



The Residual Effect of Mustard (*Brassica juncea* L. Czern.) Seed Meal for Suppression of *Sclerotinia homoeocarpa*

Xiaowei Pan¹, James T. English¹, Carl E. Sams² and Xi Xiong^{1*}

¹Division of Plant Sciences, University of Missouri, Columbia, MO, 65211

²Plant Sciences Department, University of Tennessee, Knoxville, TN, 37996

*Corresponding author: Xiongx@missouri.edu

Introduction

Dollar spot (Fig. 1) is a common turfgrass disease in the United States caused by *Sclerotinia homoeocarpa* F.T. Bennett. Repeated applications of fungicides to turf over the past 40 years have led to fungicide resistance to almost all registered materials. With loss of effective fungicides and increasing concerns about environmental impacts of pesticide applications, it has become important to develop bio-pesticide alternatives. Mustard (*Brassica juncea* L. Czern) seed meal (MSM) is one such alternative. Volatile isothiocyanates (ITCs), derived from glucosinolates (GSLs) contained in MSM, have been reported to suppress dollar spot under field conditions. However, the residual effects of ITCs were short-lived, and more than half of the ITCs were lost within 3 days of MSM application. We hypothesized that application of MSM as a mixture of non-treated and deheated MSM (lacking any bio-activity but containing equivalent levels of glucosinolates as the original material) would extend the period of volatile release and extend the period of pathogen and disease suppression.



Figure 1. Symptoms (left) and signs (right) of dollar spot caused by *S. homoeocarpa*.

Objectives

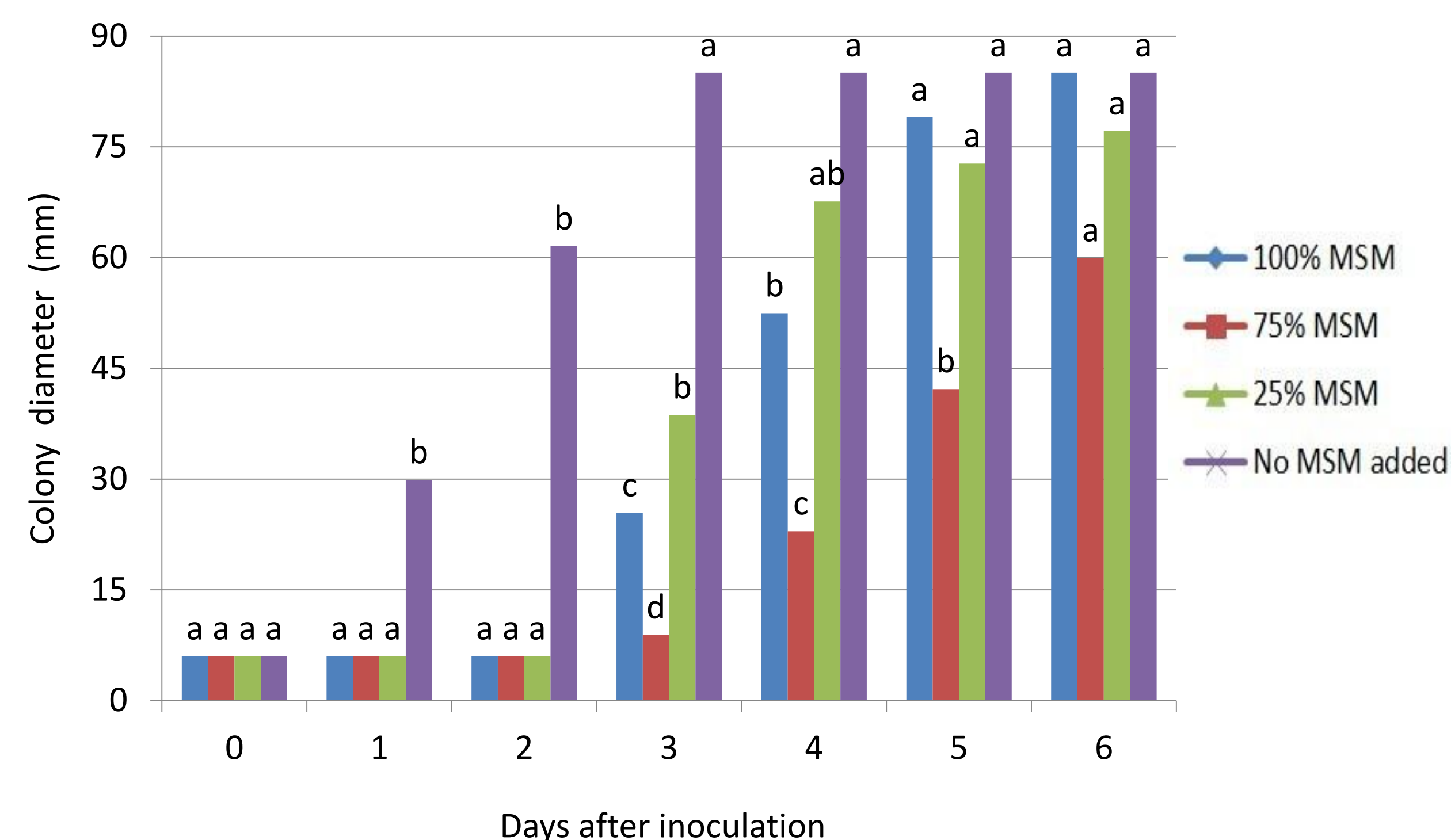
- Assess the suppressive effects of MSM applied as mixtures with deheated meal
- Assess the suppressive efficacy of MSM –deheated meal mixtures at different rates of application

