

## Control of potato late blight using a dose model to adjust fungicide input according to infection risk

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### SUMMARY

Spraying against potato late blight prior to periods with a risk of infection results in a very effective control. The 2009 trials (two field trials x two varieties x 3 locations) shows that it is possible to reduce the application of effective fungicides such as Revus and Ranman by up to 30% by adjusting the dose in relation to the infection pressure of potato late blight. The risk dependent dose model is developed for potato late blight, but the 2009 trials show that control of early blight should also be included in the overall strategy.

### KEYWORDS

Potato late blight, *Phytophthora infestans*, DSS, dose model, reduced fungicide dose

### INTRODUCTION

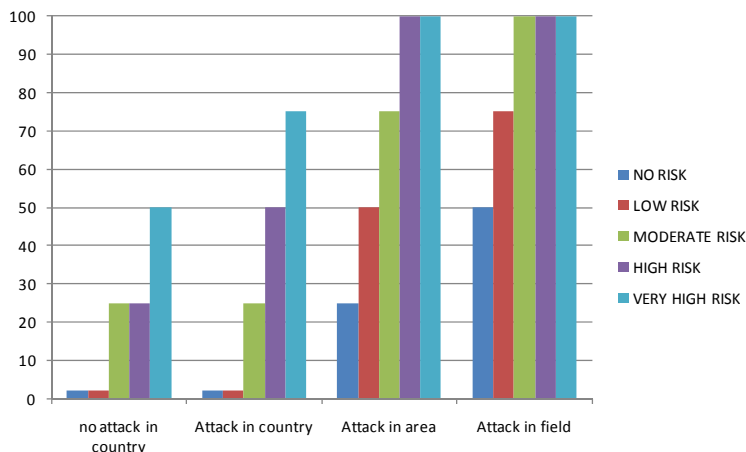
The most effective control of potato late blight is through preventive treatments before infection. In periods with a high risk of infection it is therefore important to use a full dose of the best fungicides. By contrast, in periods with a low risk of infection it is possible to reduce the applications. By optimising the spray applications according to need there is thus a possibility of cheaper disease control in potatoes while still having an effective control. A risk dependent dose model (RDDM) has been developed based on the idea that the fungicide input could be adjusted to the actual need (Nielsen, 2004). In 2009 trials were carried out using RDDM to determine the actual dose and to investigate whether a safe and economically profitable control could be achieved by adjusting the dose according to need in comparison with other models.

### METHODS

In 2009 experiments were carried out according to two trial designs in which spraying against potato late blight was managed according to the infection pressure of potato late blight using a dose model.

### A) Field trials with different dose models

The trials were carried out in the susceptible variety Folva and the moderately resistant variety Kuras at three sites (Flakkebjerg, Sunds and Dronninglund). The trial design includes 1) routine treatment with Dithane NT (*mancozeb*) 2 kg/ha; 2) routine treatment with Ranman (*cyazofamid*) 0.2 l/ha; 3) spraying with Ranman according to a Stepwise Increase Dose Model (SIDM) in which the dose is increased during the season dependent on the incidence of late blight from a 25% dose if late blight does not occur in Denmark to a full dose if late blight is found in the field; 4) spraying according to the Risk Dependent Dose Model (RDDM) in which the current dose depends on how close to the potato field late blight has been observed, the calculated infection pressure ([www.planteinfo.dk](http://www.planteinfo.dk)) and the resistance level of the cultivar (Hansen *et al.*, 2002). Early in the season when potato late blight has not been observed in Denmark and when the calculated infection pressure is low, no spraying will be recommended according to RDDM. Later, when late blight has been observed in the area, the dosage will increase depending on the infection level; 5) spraying according to the Dutch program Plant Plus ([www.dacom.nl](http://www.dacom.nl)). On the basis of a calculated risk of spore dispersal and infection as well as plant growth the most suited fungicides will be recommended. Plant Plus uses a full dose of the fungicides, but the spray interval may vary depending on the conditions. The trials are supported by the Danish Potato Duty Foundation, KAF.



**Figure 1.** Example of calculated dose (% of standard dose, 100% is full label dose) in the risk dependent dose model (RDDM) in the moderately resistant variety Kuras depending on occurrence of late blight in the country/area and the local infection pressure (measured as sum of sporulation hours, HSPO. Low risk HSPO 1-19, moderate risk HSPO 20-39, high risk HSPO 40-60, very high risk HSPO >60, see [www.planteinfo.dk](http://www.planteinfo.dk) for more explanation)

### B) Field trials with reduced inputs of effective fungicides

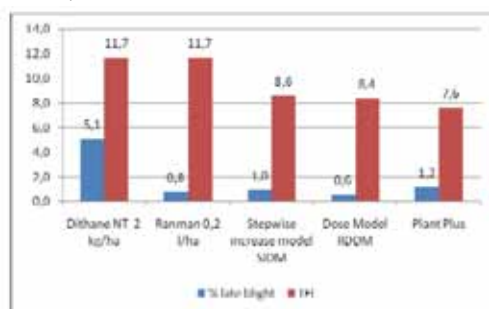
The trials were carried out in the susceptible variety Ditta and moderately resistant starch variety Kuras, and in the trial design spraying alternated between 2 x Revus (*mandipropamid*) and 2 x Ranman throughout the season. The dosage of either Revus or Ranman was adjusted according to either a fixed scheme or fixed doses using the model RDDM. The trial included the following treatments: 1) untreated, 2) Dithane NT 2 kg/ha, 3) Revus or Ranman at 1/3 dose, 4) Revus or Ranman at 1/2 dose, 5) Revus or Ranman at a full label dose (0,6 l/ha and 0,2 l/ha respectively) and 6) in which the dose of either Revus or Ranman was decided by RDDM from 25% of the full dose at low infection pressure to the full dose at high infection pressure.

