# The Rhap-Trol Spray System — A New Technique For Applying* Invert Emulsion

*By*

R. E. OGLE

*Agricultural Chemicals Synthetics Department*

*Hercules Powder Co., Inc.*

We all recognize the contributions which pesticides have made to agriculture and to related fields such as yours. At the same time, we are cognizant of the problems which have been created by the application of these pesticides. One of these problems is drift. This has caused considerable concern and is especially serious when the phenoxy herbicides which are quite active in low concentrations are being applied. The problem is intensified when applications are made by air where drift is dependent upon wind velocity and the number of fine droplets in the spray. Thus drift can be reduced if larger droplets which will not evaporate are produced and one way to accomplish this is with invert emulsions.

The use of invert emulsions in the herbicidal field was first reported in 1931; however, application techniques presented problems and it was necessary to overcome these before they could be applied commercially. Recently, new developments in equipment have been made so that these materials can be applied.

Hercules is now developing the Rhap-Trol spray system for applying invert emulsions of herbicides and other agricultural chemicals with a minimum of drift. This system provides continuous mixing and emulsion formation in small chambers of bi-fluid mixing nozzles. This is carried out by bringing the chemical and water through separate lines to the mixing chambers where a thick water-in-oil emulsion is formed and sprayed simultaneously.

The relatively large drops produced by the bi-fluid nozzle, as our slides will indicate, can be deposited with surprising accuracy on the target desired.

**FEATURES OF THE RHAP-TROL SYSTEM**

1. Produces uniform droplet size—large enough to prevent drift; small enough to insure adequate coverage.
2. Eliminates premixing—mixing equipment, mixing errors and left-over spray mix.
3. A boom lays down a uniform swath.
4. Oil droplet provides better contact, absorption, less washing away by rain.
5. Applies very thick as well as thin emulsions.
6. Can be adapted to every method of application, back pack to airplane.

The following slides show the features of this system—how it operates and results obtained.

*Presented at the Fourth Annual Meeting—Water Hyacinth Control Society, June 29, 1964, Tallahassee, Florida.

# Florida Department of Agriculture's Position On Parasites and Predators Introduced Into Florida For Biological Control[1]

*By*

H. A. DENMARK

*Chief Entomologist*

*Division of Plant Industry*

*Florida Department of Agriculture*

Gainesville, Florida

The introduction of parasites and predators into Florida dates back to 1899 when the vedalia, *Rodolia cardinalis* (Mulsant) was introduced. This lady beetle was introduced into California from Australia in 1889 and into Florida in 1899 to control cottony-cushion scale, *Icerya purchasi* Maskell, that was introduced in 1893. This predator was very successful in controlling this pest but never eradicated it. For many years the vedalia was reared by the State Plant Board and sold for $1 for a colony of ten beetles. Cottony-cushion scale is still present today but is not considered an important pest. A hymenopterous parasite, *Cryptochaetum monophlebi,* was introduced from California in 1917 to aid in controlling cottony-cushion scale. It is not known whether this parasite became established.

A whitefly-eating lady beetle, *Delphastus catalinae* (Horn) was introduced from California in 1917 to control the citrus whitefly, *Dialeurodes citri* (Ashmead). This lady beetle became established in the Bradenton area in the early 1900's, but there are no records of its being in Florida today. The Chinese lady beetle, *Leis dimidiata quinquedecimmaculata* (Hope), was introduced into several citrus areas in Florida from California in 1925 to control the spirea aphid. This aphid, often referred to as the green citrus aphid, was considered a severe pest of citrus during the 20's. Dr. A. N. Tissot was hired by the Florida Agricultural Experiment Station to work with this pest. The Chinese lady beetle can still be found in Orange County, but it is not very effective in controlling the spirea aphid. A lady beetle, *Cryptolaemus montrouzieri* Mulsant, (originally from Australia) was introduced into the citrus belt in 1930 from California to control the citrus mealybug. It became established, and Dr. Martin H. Muma reported in 1955 that it was wide-spread in the citrus belt. The convergent lady beetle, *Hypodamis convergens* Guerin-Meneville, has been introduced from California many times to control aphids on truck crops. This lady beetle is endemic to Florida. Its habit of hibernating in large numbers in California, making it easily accessible, has encouraged entomologists to collect and sell this lady beetle.

