OREGON MINT COMMISSION

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UPDATE

Weed Control in Peppermint

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Ten herbicide evaluation research studies were conducted throughout western and eastern Oregon by the OSU Weed Science Program. Results from some of these studies are discussed below. For more detailed herbicide application information and crop rotation restrictions refer to specific herbicide labels and to the Peppermint Management Chapter in the 2008 Pacific Northwest Weed Management Handbook.

Field Bindweed Control with Sulfentrazone and Sequential Herbicide Treatments

Field bindweed (*Convolvulus arvensis* L.) is a perennial weed that reproduces by seeds and an extensive lateral root system. It is a weed that many growers feel is of primary concern in peppermint production. The lack of effective herbicides and tillage in the peppermint crop result in the rapid build up of this species in peppermint production. Field bindweed is a tough perennial to kill once established with a root system that can be up to 18 feet in length.

Spartan is effective at suppressing field bindweed populations in established peppermint, however, a post-emergence herbicide applied sequentially to the established peppermint to continue to suppress field bindweed would be useful for peppermint growers. Two field studies were conducted in the Willamette Valley to assess the efficacy of Spartan applied to dormant peppermint followed by a post-emergence application of Aim (carfentrazone), Starane or Thistrol (MCPB) for the control of field bindweed. The Benton County site had a low infestation of field bindweed, while the Lane County site was heavily infested. Mid-April evaluations of field bindweed control were 100 percent in Benton County and 85 percent in Lane County following the February applications of Spartan.

Ten days after the June 1 application of the postemergence applied herbicides there was little reduction in bindweed growth in the Spartan treated plots compared to the untreated check (Table 1). The bindweed was significantly impacted by the Aim treatment

(continued on page 2)

Table 1. Field bindweed control, peppermint injury and peppermint oil yield following herbicide applications, Corvallis and Junction City 2007

			Peppermint					
			Field bindweed control [1]		Injury [1]		Oil[2]	
Treatment	Application timing	Rate	Benton	Lane	Benton	Lane	Benton	Lane
		lb. a.i./A	----------%----------				---------lb./A--------	
Check	NA	0	0	0	0	0	49	29
Spartan	February 16, 2007	0.375	13	7	0	0	40	41
Spartan/ Aim	February 16, 2007 June 1, 2007	0.375 0.015	83	92	13	17	33	34
Spartan/ Starane	February 16, 2007 June 1, 2007	0.375 0.094	67	67	3	5	41	35
Spartan/ Thistrol	February 16, 2007 June 1, 2007	0.375 0.25	70	72	3	0	45	37
LSD (0.10)			20	21	4	4	ns	ns

[1] Evaluated June 11, 2007 [2] Harvested July 26, 2007

at both sites. The Thistrol treatment ultimately provided the best bindweed suppression into July. However, it should be noted that currently Thistrol is not labeled for use in peppermint in Oregon. There were no significant differences among the treatments in peppermint biomass or oil yield at either location in 2007.

Peppermint Tolerance to Herbicide Treatments during Dormancy

Applications of currently registered herbicide treatments were compared for crop safety in an established peppermint field in Polk County. The field was very wet during the winter and spring months which may have affected the level of crop injury that was caused by some of the herbicide treatments. Gramoxone (paraquat) (0.25 lb. a.i./A) was included with each experimental herbicide treatment to control a heavy infestation of willowweed (*Epilobium* spp.) at the study site. Chateau, Spartan and Goal (oxyflurofen) caused the greatest initial crop injury when evaluated in March (Table 2), eight weeks after application. Crop injury on May 1 was still excessive in three of the four Chateau plots. When harvested on June 21, all treatments produced oil yields greater than the untreated check. However, oil yield from the Prowl H_2O (pendimethalin) treatment was lower because this treatment failed to adequately control later emerging willowweed.

Chemigation with Treflan (trifluralin) on Baby Peppermint

Treflan received registration in 2007 for chemigation use on established, dormant peppermint. A study was conducted at Hyslop farm on fall planted peppermint to evaluate crop safety and the control of summer annual broadleaf weeds with nondormant chemigation timings of Treflan. Chemigation was simulated by applying Treflan in a broadcast spray during sprinkler irrigation.

