Evaluation of Post Emergence Applications of Mustard Seed Meal for Weed Control in Chile Pepper

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Introduction

- Pre-plant applications of Mustard Seed Meal(MSM) suppress weeds and soil-borne pathogens [1] ; however, MSM applications after crop emergence(i.e.,"POST applications") are poorly understood.
- POST applications of MSM potentially injure crops because of MSM's pesticidal property is due to volatile compounds (e.g., isothiocyanates) released after hydrolysis of glucosinolates [2].
- Chile pepper is a slow growing crop that competes poorly against weeds and is susceptible to soil-borne pathogens [3].
- Chile pepper weed control programs might benefit from POST applications of MSM, provided that such applications suppress weeds without injuring the crop.

Mustard seed meal application

Objectives

1.Conduct a greenhouse experiment to identify MSM application method and rate that is safe for emerged chile plants.

2.Using insights from Objective 1, determine if the method controls weeds and maintain fruit yield for chile pepper grown in field.

Materials and Methods

- MSM – *Brassica juncea*
- Glucosinolate (sinigrin) concentration: 203 µmol/g quantified by Adam-Dohney's Method [3]

Greenhouse study

Treatment and Design

- Randomized complete block design with 4 replications
- Experimental unit : three chile pepper plants grown in soil for 8 weeks before MSM application (figure 1)
- MSM treatments: Factorial combination of MSM rate (4400kg/ha, 2200kg/ha) and application location (Surface, Buried)

Data Collection

- Photosynthetic rate measured using LIcor- 6400 every 2 d after MSM application (figure 2)
- Height, fresh weight, dry weight, and leaf area at 14 days after MSM application

Data Analysis

- ANOVA and Post hoc Tukey test in R software

Figure1: Experimental set up in greenhouse

Figure 2: Photosynthetic rate measurement through LIcor

Field Study

Locations, treatment and design

•Two university research farms and two commercial farms
•Experimental unit: 6m row (paired with control plot)
•For each MSM rate (4400 kg/ha, 2200 kg/ha) within a site, randomized complete block design with 4 replications
•MSM applied and incorporated in furrows between neighboring rows

Data collection

•Weed emergence determined every 7 d for 28 d after treatment
1.Palmer amaranth (Amaranthus palmeri) in seeded cores
(6-cm diameter PVC pipes)
2.Ambient weeds in permanent, 0.25m^2 quadrats
• Chile pepper fruit yield

Data Analysis

• Weed emergence data: percent of control
•Yield data: Paired t-test

Results: Greenhouse study

- Surface applications at the high rate inhibited chile pepper photosynthesis throughout the study period.
- By six days after application, MSM no longer inhibited photosynthesis in surface applications at the low rate.
- Buried applications at the high rate initially reduced photosynthetic rates; but, by eight days after application, photosynthetic rates were comparable to the control treatment.

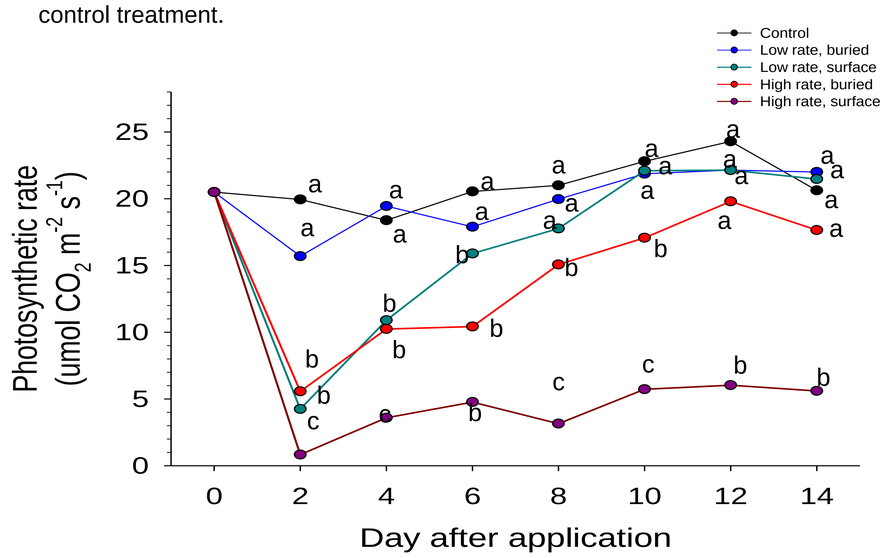

Figure 3:Photosynthetic rate of chile pepper leaves from Day 0 to day 14 of MSM application.(same alphabet within a day representing no significant difference)

- Chile pepper height, biomass and leaf area were similar between the control and buried application treatments (**Figure 4**).Surface applications at the high rate resulted in chile pepper plants that were smaller than control treatment.

