

A disease forecasting system based on the weather conditions and known physiology of the plant can lead to a more accurate spraying programme which reduces the overall usage of chemical sprays.



Large-scale horticultural enterprises have emerged under the shadows of the pyramids.

Disease forecasting

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Dacom PLANT-Service, Emmen, the Netherlands is a technology provider and consulting company. The company was founded in 1988 by the president Jan Hadders, a grower who recognised the need to make use of upcoming information technology. The company started the development of the PLANT-Plus disease forecasting tool in 1991 and it is currently used by over 1.000 growers worldwide mainly for potatoes, grapes, carrots, onions and strawberry.

The towering pyramids and the River Nile keep the ancient history of Egypt alive. For centuries the River Nile has provided water for the crops which grow in its valley as it still does today. Small family farms in the Delta zone still produce in a traditional way but in recent times new enterprises have emerged that grow potatoes, grapes and strawberries on a large scale. They implement high-tech solutions such as weather stations, contraptions that look very futuristic in their ancient setting. Nevertheless, disease forecasting has turned out to be a useful tool.

Growers around the world struggle to fight diseases and in Egypt it is no different. Here Late and Early Blight threaten potatoes and strawberries are a target for Botrytis. The whole season growers are asking themselves, "Do I have to spray today or not?"

This dilemma often results in a weekly prophylactic spray programme in order to give peace of mind. For most of the season this strategy is a safe one but sometimes a disease can catch the crop by surprise. Prophylactic spray programmes can also cause concern from an environmental and food safety point of view.

A disease forecasting system can help growers to predict the "surprise" and to match the spray programme to the seasonal disease pressure. Also, as the increasing global

concern about food safety stimulates farmers to implement schemes like EurepGAP, such measures can reassure retailers and the public that the applied sprays were necessary to grow a clean and healthy product. Archives of spray records can be used to prove how and why sprays were carried out.

Solution

The three basic factors in disease management are crop, pathogen and weather. A disease forecasting system combines the three and provides a "yes" or "no" to the question "Do I have to spray?". At least that is what most users expect. Unfortunately it is not as black and white as that. Based on the life cycle of the pathogen and the weather conditions, historical and predicted, models like PLANT-Plus calculate if a so-called "infection event" will happen. In order to make this calculation the model will simulate all consecutive steps in the life cycle like spore creation, spore release and germination into unprotected leaves. The next step will predict the effect of the infection events on the unprotected status of the crop, caused by either growth of new leaves or degradation of the last applied chemical. Whenever this analysis indicates "yes" there is a need to spray, the model will suggest a type of chemical to apply: Contact products for events that will



1 - Strawberries growers are taking part in a pilot project which will forecast potential infections of *Botrytis cinerea*.

2 - Potato growers have been using PLANT plus to significantly reduce chemical costs while improving disease control.



3 - Weather stations are equipped with sensors for temperature, relative humidity, rain, wind speed and direction and solar radiation.

4 - For centuries the Nile, which flows through hot, dusty Cairo, has supported crops grown in its delta.

at the Pyramids

happen in the near future, translaminar or systemic products for events that have happened in the last days. Growers have to consult the models on a daily basis to be up to speed with what is going on and they themselves have to make the decision. The models help to make this decision easier, although sometimes more information makes the decision more difficult. For example, what will you do if the model tells you to spray again after just four days? Or if it indicates that a spray is not needed for four weeks? These types of intervals are quite possible.

The first concern of the model is to control the disease. It indicates when infection might occur, and therefore when the maximum protection is required or if there is no infection, none at all. In bad conditions this means that sprays will be recommended in tight intervals. But when the conditions are less conducive for the disease it will be possible to save on sprays.

Prophylactic spray programmes are always a compromise between using as little as possible, and having the assurance that the programme will work effectively.

Weather

The above described calculations will of course be largely influenced by the weather which is why on-farm automated weather stations have to be installed. These stations

are equipped with sensors for temperature, relative humidity, rain, wind speed and direction and solar radiation. The hourly data of the stations is relayed back to the office and onto the Internet.

Automated data flow and processing of it is of utmost importance in disease forecasting. When data is not available, no calculations can be carried out so no advice is possible and the whole system becomes useless. To plan sprays well in advance the weather data is combined with the local five day weather forecast. Of course a forecast can be wrong, but it is the best available data at that moment for a decision.

One of the first questions that arises with potential users is often, "How can a model tell me what I should do, because my weather is very specific."

The answer is simple. The PLANT-Plus model simulates the biology of the disease and it does not matter if it is 20°C in Amsterdam or 20°C in Toronto.

