DARCOFenews

Newsletter from Danish Research Centre for Organic Farming • June 2004 • No. 2

Articles in this issue

Control of apple scab by use of the plants own defence mechanisms

By Hans Jørgen Lyngs Jørgensen, Marianne Bengtsson, Ednar Wulff and John Hockenhull, The Royal Veterinary and Agricultural University, Denmark

In organic apple production in Denmark, apple scab, caused be the fungus *Venturia inaequalis*, is most often controlled by application of elemental sulphur. Sulphur is the only product permitted against this disease in organic fruit production in the country. In certain other EU countries, also copper based products are still permitted.

Yet, there is a need to find substitutes for both sulphur and copper, since sulphur is not always efficient in controlling apple scab infections (particularly in the spring), and the use of copper in the EU will be phased out from 2006.

One obvious possibility is to utilize the plant's inherent ability to defend itself by induced resistance. Preliminary experiments with induced resistance have been started in StopScab, a collaborative project between The Royal Veterinary and Agricultural University (KVL) and the Danish Institute of Agricultural Sciences (DIAS). The concept and use of induced resistance are briefly described in the following.

The defence of plants against pathogens

All plants have the general ability to defend themselves against disease-causing organisms (pathogens). Disease occurs when the plant discovers too late that it is being attacked and/or if it does not react strongly enough to stop

low input food

Catch crops may improve plant sulphur nutrition

Simulating root growth

Nature conceptions, management and cross-compliance in organic farming

Wind dispersal of genetically modified pollen from oilseed rape and rye fields

Brief news

Front

the invading pathogen.

Plants have developed many different forms of defence against pathogens. One of these is termed active defence, meaning that defence reactions only start following attack by a pathogen. Thus, for example, when a pathogen attempts to infect through a leaf surface, it may be physically prevented from doing so by the plant forming a wall thickening (a papilla) directly under the attempted point of penetration. Papillae may also contain chemicals, which can inhibit the pathogen. Should the pathogen nevertheless succeed in penetrating, the host may react by producing different compounds that inhibit the growth of the pathogen.

A further type of defence reaction is when a plant cell that has been penetrated by the pathogen, is actually killed by the plant (a form of hypersensitive reaction). When this happens, the pathogen will in many cases die, due to toxic substances accumulating in the dead plant cell. However, because of the cell's minute size its death is usually of little importance to the overall growth and appearance of the plant.

Induced resistance

Induced resistance is when such defence reactions are activated and expressed quickly and strongly. It is thus the natural defence reactions of the plant, which form the basis for induced resistance. The more defence reactions that are activated, the greater is the chance for stopping the growth of the pathogen.

To initiate such defence reactions a so called inducer is used. This term merely denotes something that can activate the plant's defence mechanisms. There are many different types of inducers including microorganisms (fungi, bacteria), certain chemicals, plant extracts and even ultraviolet light. Induced resistance is actually widespread in nature as plants are constantly bombarded with, e.g., microorganisms, light and particles of sand, which all may act as inducers. However, in order to utilise induced resistance commercially, it is necessary to select and develop only highly effective inducers.

Characteristics of induced resistance

Common for all inducers is that they 'irritate' the plant, so its defences are put on alert. When a pathogen attempts to infect such an induced plant it will defend itself faster and stronger than a non-induced plant. While an efficient inducer will strongly irritate the plant, it must not in any other way be damaging to it. Furthermore, to have any

practical value the inducer must not be harmful to the environment.

Another important trait of an effective inducer is that it protects the plant for a long time so that frequent treatments can be avoided. This is especially the case with systemic induced resistance where the protection spreads within the plant from the part where the inducer was applied.

If a suitable inducer is identified, it may help in protecting a plant against different types of diseases, caused by different kinds of pathogens (fungi, virus and bacteria). Furthermore, with the right inducer, it is possible to activate the defence in all cultivars of a plant, even the most susceptible ones. This is because many different kinds of defence reactions are activated by induced resistance, some of which will be effective against the different kinds of pathogens, in all the cultivars.

One of the disadvantages of induced resistance is that protection against a pathogen is rarely complete. Furthermore, induced resistance acts by preventing disease from breaking out but it cannot eliminate established infections. The reason for this is that a period of time is required after application of the inducer before the defence reactions are activated.

Induced resistance in apple

There are already efficient products that work by induced resistance available for disease control in apple, one of these is Bion^{TM} (from Syngenta Crop Protection AG) which, however, is not suitable for use in organic fruit production because it is a synthetically produced compound.

In the StopScab project, alternative materials (including inducers) are tested against apple scab - initially on artificially inoculated young apple seedlings (figure 1), grown in a growth chamber at KVL. The most promising materials are later tested on trees under orchard conditions with natural inoculum at DIAS.

A number of materials comprising plant extracts, essential oils and microorganisms have already been tested. After having identified efficient materials, the mechanisms behind the disease inhibiting effect are examined using, among others methods, microscopy of apple leaves with and without treatment to see how the growth of the apple scab fungus had been stopped. This work is important in order to determine whether protection is due to a direct toxic effect on the pathogen or whether, in fact, plant defence reactions have been activated.

The selection and testing of potential alternative materials, working against both apple scab and downy mildew of grapevine by induced resistance or as fungicides, continues in the new EU-project REPCO (REPlacement of COpper Fungicides in Organic Production of Grapevine and Apple in Europe). This project has, in addition to the partners from StopScab, also partners from The Netherlands, Germany, Switzerland, Italy and France.

About DARCOFenews | Archives | DARCOF | Front