

Efficacy Evaluation Of Fungicide Programmes For The Control Of Late Blight In Potatoes



L. J. Dowley & T. Neville

Crops Research Centre, Oak Park, Carlow

Teagasc acknowledges with gratitude the help of the Agrochemical Industry in supporting this research project.

ISBN 1 84170 271 4

December 2001

Summary

Field experiments were conducted between 1989 and 1992 to compare the efficacy of different fungicide programmes to control late blight of potatoes. The protectant fungicide Shirlan, the translaminar fungicide Acrobat and the systemic fungicide Ridomil MZ followed by Dithane were compared with the protectant fungicide Dithane and an unsprayed control treatment.

The longest delay in disease incidence was recorded following the use of Ridomil MZ and this together with Shirlan were significantly better than the Dithane control. All test treatments resulted in better foliage blight control compared with the Dithane control treatment. The lowest level of foliage blight at the end of the growing season was recorded following the Shirlan treatment, but this was not significantly better than Ridomil MZ or Acrobat treatments.

All three test fungicides significantly reduced the level of tuber blight compared with untreated control. While all test fungicides gave better control of tuber blight than Dithane, these differences were only significant in some years. The three test chemicals all resulted in equivalent marketable yields when compared with the Dithane control. This would indicate that there were no phytotoxic effects from any of the test chemicals.

Introduction

Potato late blight, caused by the oomycete fungus *Phytophthora infestans* (Mont.) de Bary is the most destructive disease affecting the potato worldwide. Over time, the Irish population of *P. infestans* has shown a remarkable capacity for change. Fungicide resistance was first confirmed in 1980 (Dowley & O'Sullivan, 1981) while the presence of the A₂ mating type was confirmed in 1989 (O'Sullivan & Dowley, 1991). It has also been confirmed that there has been an increase in virulence (O'Sullivan & Dowley, 1983) while the in store spread of the disease is also a reality (Dowley & O'Sullivan, 1991).

The main varieties grown in Ireland are susceptible to infection with late blight, especially in the foliage, and annual losses have been estimated at £8 m per annum (Copeland *et al.*, 1993). As a result, disease control requires regular application of fungicides at high rates and short intervals throughout the growing season. It is therefore important that only the most effective fungicides are used and that these are used in the most efficient programmes. To obtain this information it is necessary to test the efficacy of all new fungicides to control disease in the presence of these new isolates of *P. infestans*.

New fungicides for the control of late blight are continuously being introduced to the Irish market. These fungicides fall into three categories (systemic, translaminar and protectant). This report outlines the results with 3 different fungicides, fluazinam (protectant), dimethomorph (translaminar) and metalaxyl (systemic).

Methods

Field trials were conducted at Oak Park Research Centre, Carlow, on the maincrop cultivar `Kerr`s Pink` from 1989 to 1992. This cultivar is very susceptible to late blight having ratings of 4.5 and 3 for foliage and tuber blight resistance respectively (Dowley, 1986). In each year the preceding crop was a cereal and the soils were free draining medium loams with low clay and organic matter. The pH varied from 6.4 to 6.8. The trial sites were ploughed to a depth of 25 cm during the winter and were tilled prior to planting. The compound fertiliser 10K:10P:20K was broadcast at the rate of 1.76 t/ha using a vicon fertiliser spreader. The sites were then rotovated and the drills opened in preparation for planting.

Using certified seed (Elite, Class E) the trials were planted into preformed drills using a two-row Ransomes automatic planter. The design for each trial was a randomised complete block (RCB) with 4 replications per treatment. Each replicate consisted of 6 drills 8.2 m long. The drill width was 0.76 m and the distance between tuber centres was 0.33 m. The total replicate size was 37.5 m² from which 25 m² were harvested across the centre 4 drills. A 3 m unplanted divider strip was left between each replicate to facilitate mechanical harvesting and no artificial inoculum was used in the experiments. Weed control consisted of paraquat (600 g a.i./ha) and simazine (600 g a.i./ha) applied pre-emergence.

