

Early Blight vastly underestimated

Evaluation of a PLANT-Plus, a Decision Support System for Control of Early Blight on Potatoes in South Africa

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Early blight (causal agent *Alternaria solani*) is one of the most destructive foliar diseases found in most potato growing regions of the world. In South Africa, early blight is a vastly underestimated disease in potato production.

Currently, the best disease management practice for early blight control is the use of protectant fungicide sprays from early in the growing season until senescence of the plant. However, increasing environmental awareness and high costs of pesticides have resulted in attempts to reduce the excessive use of pesticides. In the case of early blight proper timing of fungicide applications, through the use of decision support systems (DSS), can reduce the number of sprays without negatively affecting yield. Although many forecasters have been developed for early blight on potatoes and tomatoes, none are applicable to South African conditions.

The PLANT-Plus system (Dacom Plant Service, NL) was developed in the Netherlands as a DSS for the control of late blight on potatoes in Europe. The framework has since

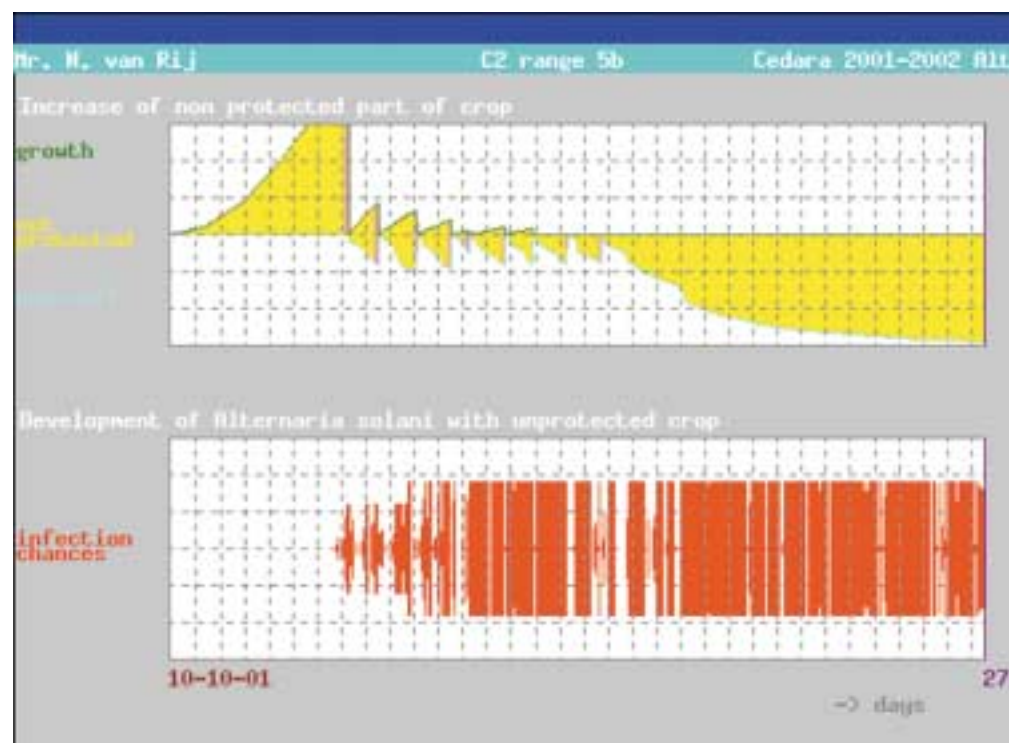


Fig. 1. Summary of the PLANT-Plus treatment for early blight on potato at Cedara (September 2001); dotted vertical lines represent a time span of 5d, thin solid vertical lines represent fungicide applications according to the PLANT-Plus model, and the thick vertical line represents the end of the season. The yellow matrix in the upper graph represents the unprotected part of the crop, while the red matrix in the lower graph represents possible infections.

been expanded and modified to include DSS for various diseases on potatoes and other crops. The PLANT-Plus potato late blight DSS is currently in use in South Africa. A study was conducted to:

- Develop an early blight

DSS in the PLANT-Plus framework, for the control of the disease in South Africa.

