

## Use of Mustard By-Products for the Control of Dandelion in Turf

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### Summary

This study was initiated in the summer and fall of 2007. The objectives of this study were to test mustard to determine glucosinilate levels, test mustard by-products for their pre and post-emergent bioherbicide effects, test rate and timing of application, and to compare mustard with corn gluten meal as a pre-emergent herbicide. Yellow mustard had high levels of benzyl glucosinilate while oriental mustard had high levels of allyl glucosinilate. In the pre-emergent study, dandelions re-established on the site and the untreated control averaged 11 dandelions per m<sup>2</sup>. Those treatments that showed control of dandelions were the spring herbicide application, the oriental mustard foots at 120g/m<sup>2</sup>, and the corn gluten meal at 240g/m<sup>2</sup>. For the post-emergent study, only the spring herbicide application and the Sustane 5-2-4 had significantly fewer dandelions than the control plots that received no treatment. From both the pre and post-emergent studies, it appeared that the mustard products were ineffective for control of dandelion. The spring herbicide application was the only treatment that gave consistent, effective control.

### Introduction

Dandelions (*Taraxacum officinale*) are an important problem weed in turfgrass. Historically, they have been controlled largely by herbicide application. Currently, however, some municipal governments in Canada and other countries have proposed a ban on pesticide use in residential and other public areas. In some areas, these bans have already been implemented. Therefore, the development of alternative tools for weed control in home lawns and gardens, school grounds, and municipal parks is needed.

Biologically based weed control methods using agricultural by-products provide a possible alternative solution to chemical herbicides. There are many plants that have allelopathic properties, including: corn gluten, soybean meal, and mustard meal.

Corn gluten (*Zea mays* L.) can, inhibit weed seed germination but has no effect on established root systems (Liu and Christians, 1994). Control of seed germination has been reported with a number of other agricultural by-products including: mustard meal (Petersen et al., 2001). To date there haven't been any studies that have looked at the effect of mustard meal on dandelions.

Mustard meal and other members of the Brassicaceae contain glucosinolates. Both the volatiles (Brown and Morra 1995) and the water soluble products of glucosinolate hydrolysis can inhibit seed germination (Brown and Morra 1996; Mason-Sedun et al. 1986) and can inhibit seedling growth of some species (Brown and Morra 1997). In addition, they can kill a number of fungi (Sarwar et al. 1998) and insect species (Borek et al. 1998). However, mammalian systems metabolize and eliminate these products rapidly so they do not pose a problem to either humans or other mammals (Brown and Morra 1997). Consequently, mustard meal can be used as a feed supplement.

There are many different types of glucosinolates. However, two broad classes of glucosinolates are the aromatic glucosinolates which contain a benzene ring in their chemical structure (referred to as benzyl) and the aliphatic glucosinolates which do not contain a benzene ring (referred to as allyl) (Norsworthy and Meeham 2005).

Different species may contain different types of glucosinolates. For example, yellow mustard (*Sinapis alba*) contains hydroxybenzyl glucosinolate which is one of the benzyl glucosinolates (Borek and Morra 2005). In contrast, oriental mustard (*Brassica juncea*) contains sinigrin which belongs to the allyl class of glucosinolates (Vaughn et al. 2006). Horseradish (*Armoracia rusticana*) also belongs to the allyl class of glucosinolates.

While glucosinolates have been identified as having the potential of controlling seed germination of many different species (Oleszek 1987), they have not been tested on dandelion seeds or seedlings. If the glucosinolates could control dandelion seed germination and inhibit seedling growth, without causing phytotoxic side effects on the turfgrass, there is potential for using a product with a wider window of application than products that merely inhibit seed germination.

Different sources of glucosinolates were utilized to determine if there were differences in efficacy on dandelions between the allyl and benzyl glucosinolates including:

- yellow mustard (benzyl)
- oriental mustard (allyl)

Previously, a growth chamber study was conducted at Olds College where yellow and oriental mustard were assessed for control of dandelion at various growth stages. In that study, effective control was attained with oriental mustard when applied as a topical application to dandelion as either a pre or post emergent.

