OREGON MINT COMMISSION

Spring 2010

UPDATE

Assessment Increase Proposed for 2010

Bryan Ostlund, Administrator

For more than 17 years the Oregon mint oil assessment has held steady at six cents per pound; however, in light of decreased movement during the past several fiscal years, the Commission is proposing to increase the assessment level to ten cents.

Currently, half the assessment (three cents) is committed to the Mint Industry Research Council in support of chemical registrations, national research and biotechnology. The remaining three cents is committed to Oregon projects.

For the past three years the Commission needed to allocate cash reserves in order to meet research and budget commitments due to the reduced production.

The Commission has debated the topic of an assessment increase for the past several meetings and acknowledged the careful review of options before proceeding with an increase at any level. At the OEOGL's annual meeting in January, Commissioners Greg Bingaman, LaGrande, and Commission Chairman Jim Cloud, Madras, spoke before the growers to inform them of these discussions and the fact that without an increase, the Commission would be unable to continue funding in-state research.

Earlier this year, the Commission reviewed the current progress and potential of industry biotechnologies and their related expenses. Through consensus of the Northwest mint commissions, it was requested that the MIRC resume management of biotechnology research, a move that was approved by the MIRC Board earlier this year.

Chairman Jim Cloud said, "When we look at the work right in front of us, both within Oregon and the MIRC, it's clear that we need to make changes in order to maintain the integrity of programs for growers. Changes within the EPA alone pose challenges that we've never seen before with regards to maintaining chemicals for mint.

"Pressure from foreign production is another, possibly the most significant, threat facing our industry, and we recognize that we can't sit still while markets erode. Biotechnology, while complicated and very long-term, is a key to the future of the industry.

"If approved, the mint assessment increase will represent just the second increase since the inception of the Commission in the mid-1980s. The research updates following in this newsletter are projects supported by Oregon assessment funds," continued Cloud.

The public hearing for the assessment change and the Commission's budget for 2010-11 is scheduled for Wednesday, May 19, 2010 at 10:00 a.m. at the Hood River Hotel, Hood River. A copy of the hearing notice has been included with this newsletter.

A Report From Rod Croteau

Rod Croteau, Washington State University

Data from the 2009 field trials have been compiled and showed several lines of genetically engineered peppermint with twice the yield of high quality oil compared to control plants. Licensing issues prevent these plant lines from being commercialized at this time. Research has also continued in an attempt to locate another yield improvement gene from the precursor supply pathway and to obtain oil gland-specific gene promoters for use in construction of "supermint." With my impending retirement, no research funding support was sought for 2010, and the Washington State University mint program is now in the process of being transferred to the laboratory of Professor Mark Lange. (See Lange's report on page 7.)

Weed Control in Peppermint

Barbara Hinds-Cook, Carol Mallory-Smith, Andrew Hulting, Daniel Curtis and Bill Brewster
Department of Crop and Soil Science, Oregon State University, Corvallis

Six studies were conducted in western Oregon by the OSU Weed Science Program. Some results from these studies are discussed below. For more detailed information regarding currently labeled herbicide applications, weed control efficacy and crop rotation restrictions associated with herbicide applications always refer to specific herbicide labels, the Weed Management in Mint Extension Publication (EM 8774, Revised 2008, http://extension.oregonstate.edu/catalog/index.php) and to the Mint Chapter in the 2009 Pacific Northwest Weed Management Handbook (http://pnwpest.org/pnw/weeds).

Herbicide Screening in Baby Peppermint and Pigweed Control

Control of summer annual weeds continues to be a significant production problem for peppermint growers. A field study was established at the Hyslop Research Farm to evaluate herbicides for use in peppermint which may have activity on pigweed species. Mint roots were donated by Glenn Ridgway and were hand planted in November 2008. Two experimental herbicides, AE1170437 and saflufenacil, were applied pre-emergence to the peppermint and compared to flumioxazin (Chateau) and oxyfluorfen (Goal, etc.) for crop safety and pigweed control. Saflufenacil is a burndown herbicide with some soil residual properties and AE1170437 has pre-emergent activity. Post-emergence applications of AE1170437, pyroxasulfone (KIH-485) and ethofumesate (Nortron) were compared to pendimethalin (Prowl H_2O), trifluralin (Treflan) and terbacil (Sinbar) applied post-emergence.

AE1170437 was applied at two rates in January and May, saflufenacil was applied at one rate in January and pyroxasulfone was applied at two rates in May. Visual evaluations of crop injury and pigweed control were conducted to evaluate potential use