- Determine the accuracy and efficiency of the predictions given by the DSS.
- Evaluate the feasibility

and cost-effectiveness of the DSS to time fungicide sprays, compared with standard calendar-based schedules currently used in South Africa.

- Achieve acceptable disease control with minimum fungicide use.

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Field evaluations of the PLANT-Plus early blight DSS were conducted during three growing seasons: March – July 2001 (autumn planting) and October 2001 – February 2002 (spring planting) at Roodeplaat¹; and September 2001 – February 2002 (spring planting) at Cedara². Planting dates were 19 March and 1 October 2001 for the Roodeplaat trials and 21 September 2001 for the Cedara trial. In each trial, two cultivars were planted, one moderately susceptible to early blight (BP1) and the other moderately resistant (Hertha / Fianna).

Fungicide sprays were initiated and timed according to the following protocols:

- Treatment 1, PLANT-Plus: Initial and subsequent sprays applied according to advice generated by the PLANT-Plus decision support system.
- Treatment 2, Conventional: Weekly to 10-day sprays initiated at appearance of first symptoms or flowering, whichever came first. Spray intervals varied depending on environmental conditions, particularly rainfall.
- Treatment 3, Unsprayed control: No fungicides were applied during the season.

Fungicides used in the March 2001 Roodeplaat trial were chlorothalonil SC 500 g/l (Bravo, Syngenta) at a rate of 2 l/ha and azoxystrobin SC 250 g/l (Amistar, Syngenta) at a rate of 300 ml/ha. In the October 2001 Roodeplaat trial, mancozeb WP 800 g/kg (Dithane M-45, Algro-Chem, South Africa) at a rate of 2.5 kg/ha and difenoconazole EC 250 g/l (Score, Syngenta) at a rate of 250 ml/ha were

used, while only mancozeb (WP) (Dithane M-45, Algro-Chem) at a rate of 2.5 kg/ha was used in the Cedara trial.

Results

Results showed that in all trials fewer sprays were applied using the PLANT-Plus forecaster when compared with the conventional spray programme. Environmental conditions during the March 2001 season (autumn planting) were not favourable for the development of early blight, as very little precipitation occurred and average daily temperatures were below 25°C, especially towards the end of the season. This resulted in low disease pressure and very few fungicide applications for both the PLANT-Plus and conventional treatments (Refer to Fig. 2. A and B). Nonetheless, there was a saving of one Bravo and one Amistar application using the PLANT-Plus schedule over the conventional spray regime. In the September 2001 Cedara trial, three Dithane applications were saved when using the PLANT-Plus forecaster over the conventional, weekly spray regime. In the October 2001 Roodeplaat trial, two Dithane applications were saved.

Analyses of economic returns in all trials shows that there were no significant differences between treatments, with two exceptions. In the Cedara trial with BP1, the returns for the PLANT-Plus and conventional treatments were significantly higher than the control. At the October 2001 Roodeplaat trial with Fianna the returns for the PLANT-Plus and conventional treatments were significantly higher than the control.

Fig. 2. Early blight disease progress curves for March (A and B) and October (E and F) 2001 trials at Roodeplaat, and September 2001 at Cedara (C and D).