Pigweed species control was good through the end of June, but the higher rate of Treflan (0.75 lb. a.i./A) was required to provide 75 percent control through mid-August (Table 3). The lower rate (0.5 lb. a.i./A) caused a similar amount of crop stunting and oil yield reduction as the higher rate at the first harvest. Oil yield reductions in the first harvest were 35 percent of the untreated check (Table 3). These initial results indicate that established peppermint stands are better able to tolerate Treflan chemigation treatments. Incorporation of Treflan by rain in established peppermint stands may be a more feasible weed management method than Treflan chemigation treatments on baby peppermint in the Willamette Valley.

Table 2. Peppermint tolerance to herbicides applied pre-emergence

Treatment	Rate	Peppermint Injury 3/21/2007	Peppermint Injury 5/1/2007	Oil Yield
	lb. a.i./A	----------%----------		lb./A
Check	0	0	0	18
Spartan	0.375	68	13	38
Command	0.5	18	18	35
Prowl H_2O	2.0	15	5	29
Sinbar	1.2	0	13	43
Chateau	0.128	82	45	38
Goal	0.5	68	25	40

Evaluation of Herbicide Treatments on Dormant Peppermint in Northeastern Oregon

Three field studies, two in Union County and one in Baker County, were established to compare the efficacy and crop safety of eight registered herbicide treatments and to evaluate Starane (fluroxypyr) for crop safety in peppermint. Starane is not currently registered for use in peppermint. The peppermint stand at the Baker County site did not survive the winter so no efficacy data was obtained from this location.

Visual evaluations of control were conducted at a site near La Grande in Union County on prickly lettuce (*Lactuca serriola*), kochia (*Kochia scoparia*) and tumble mustard (*Sisymbrium altissimim*) (Table 4). There was limited foliar injury to the peppermint from the Starane (10 percent) and Buctril (bromoxynil) (7 percent) treatments, but peppermint foliage fresh weights and oil yields did not differ among the treatments.

Kochia was the primary weed species present at the site near Union in Union County. The only treatments that provided acceptable control of kochia through late June were Starane (99 percent), Spartan (sulfentrazone) (93 percent) and Starane + Buctril (98 percent) (Table 5). Starane caused some crop injury early in the growing season and a 39 percent reduction in peppermint oil at harvest compared to the untreated check. When Buctril was tank mixed with Starane, crop injury was reduced and peppermint oil yield was comparable to the untreated check. Sinbar (terbacil), Karmex (diuron) and Command 3ME

Table 3. Chemigation with Treflan on baby peppermint

Treatment	Rate	Peppermint Injury 6/25/2007	Peppermint Injury 8/13/2007	Amaranth Control 6/25/2007	Amaranth Control 8/13/2007	Oil Yield 7/2/2007	Oil Yield 8/27/2007
	lb. a.i./A	----------%----------				lb./A	
Check	0	0	0	0	0	28	19
Treflan	0.5	28	23	90	35	19	16
Treflan	0.75	18	13	98	75	19	23

(clomazone) treatments resulted in the highest oil yields at this location (Table 5).

Chateau (flumioxazin) was included in all the Eastern Oregon research studies, however, peppermint growers should be aware of newly revised and additional advisory language on the Chateau herbicide WDG supplemental peppermint label. This includes a geographic use restriction specific to Eastern Oregon that prohibits use of Chateau on peppermint in southern Union County (south of Ladd Canyon) and all of Baker County. Additionally, the label states that Chateau should only be applied to established dormant peppermint after November 25 and before March 1 and to peppermint stands that are less than three years of age and to those stands not damaged or stressed due to disease, drought or insects. Refer to this Chateau WDG peppermint label for additional restrictions on use rates and split applications as well as for information on adverse environmental conditions that may result in peppermint injury in fields treated with Chateau.

Herbicide Screening on Baby Peppermint

Twenty-five experimental herbicide treatments applied to baby peppermint were evaluated for crop safety. Nortron (ethofumesate) appeared to be the most promising prospect for further evaluation. Nortron is effective on many species when applied pre-emergence. However, current research in peppermint suggests that Nortron may have sufficient crop safety for post-emergence applications to control summer annual broadleaf weed species. In addition, because Nortron is much less effective when applied to dry soil, coordination with Spring irrigation application will be necessary for efficient pre-emergence and post-emergence uses.