Materials and Methods

- Experiment 1: MSM was applied alone to the surface of replicate PDA plates or as 25% or 75% mixtures with deheated meal (total mixture equivalent rate of 800kg/ha). Plates were sealed with two layers of parafilm.
- Experiment 2: MSM was mixed with 2ml sterile deionized water and added to the lid of replicate inverted PDA plates. Additional treatments included MSM as 25%, 50% or 75% mixtures with deheated meal, and deheated meal alone (total mixture equivalent rates of 400kg/ha or 800kg/ha). Plates were sealed with two layers of parafilm.
- In experiment 1, eight replicate plates were opened at either 0, 2, 4, 6, 8, or 10 days after addition of MSM and inoculated with a 6-mm plug of *S. homoeocarpa*. In experiment 2, six replicate plates were opened at either 0, 4, or 8 days after addition of MSM and inoculated with a 6-mm plug of *S. homoeocarpa*. Plates were resealed after inoculation and incubated in the dark at 24°C. A control treatment of *S. homoeocarpa* on PDA without MSM application was included in each experiment.
- Colony growth rate was recorded daily for a period of 2 weeks.

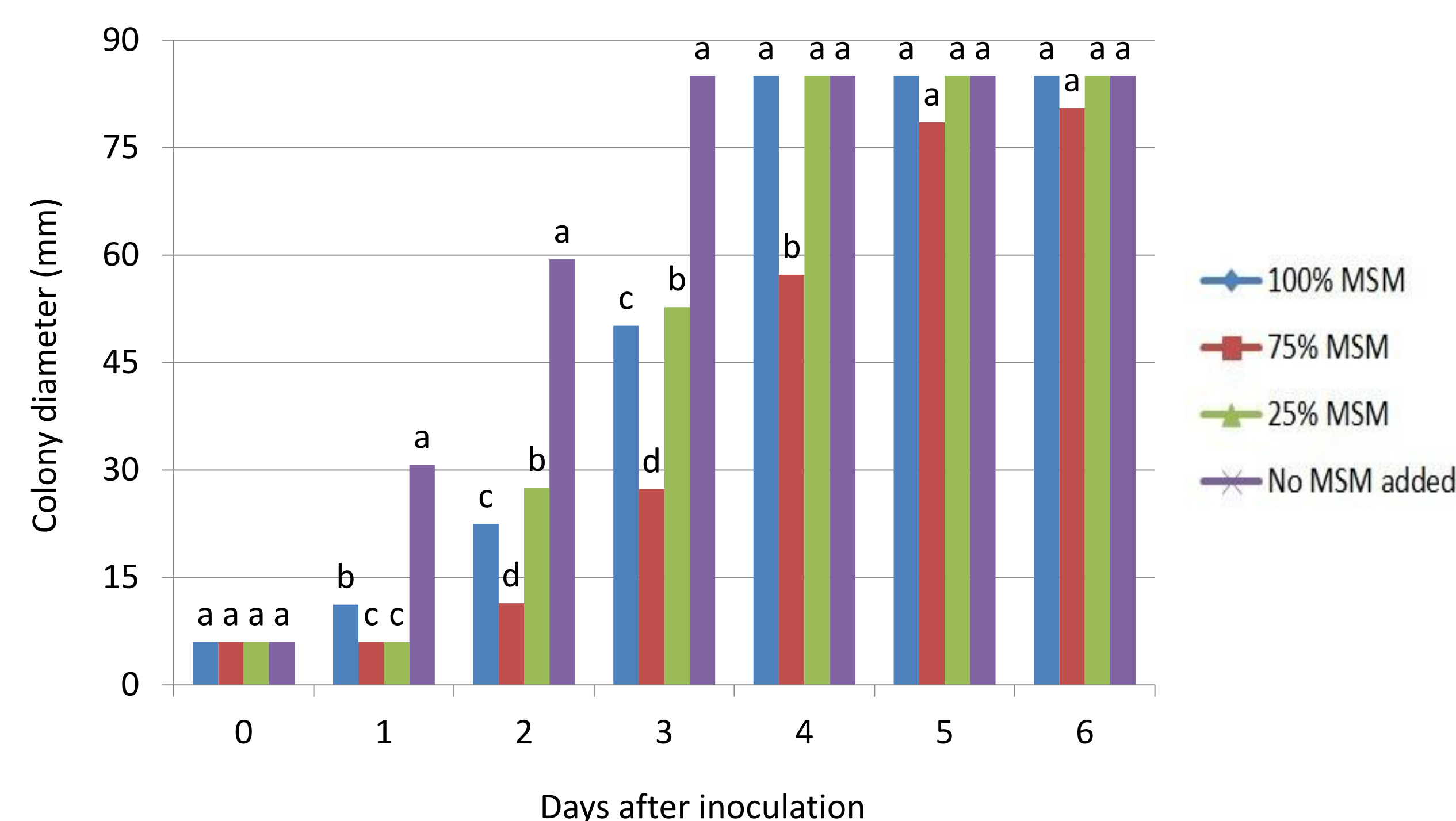
Results

Figure 2a. Growth of *S. homoeocarpa* after inoculation to PDA two days after amendment with MSM-deheated meal mixtures *



*Bars labeled by the same letter are not significantly different based on the Fishers' Protected LSD (p=0.05).

Figure 2b. Growth of *S. homoeocarpa* after inoculation to PDA four days after amendment with MSM-deheated meal mixtures.*



*Bars labeled by the same letter are not significantly different based on the Fishers' Protected LSD (p=0.05).

- 75% MSM had greater suppressive residual effect than other MSM treatments when PDA was inoculated 2 days after MSM amendment (Fig. 2a).
- Lesser suppressive residual effect was evident for any MSM treatment when PDA was inoculated 4 days after amendment (Fig. 2b).

Figure 3. *S. homoeocarpa* colony growth in experiment 1 after 3 days incubation on PDA amended with MSM alone (A), 75% MSM (B), or non-amended PDA (C). The meal mixture amendment rate was equivalent to 800kg/ha. MSM-deheated meal mixtures were applied to the surface of replicate PDA plates 4 days prior to pathogen inoculation. Colony margins are noted with blue marker.