Figure 2A

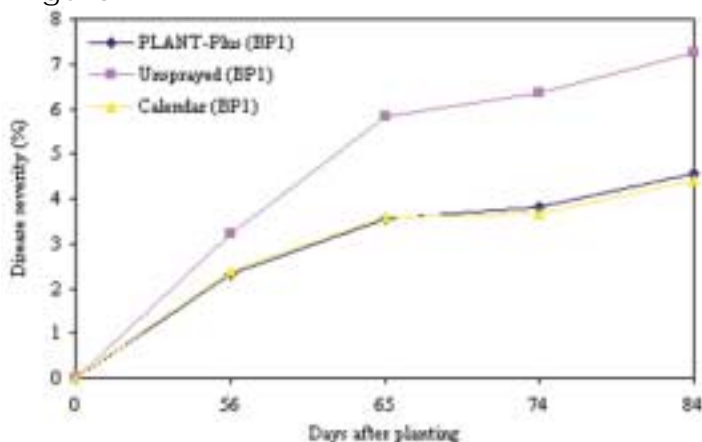


Figure 2B

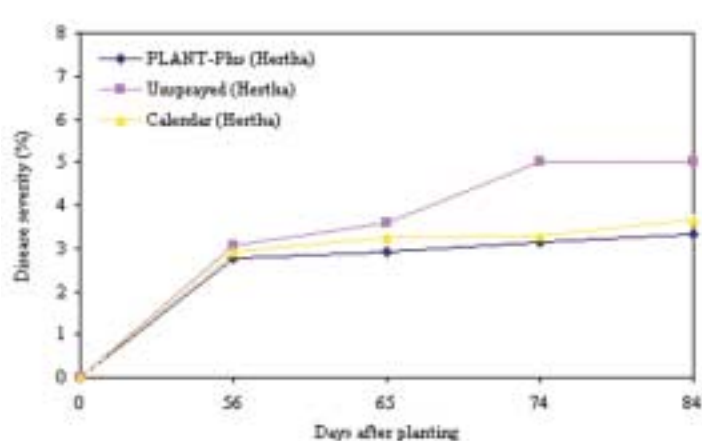


Figure 2C

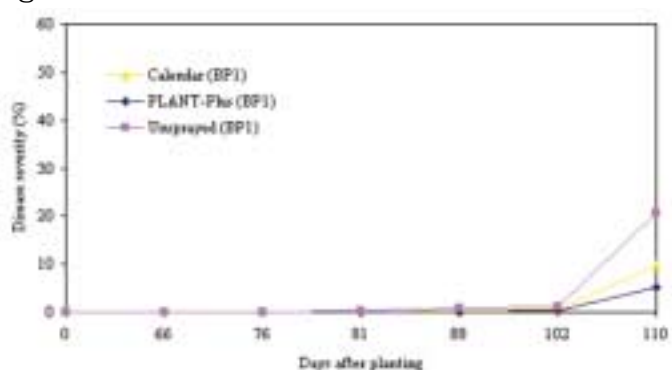
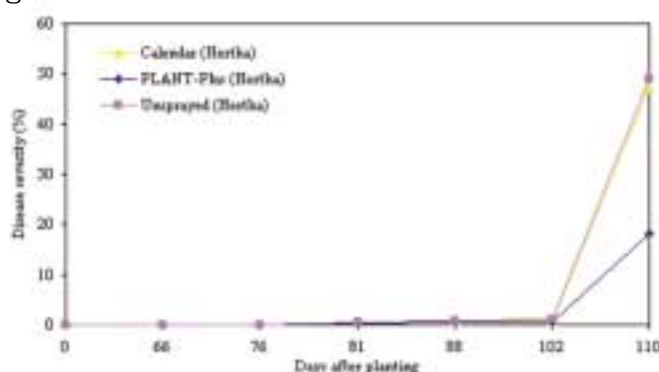


Figure 2D



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Early Blight

Disease progress curves for each treatment in each season are shown in Figure 2. In each season the disease progressed most rapidly on the unsprayed controls. Area Under the Disease Progress Curve (AUDPC) was also calculated to assess differences in disease levels between treatments. In all treatments, except Hertha in the March 2001 trial, there are significant differences in AUDPC values between PLANT-Plus, conventional treatments, and the unsprayed control. In the October 2001 season at Roodeplaat (Fig. 2 E and F), conditions were particularly favourable for the development of early blight, as day temperatures were in the range of 20-28°C and relative humidity was often above 90%. Furthermore, rain often fell during the early evening or through the night, with a dry period during the day. This resulted in interrupted wetting periods, which are highly favourable for the production and release of conidia of *A. solani* and for disease development. The AUDPC values for this trial show that, even in these conditions, the PLANT-Plus treatment significantly reduced the total amount of disease over the conventional spray regime. The only trial that showed a significant difference in yield among the three treatments was the Hertha trial at Cedara. However, yield results in all other trials showed a decreasing trend with increase in AUDPC.