These are the seven recorded introductions into Florida until 1947.

The following is a list of nineteen parasites and predators released through the U. S. Department of Agriculture, Agricultural Research Service, Entomology Research Division, since 1947:

[1] Contribution No. 40, Entomology Section

*Photo by U. S. Army Eng. Dist. Corps of Engineers*
Alligatorweed, Flea Beetle *Agasicles* and Egg Cluster. 17 April 1964. Savannah National Wildlife Refufe, S. C.

*Photo by U. S. Army Eng. Dist. Corps of Engineers*
Alligatorweed, Flea Beetle *Agasicles* and Heavy Feeding Damage. 17 April 1964. Savannah National Wildlife Refuge, S. C.



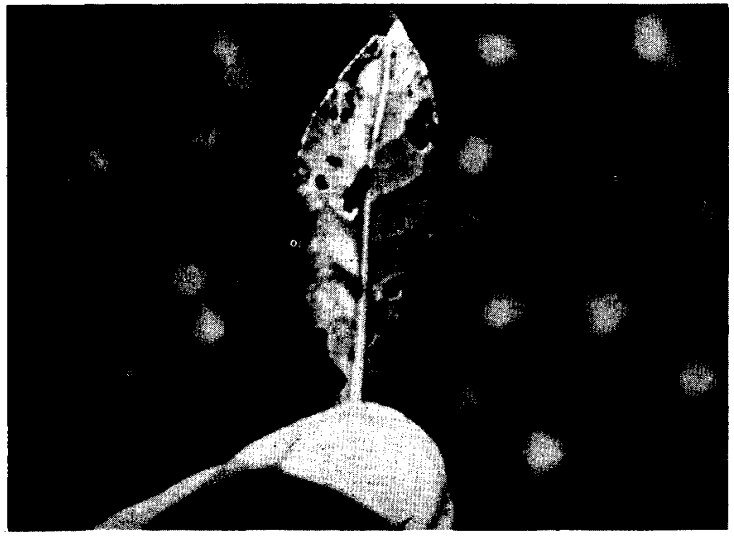

*Photo by U. S. Army Eng. Dist. Corps of Engineers*
Alligatorweed, Flea Beetle *Agasicles* larva. 10 July 1964. Savannah National Wildlife Refuge, S. C.

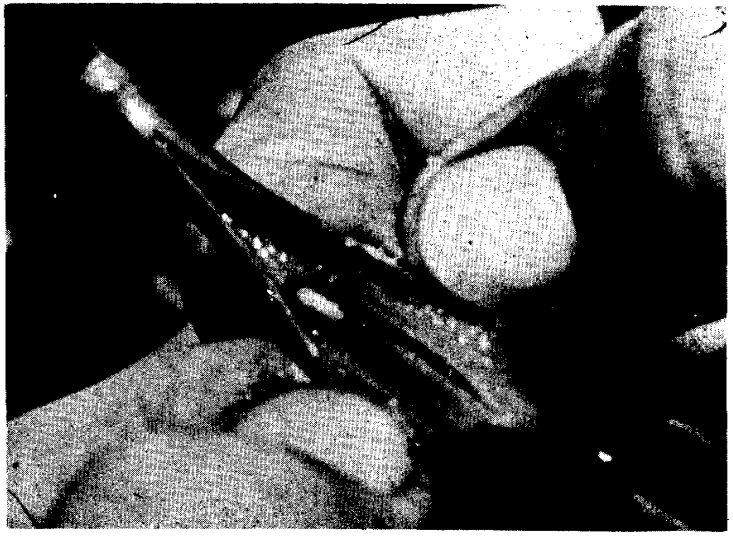

*Photo by U. S. Army Eng. Dist. Corps of Engineers*
Alligatorweed — Flea Beetle *Agasicles* Early Stage Pupa. 10 July 1964. Savannah National Wildlife Refufe, S. C.