Table 1. Herbicide Screening in Baby Peppermint and Pigweed Control

			Mint	Pigweed	Mint	Pigweed	Mint	Mint
Rating Date			6/3/2009	6/3/2009	7/17/2009	7/17/2009	7/27/2009	8/20/2009
Rating Type			injury	control	injury	control	fresh wt	oil yield
Rating Unit			%	%	%	%	lb./ 36ft^2	lb./A
Treatment	Rate lb. a.i./A	Application code	1	2	3	4	5	6
check	0		0	0	0	0	13.3 a	34 ab
AE1170437	0.011	A	78	38	60	0	3.6 cd	14 bc
AE1170437	0.022	A	83	50	75	15	1.8 d	10 c
saflufenacil	0.022	A	20	15	8	0	10.9 ab	37 ab
flumioxazin	0.128	A	63	75	38	80	5.3 c	21 abc
oxyfluorfen	0.5	A	25	23	8	0	10.1 ab	35 ab
AE1170437	0.011	B	35	93	33	83	9.3 ab	24 abc
AE1170437	0.022	B	30	92	40	94	8.5 b	19 abc
pyroxasulfone	0.092	B	0	99	0	99	13.6 a	41 a
pyroxasulfone	0.184	B	5	99	3	100	11.5 ab	35 ab
ethofumesate	0.5	B	0	63	0	75	13.6 a	39 a
ethofumesate	1.0	B	3	88	0	88	12.8 a	39 a
ethofumesate	1.5	B	3	85	0	90	12.2 ab	37 ab
pendimethalin	0.95	B	8	90	8	97	12.5 ab	30 abc
trifluralin	0.625	B	0	55	13	60	13.5 a	30 abc
terbacil	0.8	B	3	92	0	98	1.7 ab	35 ab
LSD (P=0.05)							2.6	14
CV							18	32

Means followed by the same letter do not significantly differ (P=0.05, Duncan's New MRT)
A – Applied January 15, 2009; pre-emergence
B – Applied May 19, 2009; post-emergence

timings and the peppermint was hand harvested in July. The biomass of 36 square feet of each plot was weighed, air dried and distilled.

AE1170437 was too injurious to the peppermint to be evaluated further. Salflufenacil caused injury, which the peppermint did recover from, but did not provide control of the pigweed. Pyroxasulfone was safe on the baby peppermint and provided excellent pre-emergent control of the pigweed (Table 1).

Baby Peppermint Tolerance to Trifluralin, Pendimethalin, and MCPB Combinations

Trifluralin, pendimethalin, MCPB (Thistrol) applied alone at two rates, MCPB plus bentazon (Basagran) and MCPB plus bromoxynil (Buctril) were applied post-emergence to peppermint for control of summer annual broadleaf weeds. The early application timing was followed by sprinkler irrigation. Terbacil plus paraquat were applied over the trial area on February 18, 2009 to reduce competition from seedling grass weeds and allow the mint to establish.

MCPB alone and in combinations slightly injured the peppermint. Trifluralin and pendimethalin caused no injury. The summer annual weeds were not evaluated due to inconsistent populations throughout the trial area. Peppermint was hand harvested in July. The biomass of two square yards of each plot was weighed, air dried and distilled (Table 2).

Table 2. Baby Peppermint Tolerance to Herbicides

			Mint		
Rating Date			6/29/2009	7/27/2009	8/20/2009
Rating Type			injury	fresh wt.	oil yield
Rating Unit			%	lb./2yd²	lb./A
Treatment	Rate lb. a.i./A	Application code	1	2	3
check	0		0	14	80 a
trifluralin	0.625	A	0	14	66 abc
pendimethalin	0.95	A	0	14	60 bc
MCPB	0.25	B	5	13	69 ab
MCPB	0.5	B	5	13	51 cd
MCPB + bentazon	0.375 0.75	B	6	14	63 bc
MCPB + bromoxynil	0.375 0.25	B	5	13	44 d
LSD (P=0.05)				NS	12
CV				12	13

Means followed by the same letter do not significantly differ (P=0.05, Duncan's New MRT)
A - Applied May 7, 2009; 6 inch peppermint
B – Applied June 10, 2009; 12-20 inch peppermint

Field Bindweed Control in Non-dormant Peppermint

Trifluralin, pendimethalin, pyroxasulfone, ethofumesate and MCPB applied alone and in combination with other herbicides were evaluated in actively growing peppermint for crop safety

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Table 3. Field Bindweed Control in Non-dormant Peppermint

			Mint		Field Bindweed	Mint	
Rating Date			6/17/2009	7/6/2009	7/6/2009	7/29/2009	8/27/2009
Rating Type			injury	injury	control	fresh wt	oil yield
Rating Unit			%	%	%	lb./3yd²	lb./A
Treatment	Rate lb. a.i./A	Application code	1	2	3	4	5
check	0		0	0	0	18	82
trifluralin	0.625	A	33	0	30	17	87
pendimethalin	0.95	A	33	0	13	16	75
pyroxasulfone	0.184	B	3	0	72	22	96
ethofumesate	1	B	0	8	75	22	90
MCPB	0.25	B	0	5	90	15	66
MCPB	0.5	B	8	0	94	17	83
MCPB + bentazon	0.375 0.75	B	3	0	94	22	78
MCPB + bromoxynil	0.375 0.25	B	0	3	99	21	86
LSD (P=0.05)						NS	NS
CV						20	26

A – Applied May 5, 2009; 6 inch peppermint
B – Applied June 1, 2009; 18 inch peppermint

and for field bindweed control. MCPB may broaden the weed control spectrum of herbicides such as bentazon and bromoxynil in non-dormant mint. All of the treatments were safe on the crop and all of the treatments except for trifluralin and pendimethalin provided acceptable control of the field bindweed.

Trifluralin and pendimethalin were applied May 5, 2009 at the time of sprinkler irrigation. The rest of the treatments were applied after irrigation so the soil was moist and then were sprinkler irrigated a few days after application. There were no differences between treatments in fresh weight or oil yield (Table 3).

