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(54) Titre : METHODE THERMIQUE DE LUTTE CONTRE LES RAVAGEURS
(54) Title: A METHOD FOR THERMAL PEST CONTROL

(57) Abrégé/Abstract:
A method for thermal pest control in fruit production and agriculture involves projecting at least one stream of hot air to a crop from a movable vehicle which moves in a direction substantially parallel to rows of the crop.

ABSTRACT OF THE DISCLOSURE

A method for thermal pest control in fruit production and agriculture involves projecting at least one stream of hot air to a crop from a movable vehicle which moves in a direction substantially parallel to rows of the crop.

A METHOD FOR THERMAL PEST CONTROL

FIELD OF THE INVENTION

[0002] This invention relates to thermal pest control in fruit production and agriculture. More specifically the method of the present invention is applicable in open spaces dedicated to agriculture and fruit production, as vineyards, fruit orchards, and crops to eliminate preferably undesirable fungus. The method is also suitable for eliminating insects, by dehydrating them and in the case of insects with wings, damaging the wings.

BACKGROUND OF THE INVENTION

[0003] Chemical pest control in agriculture and in fruit culture has been used very successfully, concerning the control of plagues, during the past seventy years. Every year more chemicals are developed, apparently with new advantages over its predecessors, related with cost, easiness to apply, and the range of plagues covered. Unfortunately, also for a long time, and up to these days, it has been discovered that many of this chemicals has undesirable secondary effects, polluting the environment, or other plants and animals, included man. Some of this undesirable effects has been seen only after many years of continuous use of the

chemical, due to his cumulative effect over the body, or by genetic transmission, affecting the new generations; others undesirable effects are seen very fast. By these reasons, there is a tendency to look for solutions with a very little impact over the environment or no impact at all.

[0004] One of the first non-chemical solutions was the Biological pest control, consisting in stimulating the development of natural predators of these plagues. The problem is sometimes the predator eliminates the plague, but also eliminates some of the natural controls, and then we have a serious ecological problem.

[0005] Other group of solutions for pest control, alternative to biological and chemical methods, is the modification of some physical variables of the plague habitat, in this way the plague is in an unfriendly environment for its development and reproduction. In these kinds of solutions is, between others, refrigeration, humidity reduction, applying heat, oxygen reduction. The problem with this kind of solutions is to determine the habitat variables to be modified, its magnitude and the time modified, in order to get the desired effects in the pest and not harm the specie to be protected.

[0006] In these kind of solutions, heat application has shown been very useful. One of the first solutions for eliminating microorganism was the well-known method of pasteurization. This method is only applicable to inanimate substances, of animal or vegetal origin, but it cannot be used when this animals or vegetables are alive. Others methods for pest control using heat has been proposed, like the

one disclosed by Forbes in the US Patent N° 4,817,329 or the one proposed by Binker *et al.* US Patent N° 6,279,261.

[0007] Forbes teaches a method to kill insects, termites by example, in an urban structure, lets say, an insulated space, in which a heated gas, with no phase changes, is insufflated. The gas being at a temperature between the ambient temperature and a lethal temperature for the insect, maintaining said temperature for a sufficient period of time to kill the insect. Forbes method considers the installation of entrance ducts and exit ducts for the heated gases. Forbes also teaches the space to be treated has to be insulated with mats in windows and doors, in order to facilitate the cumulating of heated gases. According to this, Forbes method cannot be used in open spaces, and therefore, cannot be used in agriculture or fruit production.

[0008] Binker also teaches a method to kill plagues in closed spaces, like mills or food processing plants. Binker procedure do not require insulating spaces, but this is because his space is normally closed and with out windows, like in the urban structures of Forbes. Then Binker cannot apply his method in open fields like in agriculture or fruit production. The most important concern of Binker is not contaminate or alter the foods in the processing plant, avoiding the introduction of combustion gases and controlling the humidity of the heated air.

[0009] Not Forbes and not Binker, teaches a pest control method using heated gases or heated air in an open space and where it is necessary to maintain

or preserve with any harm, living vegetable species like vines, fruits trees, or plants.

BRIEF DESCRIPTION OF THE INVENTION

[0010] The present invention offers a method for thermal pest control in fruit production and agriculture, in open spaces, like vineyards, fruit orchards or other. The method of the present invention allows, preferably, eliminating fungus that affects the plants, and also eliminate harmful insects, by dehydrating them and in the case of winged insect, damaging the wings. In the case of insects, the method is especially effective to eliminate harmful insects when they are in a vulnerable stage, like larvae in *Drosophila melanogaster*. Also it has been observed the clear difference between the rows treated with the thermal method of the present invention in a vineyard and the rows treated with chemicals to protect the vines against the fungus *Botritis cirenea*. In the last mentioned rows it can be observed sporadic attacks of a mite called *Brevipalpus chilensis*, while the rows treated according with the present method, are completely free of this plague.

