

## Exploiting potato late blight cultivar resistance using DSS's: 4 years of field experiments

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### Summary

Dutch commercial DSS's for control of potato late blight generally perform well. A project was carried out to further exploit differences in cultivar resistance to potato late blight to reduce the fungicide input. Purpose built experimental versions of PLANT-Plus and ProPhy were compared with their commercial versions and a WUR system that uses fixed Shirlan reduced dose rates on more resistant cultivars. The date of first spray was mostly not affected for the different cultivars. Date of first observation of potato late blight symptoms was relatively late in the high resistant cultivar Aziza, but relatively early in the high resistant cultivar Karnico. With the cultivars Seresta and Aziza it was very well possible to strongly reduce the dose of Shirlan (fluazinam, 500 g/l) except at the end of the growing season. Often the current resistance figures according to the Dutch variety list seemed not to be appropriate.

**Keywords:** *Phytophthora infestans*, cultivar resistance, decision support systems, potato late blight, fluazinam, reduced dose rate

### Introduction

The DSS's PLANT-Plus (Dacom PLANT-Service B.V.) and ProPhy (Opticrop B.V.) are well known tools for controlling potato late blight (PLB) in potatoes. Although cultivar resistance is used in DSS recommendations, recent research has shown that higher levels of PLB resistance can be used to even further reduce the input of protectant fungicides. In a series of

field experiments, experimental versions of PLANT-Plus and ProPhy, purpose built to further exploit cultivar resistance, were compared to their respective commercial versions and a system (WUR dose rate) in which more resistant cultivars were sprayed with a fixed (reduced) Shirlan dose rate.

The work focused on maximum exploitation of differences in cultivar resistance, not on comparing DSS performance. Two approaches to reduce the fungicide input were used: flexible longer spray intervals and/or (flexible) reduced Shirlan dose rates.

## Materials and Methods

A total of eight trials was carried out in the Netherlands from 2002 – 2005. Two trials were conducted each year, one trial on a clay soil at Lelystad and one trial on a sandy reclaimed peat soil at Valthermond. Trials were set up as randomized block experiments with three replications.

DSS's in the trials were: PLANT-Plus, PLANT-Plus-experimental (2003 - 2005), ProPhy, ProPhy-experimental (2003 - 2005) and WUR dose rate, a schedule using fixed combinations of cultivar and Shirlan dose rate (table 1). Spray timing of the WUR dose rate system was based on SIMCAST/WUR-blight (Wander *et al.*, 2003) in 2002 and on PLANT-Plus in all other years. WUR dose rate applied only Shirlan whereas recommendations from the other DSS's advices concerning type of fungicide and timing were followed up. DSS's were applied as described by Spits *et al.*, 2004. For ProPhy spray timing was determined by recommendations for the most susceptible cultivar. Thus all cultivars were sprayed at the same time with (potentially) different dose rates. PLANT-Plus mainly used cultivar resistance to increase the spray interval on the more resistant cultivars.

Cultivars included in the experiments (foliar resistance rating in brackets) were:

- Lelystad: Bintje (3), Santé (4½), Agria (5½), Remarka (6½) (only 2002) and Aziza (7½);
- Valthermond: Bintje (3) and starch potato cultivars Starga (5½), Karakter (6) (2002 only), Seresta (7) and Karnico (8).

Trials were monitored for PLB symptoms every week. A cumulative index of infected leaflets was calculated for each combination of cultivar and DSS by adding up the number of observed stem infections\*20 + number of petioles\*5 + the number of leaflets over an entire growing season.

The fixed Shirlan dose rates used by the WUR dose rate system are given in Table 1.

Table 1. Shirlan dose rates (l/ha) per cultivar for the WUR dose rate system.

Cultivar	Lelystad		Cultivar	Valthermond	
	2002	2003-2005		2002-2004	2005
Bintje	0.40	0.40	Bintje	0.40	0.40
Santé	0.32	0.24	Starga	0.32	0.32
Agria	0.24	0.32	Karakter	0.24	
Remarka	0.16		Seresta	0.16	0.16
Aziza	0.08	0.08	Karnico	0.08	0.24

## Results

An overview of the results is given for 2003 – 2005 when all commercial and experimental systems were incorporated in the field experiments. The parameters used are the average number of sprays per season (2003 – 2005) for each location, cultivar and DSS, the average dose rate of the protectants applied and the cumulative index of infected leaflets, a cumulative measure for disease severity throughout the growing season. Results summarizing the spray events and their results for Lelystad and Valthermond are given in Table 2 and Table 3 respectively.