As a result of these findings a field study was initiated with the following specific objectives:

- Test mustard by-products for their pre and post-emergent bioherbicide effects
- Test rate and timing of application for mustard by-products
- Test all mustard materials to determine glucosinilate levels
- Test corn gluten for comparison to the mustards as a pre-emergent herbicide

## **Materials and Methods**

This field study was established in parks areas that had a high natural infestation of dandelion in Edmonton, Red Deer, Calgary, Lethbridge and Regina. In Lethbridge, two applications of the herbicide Par 3 were applied at the rate of 55 ml/100m<sup>2</sup> prior to the initiation of the study. In Calgary a single application of Killex 500 at the rate of 32 ml/100m<sup>2</sup> was applied. In Edmonton, Red Deer and Regina plots were not sprayed in order to test the post-emergent effects of the products applied. Plots that were 1.0 by 2.0 meters were established in a randomized complete block design with four replications. Individual weed counts were conducted prior to the first application of treatments within the trials.

The plots were evaluated a single time in the fall of 2007 and, were evaluated three times in 2008. Individual plots were evaluated for three quality factors, colour, density and area cover as well as for weed population. Quality ratings were based on the National Turfgrass Evaluation Program (NTEP) protocols where numeric values are assigned to individual plots where 9 is best and 1 is poorest, and 6 is considered acceptable. Colour was evaluated by 1 is a brown dormant turf and 9 is a very uniform dark green colour. Turf density, a measure of the number of shoots per unit area, was rated based on 1 is a thin, weak turf and 9 is a very dense tight-knit stand. The third

factor rated was area cover and values ranged from a 1 for a complete absence of turf to a 9 for complete cover with the desired turf. The presence of weeds or voids in the turf reduced this rating. Weed population was determined by counting the number of weeds in each plot.

The treatments for the post-emergent study where no prior herbicide was applied were:

1. Untreated control
2. Herbicide only spring application – Killex 500 32 ml/100m<sup>2</sup>
3. Herbicide only fall application – Killex 500 32 ml/100m<sup>2</sup>
4. Oriental mustard foos 120 g/m<sup>2</sup> spring application
5. Oriental mustard foos 240 g/m<sup>2</sup> spring application
6. Oriental mustard cake 120 g/m<sup>2</sup> spring application
7. Oriental mustard cake 240 g/m<sup>2</sup> spring application
8. Yellow mustard foos 120 g/m<sup>2</sup> spring application
9. Yellow mustard foos 240 g/m<sup>2</sup> spring application
10. Yellow mustard cake 120 g/m<sup>2</sup> spring application
11. Yellow mustard cake 240 g/m<sup>2</sup> spring application
12. Oriental mustard foos 120 g/m<sup>2</sup> fall application
13. Oriental mustard foos 240 g/m<sup>2</sup> fall application
14. Oriental mustard cake 120 g/m<sup>2</sup> fall application
15. Oriental mustard cake 240 g/m<sup>2</sup> fall application
16. Yellow mustard foos 120 g/m<sup>2</sup> fall application
17. Yellow mustard foos 240 g/m<sup>2</sup> fall application
18. Yellow mustard cake 120 g/m<sup>2</sup> fall application
19. Yellow mustard cake 240 g/m<sup>2</sup> fall application
20. Fertilizer Sustane 5-2-4 200 g/m<sup>2</sup> spring and fall applications

The treatments for the pre-emergent study where herbicide was applied prior to the initiation of the study were as follows:

1. Untreated control
2. Herbicide only spring application – Killex 500 32 ml/100m<sup>2</sup>
3. Herbicide only fall application – Killex 500 32 ml/100m<sup>2</sup>
4. Oriental mustard foos 120 g/m<sup>2</sup> spring application
5. Oriental mustard foos 240 g/m<sup>2</sup> spring application
6. Oriental mustard cake 120 g/m<sup>2</sup> spring application
7. Oriental mustard cake 240 g/m<sup>2</sup> spring application
8. Yellow mustard foos 120 g/m<sup>2</sup> spring application
9. Yellow mustard foos 240 g/m<sup>2</sup> spring application
10. Yellow mustard cake 120 g/m<sup>2</sup> spring application
11. Yellow mustard cake 240 g/m<sup>2</sup> spring application
12. Oriental mustard foos 120 g/m<sup>2</sup> fall application
13. Oriental mustard foos 240 g/m<sup>2</sup> fall application
14. Oriental mustard cake 120 g/m<sup>2</sup> fall application
15. Oriental mustard cake 240 g/m<sup>2</sup> fall application
16. Yellow mustard foos 120 g/m<sup>2</sup> fall application
17. Yellow mustard foos 240 g/m<sup>2</sup> fall application
18. Yellow mustard cake 120 g/m<sup>2</sup> fall application

19. Yellow mustard cake 240 g/m<sup>2</sup> fall application
20. Corn gluten 240 g/m<sup>2</sup> spring application
21. Corn gluten 240 g/m<sup>2</sup> fall application
22. Fertilizer Sustane 5-2-4 200 g/m<sup>2</sup> spring and fall applications

## Results

### *Glucosinilate levels*

The following mustards were tested for glucosinilate levels and are reported in table 1. Foots are considered to be the screenings that are left after cleaning mustard seed. The screening may include broken or undersized seed, as well as some stems and chaff. The cake is the bran of the seed that is left after the mustard oil has been extracted. Yellow mustard had high levels of benzyl glucosinilate, while Oriental mustard had high levels of allyl glucosinilate.

Table 1. Concentration of allyl and benzyl glucosinolate in mustards (measured in umoles/g).

Type of Glucosinilate	Yellow mustard foots	Oriental mustard foots	Yellow mustard cake	Oriental mustard cake
Allyl	0.14	113.20	0.21	178.29
Benzyl	88.71	0.13	158.98	0.25

### *Pre-emergent Control Study*

Prior to the initiation of this study in Calgary and Lethbridge, dandelions were eradicated with applications of herbicide so the effect of the treatments would be on emerging dandelions as they germinated i.e. pre-emergent control.

Dandelions re-established on the site in 2008 and the untreated control averaged 11 dandelions per m<sup>2</sup>. Those treatments that showed control of dandelions were the spring herbicide application, the Oriental mustard foots at 120g/m<sup>2</sup>, and the corn gluten meal at 240g/m<sup>2</sup> (Table 2). The other mustard treatments were ineffective.

Of interest, was the fall herbicide application treatment which showed that there were 11 dandelions per m<sup>2</sup>, the same number as in the untreated control plot. Previous research has shown that effective herbicide control is achieved in the fall. This would indicate that dandelions established in the 2008 growing season when conditions were conducive to germination and establishment.

The high rate of corn gluten and Sustane 5-2-4 improved the quality of the turf in comparison to the other treatments.

Table 2 – Weed control study with herbicide pre-treatment, 2008.

\* Values that have the same letter as a suffix are not considered to be significantly different from each other