[0011] The method of the invention is very simple; the economical and environmental advantages are higher than the advantages of the previous art. The concept in which is based the invention break a paradigm, applying for the first time heated air directly or indirectly to the plants, to eliminate the plague. Basically the procedure consist in throwing, from a moving vehicle, one or more streams of heated air, at temperatures between 65°C to 250°C, throwing these streams of

heated air over the plants at a minimum distance of about 0.20 m from the exits of hot air.

[0012] The present invention has been successfully used, controlling the fungus Oidium (*Uncinula necator*) and Botritis (*Botritis cinerea*) in table grape vineyards. Up to this time, these two-fungus diseases have been controlled only with the use of chemical fungicides, with the consequent harm to the environment and to the consumers.

[0013] Secondary, the present invention allow to eliminate condensation over the fruits or plants, preventing the development of undesirable fungus, and allowing the producers to pack their fruits without the problems related with condensation.

[0014] Therefore, a primary objective of the invention is to offer a method for pest control in fruit production and agriculture, by throwing streams of hot air to the plants, from a movable vehicle.

[0015] Other objective of the present invention is to offer a method for fungus control in fruit production and in agriculture, especially in vineyards and fruit orchards, the method not being limited to it, by the application of streams of hot air to the plants from a movable vehicle.

[0016] A third objective of the present invention consist in offering a method, which beyond plague control in agriculture and fruit production, can reduce or eliminate condensation over the fruits or plants.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The present invention consists in a method for thermal control of plagues in fruit production and agriculture, in open spaces. The method of the invention is applied preferably in vineyards in order to control fungus diseases like Oidio (*Uncinula necator*) y Botritis (*Botritis cinerea*) which attacks grape bunches or, in the cases of Apple orchards, to control Venturia (*Venturia inaequalis*). These fungus dies at temperatures between 40°C to 60°C; the insects are affected at greater temperatures depending of the specie and its stage.

[0018] The method consist in throwing one or more streams of hot air, at a temperature between approximately 65°C to 250°C, at a minimum distance of about 0,20 m from the plant, from a movable vehicle, moving at a speed between approximately 5 to 15 km per hour and in a direction substantially parallel to the rows. The streams of hot air are thrown at a speed between approximately 80 to 250 km per hour, preferably at a speed approximately of 100 km per hour. Being the stream of hot air at such a high temperature, for example 250°C, and having an speed as the mentioned before, the transference of heat to the treated vegetal is sufficiently high, but sufficiently short, to damage the plague but not damaging the plant. In reality, in the plant, the hot air applied as mentioned before, stays at temperature above 45°C for a period of 16 seconds.

[0019] In preliminary trials in vineyards with fungus diseases, applying hot air at 110°C, not only fungus were controlled, but also some insects were eliminated,

like the fly *Drosophila melanogaster.* Also were severe damaged the *Micrapate scabrata*, *Capitarsia turbata* and *Proeulia auraria*.

[0020] The appropriate temperature to be used in this method will depend on each case, of the type of crop, the plague and the ambient temperature.

[0021] For the application of the streams of hot air over the treated field, from the movable vehicle, it can be considered an orientation of the streams parallel to the rows, perpendicular to them, or oblique to the rows, depending on the heat sensibility of the plant, the row thickness or the tree foliage.

[0022] It is necessary to clarify that, in spite of the very high speed and temperature of the stream of hot air, it expands very rapidly at the exit, and as the source of hot air is moving, the time in which the plant is under the effect of the hot air is very short.

Claims:

1. A method for thermal pest control in agriculture and fruit production which comprises projecting at least one stream of hot air which exits at a temperature between approximately 65ºC and 250ºC directly at a crop and at a minimum distance of about 0.20 m from the crop from a vehicle which moves in a direction substantially parallel to rows of the crop so as to provide sufficient transference of heat to produce the thermal pest control without damaging the crop.

2. The method for thermal pest control according to claim 1, wherein said at least one stream of hot air is projected at a speed between approximately 80 and 250 km per hour.

3. The method for thermal pest control according to claim 1, wherein said at least one stream of hot air is projected in a direction substantially parallel to the rows of the crop.

4. The method for thermal pest control according to claim 1, wherein said at least one stream of hot air is projected in a direction substantially transverse to the rows of the crop.

5. The method for thermal pest control according to claim 1, wherein said at least one stream of hot air is projected in a direction substantially oblique to the rows of the crop.

6. The method for thermal pest control according to any of claims 1 to 5, wherein the pest to be controlled is any of the fungi *Uncinula necator*, *Botritis cinerea* and *Venturia inaequalis* or any of the insect varieties *Drosophila melanogaster*, *Micrapate scabrata*, *Capitarsisa turbata* and *Proeulia auraria*.