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(54) **Title**: HYDROPHOBIC COMPOSITION CONTAINING POLYMER FOR THE CONTROL OF PLANT PESTS

(57) **Abstract**: A hydrophobic composition for the control of some insect species and some spider mites (acarides). The composition contains polymer comprising polystyrene. The polymer is dispersed by an agent in a sufficient amount to fully disperse the polymer. A surfactant included is a typically an agriculturally acceptable surfactant.

HYDROPHOBIC COMPOSITIONS CONTAINING POLYMER FOR THE CONTROL OF PLANT PESTS

FIELD OF THE INVENTION

The present invention relates to a composition capable of reducing the infestation of plants by some arthropods in general, and in agricultural crops specifically.

BACKGROUND OF THE INVENTION

At present the trend for replacing existing agents that are utilized by producers and amateurs for ridding the plants of pests or reducing the amount thereof by less toxic or more environmentally friendly agents is gaining strength. The present invention introduces a new composition, or composition range for producing an infestation reduction effect for the benefit of humans and environment in general, without compromising the well being of the crops on which they are applied.

DESCRIPTION OF THE PRESENT INVENTION

In accordance with the present invention, a hydrophobic polymer, chiefly polystyrene (PS) is used in a preparation (referred to also as formulation) containing a solvent for use for the purpose of effectively reducing the amount of some insects and spider mites in crops and other, non - crop plants. In addition to the solvent, typically at least one wetter is added to the formulation, in order to facilitate and enhance the spreading of the sprayed preparation onto the plants on which the formulations are applied.

Chain length of the PS

A major concern in preparing a formulation in accordance with the invention is the viscosity and stickiness of the dissolved polymer. The higher the molecular weight of the polymer, the more viscous the formulation is the more difficult the spraying of its dispersion in water becomes. A general problem is the clogging of spray nozzles. It would seem that relatively short chained PS is associated with less clogging of the spray nozzles.

Components of formulations:

Polystyrene (PS)

PS (Aldrich, typical Mw 230,000) in the form of granules is dispersed in one or more dispersing agents. PS of higher molecular weight were

dispersed and used also in experiments, but it would seem as mentioned above, that the higher molecular weight polymers tend to clog spraying nozzles. The dispersal or liquefaction of the polymer in the dispersing agent produced typically a clear, somewhat yellow, somewhat thick and sticky liquid. Since the dispersed polymer resembled a solution, the present document will sometimes refer to the fully dispersed polymer as solution.

High impact PS (HIPS), a copolymer of PS with polybutadiene without molecular weight indication was tried in experiments as well.

Dispersants (solubilizers). Typical useful solubilizing agents are limonene, known as D –limonene , and one or more citrus oils, i.e. oily extracts produced from the peel of citrus fruits. Such extracts are available commercially and are rather cheap. Orange oil, grapefruit oil and lemon oil were successfully used. These natural oils are known to contain a large amount of D- limonene. D - limonene is a common solvent for cosmetic uses and cleaning products. Benzyl alcohol was also used successfully, and it is expected that every solvent know in the art, that can solubilize PS, would be useful for a preparation in accordance with the present invention, unless limited by biological/environmental considerations, such as toxicity, phytotoxicity and pollution.

Surfactants

Surfactants (also known as wetters or wetting agents) used were Tergitol 15 S 9 or 7 (products of Dow Chemicals) , also silicon based surfactants (ethoxilated polysiloxanes) , notably Silwet L77 by Setre Chemical

Company, and break - thru S 240 by Goldschmidt Chemical Corp. Nonyl-phenol ethoxylate surfactant (also known as polyoxyethylene nonyl – phenyl ether surfactant was successfully used in other trials. Although the Nonyl-phenol ethoxylate surfactans are now obsolete or forbidden to use in many countries and generally considered harmful to the environment, nevertheless they are good surfactants, agriculturally acceptable, and their successful use in combination with the active material and solvent is considered herein to imply that the function of the surfactant relates to its wetting properties rather than the specific structure of a specific surfactant.

Actual formulations

Formulation A: 20 grams of PS (Aldrich, typical Mw 230,000) were dispersed by mixing in 40 grams of orange oil for 2 hours. After an homogeneous dispersion was formed, 10 grams of Tergitol 15 S- 7 (secondary alcohol ethoxilate by Dow chemicals) was added and a homogeneous mixture prepared.

Formulation B: 10 grams of PS (as in formulation A) were dispersed in 18.2 grams of grapefruit oil. To the homogeneous mixture 2.5 grams of Tergitol 15 S- 9 (secondary alcohol ethoxilate by Dow chemicals) was added and a homogeneous mixture prepared.

Formulation C: 1.5 grams of PS (as in formulation A) were dispersed in 11.5 grams of furaldehyde, and 4.5 grams of tetraethyl ortho silicate.

Formulation D: 62 gram polystyrene as in formulation A were dispersed in 738 grams D- limonene, to which 50 grams of polyoxyethylene nonyl – phenyl ether surfactant was added .

Formulation E: 62 gram polystyrene as in formulation A were dispersed in 738 grams D- limonene, to which 50 grams of Tergitol 15 S- 9 surfactant was added .

Laboratory Experiments

All studies were conducted at the Agricultural Research Organization at Bet Dagan, Israel, between January and April 2007, using . Formulation A, dispersed in water at 0.5 to 1.0%, in each case was used for spraying onto plants infested with pests. Tap or distilled water was used as spray agent carrier, and the dispersion in water was achieved usually by simple shaking. Dipping the plants in a suspension of the formulation was effective at least as spraying.