The fungicides were applied with a Hardi sprayer mounted on a Logic chassis with an independent power source drawn by an All Terrain Vehicle (ATV). Machinery access was by means of rotovated spray paths to prevent crop damage. Spraying commenced in mid-June when the plants were beginning to meet along the drill and was repeated at 10-day intervals throughout the season. The spray volume was equivalent to 250 l/ha and the spray pressure was 3 bars using Hardi flat spray nozzle number 370694/4110-20.

Fungicide treatments

Between 1986 and 1996 three different fungicides were assessed for their efficacy in controlling late blight of potatoes. The fungicides included Ridomil MZ 72, Acrobat MZ and Shirlan. Ridomil MZ 72 is a systemic/protectant mixture based on metalaxyl and mancozeb and is used for the first three applications in the programme. Acrobat MZ is a translaminar/protectant mixture based on dimethomorph and mancozeb and Shirlan is a protectant fungicide based on fluazinam. These were compared with routine mancozeb treatment at 10-day intervals and an untreated control.

Table 1: Fungicide formulations and application rates used

Commercial Name	Iso Name	Application rate product (kg/ha)	Application rate a.i. (g/ha)	Total a.i./ha per season
Untreated	None	0 kg	0 g	0 g
Dithane	Mancozeb	2.25 kg	1,688 g	16,880 g
Ridomil MZ	Metalaxyl + Mancozeb	2.50 kg	200 g 1,600 g	600 g 4,800 g
Followed by Dithane	Mancozeb	2.25 kg	1,800 g	12,600 g
Acrobat	Dimethomorph + Mancozeb	2.40 kg	150 g + 1,600 g	1,500 g + 16,000 g
Shirlan	Fluazinam	0.40 l	200	2,000

Type of assessment

During the growing season, disease levels were assessed at weekly intervals up to desiccation using the B.M.S. foliage blight assessment key (Cox & Large, 1960). Disease on-set was recorded as the date when the first blight lesions were observed in the centre 4 drills of each replicate. Delay in the on-set of disease was recorded as the number of days by which the disease outbreak was delayed by each fungicide when compared with the unsprayed control for each block. The crop was desiccated with diquat at the end of September and harvested in October/November using a Ransomes two-row elevator digger. The produce was hand picked and stored at a temperature of over 10°C for at least two weeks to allow tuber blight symptoms to develop. The produce was then graded into the following grades:- < 40 mm, 40-60 mm, 60-80 mm, > 80 mm, blighted and other diseases. After grading the produce was weighed and the yields expressed in tonnes per hectare.

Results

Effect on foliage blight

The effect of different fungicide programmes on the incidence of foliage blight can be compared by using the delay in disease on-set or the level of foliage blight at the end of the season.

The delay in disease on-set for the different treatments is given in Fig 1. All fungicide treatments significantly delayed the date of disease on-set compared with the untreated control. All three test treatments delayed disease on-set for longer than the Dithane control and this delay in disease on-set was significant for both the Ridomil and Shirlan treatments. No significant differences were recorded between the Acrobat, Ridomil and Shirlan.

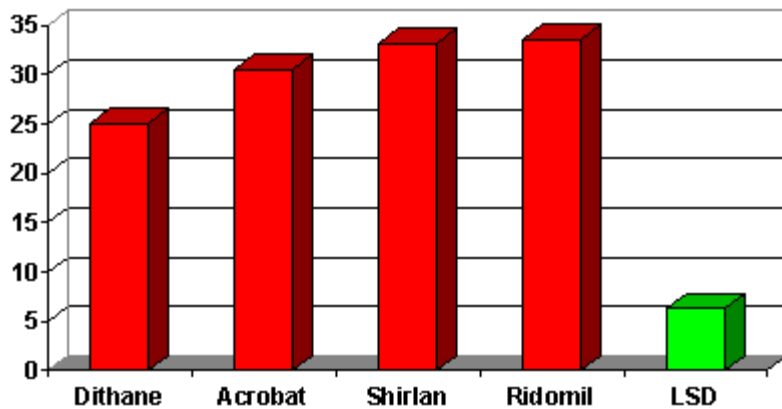


Fig. 1. Effect of fungicide on the delay in disease onset in days

The % foliage blight for the different treatments at the end of the growing season is given in Fig. 2. In each of the 4 years, all fungicide treatments resulted in good disease control and significantly reduced the incidence of foliage blight at the end of the season compared with the untreated control. Over the four years of the trials all test fungicides resulted in better foliage blight compared with the Dithane control. The best average control was recorded following the Shirlan treatment, but Acrobat, Ridomil or Shirlan were not significantly better than the Dithane control over the four years of the trial. However, in 1989 and 1990 all test fungicides resulted in significantly better foliage blight control compared with the Dithane control.

