SELECTION OF CLONES OF COMMERCIAL POTATO CULTIVARS WITH ENHANCED COMMON SCAB DISEASE RESISTANCE


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INTRODUCTION

Common scab disease is a serious economic problem for potato production in Australia. Implementation of management strategies such as chemical treatments, irrigation management, biological control, and rotation management based on studies done elsewhere (U.K., U.S.A., Canada and Japan) have provided only partial solutions to the disease problem facing the industry. The discovery and characterisation of the phytotoxin thaxtomin A, which is produced by all common scab inducing plant pathogenic strains of Streptomyces sp., (1, 2), and subsequent studies demonstrating the central importance of this toxin for induction of disease symptoms and pathogen infection (2, 3), has provided a key insight into the nature of pathogenesis. The discovery of the requirement for phytotoxin activity by pathogenic strains of Streptomyces has also provided a specific target for resistance studies; indeed purified phytotoxin has been trialed in some breeding programs to rapidly screen new lines for probable common scab resistance (4, 5).

We have utilised tissue culture technologies to select thaxtomin A tolerant potato clones of current commercial varieties.

METHODS AND RESULTS

Current commercial Solanum tuberosum cultivars including ‘Russet Burbank’, ‘Atlantic’, ‘Desiree’, ‘Ponziac’, ‘Shepody’ and ‘Iwa’ were maintained as tissue culture plants. Using purified thaxtomin A as a selection agent against cultured potato cells (callus) (6) rare variants with resistance to the toxin have been recovered and regenerated into complete plants.

From approximately 20 challenge trials, over 700 regenerated potato plants have been obtained from thaxtomin A-tolerant callus for six cultivars. Significant differences (P<0.05, ANOVA) both in selection efficiency of thaxtomin A-tolerant calli and in subsequent regeneration rate was found amongst cultivars e.g. ‘Shepody’ was inherently difficult to regenerate back into plantlets from calli, whereas ‘Desiree’ could be easily regenerated. In vitro screening of regenerants has shown significant variation in toxin tolerance with some lines demonstrating extreme resistance, others moderate resistance, and escape lines with no resistance. Glasshouse screening of over 550 clones from six cultivars has identified many (approximately 1/3rd of those tested) with enhanced disease resistance (as determined by reduced tuber surface lesion cover and lesion depth) compared to the control (unselected) cultivar. The very best of these lines have yet to succumb to common scab disease following 3-5 trials (6). Agronomic field trials with ‘Russet Burbank’ have shown that many (11 of 18 lines tested) of the resistant clones yield equivalent to their parent cultivar and most (17 of 18 lines tested) have cooking characteristics at least as good.

DISCUSSION

Utilising thaxtomin A as the sole selection agent has the advantage of acquiring enhanced resistance phenotypes whilst retaining important commercial characteristics (yield and cooking characteristics) of the parent varieties. These data suggest this approach for generation of disease resistance within commercial clones is feasible and promises to provide a significant disease management tool that will be easily incorporated into current production systems.

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REFERENCES


