which slightly injured the plants; 7 per cent more than with the use of sulphur water, and it proved to be much better than lime-sulphur, which was hardly a success as compared with the others. Lye-sulphur is prepared as follows:

Mix 20 pounds of flowers of sulphur into a paste with cold water; then add 10 pounds of pulverized caustic soda (98 per cent). The dissolving lye will boil and liquefy the sulphur. Water must be added from time to time to prevent burning, until a concentrated solution of 20 gallons is obtained. Two gallons of this is sufficient for 50 gallons of spray, giving a strength of 2 pounds of sulphur and 1 of lye to 50 gallons of water. An even stronger application can be made without danger to the foliage. This mixture can also be used in combination with other insecticides (Marlatt, *Farmers' Bulletin* 172).

Tobacco water.—Tobacco water is of some use for destroying the red spider, but can not be recommended for violets, owing to its tendency to weaken the foliage and induce "spot."

Water.—Spraying with water is usually practiced two or three times a week during the growing season, and by a little practice and experiment with a fine-spray nozzle or tip the operator is soon able to ascertain the proper degree of force to use. A pressure of about 25 pounds has proved most effective against this red spider. Care should be exercised to wash off the "spiders" and at the same time to avoid drenching the beds. When it is necessary to spray during winter, work should be done on a bright day, in order that the plants may dry off in a few hours. Water is also of use on shade trees and shrubs in parks.

NOZZLE AND TIP FOR GREENHOUSE USE.

Since the general adoption of spraying as a remedy for the red spider, the problem of how to apply a water or other spray so as not to drench the beds has been an important one. To accomplish this object, Dr. B. T. Galloway, Chief of the Bureau of Plant Industry, has devised a small spraying tip which answers the purpose admirably, being particularly serviceable where plants are syringed or sprayed on a large scale. The following description of the nozzle is taken from Circular 17 of the Division of Vegetable Physiology and Pathology:

The spray tip proper is attached to a brass fitting, which in turn screws onto the end of a three-quarter-inch hose. The apparatus is very effective for spraying roses, as it readily serves to keep the leaves in a thoroughly healthy condi-

^a For particulars see article by H. M. Russell in *Journal of Economic Entomology*, Vol. I, pp. 377-380, 1908.

tion, and at the same time wets the beds but little. It is also very useful for violets, as with a pressure of 35 to 40 pounds the leaves of the plant can be readily turned over and thoroughly washed without soaking the crowns and the bed. In spraying some plants, particularly violets, it has been found advantageous to use a lance 18 inches long, made of a piece of one-half-inch brass pipe. This increases the reach, and enables the operator to place the water to better advantage on plants which under ordinary conditions would be beyond arm's length. The apparatus can be made for 50 cents, and will be found a useful instrument wherever there is sufficient water pressure to insure a proper amount of force.

The illustration here presented (fig. 4) shows the general appearance of this tip and nozzle. The nozzle consists of a casting turned to the desired length and flattened at the end as figured. Through this flattened end a narrow slit is made, which should be absolutely true throughout, so that the water as it issues will be broken up into streams. It is even sometimes necessary to file the tips as they come from the factory, to secure the desired result.

TREATMENT OF TREES AND SHRUBS.

The methods of control which have been advised above are especially adapted to the treatment of greenhouses infested by the spider. All of the insecticides which have been recommended for indoor use are also applicable to trees and shrubs, the list including sulphur, which may be applied in the form of a powder by means of a powder bellows, or mixed with water as previously prescribed, or combined with lye or lime. Soap solutions, kerosene emulsion, and cold water may be used with profit. Resin wash and lime-sulphur are also used as for the orange mites or red spiders. Of these the lye-sulphur mixture is probably the best, as it is successfully used against these pests in California.

The sulphur treatment has an advantage, in that it adheres more closely to the leaves than other preparations which have been mentioned and kills young mites coming in contact with it as soon as they are hatched. Sulphur preparations are also of value in eradicating scale-insects which might be present at the same time; in fact, when the sulphur is being applied for scale-insects, red spiders or mites are likewise killed.

TREATMENT OF TRUCK AND GARDEN PLANTS.

In the treatment of truck crops infested by the red spider, little variation from the methods already advised for greenhouse work need be practiced. The same applies to ornamental flowering plants

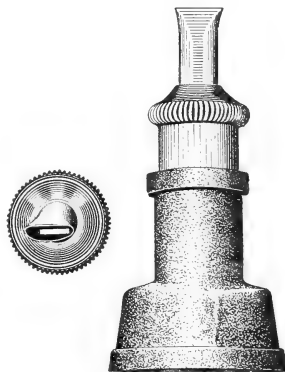


FIG. 4.—Nozzle and tip for greenhouse use. Reduced.

in gardens. Considering the great susceptibility to damage from red spider of beans, cowpeas, and other leguminous crops, and ornamental plants, it is advisable, where this mite is very destructive, as in the District of Columbia and southward, to practice rotation with plants not so subject to injury. The lye-sulphur remedy has produced the best results, as just described. Some of the remedial measures advised for the cotton red spider (*Tetranychus gloveri* Bks.), a related species occurring in the Gulf region, may be followed; indeed, the same measures are applicable to aphides and other pests which may be present on the plants at the same time.

Among cultural methods of control may be mentioned clean gardening or farming with early fall plowing, keeping down the weeds of the vicinity throughout the year, and destroying crop remnants as early as possible by burning or otherwise. Weeds growing on the edges of fields, in fence corners, and like locations should be destroyed early in the fall in order that no winter shelter may be left for the pests. Early fall plowing destroys the insects before they have an opportunity to leave the old crop plants for weeds and others.

During May, 1908, Mr. H. M. Russell, working under the writer's direction at Orlando, Fla., conducted some experiments with remedies against the red spider in its occurrence on wax beans. The results obtained, in brief, are as follows:

Kerosene-soap emulsion, 1 part stock solution to 10 parts water, killed.....	95 per cent.
Lye-sulphur, 1 pound sulphur, $\frac{1}{2}$ pound lye, to 40 gallons water, killed.....	98 per cent.
Sulphur water, 1 ounce to 1 gallon water, killed.....	91 per cent.
Lime-sulphur, 1 pound lime, 1 pound sulphur, to 25 gallons water, killed.....	68 to 85 per cent.

The results show that the red spider succumbs to any one of these four insecticides, the probabilities being that kerosene-soap emulsion, properly prepared and applied, is as satisfactory a remedy as any other applications that could be employed.

SUMMARY.

The remedies advised may be summarized as follows:

For the greenhouse and for general use, sulphur and neutral, whale-oil, and other soap solutions, kerosene-soap emulsion, and spraying with water.

For the treatment of trees and shrubs, the same as the above, with the addition of resin wash and the lime-sulphur and lye-sulphur mixtures.

For truck and garden plants, lye-sulphur wash and the same remedies as for the greenhouse, with the addition of clean gardening

or farming, early fall plowing, keeping down weeds, and crop rotation where practicable.

Finally, it should be stated that unless remedial measures be adopted and thoroughly and repeatedly applied as often as necessity demands, the red spider is almost certain to do permanent harm to delicate plants, since as soon as the plants become badly infested they seldom, if ever, fully recover.

Approved:

JAMES WILSON,

Secretary of Agriculture.

WASHINGTON, D. C., *November 30, 1908.*

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