From table 2 it is clear that PLANT-Plus is using cultivar resistance to increase the spray interval. Prophy is using increased spray intervals in combination with reduced dose rates. The WUR dose rate system is only using reduced dose rates but in a much more extreme fashion than Prophy. In general, PLANT-Plus experimental uses 1 – 4 spray applications less on more resistant cultivars than its commercial version. ProPhy experimental also recommends 1- 4 sprays less than its commercial version. The WUR dose rate system uses the same number of sprays on all cultivars but the dose rate on the more resistant cultivars is strongly reduced. Overall, expressed as the number of Shirlan full dose rate equivalent sprays, the WUR dose rate system uses less than 50% of the input on resistant cultivars as compared to susceptible cultivars. Both, ProPhy and PLANT-Plus reduce the fungicide input by 30-40% on more resistant cultivars.

When we look at Table 3 to see whether this reduction of fungicide input was justified, first

we see big differences between years and locations. When we look closer at differences within trials, in 2003 at Valthermond, more blight was observed in Karnico for both, PLANT-Plus exp and Prophy exp. In 2004, and to a lesser extend in 2005, Karnico is severely blighted again in all systems. This effect is further illustrated by Figure 1 where severity is plotted against time for four cultivars under the WUR dose rate system in 2004. Despite its high resistance rating (an eight for foliar blight), Karnico is severely attacked and the plots had to be desiccated prematurely.

In general, the reduced input systems significantly reduced the fungicide input per season although they generally result in slightly more blight than the standard systems. Exceptions are e.g. PLANT-Plus on Karnico and ProPhy on Starga in 2005 where the reduced input systems performed slightly better.

Based on the detailed results of the trials it can be stated that for the cultivar:

- Santé (4½) a lower dose (-10%) and a larger interval is possible as compared to Bintje;
- Agria (5½) should be treated with an equal or higher input as compared to Santé;
- Remarka (6½) should be treated as a low resistant cultivar, specifically end of season;
- Aziza (7½) except at end of season a very low dose protects the cultivar;
- Starga (5½) compared to Bintje the cultivar should be treated the same;
- Karakter (6) compared to Bintje the cultivar should be treated the same;
- Seresta (7) a lower dose (more than 0.16 l/ha Shirlan) or a larger interval is possible;
- Karnico (8) despite its high resistance rating, no possibilities for a lower dose or a larger interval.

## Conclusions

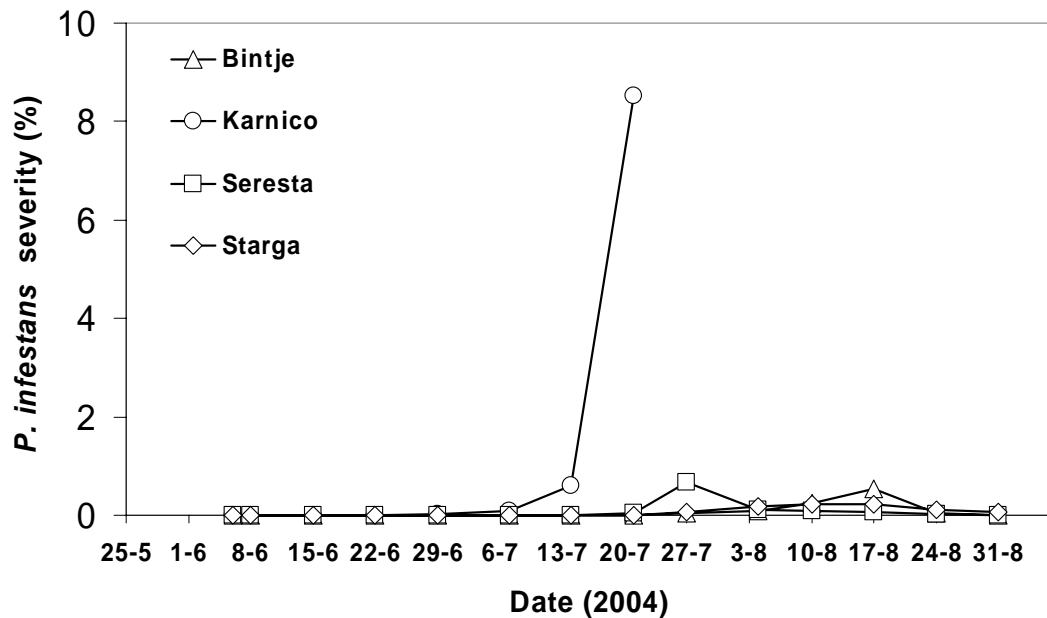
- Some of the current cultivar resistance figures are not appropriate for DSS purposes.
- Shirlan dose rates can be reduced at higher resistance levels.
- Interval can be enlarged at higher resistance levels.
- The experimental systems performed well despite the fact that they were meant to maximally reduce the fungicide input.
- More research is necessary to set up resistance specific advices for all cultivars.

**Table 2.** Average number of sprays and average dose rates applied in Lelystad during the period 2003 - 2005. Curative sprays encompass Curzate M and Tattoo C applications and were always carried out at the 100% dose rate.

