REDUCED RATE SEED MEAL AMENDMENT EFFICACY IS PLANT GENOTYPE-DEPENDENT

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Brassica seed meal formulations have been shown to provide effect control of the biologically complex disease phenomenon termed apple replant disease (Mazzola et al., 2015). The seed meal formulation when used at an application rate of 3 ton ac^{-1} provided disease control that was in some instances superior to pre-plant soil fumigation resulting in a corresponding increase in yields. In addition, the seed meal treatment resulted in a rhizosphere/soil microbiome that demonstrated greater resistance to pathogen re-infestation, which likely contributed to the greater yields relative to soil fumigation. However, due to greater upfront implementation costs relative to soil fumigation, grower adoption of this sustainable practice for control of apple replant disease has been muted irrespective of the greater potential yields attained. Therefore, studies have been initiated to examine the viability of reduced seed meal rates for control of replant disease and to determine whether rootstock genotype will influence the level of disease control attained. The potential role of soil biology in interaction between seed meal application rate and rootstock genotype-dependent disease control was also examined.

These studies employed a seed meal formulation comprised of *Brassica juncea* ‘Pacific Gold’ and *Sinapis alba* ‘IdaGold (50:50). The apple rootstocks utilized include the replant disease ‘susceptible’ M9 and MM106, and replant disease ‘tolerant’ G41 and G210. To date, categorization of these rootstock genotypes as susceptible, tolerant or resistant, in large part, has been based upon growth performance rather than a strict examination of host resistance to elements of the pathogen complex that incites replant disease. Seed meal was applied to an orchard soil having a well document pathogen complex which included *Pythium ultimum, P. sylvaticum, P. irregulare, Phytophthora cactorum, Rhizoctonia solani* AG-5 and AG-6, *Ilyonectria* spp. and *Pratylenchus penetrans*.

Significant changes in soil microbial community structure were observed in response to seed meal amendment, but occurred in a time-dependent manner. No differences in rhizosphere fungal community composition were detected by analysis of T-RFLP derived fragment data at 2 or 7 d post-seed meal amendment, but by two weeks post-amendment the community from soils treated at 2 t or 3 t ac^{-1} were different from the 1 t ac^{-1} and no treatment control soils. These differences were maintained over a period of 6.5 months. This effect appeared to be influenced by apple rootstock genotype. When studies were conducted with MM.106 and G.210 apple rootstocks, there were no apparent differences in MM.106 rhizosphere fungal community composition at 5 months post-planting (Fig. 1; top panel) but differences were observed in the rhizosphere of G.210 (Fig. 1, bottom panel). At the same time point, significant differences in rhizosphere bacterial communities were only observed at the 3 t ac^{-1} seed meal amendment rate for G.210 rootstock.

Tree growth in response to seed meal amendment rate exhibited a similar rootstock-dependency in a manner that, at times, paralleled rhizosphere microbial community dynamics. At the lowest seed meal amendment rate, MM106 rootstock did not exhibit an increase in growth relative to the no treatment control, but a progressive increase in growth at the 2 and 3 t ac^{-1} rate (Figure 2). In contrast, maximal growth of G.210 rootstock was obtained at a seed meal application rate of 2 t ac^{-1} with not additional increase in tree growth exhibited with a corresponding increase in seed meal application rate. These findings suggest that control of apple replant disease may be attained at a reduced seed meal application than that found to be effective in previous field trials when integrated with use of the appropriate apple rootstock genotype.

Reference:

Mazzola, M., Hewavitharana, S. and Strauss, S. L. 2015. *Brassica* seed meal soil amendments transform the rhizosphere microbiome and improve apple production though resistance to pathogen re-infestation. Phytopathology 105:460-469.