Table 4. Weed control on June 13, 2007 from applications made to dormant peppermint near La Grande, Oregon

Treatment	Rate	Prickly Lettuce	Kochia	Tumble Mustard
	lb. a.i./A	----------%----------		
Spartan[1]	0.28	83	100	17
Command 3ME[1]	0.50	45	33	93
Prowl H_2O[1]	2.00	23	23	0
Sinbar[1]	1.20	100	90	100
Chateau[1]	0.13	100	50	74
Goal[1]	0.50	100	13	67
Karmex[1]	0.80	90	47	100
Starane[2]	0.13	57	67	67
Starane + Buctril[2]	0.13 0.25	0	93	52
Buctril[2]	0.13	0	20	13

[1] Applied March 12, 2007 [2] Applied May 23, 2007

Table 5.
Herbicide treatments on dormant pepermint in Union, Oregon

Treatment	Rate	Kochia Control[1]	Peppermint Injury[1]	Oil yield
	lb. a.i./A	----------%----------		lb./A
Check	0.00	0	0	37
Spartan[2]	0.28	93	1	36
Command 3ME[2]	0.50	19	0	47
Prowl H_2O[2]	2.00	18	0	37
Sinbar[2]	1.20	55	0	52
Chateau[2]	0.13	60	3	45
Goal[2]	0.50	0	1	42
Karmex[2]	0.80	30	0	47
Starane[3]	0.13	99	0	23
Starane+ Buctril[3]	0.13 0.25	98	4	41
Buctril[3]	0.25	66	1	36
LSD (P=.05)		36	3	10

[1] Evaluated June 25, 2007
[2] Applied March 12, 2007
[3] Applied May 23, 2007

Puncturevine Control with Peppermint Herbicides and Subsequent Germination of Seeds from Herbicide Treated Puncturevine Plants

Two studies are currently in progress to assess puncturevine control with peppermint herbicides and improve overall management of this weed in peppermint. Puncturevine produces mostly dormant seeds and many peppermint herbicides must be applied prior to the germination of the puncturevine. Field studies have not provided quality data on the effectiveness of these types of herbicide treatments. Therefore, the first study conducted involved a collection of seeds from puncturevine populations, storing them in the laboratory for several months and then planting them in the greenhouse for herbicide screening trials. Initial results indicate that Chateau and Sinbar are the most effective pre-emergence treatments. Considerable work will be conducted to further evaluate pre-emergence treatments and to conduct post-emergence applications in the greenhouse as well. The objective of the second study is to determine the effect of a range of herbicide treatments on the viability of developing seeds on the puncturevine plants. Plants were treated in the field in 2007, the seeds have been collected and germination tests have been initiated. This information will be used to recommend herbicide treatments that not only control established puncturevine plants but that also lower the viability of any seeds that are produced.

Terpene Metabolism in Mint

Rodney Croteau, Washington State University

Much of our recent effort has been focused on completing the MOAM (Mother Of All Mints) screen for genetically enhanced peppermint bearing an oil yield improvement gene (DXR), an oil composition enhancement gene (MFSA) and an herbicide resistance gene (the BAR gene for glufosinate resistance). Plants selected from this screen have been moving into field trials since 2006 and final laboratory and greenhouse testing in this very large-scale effort is now nearly complete. We expect to move the last series of genetically enhanced plants (up to seven new lines) into field trials this spring.

Test stacking of additional yield improvement genes and compositional improvement genes is in progress. We are also evaluating potential wilt resistance genes to determine which set of genes will be added to MOAM plants to create "supermint." Work with the marker gene (needed to tag the oil from genetically enhanced plants) has confirmed the feasibility of this approach but laboratory testing indicated that the levels of marker compounds produced were too low to permit easy detection by the Industry. It was determined that the marker gene needs to be expressed with a stronger control element (promoter). The testing of stronger promoters is in progress.