The trials were carried out in collaboration between the Faculty of Agricultural Sciences, Aarhus University and Knowledge Centre for Agriculture

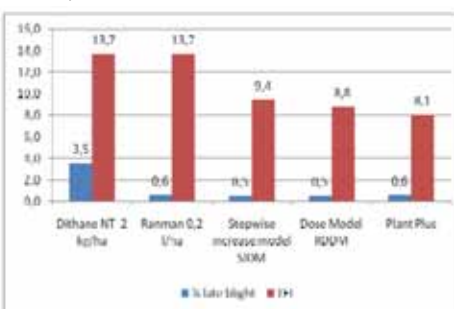
## DISCUSSION

In the Risk Dependent Dose Model (RDDM) the current dose depends on how close to the potato field late blight has been observed, the calculated infection pressure ([www.planteinfo.dk](http://www.planteinfo.dk)) and the resistance level of the cultivar. An example of actual dose for the moderately resistant variety Kuras is shown in Fig. 1. Early in the season when potato late blight has not been observed in Denmark and when the calculated infection pressure is low, no spraying will be recommended according to RDDM. Later, when late blight has been observed in the area, the dosage will increase up to full dose depending on the infection level.

Variety Folva



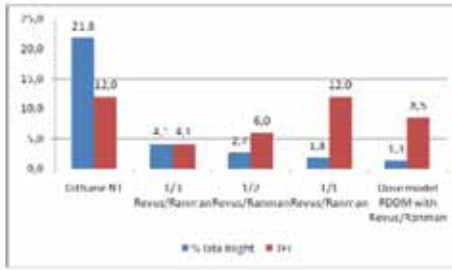
Variety Kuras



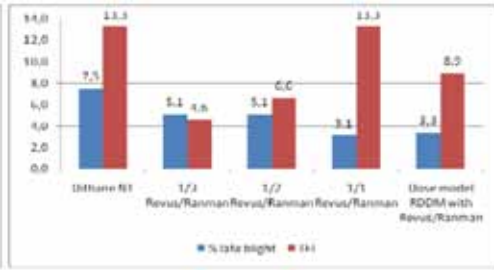
**Figure 2.** % attack of potato late blight in the different model treatments (blue column) and the amount of fungicide applied (red columns, expressed as treatment frequency index, TFI). Trial A: Spraying at approx. 7-day intervals with Dithane NT 2 kg/ha, Ranman + additive 0.2 l/ha+ 0.15 l/ha; Stepwise Increase Dose Model (SIDM) using Ranman from dosage 25% to 100% in case of late blight occurrence; Risk Dependent Dose model (RDDM) where the dosage is dependent on late blight in the area, infection pressure and cultivar resistance; Plant Plus, see explanation in the text. Average of three trials (Flakkebjerg, Sunds and Dronninglund), 2009. Left figure Folva, right figure Kuras.

It appears from Fig. 2 (trial A) that almost the same level of control of potato late blight was achieved with the different models as with the routine treatment with Ranman and better than after the routine treatment with Dithane NT but with approx. 30% less fungicide application. For both models (SIDM and RDDM) the reduction in fungicide consumption was obtained through reduction of the applied dose at the beginning of the season. Plant Plus used full doses but at longer intervals (only 7-8 treatments) with a TFI (number of sprayings with standard dose) of 7.6 and 8.1 in Folva and Kuras, respectively. There were some attacks of early blight (*Alternaria solani/A. alternata*) in the cultivar Kuras in the trial at Sunds. As Ranman has no effect on early blight, a severe attack developed late in the season in the treatments that included Ranman. There is no statistical difference in the harvested yield for the different treatments.

Variety Ditta



Variety Kuras



**Figure 3.** % attack of potato late blight in the different model treatments (blue column) and the amount of fungicide applied (red columns, expressed as treatment frequency index, TFI). Trial B: Spraying at approx. 7-day intervals with 2 x Revus and 2 x Ranman in sequence throughout the season. Dose of applied fungicide is: 1/3 dose Revus or Ranman; 1/2 dose of Revus or Ranman, full dose (0.6 l Revus and 0.2 l Ranman) In the plot with dose model the actual dosage of Revus or Ranman is decided by the Risk Dependent Dose Model (RDDM). Average of three trials in the variety Ditta (left) and Kuras (right) at Flakkebjerg, Sunds and Dronninglund, 2009.

It appears from Fig. 3 (trial B) that by using models (RDDM) in which the dose of Revus or Ranman is regulated by the infection pressure a level of control is achieved that is on a level with a full dose but with approx. 30% less fungicide consumption. There were attacks of early blight in the variety Kuras at both Flakkebjerg and Sunds, but only at Sunds did the attacks develop in the treatments sprayed with Revus or Ranman. When the trials are taken together, the yield and the quality have been maintained through use of the dose model despite a reduction in TFI (Nielsen *et al.*, 2010). The work with the dose models will be continued including further development of the sub model for calculating the infection pressure (Nielsen *et al.*, 2007, Nielsen *et al.*, 2008)

## CONCLUSION

Spraying against potato late blight prior to periods with a risk of infection results in a very reliable and effective control. In 2009 the attacks of potato late blight occurred relatively late and did not develop until the end of July. Under these conditions the trials with reduced doses show that it is possible to reduce the application of effective fungicides such as Revus and Ranman by up to 30% by adjusting the dose in relation to the resistance of the potato cultivar and the infection pressure of potato late blight. The dose model is developed for late blight, but the 2009 trials show that control of early blight should also be included in the overall strategy.

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