Potential of Brassicaceae Seed Meal Formulations for Replant Disease Control in Organic and Conventional Orchard Systems

Mark Mazzola, USDA-ARS Tree Fruit Research Laboratory, Wenatchee, WA
David Granatstein, Washington State University, Wenatchee, WA

Program Goal:
Develop economically viable strategies for apple replant disease control in organic orchard systems. The strategy will focus on the use of brassicacous seed meals as these materials possess activity toward the breadth of pathogens and parasites which incite this disease.

Pathogen complex targeted for control:
➢The following organisms contribute to replant disease and comprise the pathogen complex targeted in our control program:

Fungi/Oomycetes
Cylindrocarpon
Pythium
Phytophthora
Rhizoctonia

Lesion nematode
Pratylenchus penetrans

2002 Field Trial:
➢In May 2002, field trials were planted to Gala/M26 and Golden Delicious/M7 at CV orchard and WVC orchard, respectively.
➢*B. napus* seed meal (BnSM) was applied to the old tree row at 8533 kg ha^{-1} with a Ridomil (mefenoxam) soil drench applied one week after planting.
➢BnSM/Ridomil treatment provided disease control and increased growth and yield comparable to that of pre-plant soil fumigation at the CV Orchard (Table 1).
➢BnSM/Ridomil **did not** provide long-term **control of lesion nematode** populations, and was inferior to pre-plant fumigation for replant disease control at the WVC orchard.

Field application of Brassica seed meal

Table 1. Impact of soil treatments on yield Of Gala/M26 at Columbia View Orchard

Treatment	Cumulative Yield Kg/tree (2003-06)
Control	**13.0a**
Telone-C17	**22.6b**
BnSM/Ridomil	**23.6b**

2005 Field Trial:
In April 2005, BnSM, *Sinapis alba* SM (SaSM) and *Brassica juncea* SM (BjSM) were applied individually with or without Ridomil post-plant soil drench at CV orchard and planted to Gala/M26, May 2005.

- Seed meal plus Ridomil treatments enhanced Gala/M26 growth relative to the control and were as effective asTelone-C17 (Fig. 1).
- In the absence of Ridomil, SaSM was the only seed meal that significantly improved tree growth relative to the non-treated control.
- In 2007, yields for all seed meal+Ridomil treatments and SaSM alone were comparable or superior to pre-plant soil fumigation (Table 2).

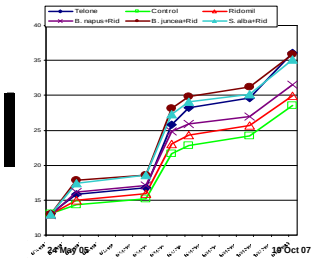

Figure 1. Impact of seed meal + Ridomil treatments on trunk diameter growth of Gala/M26 at CV orchard.

Table 2. Impact of soil treatments on yield (kg fruit/tree) of Gala/M26 at CV orchard

Treatment	2006	2007
Control	0.0	4.71a
Control + Ridomil	0.17	5.76ab
Telone-C17	0.20	6.94bc
B. napus	0.78	4.70a
B. napus + Ridomil	0.94	7.83cd
B. juncea	0.95	4.96a
B. juncea + Ridomil	1.49	9.29d
S. alba	0.45	7.01bc
S. alba + Ridomil	1.55	8.67d
P=	0.234	0.002

Ridomil effect:
❖ BnSM and SaSM amendments elevate activity of *Pythium* spp., which are controlled by Ridomil.
❖BjSM does not stimulate *Pythium* populations; in this instance Ridomil enhanced growth resulted from control of *Phytophthora cambivora*.

2006 Field Trial:
BnSM or a composite BnSM+BjSM amendment were applied at the RF organic orchard without Ridomil. The site was planted to various apple rootstocks in May and harvested in October.

- Application of the BnSM+BjSM composite seed meal or Telone-C17 fumigation suppressed *Pythium* populations (Table 3). The composite seed meal, but not BnSM alone, enhanced root biomass for certain rootstocks (Table 4).

Table 3. Effect of treatments on *Pythium* soil populations

Treatment	*Pythium* spp. cfu/g soil
Control	550b
Telone-C17	135a
BnSM	3890c
BnSM+BjSM	120a

Table 4. Effect of soil treatments on apple rootstock root biomass (g)

Treatment	G16	G30
Control	9.1a	9.8a
Telone-C17	16.5c	10.4a
BnSM	11.8ab	10.1a
BnSM+BjSM	14.2b	13.8b

2007 Field Trial:
At the same organic orchard, soil was fumigated with TeloneC17 or treated with BnSM+BjSM and planted to Gala/M26. Lesion nematode control (A) and initial tree growth (B) in seed meal amended soils was equivalent to that in fumigated soil and significantly better than the non-treated control (Figure 2).

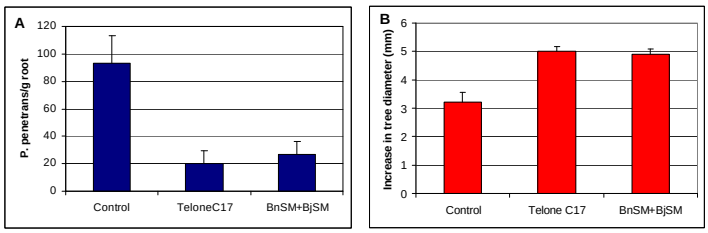

Figure 2. Impact of soil treatments on lesion nematode root populations (A) and increase in trunk diameter (B) of Gala/M26 at the RF organic orchard.

Conclusions:

- Brassicaceous seed meal amendments exhibit potential as an alternative to soil fumigation for control of apple replant disease.
- In organic orchard systems, a composite seed meal formulation is likely required to achieve effective disease control.
- Implementation of this strategy requires some knowledge of the causal pathogen complex, specifically with regard to populations of plant parasitic nematodes.
- Viability of the method requires additional examination for extended periods to determine long-term impact on orchard productivity.

ACKNOWLEDGEMENTS:
Funding for this research program was provided by the USDA-CSREES Integrated Organic Grants Program