Pests

The following pests were experimented upon:

1. White fly, (*Bemisia tabaci*) on cotton:

Two mature cotton plants, *Gossypium spp.*, kept in a screen cage were infested once a week with 50 adult whiteflies, *Bemisia tabaci*, for a total of 4 weeks. One week after the last infestation leaves of various ages were collected from the plants and treated with the compositions. Old leaves were placed in emergence cages to evaluate the effect on the "pupa" stage. The number of emerged adults in each cage was determined 3 days after treatment. There were 3 replicates for each treatment.

No phytotoxic symptoms were observed on the cotton leaves after treatment with the compositions. In observations performed immediately after treatment, most immature whiteflies appeared dead and many looked shrunken and deformed.

2. Cotton aphids, (*Aphis gosypii*) on cotton

Cotton seedlings, *Gossypium spp.*, were kept in 0.5 liter pots, in a screen house and were each infested with 10 females of *Aphis gossypii*. The aphids were allowed 18 days to establish on the plant before treatments. Five (5) replicates (pots) were provided for each treatment. The sampling unit was a central true leaf from each plant. Stereomicroscope observations were performed 5, 60 and 120 min after treatment. Aphid infestation levels were recorded 24 hrs after treatment.

Minor phytotoxic symptoms (red spots) were observed on the cotton seedlings after treatment with both compositions at 1% concentration. Aphids of all life stages were present on the observed leaves. Only the combined numbers of nymphs and adults together were recorded. Five minutes after treatment the mortality rates of the aphids on leaves treated was 50%. Dipping resulted in slightly better control than spraying.

3. Yellow spider mite, (*Tetranychus urticae*) on cucumber

Cucumber plants, Cucumis sativus, were grown each in 0.5 liter pot. Each plant was infested with 10 females of the yellow spider mite Tetranychus urticae, allowing 15 days to establish on the plant before treating. There were 10 replicates (plants) for each treatment. Plants were treated by spraying on the underside of the leaves where the mites are congregated. The sampling unit was a central true leaf from each plant. Stereomicroscope observations were performed 5, 60 and 120 min after treatment. Leaves were collected 24 hrs after treatment and mites were removed and counted using Berlese funnel.

No phytotoxic symptoms were observed on the cucumber plants after treatment with both compositions at 1% concentration. Mites of all life stages were present on the observed leaves. We only recorded the numbers of nymphs and adults together. Five minutes after treatment the mortality rate of the mites on leaves treated with 1% composition appeared to reach 90%. However, after the composition dried up, most adult mites resumed their normal activities. Spraying reduced mite population but the level of infestation remained relatively high.

4. Onion thrips, (*Thrips tabaci*) on chive.

Chive plants, Allium schoenopransum, were kept in 0.5 liter pots (ten replicates for each treatment), in a screen house. The chive leaves were cut to a height of 5 cm above ground and each plant was infested with 10 females of the onion thrips, Thrips tabaci. The thrips were allowed 14 days to establish on the plant before treatments. Plants were treated by spraying on the leaves. Following the first spraying treatment, a second spraying treatment was carried out using the same plants 9 days later. The sampling unit was all the leaves of a plant cut at ground level. Thrips were removed and counted using Berlese funnel. Treated leaves were collected 3 days after treatment. Stereomicroscope observations were done by spraying the compositions on thrips that had been placed on a filter paper in a Petri dish.

No phytotoxic symptoms were exhibited by the chive leaves after treatment. Thrips levels were about 21 and 49 per plant during the first and second spray, respectively. Most thrips were in their larval stage. None of the treatments reduce the level of thrips infestation. However, 5 min after treatment in the Petri dishes, the mortality rate of the thrips (adults and nymphs) was 50%. It appears that a transparent film was formed around the dead thrips. These rates did not increase up to two hours after treatment.

Field experiments

Were carried out using formulation D, in 1% sprayed in water:

Cicada *(Empoasca lybica) on Diospyros* (persimmon)

Good control was obtained.

Glass house experiments were performed, using formulation D, in 1% sprayed in water:

Red spider mites *(Tetranychus urticae*) using formulation D, on Rose. Good control was obtained.

Phytotoxicity in field and glass house experiments

No phytotoxic effects were observed in the experiments

Some conclusions about the surfactants.

In some formulations two well known and acceptable silicon surfactants were used, but it seems that the involvement of such expensive surfactants is not substantially beneficial over the use of non silicon surfactants. The term agriculturally acceptable surfactants used above indicates that for the sake of convenience such surfactants were used. This should not be interpreted that the efficacy of a formulation in accordance with the present invention is to benefit specifically from the fact that a certain surfactant has been approved for use in agriculture.

CLAIMS

1. A hydrophobic composition for the control of some insect species and some spider mites (acarides), said composition comprising:

- a polymer comprising at least polystyrene ;
- a dispersing agent for dispersing said polymer, in a sufficient amount to fully solubilized said polymer;
- at least one agriculturally acceptable surfactant.

2. A hydrophobic composition for the control of some insect species and some spider mites (acarides) as in claim 1, in which two surfactants are incorporated.

3. A hydrophobic composition for the control of some insect species and some spider mites (acarides) as in claim 1 wherein said dispersing agent is D- limonene.