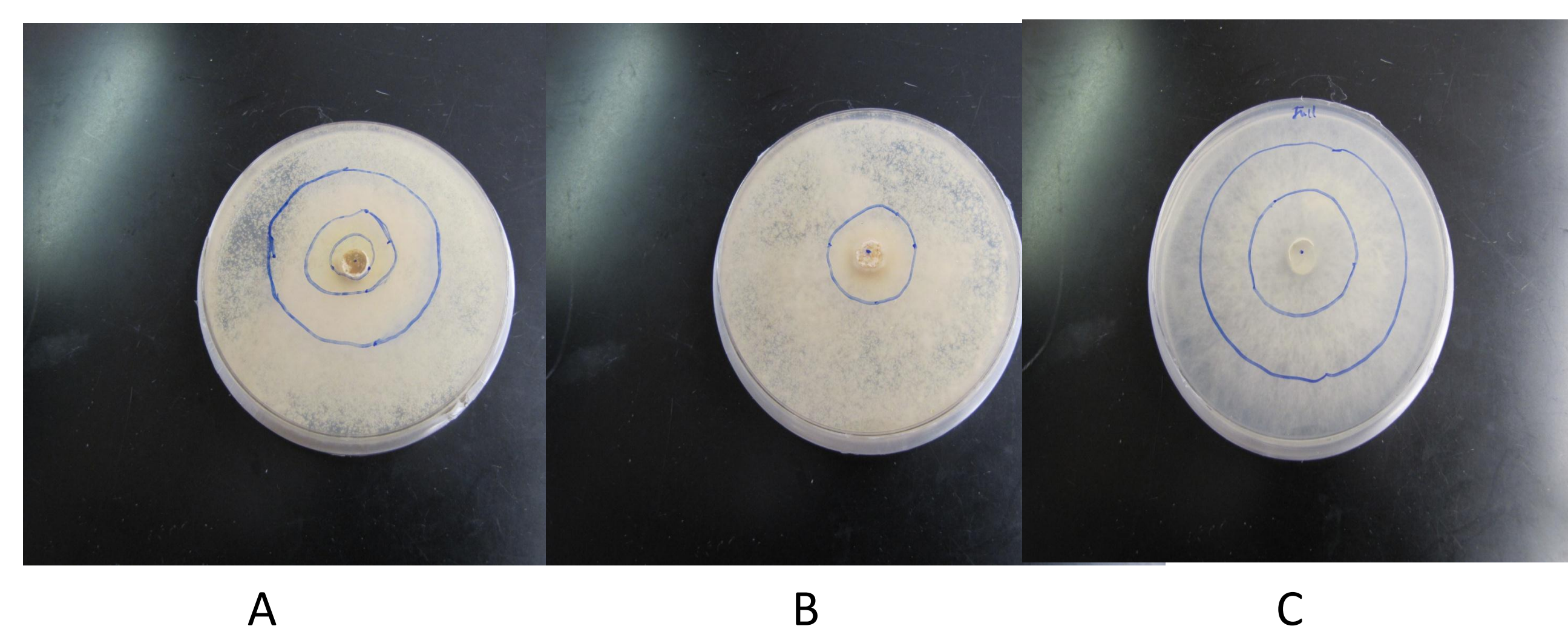


Table 1a. Growth of *S. homoeocarpa* inoculated to PDA 4 days after addition of MSM-deheated meal mixtures in water at equivalent rates of 400 or 800 kg/ha.

Treatment	Total rate (kg/ha)	Days after inoculation						
		0	1	2	3	4	5	6
25% MSM	400	6.0 ^a	14.6	37.3	65.1	84.3	85.0	85.0
50% MSM	400	6.0	6.0	15.1	37.7	62.4	79.2	81.2
75% MSM	400	6.0	6.0	6.0	10.4	18.8	31.4	45.4
100% MSM	400	6.0	6.0	10.9	28.9	51.9	70.2	71.7
100% D-Meal ^b	400	6.0	33.1	62.1	85.0	85.0	85.0	85.0
25% MSM	800	6.0	6.0	10.1	26.1	48.7	72.4	80.5
50% MSM	800	6.0	6.0	6.0	6.0	6.0	6.0	6.0
75% MSM	800	6.0	6.0	6.0	6.0	6.0	6.0	6.0
100% MSM	800	6.0	6.0	6.0	6.0	6.0	6.0	6.0
100% D-Meal	800	6.0	32.8	60.3	85.0	85.0	85.0	85.0
non-amended	0	6.0	27.5	56.8	85.0	85.0	85.0	85.0
LSD _{0.05}		0.0	0.9	1.7	4.1	7.1	9.0	10.6

^aColony diameter (mm); ^bDeheated meal.