Although we lack sufficient information at present to create the "supermint," we do have superior MOAM plants now in field trials that exhibit up to 60 percent oil yield improvement, produce an excellent quality oil and are highly resistant to glufosinate. With the installation of a functional marker gene, these plants could be considered for commercial release as an interim measure. However, before release of either a MOAM line or a supermint line there are a number of significant legal and regulatory issues that will first need to be dealt with by the Industry.

Production of Pharmaceutical Feedstocks in Mint

Mark Lange, Institute of Biological Chemistry, Washington State University

Starting in spring 2008, the mint commissions of the Pacific Northwest are funding an exciting new program aimed at developing peppermint plants as biological factories for the production of pharmaceuticals and other valuable chemicals. Directed by me, a faculty at Washington State University (WSU) Institute of Biological Chemistry, this project builds on the successes of Rod Croteau's work on improving peppermint essential oil yield and composition, which has a long history with the mint commissions. My group will use genetic engineering technology to drastically reduce the expression of genes required to produce mint essential oils, while introducing genes, obtained from other plants, which are involved in the synthesis of metabolites used in the pharmaceutical industry. The net result will be that the highly active pathways that usually synthesize mint essential oils will now be modified to produce drug precursors and other highly valuable chemicals.

In the proof-of-concept phase of the project, which is funded by the Northwest mint commissions, I hope to demonstrate that peppermint can be used to produce copious amounts of one chemical that has cleared Phase II trials as an anti-cancer drug and a precursor for a second chemical that is a best-selling anti-malarial drug. Lange and WSU's Research Foundation will work with the mint commissions to develop a strategy for the commercialization of the novel pharmaceutical oils. While transgenic plants for food production are controversial subjects at present, genetic engineering is widely used in feed and biomaterials crops. The current *Roundup Ready* suite of plants includes soybean, corn, sorghum, canola, alfalfa and cotton. Genetic engineering is also used in the production of various bio-pharmaceuticals. One example is Lilly's Humulin, a human insulin produced in engineered microbes, which was approved by the Food & Drug Administration in 1982. Although sales growth was initially modest, engineered insulin analogues now account for more than $6 billion per year in revenues for the top three producers. The tight milestones for the newly funded mint pharmaceuticals project include the production of two pharmaceutical precursors at commercially relevant levels within two years. You will be able to monitor the progress of this project on the following website (available in May 2008): www.wsu.edu/~lange-m/terpenoid.htm.

Scale-up Evaluation of Solvent Free Microwave Extraction of Mint Oil

David Hackleman, Oregon State University

The Pilot Scale Evaluation Proposal was partially funded by MIRC. This has led to necessary adjustments on the scope of the project for 2008-09. Hence, this status report will offer a description of the work planned to be accomplished with the funding available and progress to date.

Modified Research Project Goals/Objectives: (partial funding)

- Detailed energy balance analysis on steam distillation compared to microwave.
- Calculation tables for current method for farmers to use for decision making.
- Exploration of funding options to enable microwave unit construction.
- Completion of summary of experiments to date.
- Exploration of IP space on the microwave extraction process.
- Build/create a design plan for a full-scale unit.

In addition, during the MIRC meeting, interest in evaluating a previously manufactured insulated mint tub for actual energy savings was expressed.

Actions Taken 1/24/08 through 3/15/08:

January:

- Attended MIRC meeting, presented research results, new proposal.
- Posted Velasco Thesis at MIRC website: www.usmintindustry.org.
- Revised research plan for 08/09.
- Microwave extraction results (oil quality) shown comparable to the existing (steam distillation) process.

February:

- Interactions with microwave source suppliers.
- Estimated power demand and chamber size for "bale test."
- Assembled team to "double check" energy computations prior to web publication.

March:

- Checking energy computations.

Commentary:

The majority of the six weeks since the beginning of this phase of the project work has been focused on planning and establishing contacts to enable further actions to take place.

Microwave Generator Suppliers:

Interaction with microwave generator suppliers has resulted in the identification of a possible opportunity for an evaluation, however, the suppliers are not strongly interested in experimentation taking place at their facilities. Depending on continued communications to take place in March/April, it will be determined whether such a method to test the process is feasible. If so, it likely will be at a facility in Kentucky, not far from the P&G facility in Mason, Ohio.