Pilot project

Back to the pyramids, disease control can be a problem because crops are grown during the winter, from October to March. During this period the temperatures stay at comfortable levels but humidity rises due to fogs that come from the river Nile. With these temperatures

diseases can establish themselves rapidly and growers find it difficult to control them.

Exporters of Egypt's key crops, i.e. table grapes, melon and strawberry, are united in the Horticultural Export Improvement Association (HEIA). One of its functions is to provide its 300 members with technical services. These growers have already seen the advantage the PLANT-Plus model for disease forecasting in potatoes has had in the control of both Late and Early Blight. A pilot scheme started in Egypt in 2000 and companies like Farm Frites, CHIPSY and Nahdet MISR have used it commercially and managed to reduce chemical costs significantly while disease control has improved.

Based on this, HEAI in cooperation with the Ministry of Agriculture, has decided to execute a pilot project for disease forecasting of *Botrytis cinerea* in strawberries. Weather stations have been installed on two farms, PICO and Technogreen, to measure the climatic conditions. The farm managers have consulted the recommendations on daily basis. The first results are very promising: the number of sprays was reduced from ten to four and the

harvested product was of a good quality.

Past and future

With the whole platform and infrastructure in place new ideas and requests are emerging with regards to extended use. The available advice models are being extended towards other crops, like hard and soft fruit. Also solutions for other day-to-day issues, like insect control and irrigation management are being implemented.

Prototypes are available for insects like Carrot fly and Thrips tabaci. The solutions for irrigations management follow a dual approach: soil sensing based on installed soil moisture sensors and scheduling based on ET calculations following the FAO guidelines. The latest development is data entry on a handheld pocket PC, which eases the workload of farm managers and consultants.

Coming back to the river Nile and the pyramids: there is a parallel. The ancient history gives a kind of acquiesce in the day to day worries, while a disease forecasting tool puts growers at ease about what is going on in the field. That is where past and future come together. ■

AROUND THE WORLD

Carrots in the Netherlands



Carrots in the Netherlands are mainly grown in the South-West and Flevoland. The major concern is *Alternaria dauci*. Trials with the PLANT-Plus system have shown that in case of *Alternaria* controlling the first infection event is the most important.

Probably because available fungicides only act preventively and there is no kick-back activity. The traditional

approach to start spraying against *Alternaria* in a maturing crop has proven to be too late in the last seasons. The model recommends spraying much earlier in early July, a strategy that has resulted in improved product quality.

At present over 100 carrot growers are receiving a daily fax with the local weather forecast and predicted infection conditions. Beside disease control the system is now being implemented to manage carrot flies (*Psylla rosae*).

Onions in the UK



David Martin of Plantsystems Ltd in the UK is an independent advisor for potato, carrot and onion growers. "Our consultants advise growers on a wide range of issues including crop protection and water management. Being effective is a matter of developing personal relationships together with delivering technical advice. PLANT-Plus has made us more effective as it enables us to deliver higher quality advice. The output of the

models backs-up and explains what we tell the growers." Packers, processors and multiple retailers all expect growers to use the minimum number of sprays consistent with protecting the crop. Prophylactic treatments are unpopular as they cannot readily be justified. The model clearly identifies when the risks occur and by spraying in accordance with such events the crop is protected and the needs of the customer are satisfied. In some seasons spray input can be reduced but that depends on the seasonal weather and disease pressure. In the UK it is not always possible to achieve this additional benefit.

Grapes in South Africa



South Africa has over 100,000 ha of vine grapes and over 10,000 ha of table grapes. "The 2001-2002 season was one with extremely bad weather conditions for the control of downy mildew," reports Janine Engelke, agronomist with Cropsystems. "Yield losses were up to 75%. The users of the PLANT-Plus models were able to time the crucial sprays around blooming to exactly the right

moment. This way Faure Wine Farms was able to minimise the damage from *Plasmopara* to less than 1%." In the 2002-2003 season the disease pressure was considerably lower and growers were able to reduce the input of chemicals, some by 50%. Currently over 100 growers work with the models for grapes.

Lettuce in the Netherlands



Proeftuin Zwaagdijk has evaluated the Bremia model in lettuces, both outside and in greenhouses. One of the biggest challenges is the pre-harvest interval of the last treatment. In comparison with prophylactic bi-weekly treatments the number of sprays was reduced by two sprays in a greenhouse trial in 2003. PLANT-Plus has increased the efficacy of treatments as they were timed

just around infection events. Although Bremia was found in the direct surroundings, the trial plots were kept clean. As the weather forecast is less appropriate in predicting the climate inside greenhouses, waiting for the infection events to happen and treat curatively has proven a successful strategy. ■