| Beneficial Species | Pest Species | Released From |
|---|---|---|
| *Adenis variegata* | aphids | Quincy |
| | yellow sugarcane aphid | Belle Glade |
| | spotted alfalfa aphid | |
| | green peach aphid | |
| | pea aphid | |
| *Anagyrus diversicornis* | Rhodes-grass scale | Belle Glade |
| *Anagyrus* sp. | West Indian cane fly | Belle Glade |
| *Aphelinus semiflavus* | yellow sugarcane aphid | Belle Glade |
| *Aphidius metricariae* | green peach aphid | Quincy |
| | yellow sugarcane aphid | Belle Glade |
| *Aphidius smithi* | pea aphid | Belle Glade |
| *Brumus suturalis* | citrus whitefly | Orlando |
| *Catana parcesetosa* | citrus whitefly | Orlando |
| *Chrysopa carnea* | aphids | Quincy & Belle Glade |
| | spotted alfalfa aphid | Quincy & Belle Glade |
| | yellow sugarcane aphid | Quincy & Belle Glade |
| | green peach aphid | Quincy & Belle Glade |
| *Coccinella septempunctata* | aphids | Quincy & Belle Glade |
| | spotted alfalfa aphid | Quincy & Belle Glade |
| | yellow sugarcane aphid | Quincy & Belle Glade |
| | green peach aphid | Quincy & Belle Glade |
| *Copidosoma* sp. | cabbage looper | Quincy |
| *Dusmetia sangwani* | Rhodes-grass scale | Belle Glade |
| *Gonatopus* sp. | West Indian cane fly | Belle Glade |
| *Praon palitans* | yellow sugarcane aphid | Belle Glade |
| *Scymnus nubilis* | aphids | Quincy & Belle Glade |
| | spotted alfalfa aphid | Quincy & Belle Glade |
| | yellow sugarcane aphid | Quincy & Belle Glade |
| | green peach aphid | Quincy & Belle Glade |
| *Stenocranophilus quadratus* | West Indian cane fly | Belle Glade |
| *Timberlakia europaea* | Rhodes-grass scale | Belle Glade |
| *Trioxys utilis* | yellow sugarcane aphid | Belle Glade |
| *Chelonus* sp. | tobacco budworm | Quincy |

In 1952, the University of Florida Citrus Experiment Station at Lake Alfred intensified its interest in biological control of insect pests infesting citrus. Dr. Martin H. Muma was hired by the Citrus Experiment Station to conduct an intensive survey for the native parasites and predators of citrus pests. It was felt that it was necessary to have a better understanding of the native parasites and predators before exotic species were introduced. Through selected introduction, competition of native and exotic species can be kept at a minimum. This would reduce the possibility of eliminating native parasites and predators with the competing introduced species.

The following is a list of nine parasites and predators released by the Florida Agricultural Experiment Station:

| Beneficial Species | Pest Species | Released at | Date |
|---|---|---|---|
| *Rodolia cardinalis* (Mulsant) | cottony-cushion scale | Pinellas County | 1899 |
| *Cryptochaetum monophlebi* | cottony-cushion scale | Pinellas County | 1917 |
| *Delphastus catalinae* (Horn) | citrus whitefly | Bradenton | 1917 |
| *Leis dimidiata quinque-decimmaculata* (Hope) | spirea aphid | Orlando | 1925 |
| *Cryptolaemus montrouzieri* Mulsant | citrus mealybug | citrus belt | 1930 |
| *Hypodamis convergens* Guerin-Meneville | aphids | general | 1930 |
| *Anagyrus cintoninae* Timberlake | Rhodes-grass scale | Belle Glade | 1950 |
| *Eretmocerus* spp. | citrus whitefly | Winter Haven | 1952 |
| *Stethorus atomus* Clay | ? | Weirsdale | 1956 |

The following is a list of seven parasites and predators introduced by the Florida Agricultural Experiment Station at Lake Alfred and the U. S. Department of Agriculture, Agricultural Research Service, Entomology Research Station:

| Beneficial Species | Pest Species | Released at | Date |
|---|---|---|---|
| *Aphytis lepidosaphes* Compere | Florida red scale | central Florida | 1958 |
| *Aphytis holoxanthus* DeBach | Florida red scale | central Florida | 1960 |
| *Amblydromella rickeri* (Chant) | citrus red mite | Lake Alfred (Lab) | 1962 |
| *Typhlodromus pyri* Scheuter | citrus rust mite | Lake Alfred | 1962 |
| *Typhlodromus rhenana* (Oud.) | citrus rust mite | Lake Alfred | 1962 |
| *Phytoseiulus persimilis* A.&H. | citrus rust mite | Lake Alfred | 1963 |
| *Apanteles flavipes* | *Diatraea* spp. | Canal Point | 1964* |

*expected date of release.