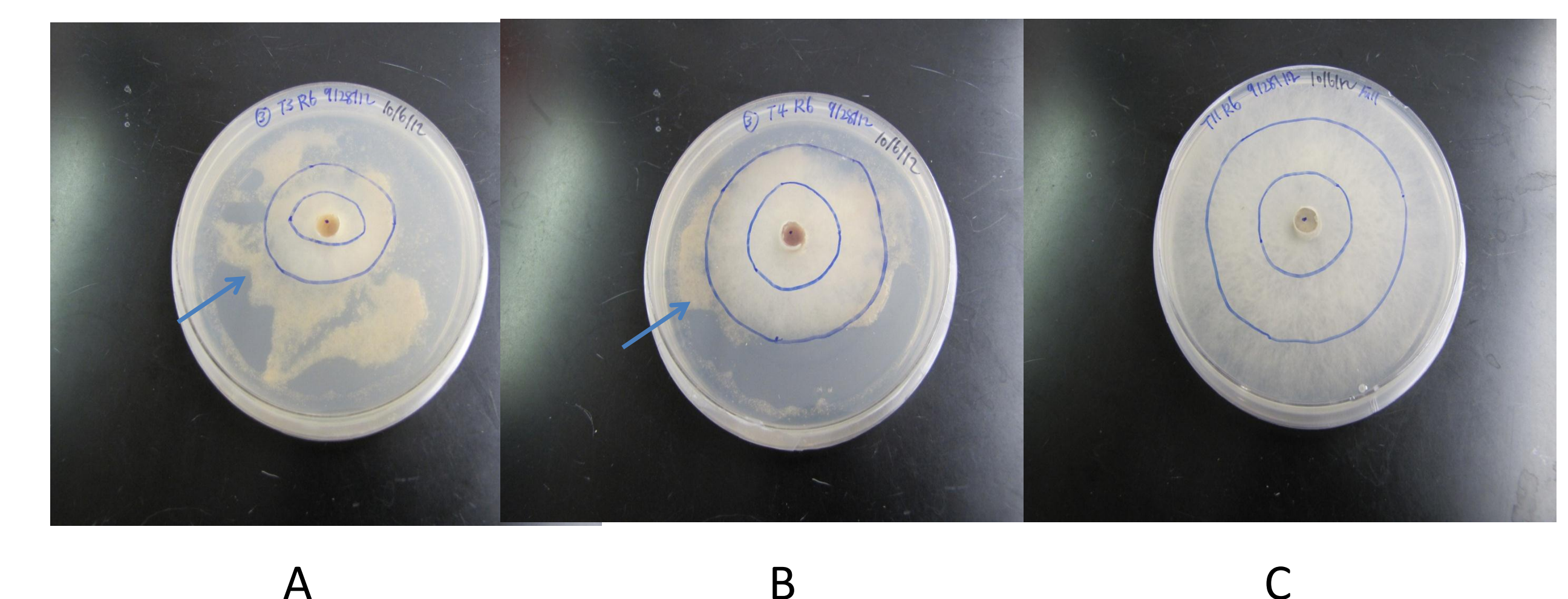
Table 1b. Growth of *S. homoeocarpa* inoculated to PDA 8 days after addition of MSM-deheated meal mixtures in water at equivalent rates of 400 or 800 kg/ha.

Treatment	Total rate (kg/ha)	Days after inoculation						
		0	1	2	3	4	5	6
25% MSM	400	6.0 ^a	15.6	43.4	71.3	85.0	85.0	85.0
50% MSM	400	6.0	7.3	25.5	51.4	77.8	85.0	85.0
75% MSM	400	6.0	6.0	16.9	35.4	59.6	75.5	83.6
100% MSM	400	6.0	6.0	25.0	49.4	74.7	82.4	85.0
100% D-Meal ^b	400	6.0	30.3	60.7	85.0	85.0	85.0	85.0
25% MSM	800	6.0	6.0	19.8	44.3	68.0	83.4	85.0
50% MSM	800	6.0	6.0	6.0	7.0	8.8	11.5	14.1
75% MSM	800	6.0	6.0	6.0	6.0	6.0	6.0	6.0
100% MSM	800	6.0	6.0	6.0	6.0	6.0	6.0	6.0
100% D-Meal	800	6.0	30.4	60.2	85.0	85.0	85.0	85.0
non-amended	0	6.0	25.5	56.0	85.0	85.0	85.0	85.0
LSD _{0.05}		0.0	0.7	1.8	2.4	2.5	3.2	3.7

^aColony diameter (mm); ^bDeheated meal.

- 75% MSM had a greater suppressive residual effect than other MSM treatments at the 400 kg/ha application rate when PDA was inoculated either 4 or 8 days after MSM amendment (Table 1a and Table 1b).
- At an application rate of 800 kg/ha, 50%, 75% and 100% MSM completely suppressed pathogen growth when PDA was inoculated 4 days after MSM amendment (Table 1a). When inoculated 8 days after MSM amendment, only the 75% and 100% MSM treatments completely suppressed pathogen growth (Table 1b).

Figure 4. *S. homoeocarpa* colony growth in experiment 2 after 3 days incubation on PDA amended with MSM alone (A), 75% MSM (B), or non-amended PDA (C). Meal mixture amendment rate was equivalent to 800kg/ha. Inverted PDA plates amended with MSM-deheated meal mixtures in water were applied to the lid (arrow) 8 days prior to pathogen inoculation. Colony margins are noted with blue marker.



Conclusions

- A 75%:25% MSM - deheated meal mixture provided greater residual suppression of pathogen growth than 100% MSM only at the 400 kg/ha rate.
- All MSM provided greater residual suppressive effect when applied in water treatments to the Petri plate lids compared to the application on the agar surface.