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Evaluation of corn gluten meal for preemergence weed management in cranberry SARE ONE 13-193

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Summary

Corn gluten meal (CGM) is a natural product that is typically used as a fertilizer (8-0-0), but also has reported herbicidal activity against germinating seeds. Its use as a method of preemergence weed control on cranberry farms was evaluated. The use of CGM in cranberry is a novel approach, therefore a greenhouse study was conducted to evaluate any potential phytotoxicity or harmful effects of CGM on cranberry plants prior to the establishment of a field study. With assistance from the grower, the field study was established at two sites on a recently planted organic cranberry farm in southeastern Massachusetts to evaluate if CGM suppressed new weeds. The results of this study showed that CGM was not an effective weed control on new cranberry beds, and that the addition of CGM actually led to an increase in weed biomass. Four months after the initiation on the experiment, untreated plots had an average weed biomass of 19.1 g/m^2, while plots which received CGM treatments averaged 109.4 g/m^2 (a range of 67.1 – 156.2 based on treatment). However, cranberry plants that received CGM showed a significant increase in growth, presumably from the additional nitrogen. Untreated plots had an average cranberry biomass of 3.4 g/ft^2, while plots which received CGM treatments averaged 7.3 g/ft^2 (range of 6.7 to 9.2 based on treatment). Providing adequate nutrition to organic cranberry beds is a challenge, and CGM may offer organic growers a good fertilizer option, especially when establishing new vines.

Introduction

There is a small but interested group of growers who want to produce organic cranberries in the Northeast. Cranberry growers cite weeds as serious pests that cause yield loss in commercial cranberry production (Pest Management Strategic Plan 2001; Sandler 2010), and lack of weed control has been cited as a primary obstacle to organic production. Organic cranberry production is not a common practice in the Northeast region, and research on pest management options for organic cranberry production is lacking. Organic growers are often operating on trial-and-error, rather than scientifically based practices. Information that drives and supports recommendations for organic management is also lacking. We recognize that there are gaps in our knowledge on organic management that, when filled, would increase the sustainability of cranberry farming. As a step towards closing this gap, we evaluated if corn gluten meal (CGM), a natural product approved for use in organic farming (OMRI 2012), could be an adequate method of preemergence weed control in new bogs.

Cranberry is a long-lived woody perennial, and in well-established production areas there is little open ground; most of the problematic weeds are perennial plants as well. Because CGM works against germinating weed seeds, it would provide little control in established beds. However, newly planted bogs have a lot of open space that can be colonized by weeds germinating from seeds that have been introduced to the agroecosystem by wind, water, or sand sources. Weed control is particularly critical for new plantings (DeMoranville et al. 2001). If weeds are not controlled in this initial stage, they retard or prevent cranberry vines from becoming established (Sandler 2004), which can negatively impact fruit production. Cranberry growers have expressed dissatisfaction with some weed control options and are willing to adopt new non-chemical methods if they are shown to be effective (Ghantous and Sandler 2010).

While conventional cranberry growers use herbicides on new plantings to control emerging weeds, organic growers rely primarily on labor-intensive hand weeding. Providing organic growers with effective supplements to hand weeding will help them become more sustainable. The cranberry industry is motivated to adopt effective pest management strategies that promote sustainability. Growers are motivated to reduce chemical inputs whenever possible because cranberries are grown in wetlands and farms are located in areas of dense suburbanization. If effective, the implementation of CGM as a preemergence weed management option could also be adopted by conventional cranberry growers who are committed to sustainability through adoption of IPM (integrated pest management) and willing to reduce chemical inputs when possible (Blake et al. 2007).

Corn gluten meal is a byproduct of wet-milling corn, and is a natural product which is approved for use in organic farming (OMRI 2012). It has been shown that CGM can provide effective weed control by inhibiting the root formation of germinating plants and affects both monocotyledonous (grasses) and dicotyledonous (broadleaf) species (Bingaman and

Christians 1995; Liu and Christians 1997). It works as a preemergence herbicide with no known effect on established weeds. The use of CGM as an herbicide use was pioneered in turf management, and it has also been used in crops such as onions and strawberries, but its utility as a weed control agent has not been tested in cranberry production (Abouziena et al. 2009; Christians 2002; Dilley et al. 2002; Webber et al. 2007). This project would focus on cranberry beds that were in the “vine establishment”, which is has ample open space to allow weeds to enter the system as germinating seeds, as opposed to established beds that have mainly perennial weed species. Since CGM has a high organic nitrogen content (typically 8%), applications would also provide nutrition for establishing young vines in organic plantings as well as reduce the use of inorganic fertilizer for conventional growers who incorporate CGM into their IPM program.