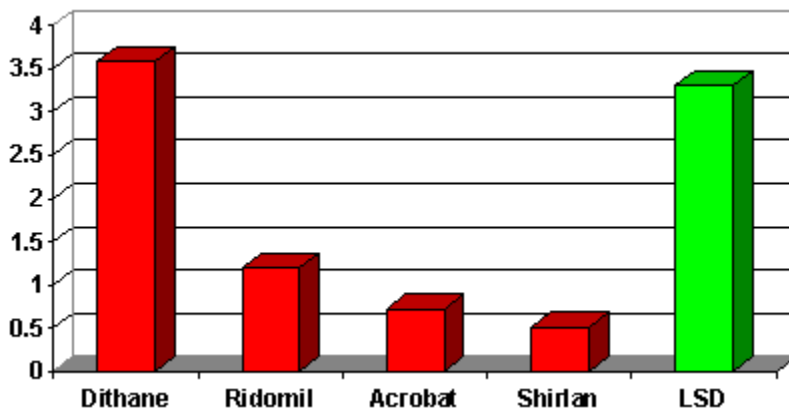


Fig. 2. % foliage blight following different fungicide treatments (mean 1989-1992)

Effect on tuber blight

Despite relatively dry conditions in 1989 and 1992, good tuber blight levels were recorded in the untreated control during all years of the experiment. The mean incidence of tuber blight following the different fungicide programmes is given in Fig. 3. All fungicide treatments resulted in significantly lower levels of tuber blight compared with the untreated control.

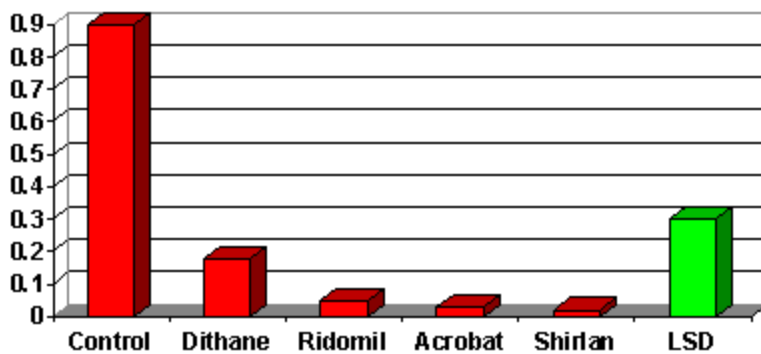


Fig. 3. Effect of different fungicide treatments on the incidence of tuber blight (mean 1989-1992)

Effect on yield

The yield varied considerably between years with the highest yields recorded in 1989 and the lowest in 1991. In general yields tended to be lowest in the years that were most suitable for disease spread. The mean marketable yield of all treatments is given in Fig. 4. All fungicide treatments resulted in significantly higher marketable yields compared with the untreated control in all years of the

experiment. There was little difference between the fungicide treatments in terms of marketable yield and none of these differences were significant.

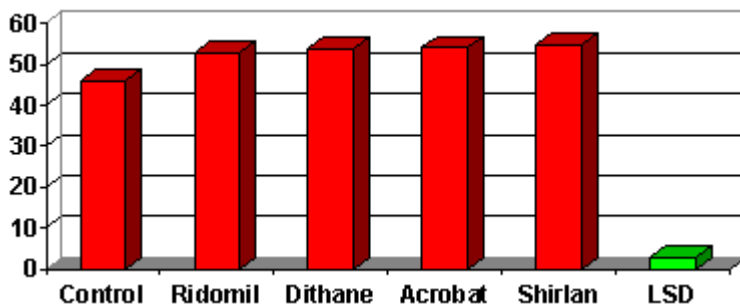


Fig. 4. Effect of fungicide treatment on marketable yield (mean 1989-1992)

