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Fungicide dose rates & cultivar resistance: Results and analysis of three years of field experiments in the Netherlands

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Introduction

In 2004, the Dutch Umbrella Plan Phytophthora was launched. Within the Umbrella Plan, the Dutch grower organisation LTO, potato industry, potato trade and Wageningen–UR work together to achieve the common goal of 75% reduction of the environmental pressure due to potato late blight control within 10 years. One of the possibilities to reduce the fungicide input in a preventive control strategy is to use reduced dose rates of protectant fungicides on more resistant potato cultivars (Kessel *et al.*, 2004). This option was explored in a series of field experiments 2002 – 2004 in which 30 potato cultivars were protected with a range of Shirlan dose rates (0%, 20%, 40%, .,., 100% of the recommended dose rate of 0.4 l/ha) under high disease pressure. Spray timing was based on PLANT-Plus recommendations except for the first three sprays which were applied at a weekly interval. Spreader rows (cv Nicola) within the field experiments were artificially inoculated with a mixture of 15 current *P. infestans* isolates. This paper describes the analysis of the resulting data set and some of the results.

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Materials and Methods

Severity data on the epidemics occurring in 2002 and 2004 were analysed. The weather in 2003 was hot and dry resulting in non-representative low-level epidemics. Logistic curves were fitted to the severity data for each plot (Oude Voshaar 1995). From the logistic curves the following parameters were derived (Zadoks and Schein, 1979): area under the disease progress curve up to 25 days after inoculation ($AUDPC_{25}$), apparent infection rate (r), the day at which 5% severity was reached ($delay_{05}$) and the severity 25 days post inoculation (sev_{25}). The resulting parameter values were plotted against their corresponding Shirlan dose rate and linear or exponential curves were fitted yielding dose response curves for each cultivar and each parameter.

Results and discussion

The relationship of $AUDPC_{25}$ and sev_{25} against Shirlan dose rate were best described by an exponential function (Y = A + B(R**X)). The relationship between $delay_{05}$ and the Shirlan dose rate was best described by linear regression. An exponential function should, at least theoretically, describe this relationship better but within the range covered by the current data, fitting an exponential function did not give an improvement over linear regression. The apparent infection rate was generally very high and hardly influenced by the Shirlan dose rate. It was therefore decided not to use this parameter for further analysis.
As illustrated for cv's Aziza (resistant) an Bintje (susceptible) in the 2004 experiment by figure 1, results show clear differences in the response of the cultivars to increasing Shirlan dose rates. The regression line describing the relationship between the Shirlan dose rate and $delay_{05}$ for Aziza is well above the line for Bintje (fig. 1A). When Bintje at 0.4 l Shirlan/ha is used as a reference, the same delay can be reached with Aziza at approximately 0.1 l Shirlan/ha. For sev_{25} and $AUDPC_{25}$, similar curves indicate that increasing the dose rate above 0.1 – 0.2 l Shirlan/ha for Aziza does not result in a better protection against potato late blight, even under the high disease pressure in the 2004 experiment. Bintje on the other hand does benefit from increasing Shirlan dose rates up to the recommended dose rate of 0.4 l/ha.

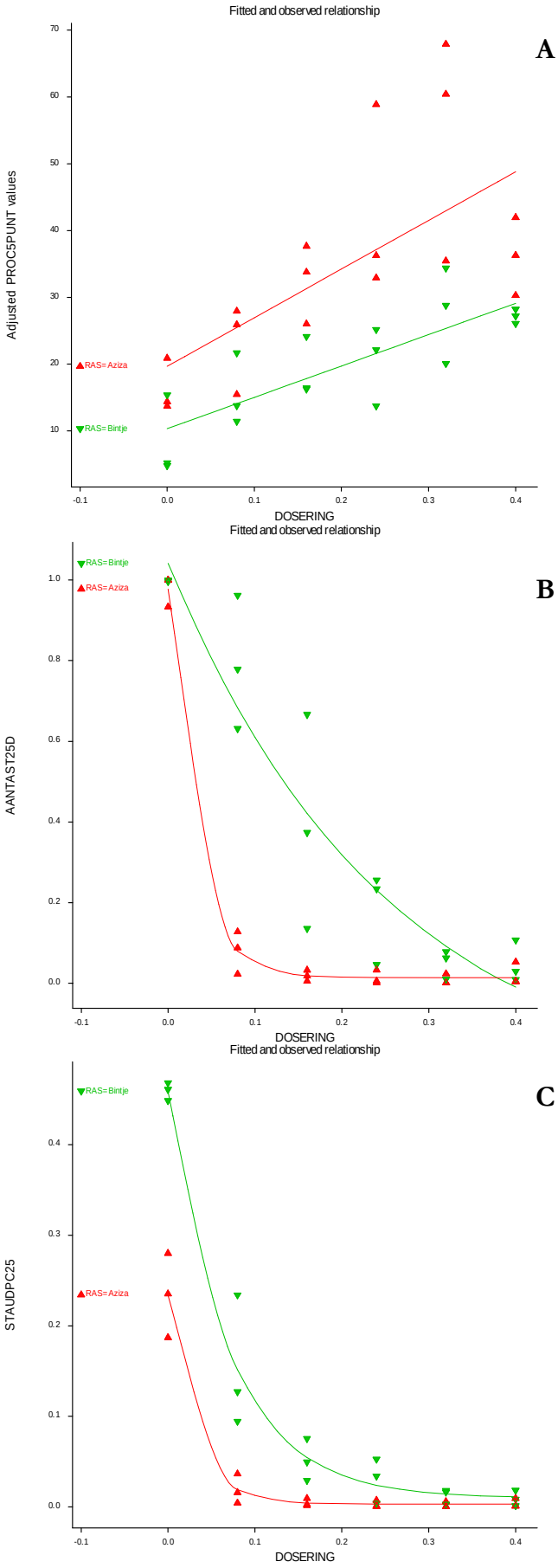

Figure 10. Dose response curves for potato cultivar Aziza representing the effect of a range of Shirlan dose rates on three parameters describing epidemic progress; $delay_{05}$, the day at which 5% severity is reached (A), sev_{25}, the severity 25 days post inoculation of the spreaders (B) and $AUDPC_{25}$, the area under the disease progress curve up to 25 days into the epidemic (C).

If the protection level achieved for Bintje at 0.4 l Shirlan/ha is used as a reference point accepted by practice, new recommended reduced dose rates can be derived for each cultivar based on the three parameters mentioned above. For Aziza the resulting recommended reduced Shirlan dose rate would be around 0.15 l Shirlan/ha, only 37% of the official recommended dose rate.

The example above clearly shows that the fungicide input can be drastically reduced on more resistant cultivars. Even more so when the disease pressure is lower than the disease pressure generated in the field experiments which in practice is often the case. A potential problem is posed by the possibility of degradation of cultivar resistance by adaptation of the *P. infestans* population. Reliable and up to date resistance ratings for potato cultivars are therefore essential to implement reduced dose rates of protectant fungicides on more resistant cultivars in practice.

References

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