<i>Post Emergent Control Study</i>	Treatment	Rate	Applied	Dandelion	Turf Quality
				per m <sup>2</sup>	1 – 9 scale
This portion of the study was conducted in Edmonton, Red Deer and Regina. For those sites that had no herbicide treatment prior to the initiation of the study, only the	Untreated Control			118abcd*	5.5def
	Herbicide Killex 500	32ml/100m <sup>2</sup>	Spring	4e	5.7defe
	Herbicide Killex 500	32ml/100m <sup>2</sup>	Fall	115bcd	5.6def
	Oriental Mustard Foots	120g/m <sup>2</sup>	Spring	18abc	5.6g
	Oriental Mustard Foots	240g/m <sup>2</sup>	Spring	11abcd	5.6c
	Oriental Mustard Cake	120g/m <sup>2</sup>	Spring	12abc	5.7de
	Oriental Mustard Cake	240g/m <sup>2</sup>	Spring	13abc	6.1bc
	Yellow Mustard Foots	120g/m <sup>2</sup>	Spring	13abc	5.8cde
	Yellow Mustard Foots	240g/m <sup>2</sup>	Spring	15ab	5.7de
	Yellow Mustard Cake	120g/m <sup>2</sup>	Spring	16a	5.8cde
	Yellow Mustard Cake	240g/m <sup>2</sup>	Spring	10bcde	6.0bcd
	Oriental Mustard Foots	120g/m <sup>2</sup>	Fall	14abc	5.8cde
	Oriental Mustard Foots	240g/m <sup>2</sup>	Fall	13abc	6.2b
	Oriental Mustard Cake	120g/m <sup>2</sup>	Fall	13abc	6.1bc
	Oriental Mustard Cake	240g/m <sup>2</sup>	Fall	9cdef	6.6a
	Yellow Mustard Foots	120g/m <sup>2</sup>	Fall	11abcd	6.0bcd
	Yellow Mustard Foots	240g/m <sup>2</sup>	Fall	10bcde	6.1bc
	Yellow Mustard Cake	120g/m <sup>2</sup>	Fall	15ab	5.9bcde
	Yellow Mustard Cake	240g/m <sup>2</sup>	Fall	9cdef	6.6bcde
	Corn gluten Meal	240g/m <sup>2</sup>	Spring	6def	6.0bcd
Corn gluten Meal	240g/m <sup>2</sup>	Fall	4f	6.8a	
Fertilizer Sustane 5-2-4	1kg N/100m <sup>2</sup>	Spring	6def	6.7a	
				LSD <sub>0.05</sub> =	
				5	0.3

spring herbicide application and the Sustane 5-2-4 had significantly fewer dandelions than the control plots that received no treatment (Table 3). The Sustane also improved the turf quality in comparison to the other treatments.

Table 3 – Weed control study with no herbicide pre-treatment, 2008.

\* Values that have the same letter as a suffix are not considered to be significantly different from each other

Oriental Mustard Foots	240g/m <sup>2</sup>	Spring	18abc	5.6bcd
Oriental Mustard Cake	120g/m <sup>2</sup>	Spring	17bc	5.5cde
Oriental Mustard Cake	240g/m <sup>2</sup>	Spring	20ab	5.7bc
Yellow Mustard Foots	120g/m <sup>2</sup>	Spring	20ab	5.2f
Yellow Mustard Foots	240g/m <sup>2</sup>	Spring	20ab	5.4def
Yellow Mustard Cake	120g/m <sup>2</sup>	Spring	17bc	5.3ef
Yellow Mustard Cake	240g/m <sup>2</sup>	Spring	19ab	5.7bc
Oriental Mustard Foots	120g/m <sup>2</sup>	Fall	19ab	5.3ef
Oriental Mustard Foots	240g/m <sup>2</sup>	Fall	17bc	5.6bcd
Oriental Mustard Cake	120g/m <sup>2</sup>	Fall	17bc	5.4def
Oriental Mustard Cake	240g/m <sup>2</sup>	Fall	18abc	5.8b
Yellow Mustard Foots	120g/m <sup>2</sup>	Fall	19ab	5.5cde
Yellow Mustard Foots	240g/m <sup>2</sup>	Fall	18abc	5.7bc
Yellow Mustard Cake	120g/m <sup>2</sup>	Fall	21a	5.4def
Yellow Mustard Cake	240g/m <sup>2</sup>	Fall	18abc	5.7bc
Fertilizer Sustane 5-2-4	1kg N/100m <sup>2</sup>	Spring	12d	6.2a
LSD <sub>0.05</sub> =			3	0.2