Energy/Efficiency Calculations for Standard Process:

One error was detected in the computation of the conductive, convective and radiative heat losses for mint tubs with and without insulation. Therefore, all formulas are currently being rechecked to ensure no other errors. After this is completed, the resulting material will be placed in a format which will lend itself to MIRC member's use from the MIRC web system or by downloading a spreadsheet.

Field Experiment Planning:

The Insulated mint tub is located at Butler Valley Farms, near Oregon State University and consequently some tests this summer to determine the difference in energy demand (and possibly oil yield) should be able to be accomplished relatively easily.

Plans for Next Period:

- Complete the re-check of the computations on heat losses.
- Develop a full-scale design and evaluate the energy requirements.
- Use the full-scale design to explore IP-space
- Potential site-visit to microwave source supplier.

Thanks to you all for your support in this endeavor. The fact that the microwave extraction process is significantly different than the existing technology indeed leads us to many challenges in developing an effective design and your help in that process has been and continues to be essential.

New Mint Industry Website

David Hackleman, MIRC Excecutive Director

The Mint Industry Research Council has developed and released a new website. The website is located at: www.usmintindustry.org and has both public and members-only sections with the latter requiring passwords for admission. The website has a dynamic user interface which adds a public presence to educate the public on the role that mint growers and industry play in bringing them a first class worldly product. The public website section displays images of mint products and mint production, information about mint pests, history of the mint industry, products of yesteryear, the board of directors and their websites and links to other mint related resources.

The members-only section is a secure password-protected area. User name and password are issued to the user after review/approval of each individual's registration. Upon successful registration members can log on to gain access to the core part of the website which includes:

- Contact information for the board of directors, growers, corporate members, propagators and researchers.
- A huge searchable database of research articles, conference proceedings, MIRC publications and other literature.
- Resources, including sections on pesticide registrations, mint pests, mint products, the IR-4 program, etc.
- Mint articles in the media and news, newsletters, video clips, etc.
- Mint grower organizations and a "mint grower's corner" for information that is useful to the growers.
- Details of upcoming meetings/events.
- Searchable research library, well organized and comprehensive including the MIRC proceedings under a secured section.
- Ability to survey growers and researchers.
- Bulletin board for members-only and for public.
- Links to state mint and other related websites.

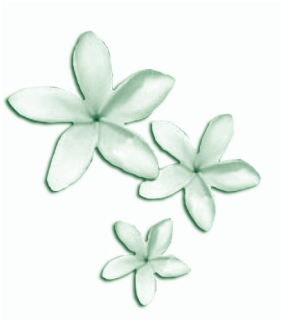
To gain access to the restricted members-only section of the new website go to: www.usmintindustry.org. In the upper right-hand corner of the home page there is a login option. Click on login – there will be a register button near the bottom of the page. Click on the register button and submit your registration. You will be notified by e-mail when you have access to the members' only area. Enjoy!

Combined State and MIRC Meetings to be Held in Hawaii in 2009

Included with this newsletter you will find a flyer for the 2009 National Mint Industry Convention to be held January 20-22 at the Sheraton Maui. We hope you will be able to attend this special one-time combined meeting.

The Mint Industry Research Council has obtained a block of rooms with savings of more than 50 percent off the standard room rates. Please be sure to reserve your room early to take advantage of these rates. Reservations can be made by calling the Resort desk at (808) 921-4645 or online at: www.starwoodmeeting.com/StarGroupsWeb/booking/reservation?id=0711052045&key=60C57

To help us plan the combined states meeting (scheduled for Tuesday, January 20), please take a moment to complete the enclosed postcard to let us know how many (if any) from your farm are planning on attending.



News from O.E.O.G.L.

Tim Butler, Chairman, Stayton, Oregon

The National Mint Industry Convention is scheduled for January 20-22, 2009 at the Sheraton Resort in Maui, Hawaii. The State meetings are scheduled for Tuesday, January 20. To help us with planning the State meeting, please complete the enclosed postcard and return it at your earliest opportunity. Plans are beginning for the 2009 Annual Convention. Be sure to mark your calendars and we hope to see to many of you there.

This publication is available in alternative formats upon request.

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