Sharppoint Fluvellin Control in Non-dormant Baby Row Peppermint with MCPB Combinations

A study was established in a commercial peppermint field with a population of sharppoint fluvellin. The treatments were applied post-emergence to the peppermint and the sharppoint fluvellin. A pyroxasulfone treatment was included to evaluate crop tolerance to this herbicide. Two rates of MCPB applied alone and MCPB applied in combination with bentazon, bromoxynil, fluroxypyr (Starane) and carfentrazone (Aim) were evaluated for crop safety and efficacy. All treatments were safe on the crop. Pyroxasulfone, MCPB plus bentazon and MCPB plus

Table 4. Fluvellin Control in Non-dormant Baby Row Peppermint with MCPB Combinations

			Fluvellin	Mint		
Rating Date Rating Type Rating Unit			7/17/2009 control %	7/1/2009 injury %	7/30/2009 fresh wt lb./2 yd²	8/27/2009 oil yield lb./A
Treatment	Rate lb. a.i./A	Application code	1	2	3	4
check	0		0	0	14	83
pyroxasulfone	0.184	A	80	3	11	54
MCPB	0.25	A	30	0	15	78
MCPB	0.5	A	33	3	12	63
MCPB + bentazon	0.375 0.75	A	71	0	13	66
MCPB + bromoxynil	0.375 0.25	A	70	5	14	71
MCPB + fluroxypyr	0.375 0.07	A	38	3	12	68
MCPB + carfentrazone	0.375 0.012	A	43	0	11	54
LSD (P=0.05)					NS	NS
CV					22	23

A – Applied April 20, 2009; 0.5-2 inch peppermint

Table 5. Non-dormant Peppermint Tolerance to Herbicides

			Mint			
Rating Date Rating Type Rating Unit			06/08/09 injury %	7/6/2009 injury %	7/29/2009 fresh wt lb./ 2 yd²	8/27/2009 oil yield lb./A
Treatment	Rate lb. a.i./A	Application code	1	2	3	4
check	0		0	0	13	57
trifluralin	0.625	A	20	3	10	65
pendimethalin	0.95	A	30	4	12	76
pyroxasulfone	0.184	B	0	1	11	48
ethofumesate	1	B	0	0	14	57
LSD (P=0.05)					NS	NS
CV					23	38

A - Applied May 13, 2009; 4-6 inch peppermint
B - Applied June 8, 2009; 12-15 inch peppermint

bromoxynil provided the best control of the fluvellin. However, the best treatment for sharppoint fluvellin in baby peppermint fields seems to be patience and may not involve chemical control. The peppermint outgrew the sharppoint fluvellin quickly, eventually out-competing it. The check was one of the greatest fresh weight and oil yielding treatments though it was not statistically different from any other treatment. However, if the sharppoint fluvellin growing in mint fields is not treated and produces seeds it may be problematic in subsequent crops such as spring planted tall fescue (Table 4).

Non-dormant Peppermint Tolerance to Herbicides

Trifluralin, pendimethalin, pyroxasulfone and ethofumesate were evaluated for crop safety on established non-dormant peppermint. Trifluralin and pendimethalin were applied on May 13, 2009 and it rained shortly after application. Pyroxasulfone and ethofumesate were applied to dry soil on June 8, 2009 and the plots were irrigated later that day. Initial injury was evaluated in June for the trifluralin and pendimethalin treatments, with the severity of injury decreasing over time. Peppermint was hand harvested in July. The biomass of two square yards of each plot was weighed, air dried and distilled. There were no statistical differences in fresh weight or oil yield between any of the treatments (Table 5).

Table 6. Weed Control in Post-Harvest Peppermint

		Mint	Mint	Groundsel
Rating Date:		9/3/2009	10/8/2009	10/8/2009
Rating Type		injury	injury	control
Rating Unit		%	%	%
Treatment	Rate lb. a.i./A			
check	0	0	0	0
pyroxasulfone	0.09	0	0	0
flufenacet-metribuzin	0.42	30	13	50
terbacil	1.2	0	0	50
diuron	0.8	4	4	75
oxyfluorfen	0.5	23	4	70

Weed Control in Post-harvest Peppermint

A study was established in a commercial field following harvest of single cut mint. The plots were sprayed just prior to the first irrigation following harvest. Pyroxasulfone and flufenecet-metribuzin (Axiom) were compared to terbacil, diuron (Karmex, etc.) and oxyfluorfen for residual weed control.

No pigweed emerged in the trial area; however, common groundsel emerged evenly throughout the trial and control ratings were taken for this species. Diuron and oxyfluorfen provided moderate control of the common groundsel (Table 6).

Evaluation of Fungicides to Control *Verticillium* Wilt in Mint

Richard Affeldt, Rhonda Simmons and Bo-Ming Wu, Oregon State University
Jim Cloud, Cloud Farms, Culver, Oregon

Research conducted by Crowe and Simmons in 2007 showed that some newer fungicides reduced *Verticillium* wilt symptoms on peppermint. However, in order to screen a large number of fungicides, their experiment was not conducted under normal field conditions. Therefore, the fungicide efficacy observed in that trial may not accurately reflect fungicide efficacy in the field. To follow up on their observations two field trials were conducted in Central Oregon, one in new planted and one in established peppermint. The trials were one-year projects and the results are summarized here.