The Division of Plant Industry is the agency that regulates the movement of insects into and within the state. However, until 1961 there was little or no attempt to control the introduction of parasites and predators into Florida. At this time the Division of Plant Industry felt it needed some control over the introduction of parasites and predators. The three agencies concerned with parasites and predators to date are the Division of Plant Industry; University of Florida Agricultural Experiment Station; and the U. S. Department of Agriculture, ARS, Entomology Research Division. These three agencies must agree unanimously on the introduction of any parasite or predator. In the past some pressure was exerted on agencies to bring in parasites and predators before sufficient screening of the beneficial insect was completed. The Division of Plant Industry tries to take an unbiased position on the proposed introductions and attempts to evaluate the over-all benefits to the state. Occasionally biases cloud the issue when a person is determined to bring in an insect to conduct his research.

When an introduction is proposed, the representatives of each agency review the case, and a decision is reached on the basis of their findings. Most proposals are now accepted as the sponsoring agency does extensive ground work before considering the introduction.

Some rules for preventing failures in biological control attempts are:

1. A thorough knowledge of the identities of indigenous and exotic biological control agents is essential before any are introduced.
2. After species have been identified, the taxonomic information should be confirmed by an investigation of their life histories and habits.
3. A successful parasite must be attracted to, and capable of, parasitizing its hosts.
4. Life histories of biotic agents should synchronize with those of their hosts.
5. Though there may be exceptions, a colony should consist of 100 or more individuals.
6. Releases should be discontinued after a period of five years if there is no evidence of establishment.
7. The results of introductions should be investigated and assessed.
8. The mass production of biotic agents is of little value except under special circumstances.
9. The failure of many biotic agents to become established results from their physical weakness through poor handling methods rather than from an inherent unsuitability.
10. Greater consideration should be given to predators as potential biological control agents.
11. The effects of pesticides to which parasites and predators may be exposed should be investigated.

The 35 predators and/or parasites that have been introduced into Florida to date fall into 4 categories: (1) became established and controlled the pest; (2) became established, but did not control the pest; (3) did not become established; (4) supplemented the native population of parasites or predators.

Specimens of the introduced species are deposited in the Florida State Collection of Arthropods in Gainesville, and the Division of Plant Industry is notified of the location and date of releases.

The representatives of the three agencies are: H. A. Denmark, Chief Entomologist, Division of Plant Industry; Dr. L. C. Kuitert, Head Entomologist, University of Florida Agricultural Experiment Station, may represent the University, or he may appoint a person concerned with the introduction; and Dr. W. H. Anderson, Head, Insect Identification and Parasite Introduction Research Branch, USDA, Beltsville, Maryland, appoints a representative that is working with or in some way connected with the insect being introduced.

There is no one in Florida actively working with the leaf beetle (flea beetle), *Agasicles* n. sp. For convenience, Dr. Carroll Smith, Head, Insects Affecting Man and Animals Research Laboratory, USDA, located in Gainesville, was asked to meet with the University of Florida and Division of Plant Industry representatives. After reviewing the request to introduce this leaf beetle into Florida, there was only one objection raised. The committee felt the organism being introduced should be described in a scientific journal. It is the understanding of the committee that this insect will be described in the near future. In general the committee felt the work that had been done with this insect in South America showed this leaf beetle to be host specific to alligator weed and would probably help reduce the presence of this noxious weed in the southeastern United States.

*Agasicles* n. sp. has been introduced in the adult stages into the southern part of South Carolina (Savannah River Wild Life Reserve). It is becoming established and actively feeding on alligator weed. It is too early to assess control measures this beetle may have on alligator weed.

The position of the Division of Plant Industry in considering the introduction of the above leaf beetle or other introductions is one of helpfulness to the future development of Florida. It is felt that the Division of Plant Industry is getting close cooperation in the introductions of parasites and predators.