This study evaluated the efficacy of CGM for preemergence weed control on young cranberry bogs based on current knowledge about CGM from studies done with turf and other crops. Two sets of experimental plots were established on an organic farm that was planted less than 3 years ago and where vines were still not adequately colonizing the surface. In the early spring of 2013, the plots were hand weeded to remove existing weeds, and then treated with a granular application of CGM. Susceptibility of weeds to CGM may vary by species (Bingaman and Christians 1995) so plots were evaluated for which weed species were present in each plot, and the relative cover of each weed. Prior to cranberry harvest, all the weeds were collected from each plot and biomasses were quantified by drying and weighing weeds by species.

The grower collaborator provided the research area on the farm, general farm maintenance, and the grower assisted with the initial establishment of the plots and was present during CGM application. The staff from the Cranberry Station was responsible for treatment applications, data collection and analysis, outreach programs, and other communications with the industry.

Objectives/Performance Targets

A granular CGM product formulated for organic agricultural use was obtained from a commercial supplier (McGeary Organics, Inc., Lancaster PA).

A greenhouse experiment was conducted on potted cranberry plants at the UMass Cranberry Station in East Wareham, MA, to evaluate any potential negative effects of CGM on cranberry plants. Plants were treated, monitored, and data were collected and analyzed.

A field study was established on two sites at a farm in Manomet, MA to evaluate CGM for preemergence weed control on recently planted cranberry beds. Plots were treated, monitored, and data were collected and analyzed.

In addition to originally proposed work, samples were collected for tissue nutrient analysis. It was noted that cranberry plants that received CGM were larger than untreated plants. CGM is also used as a fertilizer, and it may be a good source of nutrition for establishing cranberry beds, especially for organic growers.

We obtained contact information for organic cranberry growers in the Northeast from 2013 List of certified USDA organic operations (USDA National Organic Program). A phone survey was conducted in the spring of 2014 to gather information on pest management currently used by organic cranberry growers.

We had proposed hosting a bogside workshop at the study site. The CGM did not provide any weed control to treated plots. In fact, weeds treated with CGM were larger and more numerous than those in untreated areas. We did not host a bogside workshop because we felt we had failed to demonstrate the efficacy of CGM as a preemergence weed control.

Materials and Methods

A granular CGM product formulated for organic agricultural was obtained from a commercial supplier (McGeary Organics, Inc., Lancaster PA). On April 1, 2013 a greenhouse experiment, utilizing the facilities at the UMass Cranberry Station in East Wareham, MA, was initiated using potted cranberry plants to evaluate any potential negative effects of CGM on cranberry plants. Rooted cranberry plants established from cuttings approximately six months prior to treatment were used in the greenhouse test. Each pot contained a single cranberry plant. Baseline measurements were made for each plant (number of stems counted and length of stems measured). Each plant received one of three rates (untreated, low, and high) of CGM, and treatments will be replicated four times. The low rate was 20 lbs/1000 ft^2 (manufacturer's recommendation), and the high rate was be 40 lbs/1000 ft^2. The plants were visually monitored for signs of damage (1 week after treatment, and monthly thereafter). Five months after treatment on September 3, 2013, the number and length of stems were determined for each plant, and the aboveground portion of the plants was collected. The biomass was placed into paper bags and dried in an oven at 60°C for at least 3 days, then weighed. The data were analyzed to test for differences in stem number, stem length, and cranberry biomass between the CGM treatments (SAS Institute 2008).

The field study was established at two sites on an organic cranberry farm in Manomet, MA as a randomized complete block design. Each site was a young cranberry planting (< 3 yr since planting).Plots 1 m^2 were marked with pin flags and hand weeded on April 11, 2013. Each plot received one of five treatments: untreated, low CGM (one application of 20 lbs/1000 ft^2), low CGM with a follow up application (one application of 20 lbs/1000 ft^2 followed by 10 lb/1000 ft^2 four weeks later), high CGM (one application of 40 lbs/1000 ft^2),

or high CGM with a follow up application (one application of 40 lbs/1000 ft^2 followed by 10 lb/1000 ft^2 four weeks later). Evidence indicates that CGM will affect germinating seeds for several weeks, so treatment timings were spaced 1 month apart to capture a total of 8 weeks when the majority of annual weeds germinate (Christians 2012). All treatments were replicated five times per site. The initial CGM application was made April 15, 2013. The second CGM application was made on May 14, 2013 to plots scheduled to receive two applications.