A trial in newly planted peppermint was conducted at the Central Oregon Agricultural Research Center (COARC) near Madras in a field with no history of peppermint or potato production. Prior to planting peppermint, the site was inoculated with laboratory-grown *Verticillium* wilt at a rate of two microsclerotia per gram of soil. On May 21, 2009 Black Mitcham rootstock was planted in furrows. Prior to covering the roots, fungicide treatments were applied over the top of the roots and on the sides of the furrow in a 12-inch wide band.

Another trial was conducted in a field of established peppermint near Culver that had a history of *Verticillium* wilt. The peppermint was entering the third production year. Fungicide treatments were broadcast over emerged peppermint shoots on May 19, 2009, two days prior to the first irrigation of the spring. At the time of application the mint was one to two inches tall and covering 10 to 30 percent of the soil surface. Since some of

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the peppermint had already emerged, these fungicide treatments were applied with a non-ionic surfactant at 0.25 percent v/v. The soil surface was dry at the time of application and the field had been sub-soiled and tilled the previous fall.

Unfortunately, none of the fungicides significantly lowered the incidence of *Verticillium* wilt or increased peppermint fresh weights compared to the untreated check, as indicated by the high F-test scores in Tables 1 and 2. A combined ranking of each treatment across all five data collection parameters and both trials show that the fungicides Proline, Headline and Quadris slightly lowered the severity of wilt symptoms on the peppermint (Figure 1). However, control of this disease with fungicides will likely be difficult because of the persistent nature of *Verticillium* microsclerotia in the soil and the perennial production practices for peppermint.

Figure 1. Combined ranking of five data collection parameters across two trials evaluating fungicide efficacy for *Verticillium* wilt in peppermint in Central Oregon, 2009.

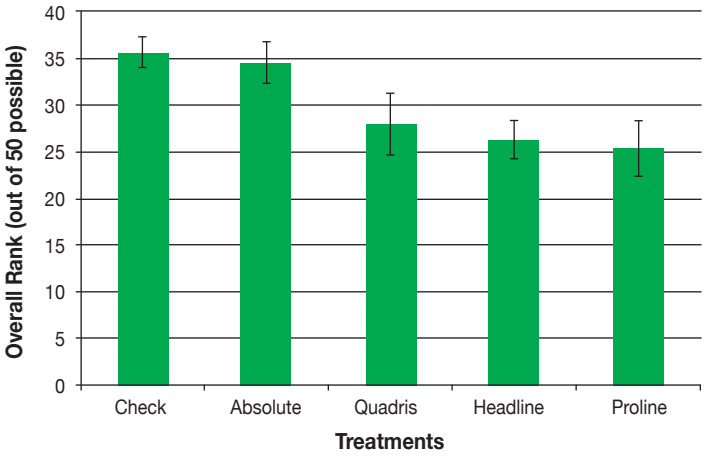


Table 1. Incidence of *Verticillium* wilt symptoms and response of baby peppermint following fungicide applications at COARC, Madras, Oregon, 2009.

Treatment[1]	Rate	Incidence of *Verticillium* wilt symptoms[2]			Peppermint height[3]	Peppermint fresh wt.
		8/5/2009	8/14/2009	8/19/2009	8/19/2009	8/19/2009
	fl. oz./A		0-5 scale		inches	lb./plot
Check	0	1.82	3.48	4.18	16.4	9.3
Quadris	15.5	1.77	3.33	3.98	17.1	10.2
Headline	12.0	1.55	3.18	3.72	16.9	8.6
Absolute	7.7	1.88	4.00	4.02	16.7	9.0
Proline	5.7	1.58	3.20	3.77	17.8	10.2
F-test		0.56	0.17	0.58	0.41	0.62
CV		23.80	17.80	13.90	7.60	22.50

[1] Fungicides were applied in furrow at planting on 5/21/2009.

[2] Evaluation scale of 0=no symptoms, 1=1 to 10% symptoms, 2=11 to 20% symptoms, 3=21 to 40% symptoms, 4=41 to 60% symptoms, and 5=61% or more symptoms.

[3] Three stems per plot were measured and averaged.

Table 2. Incidence of *Verticillium* wilt symptoms and response of established peppermint following fungicide applications near Culver, Oregon, 2009.

Treatment[1]	Rate	Incidence of *Verticillium* wilt symptoms[2]			Peppermint height[3]	Peppermint fresh wt.
		7/6/2009	7/17/2009	7/30/2009	7/10/2009	8/6/2009
	fl. oz./A		0-5 scale		inches	lb./plot
Check	0	2.68	3.30	4.22	23.7	25.0
Quadris	15.5	2.37	2.87	3.98	23.7	26.2
Headline	12.0	2.33	2.92	3.92	24.6	26.9
Absolute	7.7	2.58	3.00	4.33	23.8	25.3
Proline	5.7	2.25	2.78	4.13	24.5	27.1
F-test		0.41	0.35	0.24	0.49	0.81
CV		24.90	15.10	8.30	5.10	13.90

[1] Fungicides were broadcast on the soil surface and emerged shoots on 5/19/2009.

[2] Evaluation scale of 0=no symptoms, 1=1 to 10% symptoms, 2=11 to 20% symptoms, 3=21 to 40% symptoms, 4=41 to 60% symptoms, and 5=61% or more symptoms.

[3] Three stems per plot were measured and averaged.

The Mint Biotechnology Project – A New Emphasis on *Verticillium* Resistance

Mark Lange, Washington State University

In February of 2010 my laboratory took over the baton from Rod Croteau, who will be retiring in the near future. We will continue to build on the successes of Dr. Croteau's program, in particular with regard to the biotechnological enhancement of peppermint essential oil yield and composition.