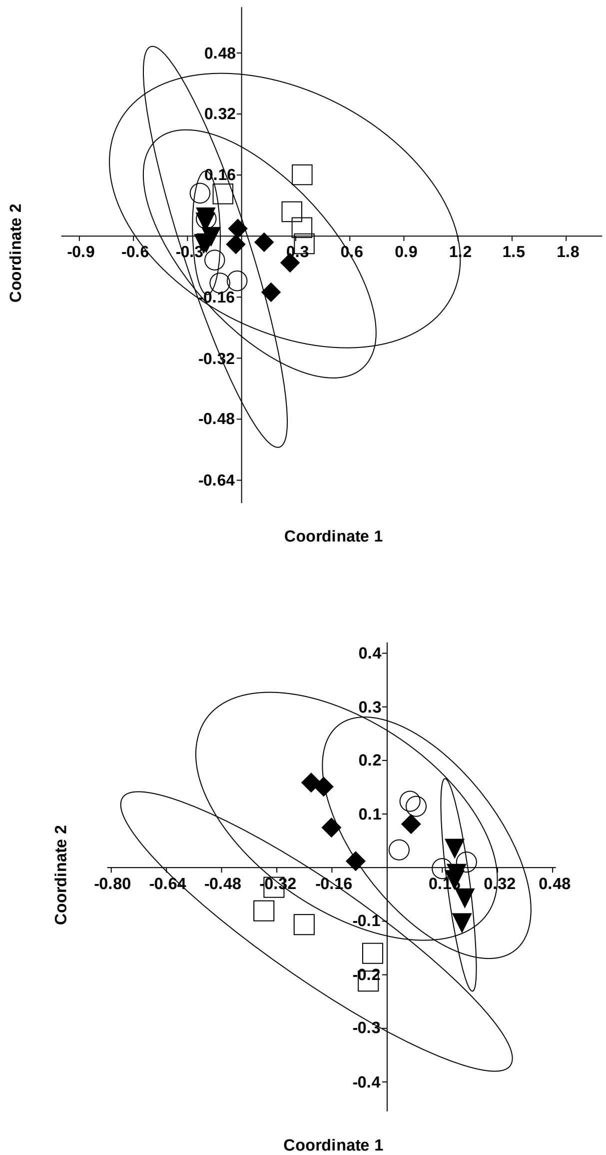

Figure 1. Effect of seed meal amendment rate and apple rootstock on composition of the rhizosphere fungal community detected at five months after planting as assessed by non-metric multidimensional scaling analysis of T-RFLP data. Top panel = MM.106 rootstock; Bottom Panel = G.210 rootstock. Ellipses represent the 95% confidence region. □= no treatment control; ♦ = seed meal 1 t ac^{-1}; ○ = seed meal 2 t ac^{-1}; ▼ = seed meal 3 t ac^{-1}.

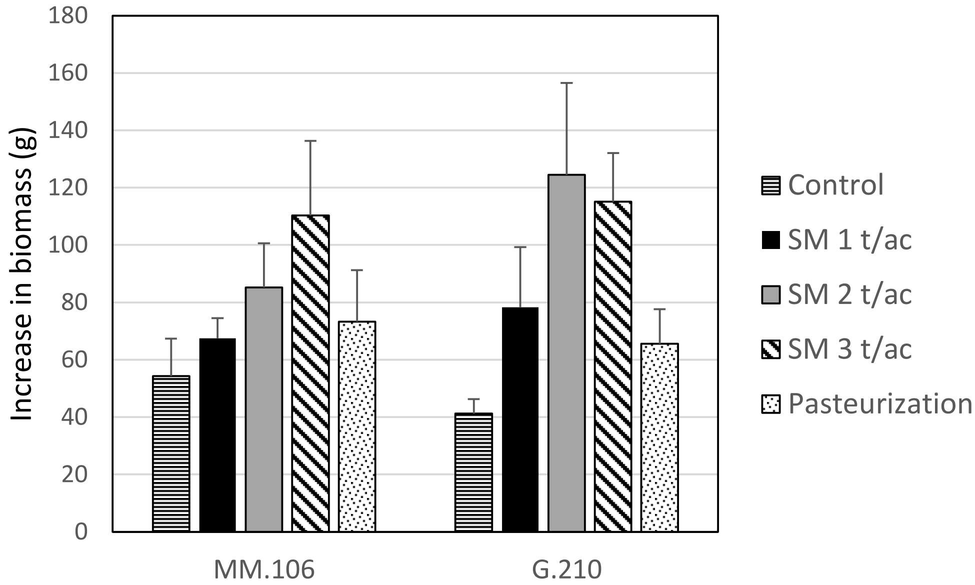

Figure 2. Increase in tree biomass after five months growth in orchard replant soil as influenced by seed meal amendment and rootstock genotype. Error bars indicate one standard deviation of the mean