EXECUTIVE SUMMARY

P15-01: Increasing potato yield through understanding the impacts of crop rotations and soil compaction – Year 3

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Investigations from Year One and Two of the FAR Sustainable Farming Fund project (P15-01) have shown that potato crop performance can be negatively affected by poor soil structural conditions and the presence of seed- and soil-borne diseases, and that these two yield limiting factors are often inextricably linked. The severity of these factors is in turn influenced by the cropping history of a field (crop type and associated cultivation practices), along with disease management of preceding seed generations (including during crop growth, winter storage and handling).

All 35 crops monitored in the first 2 years of this study exhibited *Rhizoctonia* stem canker symptoms with potential to limit growth during the tuber bulking phase. This was especially true for the crops grown in poorly structured soils (19 fields) that also harboured other pathogens, particularly *Spongospora* (21 fields). The work showed that yield was maximised by using whole seed (more vigorous than cut seed) and choosing fields with enhanced soil structure resulting from 7+ years of uninterrupted restorative crop growth (for example, grass). This was despite the continued presence of soil- and seed-borne disease and the fact that pre-plant potato cultivation negatively impacted some of the soil structural gains from the restorative grass phase.

Further work is needed to quantify the effect of crop type and cultivation history on soil physical quality, especially the cultivation undertaken immediately pre-potato planting, but is beyond the scope of the final year in this project. Instead, the team concentrated on measuring the contribution of seed-borne diseases on crop health.

The third year had three research components:

Firstly, a line of 'Russet Burbank' whole seed tubers was graded for visible *Rhizoctonia* black scurf (the resting structure or sclerotia, which can later cause stem canker) severity, using a standardised scale of 0%, 5%, 20%, 46%, 60% black scurf coverage. The tubers were either dipped or not dipped in formalin solution, and then planted in pathogen-free growing medium in planter bags (10 replicates). The resulting *Rhizoctonia* stem canker on the growing plants was just as severe for the 0% black scurf coverage (treated and untreated with formalin) as it was for the other four severity categories (formalin treatment average), with formalin treatment reducing overall severity by only 30% compared with the untreated controls. Implications are that an unknown proportion of commercial seed could be infected with *Rhizoctonia*, but without visible symptoms, and that formalin seed treatment may be only partially effective at controlling this disease. This warrants further investigation.

Secondly, a second planter bag experiment (10 replicates) used a random sample of commercially cut and Mancozeb-treated 'Russet Burbank' seed, arranged into categories relating to the number of cut sides (zero to three), half of which were also dipped in formalin to control surface diseases. Nine out of ten tubers with three cut sides and untreated with formalin failed to emerge, compared with only one out of ten tubers with three cut sides and treated with formalin. This reflects the amount of disease possibly present on cut seed. Increasing numbers of cut sides equated to increased variability in emergence rate and stem number, as well as reduced yields. In a field situation this could translate into a crop with a lowered yield potential and an unfavourable tuber size class distribution.

Thirdly, the health of seven commercial 'Agria' crops (harvested as G5, 2017–18) was monitored and compared with in-season health of the preceding seed lines (harvested as G4, 2016–17). A selected sample of the same G5 seed was grown in a controlled environment to estimate the potential incidence and severity of any seed-borne pathogens. For this study, all seed was planted whole. Amounts of *Rhizoctonia* stem canker were low in the G4 seed crops, G5 glasshouse plants and in all but one daughter crop, the latter of which was subjected to drought and flood conditions (Manawatu) during growth. *Spongospora* disease was scarce in the G4 seed crops and G5 daughter crops (some were grown in 'supressive' Pukekohe soils), but severe in the G5 glasshouse plants (this polycylic pathogen multiplies rapidly in optimum conditions). These results show that the presence of seed-borne inoculum is often highly likely, but if amounts are minimised through the supply chain, the impact on well-managed crops can also be minimal.

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