The emphasis for the next two years, however, will be shifted toward combining yield and compositional enhancements in a *Verticillium*-resistant mint line. For these efforts we have chosen a high yielding spearmint variety (termed "Erospicata") with a peppermint-like oil profile. The Erospicata line was initially developed by Aromatics Inc., with RCB International being the current licensee for the use of this variety. Based on our experience with oil biosynthesis in peppermint, it should be possible to engineer Erospicata with an oil composition similar to that of peppermint, while retaining high yield and *Verticillium* resistance.

As a first step toward generating such a line, we will develop a transformation protocol for Erospicata, which will allow us to introduce genes the expression of which is expected to yield an essential oil with even more peppermint-like properties.

As a second step we will test the utility of genetic elements called promoters (strong "on/off switches" of genes) for expressing transgenes specifically in glandular trichomes (the anatomical structures responsible for oil synthesis). Three of these promoters have just been cloned by the Croteau group and Lange laboratory personnel is already working on the evaluation of their properties. This is done by fusing each promoter to a gene encoding a fluorescent marker protein. This fusion gene is then transformed into peppermint. The expression of the marker protein in transgenic peppermint plants can be detected by observing its fluorescence when excited with blue or ultraviolet light.

We will then test if this marker protein is expressed at high levels and preferentially in glandular trichomes. Once a suitable promoter has been identified using this assay, we will utilize that promoter in combination with a mint gene that encodes enzyme for the conversion of menthone (the primary component of Erospicata) into menthol (the primary component of high quality peppermint oil). Combining high oil yields, desirable oil composition and wilt resistance in a single mint line has the potential of benefitting all growers in all growing areas.

In Crop Use of Telone II for the Control/Management of *Verticillium* Wilt and/or Nematodes Impacting Mint

Philip B. Hamm and Russ Ingham, Oregon State University

A first year mint field was selected to test the use of Telone II. This particular field was chosen over other older fields for two reasons. One, this field has experienced poor growth the first year due to wilt and/or nematodes and two, the field could be used another year for trials so that the impact of infield use of the fumigant could be measured over two years.

Nematode and *Verticillium* assays were done prior to fumigation from throughout the 125 acre field. Two areas were selected primarily due to the presence of high levels of nematodes. Unfortunately, *Verticillium* levels were low in both areas, though one area had levels up to 14 colony forming units/g of dry soil. Lesion nematode numbers were high, averaging 700 to over 1,600/gram of root while soil levels were nearly 300/250 grams of soil. Both root lesion nematodes were present, *Pratylenchus neglectus* and *P. penetrans*. Fall fumigation with Telone II was done on October 28 and an additional treatment was added, Mocap, to one of the two replicated areas. Post fumigation soil and root samples will be done the week of March 15 to determine the impact of the fumigation and Mocap treatments on soilborne mint pathogens. Infrared photos will be taken monthly throughout the season and mint from each treatment will be harvested twice through the growing season to determine biomass levels.

Effect of Headline Fungicide Applied at Four Different Dates on Baby and Established Peppermint Oil Yields in Northeast Oregon

Bryon Quebbeman, Quebbeman's Crop Monitoring, La Grande, Oregon

Headline (Pyraclostrobin) has been reported to increase plant health and increase oil yields in addition to controlling foliar diseases in peppermint. It is not fully understood how this fungicide increases oil yields by improving plant health in the absence of any visual diseases. Research that was conducted in the La Grande area in 2008 using Headline found a strong trend for increasing oil yields but results were not consistent and yield data was variable. The research in 2009 focused on determining the best time to apply the Headline to maximize oil yields.

A total of four experiments were established in four different fields in the spring of 2009.

Each treatment consisted of a single application of Headline fungicide applied at 12 oz. per acre (0.2 lb. a.i./acre). Each treatment was applied approximately two weeks apart, starting approximately eight weeks before harvest for the first treatment and ending approximately two weeks before harvest. All treatments were compared to an untreated check.

RESULTS AND DISCUSSION

Disease Control

Only one of the four experiments had any visible powdery mildew. In this one experiment it was observed that the application of Headline partly controlled the powdery mildew for about 16 days, but control was not present at 28 days. (Table 1)

Table 1.

Relative levels of powdery mildew present on baby mint in Experiment Three.

Treatment number and application date	Rate of Headline	Observation dates and powdery mildew levels*		
	lb. a.i./acre	July 25	Aug. 10	Aug. 24
1. Applied 6/27/09	0.2	0	2	3
2. Applied 7/13/09	0.2	0	2	3
3. Applied 7/25/09	0.2	0	1	2
4. Applied 8/10/09	0.2	0	2	1
5. Untreated check	---	0	2	3

**Rating scale of powdery mildew infestation:*
0= none, 1=trace, 2= low level, 3= moderate level, 4= heavy level

Yields Established Mint Trials, Experiments One and Two

In both experiments all but one of the fungicide treatments increased the oil yields significantly compared to the untreated check (Table 2). The one treatment in Experiment One that did not have a significantly higher oil yield was still numerically greater than the untreated check (UTC).

The yields that were significantly increased in Experiment One ranged between 8-13 pounds per acre while the increased yields ranged significantly between 13-15 pounds per acre in Experiment Two. The application date appears to have little to no effect on the oil yields (Table Two).