Discussion

Dithane has been the standard fungicide for the control of late blight in Ireland since the disappearance of copper sulfate in the mid-1960's. It provides good foliage blight control, especially where the disease pressure is not above normal and has no confirmed resistance problems. It is also less phytotoxic than most other fungicides, but is less effective in controlling tuber blight infection. Apart from efficacy, other factors will always be taken into account in making a decision to use a particular fungicide. These include variety, tuber resistance, disease pressure and cost.

Good foliage and tuber blight levels were recorded during the experimental period and this allowed good comparisons to be made between the fungicide treatments. All test products significantly delayed disease on-set, reduced the level of foliage and tuber blight and increased marketable yields compared with the untreated control.

The longest delay in disease incidence was recorded following the use of Ridomil MZ and this together with Shirlan were significantly better than the Dithane control. Where Ridomil MZ forms part of the disease control programme it is important that the anti-resistance

strategy is followed in order to prevent the build-up of phenylamide resistance in the population (Dowley, 1994).

All test treatments resulted in better foliage blight control compared with the Dithane control treatment. The lowest level of foliage blight at the end of the growing season was recorded following the Shirlan treatment, but this was not significantly better than Ridomil MZ or Acrobat treatments.

The most important aspect of late blight control is the reduction or elimination of tuber infection. This is particularly important with varieties that are very prone to tuber infection, as small levels of tuber blight can lead to large financial losses due to problems with storage and grading. All three test fungicides significantly reduced the level of tuber blight compared with untreated control. While all test fungicides gave markedly better control of tuber blight than Dithane, these differences were only significant in some years.

The three test chemicals all resulted in equivalent marketable yields when compared with the Dithane control. This would suggest that in terms of phytotoxicity, they were all similar to Dithane.

This report is a summary of three separate trials. The full details of each trial have already been published (Dowley & O'Sullivan, 1994; Dowley & O'Sullivan, 1995; Dowley & O'Sullivan, 1996) and should be consulted where more detailed information is required.

Conclusions

- All three test fungicides (Acrobat, Ridomil MZ and Shirlan) gave good control of both foliage and tuber blight.
- Ridomil MZ resulted in the best delay in disease on-set.
- Shirlan resulted in the best foliage blight control at the end of the season
- All three fungicides resulted in better tuber blight control than Dithane.
- All three fungicides resulted in higher marketable yields when compared with the untreated control.
- No phytotoxic effects were observed with any of the three test fungicides.

References

- Copeland, R. B., Dowley, L. J. & J. F. Moore. 1993. Vulnerability of the Irish potato industry to harmful organisms. *Proceedings of Royal Irish Academy Seminar*, (Eds. J. A. Kavanagh and P. Brennan), pp 95-106
- Dowley, L. J. & E. O'Sullivan. 1981. Metalaxyl-resistant strains of *Phytophthora infestans* (Mont.) de Bary in Ireland. *Potato Research***24**: 417-421.
- O'Sullivan E. & L. J. Dowley. 1991. A note on the occurrence of the A2 mating type and self-fertile isolates of *Phytophthora infestans* (Mont.) de Bary in the Republic of Ireland. *Irish Journal of Agricultural Research***30**: 67-69.
- O'Sullivan, E. & Dowley, L. J. 1983. Physiological specialisation of strains of *Phytophthora infestans* sensitive and resistant to metalaxyl. *Irish Journal of Agricultural Research*, **22**:105-107.
- Dowley, L. J. & E. O'Sullivan. 1991. Sporulation of *Phytophthora infestans* (Mont.) de Bary on the surface of diseased potatoes and tuber-to-tuber spread during handling. *Potato Research***34**: 295-296.

Dowley, L. J. 1994. Practical aspects of phenylamide resistance management. In: *Fungicide Resistance* (Eds S. Heaney, D. Slawson D. W. Hollomon, M. Smith, P. E. Russell and D. W. Parry) BCPC Monograph No 60 pp 147-153.