

HEATING THINGS UP FOR CONTROLLING SEED-BORNE DISEASE IN DRY BEAN

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INTRODUCTION: In dry bean production, the use of high quality seed is very important as it can account for a large part of the input costs. The presence of seed-borne pathogens can lower dry bean yield and seed quality (Agarwal 1997). Currently several management practices including cultural, chemical, and genetic controls are used to lower disease incidence and severity (Agarwal 1997; Maude 1996; McGee 1997). Even with those control practices, seed-borne diseases are still difficult to manage. Therefore, the use of an alternative control method, microwave radiation, was tested to determine the effect on seed germination and pathogen viability of *Xanthomonas axonopodis* pv. *phaseoli* (Xap), *Pseudomonas syringae* pv. *phaseolicola* (Psp) and *Colletotrichum lindemuthianum*.

MATERIALS & METHODS:

Lab Study: Various microwave radiation treatments were applied to navy (cv. Navigator) and pinto (cv. Pintoba) beans infected with Xap or *C. lindemuthianum* and navy (cv. Envoy) and kidney (cv. GTS 402) beans infected with Psp using a home microwave oven (General Electric JES 1142 WPC microwave). Microwave exposures ranging from 0-90 s were applied at 10 s intervals (0-90 s) to each experimental unit. The seed was then planted following the Canadian Germination Commission (CGC) warm germ test protocol and evaluated using the Canadian Food Inspection Agency (CFIA) methods and procedures for seed testing. Disease plating was conducted to evaluate disease control on each seed lot using potato dextrose agar amended with 50% lactic acid for *C. lindemuthianum* and Xap and King's Medium B for Psp. From these results, a maximum exposure rate (MER) was determined for each seed lot, based on a minor decrease (<10%) in germination. Using the MER, a maximum rate (1x) and 1/2 x rate for microwave radiation exposure were determined for field trials in Ontario and Manitoba.

Field Study: A randomized complete block design (RCBD) was used to compare the effect of microwave radiation alone and in combination with two chemical seed treatments, a BASF experimental (BAS 720) and an industry standard using copper hydroxide (58.3%) for the bacterial blights and thiamethoxam, fludioxinol, metalaxyl-M, azoxystrobin for anthracnose. Ratings for percent disease severity (leaf and pod) were conducted throughout the growing season. In addition, ratings for plant emergence, vigour, yield, pick and a calculation on return on investment (ROI) were carried out.

Trt #	Treatment
1	Uninfected ('Disease Free') Control (UC)
2	Infected Control (IC)
3	BAS 720
4	Industry Standard
5	1/2 x Microwave (25 seconds)
6	1x Microwave (50 seconds)
7	1/2 x Microwave + BAS 720
8	1x Microwave + BAS 720
9	1/2 x Microwave + Industry Standard
10	1x Microwave + Industry Standard

RESULTS & DISCUSSION:

Lab Study: When microwave radiation was applied at 0-40 s no decrease occurred in seed germination for any of the seed lots. Over 60 s a decrease in seed germination was observed in all the seed lots. In the 40-60 s range a slight decrease in germination was observed, this length of time was where the MER was determined for each seed lot. For Xap, the MER of navy bean

was 60 s for both years and 60 s and 50 s for the pinto beans in 2012 and 2013, respectively. For Psp a MER of 50 s was determined for the navy beans in both years and 50 s and 40 s for kidney beans in 2012 and 2013, respectively. For the *C. lindemuthianum* infected navy beans a MER of 50 s was set for 2012 and 2013 and 50 s and 40 s was set for the pinto beans in 2012 and 2013, respectively. For disease plating a linear decrease in pathogen growth of *C. lindemuthianum* was seen with increased microwave exposure, however, no differences occurred for either of the bacterial blights.

Field Study: The microwave treatment caused a slight decrease in field emergence, ranging between 2-9%, for all seed lots. This loss was considered acceptable based on the MER parameters set in the lab studies. Two other differences were seen in emergence; the NIC was better than the IC for all studies (NIC used uninfected seed) and BAS 720 (92%) treatment had higher emergence compared to the TFMA (84%) in the navy bean trial for *C. lindemuthianum*. No differences were observed in vigour for any of the studies. For disease control in the bacterial blights, no differences in leaf or pod ratings were observed when the microwave treatment was applied. In the *C. lindemuthianum* studies, disease ratings were evaluated using an area under disease progress curve (AUPDC). The NIC had less disease symptoms than the IC and the addition of chemical seed treatment decreased disease symptoms when applied alone or in combination with microwave treatment. The application of microwave treatment did not decrease disease symptoms compared to the IC when applied alone or in combination with chemical treatments for both leaf and pod infection. For seed pick, no differences were detected in the Xap studies. In the kidney bean Psp studies, the NIC, chemical treatments and microwave treatments had lower visible infection compared to the IC. However, no differences were seen between any of the other treatments. In the pinto bean *C. lindemuthianum* studies, the NIC had lower infection compared to the IC and BAS 720 had fewer symptoms compared to the TFMA treatment. Finally for yield, no differences were seen in the Xap studies. In the Psp studies, a slight increase in yield occurred when chemical treatment was applied, however this was only seen at one study for both the navy and kidney beans. For *C. lindemuthianum*, the addition of chemical treatment to the microwave treatment increased yield compared to microwave treatment alone in the navy bean studies. However, only in 2013 did the chemical treatments alone yield higher than the IC. For ROI no differences were detected for Xap. For Psp, differences were only seen at one study for kidney beans, where the application of microwave and chemical treatment in combination lowered ROI compared to chemical treatment alone. Finally, for *C. lindemuthianum* ROI increased in the pinto studies when chemical and microwave treatment were applied together.

CONCLUSIONS: The application of a microwave treatment did not lower seed germination and had little impact on Xap, Psp, or *C. lindemuthianum* in the field. The addition of chemical treatment to microwave radiation or on its own also had limited impact on disease control.

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