Baby Mint Trials, Experiments Three and Four

Treatment two was the only treatment in Experiment Three that did not increase the oil yields significantly compared to the UTC; however, this yield was still numerically greater than the UTC (Table 3).

Conversely, treatment two was the only treatment in Experiment Four that did have a yield significantly higher than the UTC. The other three treatments in Experiment Four were not significantly greater than the UTC, but they were numerically greater.

In Experiment Three significant oil yield increases ranged from 10-14 pounds per acre while in Experiment Four the only significant oil increase was 11 pounds per acre. There is no clear pattern indicating that any one of the application dates provided a higher oil yield.

Oil Analysis

There were no significant differences in the oil analysis of Experiments One and Three. In Experiment Two there were significant differences between the four Headline treatments and the untreated check (Table 4). In general, the Headline treatments increased the total alcohol levels while decreasing the total ketone, mentholfuran and pulegone.

Experiment Four had a similar trend with the Headline treatments generally increasing the total alcohol levels and decreasing the total ketone levels (Table 5). However, in Experiment Four there were no significant differences in the mentholfuran and pulegone levels.

Conclusions

Headline did reduce powdery mildew in one experiment, but only for about 16 days. The partial control of the powdery mildew did not appear to contribute to increased oil yields.

Applying 12 oz. per acre Headline fungicide on established mint increased the oil yield significantly, (P=0.05), 88 percent of the time. The same applications on baby mint increased oil yields significantly 50 percent of the time. All Headline treatments in established and baby mint did numerically increase oil yields compared to the untreated checks. This data indicates that applying Headline any time within two to eight weeks before harvest can increase mint yields.

The effect of the Headline applied at different dates on the oil assays was inconsistent between experiments. When the treatments did significantly change the oil assays, there was a trend for the Headline treatments to increase the alcohol level and decrease the total ketone, mentholfuran and pulegone levels. The date of the Headline application did not appear to affect the oil quality.

Table 2. Experiments One and Two

Oil yields of peppermint treated with Headline fungicide applied to second year mint located near La Grande, Oregon 2009. (Experiments One and Two harvested August 18 and 17, 2009 respectively)

				Experiment 1	Experiment 2
Treatment Number	Treatments	Rate lb. a.i./A	Application dates	Mean oil yield (lbs./acre)	
1.	Headline 12 oz./a	0.2	June 15	93 b	123 b
2.	Headline 12 oz/a	0.2	June 27	92 ab	121 b
3.	Headline 12 oz/a	0.2	July 13	94 b	123 b
4.	Headline 12 oz/a	0.2	July 25	98 b	122 b
5.	Untreated check	---	---	85 a	108 a
	LSD			8	9

Sample means were compared with Fisher's Protected LSD (p=0.05).

Table 3. Experiments Three and Four

Oil yields of peppermint treated with Headline fungicide applied to fall planted baby mint, located near La Grande, Oregon 2009. (Experiments 3 and 4 harvested August 24 and 23, 2009, respectively)

				Experiment 3	Experiment 4
Treatment Number	Treatments	Rate lb. a.i./A	Application dates	Mean oil yield (lbs./acre)	
1.	Headline 12 oz./A	0.2	June 27	92 c	101 ab
2.	Headline 12 oz./A	0.2	July 13	84 ab	107 b
3.	Headline 12 oz./A	0.2	July 25	91 bc	98 a
4.	Headline 12 oz./A	0.2	August 10	88 bc	101 ab
5.	Untreated check	---		78 a	96 a
	LSD			8	7

Sample means were compared with Fisher's Protected LSD (p=0.05).

Table 4. *Experiment Two. Oil assays of selected components of established mint treated with Headline fungicide on four application dates.*

Treatments	Rate lb. a.i./acre	Application Dates	% Total Alcohol	% Total Ketone	% Mentholfuran	% Pulegone
Headline	0.2	6/15/09	52.2 b	18.4 a	6.6 bc	1.41 bc
Headline	0.2	6/27/09	51.8 b	19.4 bc	6.2 ab	1.26 ab
Headline	0.2	7/13/09	53.0 c	18.6 ab	5.8 a	1.18 a
Headline	0.2	7/25/09	52.1 b	19.4 bc	6.1 ab	1.23 a
UTC	---	--	50.9 a	19.7 c	7.0 c	1.47 c
LSD			0.7	0.9	0.7	0.16

Sample means were compared with Fisher's Protected LSD (p=0.05).

Table 5. *Experiment Four. Oil assays of selected components of baby mint treated with Headline fungicide on different dates.*

Treatments	Rate lb. a.i./acre	Application Dates	% Total Alcohol	% Total Ketone	% Mentholfuran	% Pulegone
Headline	0.2	6/27/09	52.7 ab	19.5 a	5.1	1.1
Headline	0.2	7/13/09	53.6 c	18.9 a	4.7	1.03
Headline	0.2	7/25/09	53.4 c	19.0 a	4.9	1.12
Headline	0.2	8/10/09	53.1 bc	19.3 a	4.9	1.04
UTC	---	---	52.2 a	20.4 b	4.9	1.06
LSD			0.6	0.8	NS	NS

Sample means were compared with Fisher's Protected LSD (p=0.05).