Lelystad	Location	Cultivar	Average number of sprays		Shirlan Dose rate	Full dose equivalents Shirlan
			Shirlan	Curative		
PLANT-Plus	Lelystad	Bintje	9.0	0.0	0.4	9.0
	Lelystad	Santé	9.3	0.0	0.4	9.3
	Lelystad	Agria	8.3	0.7	0.4	8.3
	Lelystad	Aziza	8.7	0.3	0.4	8.7
PLANT-Plus exp.	Lelystad	Bintje	8.0	0.7	0.4	8.0
	Lelystad	Santé	6.7	0.3	0.4	6.7
	Lelystad	Agria	6.7	0.3	0.4	6.7
	Lelystad	Aziza	5.7	0.3	0.4	5.7
ProPhy	Lelystad	Bintje	11.7	1.0	0.4	11.6
	Lelystad	Santé	11.7	1.0	0.4	11.3
	Lelystad	Agria	11.3	1.3	0.4	11.2
	Lelystad	Aziza	12.7	0.0	0.3	9.7
ProPhy exp.	Lelystad	Bintje	11.7	0.0	0.4	10.6
	Lelystad	Santé	10.0	0.0	0.3	8.0
	Lelystad	Agria	10.3	0.0	0.3	8.2
	Lelystad	Aziza	8.7	0.0	0.3	5.7
WUR dose rate	Lelystad	Bintje	9.0	0.0	0.4	9.0
	Lelystad	Santé	9.0	0.0	0.2	5.4
	Lelystad	Agria	9.0	0.0	0.3	7.2
	Lelystad	Aziza	9.0	0.0	0.1	1.8
PLANT-Plus	Valthermond	Bintje	11.0	0.3	0.40	11.0
	Valthermond	Starga	11.3	0.0	0.40	11.3
	Valthermond	Seresta	10.0	1.0	0.40	10.0
	Valthermond	Karnico	10.0	0.7	0.40	10.0
PLANT-Plus exp.	Valthermond	Bintje	9.0	0.7	0.40	9.0
	Valthermond	Starga	9.3	0.0	0.40	9.3
	Valthermond	Seresta	6.0	1.3	0.40	6.0
	Valthermond	Karnico	6.7	1.0	0.40	6.7
ProPhy	Valthermond	Bintje	11.7	0.0	0.40	11.6
	Valthermond	Starga	11.7	0.0	0.39	11.4
	Valthermond	Seresta	11.7	0.0	0.33	9.7
	Valthermond	Karnico	11.7	0.0	0.36	10.5
ProPhy exp.	Valthermond	Bintje	10.7	0.0	0.36	9.7
	Valthermond	Starga	10.7	0.0	0.35	9.4
	Valthermond	Seresta	9.0	0.0	0.33	7.5
	Valthermond	Karnico	8.0	0.0	0.30	6.0
WUR dose rate	Valthermond	Bintje	10.7	0.0	0.40	10.7
	Valthermond	Starga	10.7	0.0	0.32	8.5
	Valthermond	Seresta	10.7	0.0	0.16	4.3
	Valthermond	Karnico	10.7	0.0	0.13	3.6

**Table 3.** Cumulative index of infected leaflets as a measure of the protection level provided by the different DSS's at two locations during the period 2003 – 2005.

		Valthermond				Lelystad			
		Bintje	Karnico	Seresta	Starga	Bintje	Agria	Aziza	Santé
2003	WUR dose rate	0.0	0.3	0.0	0.0	0.01	0.01	0.33	3.67
2003	Plant-Plus	0.0	0.0	1.3	0.0	0.01	0.01	0.01	0.01
2003	Plant-Plus exp	0.0	38.7	8.0	1.7	0.01	0.01	0.01	0.01
2003	ProPhy	0.0	0.3	0.0	0.7	0.30	0.01	0.01	0.01
2003	ProPhy exp	7.0	11.7	0.0	23.0	0.01	0.01	0.01	5.00
2004	WUR dose rate	597	5759	579	554	1	26	844	9
2004	Plant-Plus	413	2213	63	987	3	5	1	0
2004	Plant-Plus exp	527	3103	69	1536	2	45	5	2
2004	ProPhy	623	1695	229	305	1	11	1	0
2004	ProPhy exp	257	3423	154	255	1	32	32	2
2005	WUR dose rate	6	776	2	41	118.0	105	71.7	98.0
2005	Plant-Plus	2	226	3	2	145.0	47.3	10.0	43.0
2005	Plant-Plus exp	0	173	10	19	244.3	127.3	87.7	20.7
2005	ProPhy	3	68	1	18	55.3	10.3	11.0	7.7
2005	ProPhy exp	6	98	3	8	117.0	24.7	11.0	68.0



**Figure 1.** The time course of *P. infestans* severity for four cultivars under the WUR dose rate system in Valthermond in 2004.

## References

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