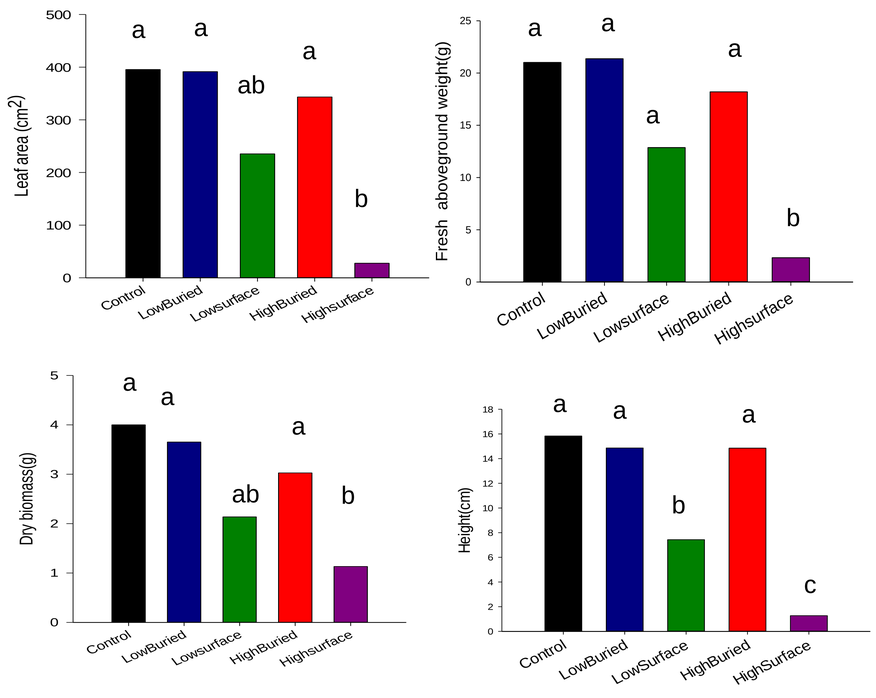

Figure 4: Leaf area ,Dry Biomass, Fresh weight and height of chile pepper plant through destructive sampling.(same alphabet represent no significant difference)

Results: Field study

- Post-emergence applications of MSM provided more than 50 percent of weed control in all sites and in average more than 80% weed control was achieved. Generally higher for MSM at 4400 kg ha^{-1} (**Table 1**)compared to MSM at 2200 kg ha^{-1} (not shown here**)**.
- For both rates and at all sites, post-emergence applications of MSM did not cause visual injury and did not reduce chile pepper yield (**Table 1)**.

Table 1:. The effects of mustard seed meal (MSM) at 4400 kg ha^{-1} on weeds and chile pepper fruit yield at four sites in southern New Mexico. Data are means with standard error, n = 4 unless noted otherwise.

Site	Treatment[1]	Weed control: Palmer amaranth[2]	Weed control: Ambient weeds	Chile pepper fruit yield[3]
		% of non-treated		kg $4m^{-1}$
Deming	MSM	83.3	100[4]	14.3 a
	Non-treated	--	--	14.9 a
Las Uvas	MSM	100	91.7	4.8 a
	Non-treated	--	--	5.2 a
Leyendecker	MSM	100	86.1	3.0 a
	Non-treated	--	--	4.6 a
Los Lunas	MSM	100	54.2	4.5 a
	Non-treated	--	--	4.8 a
	Weighted mean[5]	95.8	80.6	

[1]MSM was incorporated into soil between crop rows at 2 to 3 weeks after crop thinning.
[2] Control was determined using emergence data for a Palmer amaranth population that was intentionally seeded at all sites.
[3] Fresh weight of marketable, green chile peppers. Means with the same letter are not significantly different according to paired t-tests (α =0.05).
[4] Due to the absence of weeds in control plots, n = 2.

Impact statement

Weeds emerging in mid-season are difficult to control as there are few registered herbicides for chile pepper and mechanical control is only partially effective when crops are tall. Organic material review institute (OMRI) listed product MSM, could be an alternative tool for controlling late-emerging weeds. This research shows that MSM ,when applied in mid-season chile pepper by incorporating in middle of rows, controlled weeds significantly without causing injury to chile peppers. Findings from this research could specially benefit organic growers looking for weed control options after crop emergence.

Literature Cited

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[3]Doheny-Adams, T., Redeker, K., Kittipol, V., Bancroft, I., & Hartley, S. E. (2017). Development of an efficient glucosinolate extraction method. Plant Methods, 13(1), 17.

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