A weed survey was done to document which weed species were present in each plot, and the percentage of weed and cranberry cover in each plot on June 27, 2013. Cranberry cover was also evaluated. Approximately 4 months after the study was initiated, all weeds in each plot were collected and sorted by species on August 15 (Site 1) and August 20 (Site 2), 2013. Cranberry biomass was evaluated by harvesting a 1-ft^2 area of cranberry vines from each plot. In addition, cranberry samples were collected from the grower managed areas outside the plots so that cranberry plants in plots could be compared to the grower practice. These samples were dried in an oven at 60°C for at least 3 days and weighed to determine weed biomass of each weed species in each plot. This information was analyzed to determine if CGM reduces the overall amount of weed biomass, which weed species it controls, which rate and frequency of treatment gives the best weed control, and if CGM affects cranberry vine coverage (SAS Institute 2008).

We obtained contact information for organic cranberry growers in the Northeast from 2013 List of certified USDA organic operations (USDA National Organic Program http://apps.ams.usda.gov/nop/). For the Northeast region, the only certified organic cranberry operations were nine Massachusetts growers. A phone survey was conducted in the spring of 2014 regarding current pest management practices. We contacted seven growers and spoke with three people.

Results and Discussion/Milestones

The greenhouse experiment conducted on potted cranberry plants to evaluate effects of CGM on cranberry plants did not show any negative impacts on the plants. Plants which received either the low or the high rate of CGM were significantly larger (greater stem length and biomass) that untreated plants (Table 1).

The field study showed that CGM is not effective for preemergence weed control on cranberry plantings. CGM is also used as a fertilizer since it releases nitrogen as it breaks down (8-0-0). The plots that received CGM had significantly more weeds than untreated plots, and it is likely that the addition of nitrogen supported weed growth rather than suppressed it (Dilley et al. 2002) (Figure 1).

Other studies have found that CGM inhibits root formation during the seed germination period, and that weed control results from seedling mortality due to water stress (Bingaman

and Christians 1995). It is possible that the cranberry environment has too much moisture for seedlings to suffer water stress, and they can recover from the initial root inhibition (Christians 1993).

Despite the lack of weed control, CGM may be a good fertilizer option for organic cranberry growers. Cranberry biomass was collected from a $1ft^2$ area in each plot. Plots that received CGM treatments had significantly more cranberry biomass than either untreated plots or samples obtained from areas receiving standard grower management (Figure 2). Providing new cranberry plantings with sufficient nutrients to quickly establish a continuous canopy is important, and is especially challenging with organic fertilizers. See photos of all plots in Document 5.

Three organic cranberry growers were surveyed about their farm operations and production challenges. All three used chicken manure (typically 4 lbs N or less per 100 lbs) and/or fish fertilizers (similar N to chicken manure) as their sole fertilizers. Two growers were utilizing organic pesticides to control insects, and two were using a cultural practice referred to as “late water”, which is a one-month spring flood. All three growers were using hand weeding as their primary weed management. Only one grower was using organic herbicides. All growers indicated that they would like more cost-effective options for controlling pests, and would be willing to participate in research efforts.

Impact of Results/Outcomes

The original focus of this study was preemergence weed management with CGM. The product was not effective for weed control on cranberry plantings, but future work may focus on the use of this product as a fertilizer for new cranberry plantings, especially for organic farms. In addition, this project served to foster a good working relationship with the partner farmer, who has now become part of an IPM mentoring program through UMass Extension. In addition, we have identified other organic cranberry growers in the region, and would like to host a brainstorming/discussion group in the near future to bring together the small population of organic cranberry growers to discuss the challenges of organic production in the region.

Economic Analysis

Publications/Outreach

The results of this study were shared with cranberry growers in the UMass Cranberry Station Newsletter, June 2014:
http://www.umass.edu/cranberry/downloads/newsletters/June.5.2014.pdf

Farmer Adoption

Areas Needing Additional Study

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Supporting File(s):

Figure 1: http://mysare.sare.org/mySARE/assocfiles/986512Figure 1.docx
Figure 2: http://mysare.sare.org/mySARE/assocfiles/986512Figure 2.docx
Table 1: http://mysare.sare.org/mySARE/assocfiles/986512Table 1.docx
Literature Cited: http://mysare.sare.org/mySARE/assocfiles/986512Literature Cited.docx
June 5 2014 Article in UMass Cranberry Experiement Station Newsletter:
http://mysare.sare.org/mySARE/assocfiles/986522ONE13-193SandlerNewsletterJune.5.2014.pdf
Photos of treated plots: http://mysare.sare.org/mySARE/assocfiles/986512CGM pictures.docx
View this report online: http://mysare.sare.org/mySARE/sare_main.aspx?do=viewRept&pn=ONE13-193&y=2014&t=1

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