Microwave Field Test Project

David Hackleman, Oregon State University

The Microwave project completed a "first ever" field test of the process in mid-August 2009 as well as supplemental experiments at the microwave equipment supplier in November. A video of the August test was issued and has been shown at several meetings. Current work is in engineering and financial data analysis.

The purpose of this project is to determine whether large-scale microwave excitation of mint hay for the purpose of extraction of its essential oils can be reduced to practice.

I would like to acknowledge and thank the MIRC through Rocky Lundy for all the support and advice and especially Kevin Allen of IP Callison for the considerable number of sample analyses performed this period.

Since the last report in this newsletter took place, the results of the summer 2009 test were reported upon both in a very extensive field report as well as several conference presentations including the Oregon, Washington and Idaho Mint Growers meetings as well as the MIRC annual event in January 2010. A video has been produced to enable growers and interested parties to observe the large scale test device in operation at Butler Farms, Stayton, Oregon during August of 2009. This video is a component of a package of information including technical information on the energy demands required for such a full-scale unit.

Figure 1. Process Diagram

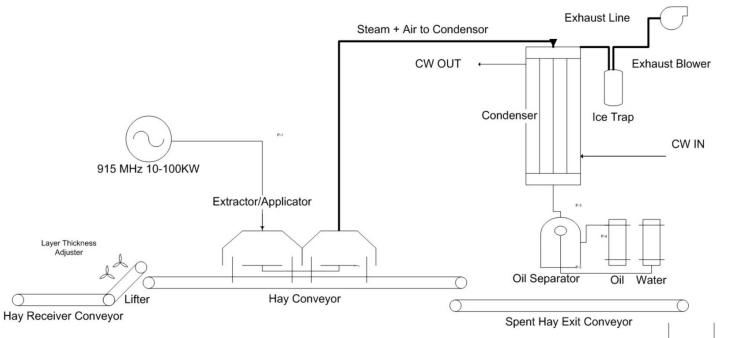
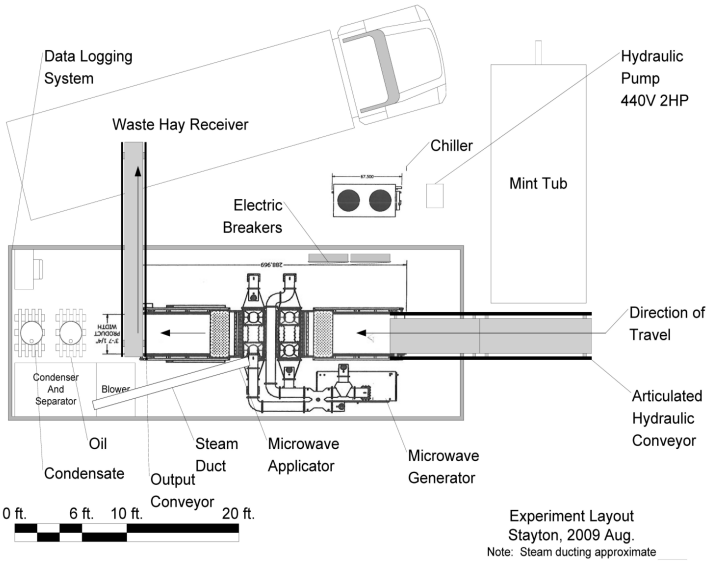


Figure 1 is a diagram of the test system used in August 2009 and Figure 2 is a top view pictorial layout. The video is available at the MIRC website, technical report section.

Figure 2. Pictorial View



Discoveries:

The summer trials demonstrated that essential key elements of the process were able to work effectively in the ambient conditions of a mint farm. These were:

1. The microwave applicator was able to be operated in the environment of the mint farm. It was found that protection from rainfall directly on the unit as well as filtering the input air system to avoid dust entry was easy to accomplish. The electrical system was found to be as safe or safer in operation than the conventional system. No high temperature pressurized steam generation or piping exists in the microwave system.

2. The conveyor belt system for passing mint hay through the applicator - No residue hay was found in the system after completion of the trial runs. This means maintenance will be relatively simple, less involved than with a conventional boiler system.

3. The power regulation of the microwave energy to the hay - Temperature of the mint hay was able to be kept controlled to within one degree Celsius without temperature feedback power control, merely by absorbed power feedback. This means when temperature feedback control is applied, even better control of the mint hay exit temperature is feasible.

4. The electrical power available to the farm was able to be adjusted to support the microwave unit. It was necessary to exchange the transformers on the power distribution pole to ones capable of supporting the demand and appropriate electrical wiring. This required a significant one-time investment. The utility company time involved was less than one day.

The summer trials showed the experimenters that certain key elements still need engineering to be effective. These are:

1. The input feed mechanism for hay to enter the microwave unit was not capable of automatic operation. While the long-term vision is that mint hay may not need to be chopped to be passed through the unit or even that one might have a portable system, in the design tested in August of 2009, the weight of the mint hay placed on the feed hopper as designed was too great to allow it to feed hay. An alternative design has been developed if it is decided to construct a "beta test" unit.

2. The vapor emission path, i.e., the mint oil and steam emitted from the heated mint hay, was not adequately constrained. Mint oil vapor and steam was found to emit from the entrance and exit sites from the microwave applicator and, therefore, not travel to the condenser. This was in spite of a reduced pressure applied to the exit port of the condenser. Alternative designs for the applicator to avoid this issue are in progress.

