Advances in Brassicaceae Seed Meal Formulation and Application Protocol for Control of Apple Replant Disease

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Successful use of Brassica seed meals as a method to control replant disease requires knowledge of active mechanisms and attention to detail. When used correctly, such treatment can be as effective as pre-plant soil fumigation **(Fig. 1).** When used incorrectly, tree death may be the only outcome.

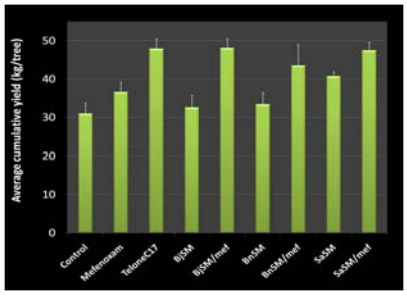

Figure 1. Cumulative fruit yield of Gala/M26 at Columbia View Orchard. When used in conjunction with the post-plant Ridomil (mefenoxam) soil drench, pre-plant soil amendment with brassicaceae seed meal significantly increased cumulative (2006-2009) fruit yields. Yields among Telone-C17 fumigation, *Brassica juncea*/mefenoxam (BjSM/mef), *Brassica napus*/mefenoxam (BnSM/mef), and *Sinapis alba*/mefenoxam (SaSM/mef) treatments were equal. When used **alone all** seed meal treatments failed to sufficiently improve fruit yields.

Three new plantings were established in 2010; STM Orchard, Chelan; WSU-Sunrise Orchard; WSU-Tukey Orchard, Pullman. The treatment was a *Brassica juncea + Sinapis alba* seed meal formulation; autumn or spring application; treated plots were tarped with VIF (**Fig. 2**).

Figure 2. Spring application and incorporation of seed meal prior to orchard planting. Treated soils were tarped with a virtually impermeable film (VIF) to contain volatile chemistries produced in response to *B. juncea* seed meal amendment.

Spring application of the *B. juncea + S. alba* seed meal formulation resulted in first year growth of apple that was superior to pre-plant fumigation at the STM organic orchard (**Fig. 3)** and significant weed control (**Fig. 4**). The same spring treatment significantly improved tree growth at Tukey organic orchard (no fumigation treatment) **(Fig. 5)** but did not suppress weeds.

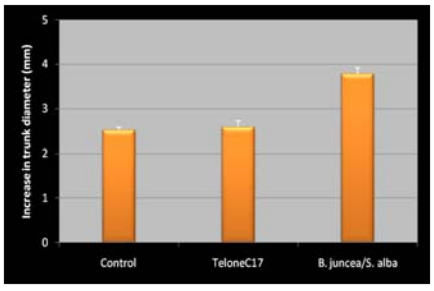

Figure 3. Increase in trunk diameter of Jonagold/G11 after the initial growing season at the STM organic orchard Chelan, WA.

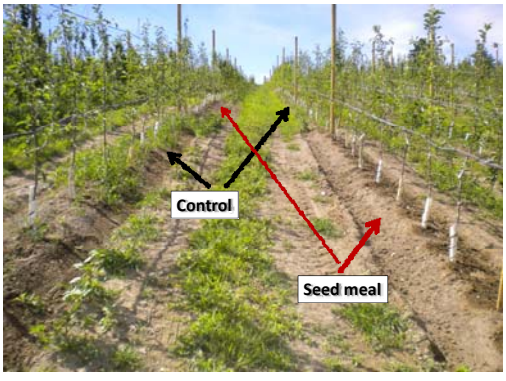

Figure 5. Relative weed density at the STM orchard on July 20, 2010 as influenced by seed meal (*B. juncea/S. alba*) amendment. At the STM organic orchard, seed meal amendment provided effective weed control throughout the initial growing season. Within row weed density was reduced by 85%. The same amendment **did not** provide weed suppression at the Tukey orchard.

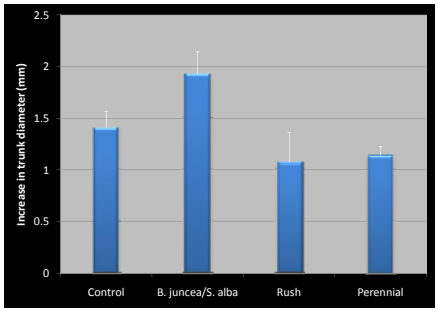

Figure 4. Increase in trunk diameter of Jonagold/G11 after the initial growing season at the Tukey organic orchard Pullman, WA. Perennial= perennial wheat; Rush=rush grass; plants were cultivated in the orchard for one season prior to planting apple.

Tree root health was superior in seed meal treated soil than in either the control or fumigated soils **(Fig. 6).**

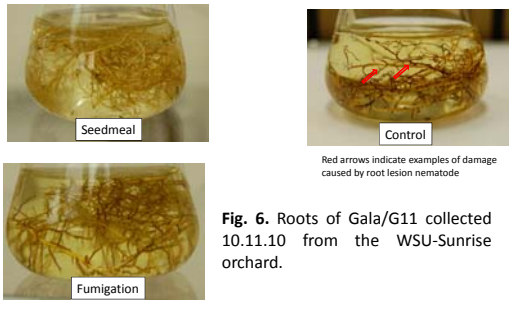

Fig. 6. Roots of Gala/G11 collected 10.11.10 from the WSU-Sunrise orchard.

At the WSU-Sunrise orchard, application date dramatically influenced efficacy of seed meal amendments. Spring applications of the *B. juncea + S. alba* formulation prior to planting induced severe phytotoxicity symptoms including tree mortality **(Fig. 7)**.

Figure 7. Mortality of Gala/G11 planted into soils treated with brassicaceae seed meal formulation April 6, 2010 and planted May 12, 2010 at the WSU-Sunrise orchard.

At the same site, autumn (September 29, 2009) application of the same seed meal formulation followed by planting on May 12, 2010 resulted in tree growth that was equivalent to that in fumigated soil **(Fig. 8).**

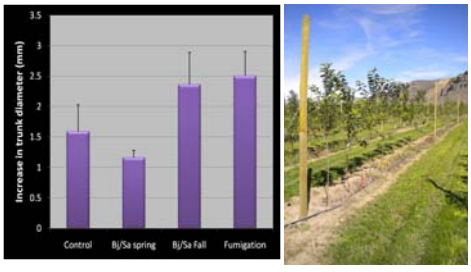

Figure 8. Relative growth of Gala/G11 planted into soils treated with seed meal formulations September 29, 2009 and planted May 12, 2010 at the WSU-Sunrise orchard (left). No phytotoxicity symptoms were observed (right panel).

Conclusions:

- Significant knowledge is required to effectively use brassicaceae seed meals for replant disease control
- Seed meal formulations, but not individual seed meals, can be effective
- Spring application with appropriate plant-back delay can be effective in high organic matter loam soils
- Spring application in low organic matter sandy soils will cause significant phytotoxicity and tree mortality; autumn applications are appropriate in such soils
- Seed meal treatment may provide weed control but will be dependent upon weed species composition resident to the orchard
- Tarping of soil after seed meal amendment with a virtually impermeable film is vital to attain effective disease control

Acknowledgments:
We thank **Custom Orchard Fumigation** for fumigation conducted at Sunrise orchard and **Stormy Mountain Ranch** for access to orchard ground. This research was funded by a grant from the **USDA-Integrated Organic Competitive Grants Program**.