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Control of common scab without the use of water

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Summary

The most effective way to control common scab is by irrigating a potato crop at tuber initiation. With the introduction of legislation such as the Water Framework Directive this will become increasingly difficult. In this field experiment, we assessed the potential of a number of non-water measures for controlling this disease. Common scab on daughter tubers at harvest was reduced by applying rapeseed meal at 1 t ha^{-1} to the beds and then incorporating it into the soil, and adding a mixture of *Trichoderma viride* isolates into the furrow at planting. None of these treatments was as effective as using water.

Key words: Common scab, *Solanum tubersosum, Streptomyces scabies*, non-water control, soil amendments

Introduction

Common scab is a disease which causes corky lesions on the surface of potato tubers. Such symptoms are unsightly so growers must remove badly effected tubers at grading so that they can be sold as ware produce. The disease is caused by soil-borne bacteria of the genus *Streptomyces*. In the UK, the most common species is believed to be *S. scabiei* (Formerly *scabies*) although 38 species of Streptomyces have been described, of which 23 are reputed to be pathogenic on potatoes (Bradbury, 1986). Although the distribution of individual species is not known, *Streptomyces* bacteria are common in soil and most fields can be considered as being at risk.

Crops are at risk of infection as soon as tubers start to form, particularly in dry weather. The most effective control measure is use of irrigation water during the period of tuber initiation (Lapwood *et al*., 1973). As of April 2006, the Water Framework Directive (WFD) has meant water use is no longer free in the UK. Thus controlling this disease by irrigation will become increasingly difficult and a need for non-water control measures has been highlighted (Elphinstone *et al*., 2005).

The aim of this study was to examine a range of treatments which could control common scab including several suitable for organic use.

Materials and Methods

Field experiment

A field site, at Gourdie Farm, Scottish Crop Research Institute, in Dundee Scotland was selected. The site was well drained and the soil was a sandy clay loam with a pH of 6.2.

Certified seed of Maris Piper was planted on 17 May 2005. The seven treatments and control are described in Table 1. Rapeseed meal was applied to beds prior to planting and then incorporated. Biomex powder, Biomex SA and Mycortex were applied in solution using a specially adapted sprayer mounted on the back of the planter. The sulphur pastiles and bactolife were applied as a dust into the furrow at planting. Plots consisted of two drills 6.25 m long with 1.75 m between plot ends, and a seed spacing of 0.25 m. The trial was laid out in a randomised block with 2 replicates.

Table 1. *Treatments used in field experiment*

Active ingredient	Product	Company	Dose and application method
Untreated control	-		-
Sulphur	Tiger 90	Stefes UK Ltd	125 kg S ha^{-1} applied in furrow at planting
Sulphur	Tiger 90	Stefes UK Ltd	250 kg S ha^{-1} applied in furrow at planting
Trichoderma viride	Biomex Powder	Omex, Kings Lynn, Norfolk UK	1 kg ha^{-1} in 100 L ha^{-1} water, applied in-furrow at planting
Trichoderma viride	Biomex SA	Omex, Kings Lynn, Norfolk UK	1 L ha^{-1} in 100 L ha^{-1} water, applied in-furrow at planting
Blend of: *Bacillus* spp, Rhizobia, Azobacteria and *Sacchoromyces*	Mycortex	Biotechnica, Reading, UK	10 kg ha^{-1} in 100 L ha^{-1} water, applied in furrow at planting
Blend of: *Trichoderma viride*, *Bacillus* spp, Rhizobia, Azobacteria, *Sacchoromyces* and other	Bactolife	Biotechnica, Reading, UK	Applied at a rate of 1 kg ha^{-1} in furrow at planting
Rapeseed meal	Ground rapeseed		1 t ha^{-1} applied to beds and incorporated

Disease assessment

During the course of the experiment records were kept on emergence and % ground cover of the plots and notes on phytotoxic effects were taken. Haulm destruction occurred on 2 September 2005 and plots were harvested mechanically on 22 September 2005.

A sample of 50 daughter tubers from each plot was taken. The assessment involved washing the tubers and then examining each daughter tuber for the percentage area covered in symptoms of common scab.

Results

Disease on daughter tubers

The combination of a dry summer and the use of the susceptible variety, Maris Piper, meant that common scab was the predominant disease found (93% of tubers infected in untreated control plots). Use of Bomex SA significantly reduced incidence to 73%, whilst use of rapeseed meal reduced severity from 8% in the untreated to 2.8% (Table 2). Although there are numerical reductions using other treatments they are not significantly lower than the untreated controls.

Table 2. *Incidence and severity of common scab on daughter tubers at harvest*

Treatments	Incidence	Severity
Untreated	93a	8.1ab
Sulphur 250 kg ha^{-1}	90ab	4.9abc
Sulphur 150 kg ha^{-1}	79ab	3.7bc
Biomex Powder	87ab	4.6abc
Biomex SA	73b	3.6bc
Rapeseed meal	77ab	2.8c
Mycortex	81ab	8.4a
Bactolife	86ab	3.5bc
L.S.D (*P*=0.5)	10.7	2.88

Means followed by same letter do not significantly differ ($P = 0.05$, Student-Newman-Keuls)

Discussion

Reductions of over 90% in the incidence of common scab have been reported in the susceptible variety King Edward when irrigated early in the season compared with the un-watered control (Lapwood *et al*., 1973). Thus, none of the non-water measures examined in this study were as effective as water in controlling common scab. Incidence and severity of common scab in daughter tubers was reduced by the use of Biomex SA and rapeseed meal respectively, but these reductions can be regarded as small. However, as pressure on water use increases so alternatives must be found. Although using Biomex SA and rapeseed meal on their own may not be viable, if they are used in-conjunction with other measures such as resistant varieties or reduced water then their use may be practicable.

How these treatments work is unclear. It is believed that the rapeseed meal may have some biofumigation activity. When added to the soil the glucosinolates in the rapeseed meal may break-down to produce the anti-microbial compounds isothiocyanates. In Australia, these compounds have been shown to inhibit mycelial growth of *Rhizoctonia solani*, the cause of black scurf in potatoes (Kirkegaard *et al*.,1996). Biomex SA contains a mixture of isolates of *T. viride* which may compete for resources with Streptomyces bacteria and hence reduce the amount of common scab which develops. Where soil is contaminated with *R. solani* biological control agents such as *T. viride* and *T. harzianum* can reduce black scurf. In field experiments in Israel soil treatment with *T. harzianum* significantly reduced black scurf with better control being achieved where the treatment was applied in-furrow compared with being applied to the ridges and then being incorporated (Tsror (Lahkim) *et al*., 2001). The improved efficacy of Biomex SA compared with Biomex powder can be attributed to its liquid formulation which allows better incorporation into the drill compared with the powder formulation. These initial results show promise, and further investigations are planned for the future.

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