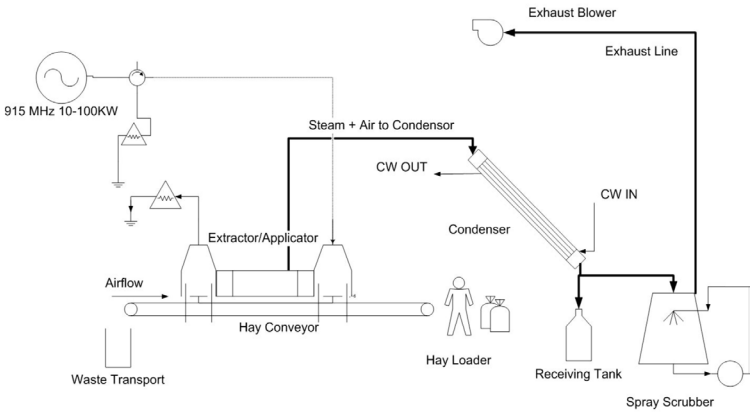
3. The oil was condensing much more rapidly than expected and the exhaust fan attached to the exit port of the condenser was drawing the condensed mint oil out of the system instead of allowing it to travel to the separator. Alternative solutions to the condenser system were designed and tested at the microwave unit supplier's site in November.

As a consequence of these conditions, while the test unit was able to function during the trial in August, it was not possible to actually recover mint oil to any appreciable extent. Hence, a second trial of the smaller test unit at the microwave applicator supplier was performed in November with the following goals:

1. Recover mint oil from stored (frozen) samples of the hay tested in August.
   a. Analyze these samples for oil composition.
2. Test out alternative elements of the microwave applicator/vapor path.
3. Test out an alternative mint oil vapor recovery concept.

The design utilized in November is shown in Figure 3:

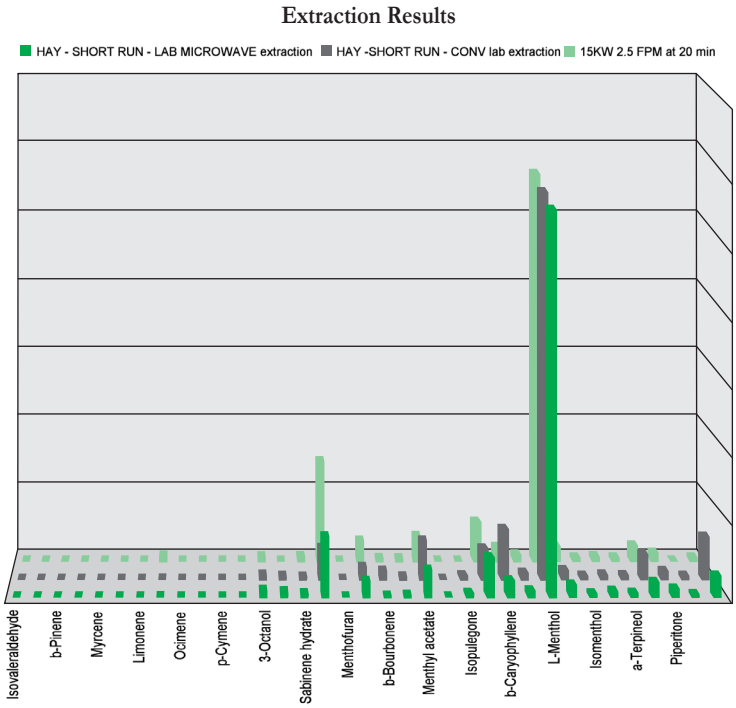
Figure 3. Experiment Design



Hay, Microwave and Vapor transport Diagram
Microwave Mint oil Extraction System
November 2009

During this test, all three of the goals were achieved. At this writing, detailed analysis of the results of the trials is still in progress. The recovered oil from this study appears to have the desired components as shown in Figure 4.

Figure 4. Comparison, Microwave to Conventional – Same Hay Source



Current Activities:

A great deal of experimental data has been amassed and is not yet completely analyzed. The process of this analysis is underway. Further reports on the economic and technical viability of the microwave process will be completed this year and focused toward developing partnerships in industry toward development.

At this point, it is the researcher's opinion that significant engineering is necessary to implement the microwave extraction process at the scale of mint farm application. Since such engineering is better accomplished by a business concern than at a University, companies are being investigated to see if they are interested in pursuing the final process development. Part of the challenge at this point is based on the time and physical limitations of this researcher, hence solutions to this issue are also being addressed.

Discussion/Conclusion

We have investigated a radically different approach to the extraction of essential oils from plants and found that it is applicable to a wide range of materials. We currently need significant engineering to scale it up to the quantities of extraction performed at a mint farm. With the support of the mint community, sufficient experimentally derived information has now been attained to complete this analysis. Thank you again for your support in this phase.

Oregon Mint
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News from O.E.O.G.L.

Tim Butler, Chairman, Aumsville, Oregon

Plans are beginning for the 2011 Annual Convention. Be sure to mark your calendars. The dates will be January 13 & 14 at the Salishan Lodge and Golf Resort, Gleneden Beach, Oregon.

If you are interested in advertising in the 2011 Meeting Program and Directory, a mailing will be made in August. If you do not receive the mailing or would like additional information on advertising, contact Kari or Sue at the Association office at (503) 364-2944.

This publication is available in alternative formats upon request.

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