Discussion

In this study it was shown that this early blight forecasting system accurately indicates when fungicides should be applied. Both early and late blight decision support systems require conscientious crop and disease monitoring by growers and subsequent updating of the model. The model assumes that inoculum (in the form of fungal spores) is always available and that plants are susceptible beginning at the time of flowering. Growers must ensure that the correct values for growth stage and -rate are updated in the model, as the season progresses. Growers also need to continually monitor the disease pressure in and around their field and enter this value into the model, as it will affect the probability of infection and thus fungicide recommendations given by the model. Another factor that is taken into account in predicting infection probability by PLANT-Plus is the susceptibility of the cultivar to early blight. Disease severity ratings in each trial showed that the appearance of the first symptoms was at approximately the same time for both cultivars, but the disease progressed faster on the more susceptible cultivar.

Results of this study indicate that the PLANT-Plus early blight-forecasting model accurately timed fungicide applications and reduced the number of applications without negatively affecting the

Figure 2E

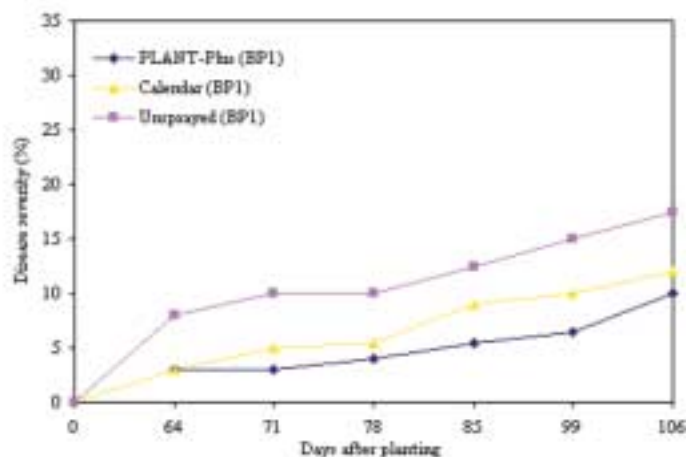
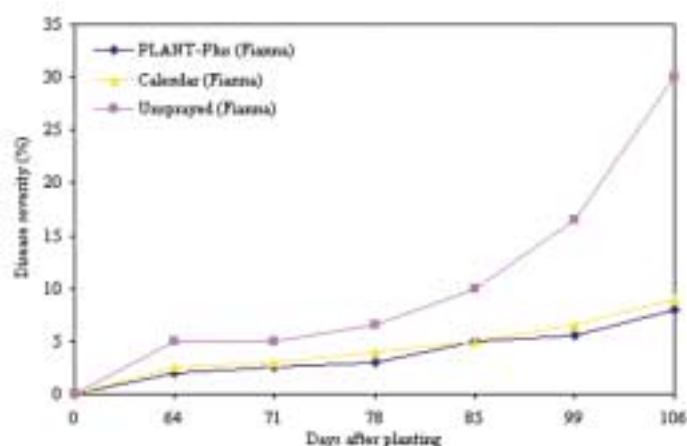


Figure 2F



yield. Although reducing chemical sprays has economical and environmental advantages, results show that only in the Cedara trial with BP1 were there statistically significant differences in returns among the three treatments. The lack of significant differences in yield and returns between the unsprayed control and the other treatments in the current study does not, however, reflect the situation in commercial fields. In this study, plots and fields in which the disease was effectively controlled surrounded the unsprayed plots, resulting in lower inoculum pressure than would be expected in a commercial planting. Early blight has been shown to cause yield losses of 20% - 50% in South

Africa if not adequately controlled. Whether the grower is able to save money using this decision support system will depend on the season, cultivar planted, fungicides applied and the cost of using the forecaster. In order to further evaluate the efficiency of the PLANT-Plus DSS in South Africa, trials should also be conducted on a commercial scale over several seasons in different potato-growing areas of the country.

The PLANT-Plus early blight forecaster holds great potential for use in the potato industry in South Africa, but it must be incorporated into the late blight forecaster in order to be cost-effective and have multipurpose applicability.