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Dragonhead mint (*Dracocephalum parviflorum* Nutt.) as a potential agronomic crop for Alaska

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Introduction

This study investigates dragonhead mint (*Dracocephalum parviflorum* Nutt.) for its potential as an ingredient in commercially sold food for wild birds. In the Delta Junction area, we have observed wild birds feeding in farm fields and other sites where the native vegetation has been disturbed. A number of different plant species could be used as bird food in interior Alaska, where in 1992, 30 tons of wild bird seed was sold in the Fairbanks area alone.

Past experience in feeding wild birds in interior Alaska with commercial birdseed mixes has shown that they pick out seeds high in oil content, such as sunflower (preferred by chickadees and pine grosbeaks) and canola or rapeseed (preferred by redpolls), and leave the rest (Quinlan 1982, Knight 1992). Both of these oilseeds contain high levels of oil by weight, 51% and 41% respectively (Table 1). This oil is easy for the birds to metabolize and thus is an important source of energy during cold weather (Harrold and Nalewja 1977). Since the birds appear to be selective in picking out from feeders only the seeds that will supply them

Dragonhead mint in bloom.

with the necessary energy to keep warm, we assumed that they were also selective in the fields. To determine which plant species are utilized, we needed to identify which species with seeds available throughout the winter contain the highest amount of food energy (percent oil by weight).

From previous research on feeding wild birds by Harrold and Nalewja (1977), Geis (1980), Quinlan (1982), as well as Quinlan and Cuccarese (1982), a list of 18 plant species (both native and escaped domestic plants), was prepared. To be considered, each species had to occur as a common weed in and along agricultural fields in the Delta Junction area in sufficient quantities potentially to attract wild birds. During the late summer and early fall, mature seeds were collected from these 18 species for evaluatation.

These seeds were prepared, along with oilseed sunflower and polish canola as comparison standards, for laboratory analysis of nutrients and percent oil content (Table 1). Two members of the Mint family, hempnettle (*Galeopsis bifida* L.) and dragonhead mint (*Dracocephalum parviflorum* Nutt.) turned out to have quite high oil content, 35% and 20% respectively (Knight 1992). The main stem on both species is stiff and remains upright throughout the winter, placing the seed heads above the snow layer. Most of the seeds remain in the seed head, creating a food energy source for wild birds.

Another important factor regarding the suitability of these species as potential bird food is their potential to become an invasive plant. Hempnettle (Figure 1 and back cover) is an introduced weed that is on the list of potentially invasive weeds for Alaska (Carlson et al. 2005). It is found rather infrequently throughout the Delta Junction area in low-lying wet spots, thus limiting its importance as a major food source. For these reasons, hempnettle was not chosen for testing in this study.

Dragonhead mint is a native species found in drier sites along fencerows and old berm piles in mechanically disturbed areas (Hulten 1974, Knight 1992, Figure 2). In the natural environment, it will occur after forest fires and the seeds produced will then lie dormant until the next fire. In either situation, the seed can remain viable in the soil for maybe hundreds of years (Conn and Farris 1987, Conn 1990, Conn and Beattie 2006). Thus, every time buried seed is exposed to the proper conditions for germination by tillage, berm-pile management, or forest fire, more dragonhead mint becomes available for wild bird populations (Figure 3). Dragonhead mint was therefore selected to test for its potential as an agronomic crop for oilseed or birdseed in Alaska.

Dragonhead mint is also known as American dragonhead. It grows from New York state through the midwestern states north through the Canadian provinces and into Alaska. It has

Figure 1. Hempnettle (Galeopsis bifida L.).
—Michael Shephard, USDA Forest Service, www.forestryimages.org

Figure 2. Mature dragonhead mint plants growing on a berm pile that had been burned and repiled two years previously, showing the erect growth habit and the seed heads where the seed is retained until the plant is disturbed. The plants in the photo are approximately 30 cm (1 ft) tall (photo taken in early September 2004).

Table 1. Seed analysis of 20 native and escaped domestic plant species found in the Delta Junction area, Alaska. (Polish canola and oilseed sunflower in bold type and yellow rows are comparison standards.)

Plant Species (scientific name)	% Dry Matter	% N	% P	% K	% Crude Protein	% Oil	% Neutral Fiber	% Acid Fiber	% Hemi-cellulose	% Lignin	% Cellulose	% Ash
Alpine Milk Vetch (*Astragulus alpinus* L.)	95.38	5.44	0.52	1.24	34.00	2.24	23.88	14.19	9.69	2.13	12.06	3.98
Bird Vetch (*Vicia cracca* L.)	93.57	5.23	0.52	1.01	32.69	1.92	19.07	10.97	8.10	2.10	8.88	3.45
Cinquefoil (*Potentilla norvegica* L.)	97.25	2.15	0.39	1.37	13.44	22.00	44.85	22.57	22.28	9.29	24.28	8.13
Corn Spurry (*Spergula arvensis* L.)	97.06	2.05	0.50	0.61	12.81	9.50	41.04	29.53	11.51	5.09	24.44	21.50
Dragonhead Mint (*Dracocephalum parviflorum* Nutt.)	98.15	2.09	0.37	1.26	13.06	19.66	57.41	37.09	20.32	14.79	22.31	4.07
Eskimo Potato (with hulls) (*Hedysarum alpinum* L.)	96.02	4.43	0.45	1.09	27.69	6.92	36.21	24.21	12.00	8.59	15.61	4.84
Hempnettle (*Galeopis bifida* Boenn.)	97.42	2.51	0.58	0.47	15.69	35.21	36.94	29.75	7.19	5.98	23.77	4.34
Indian Paintbrush (*Castilleja raupii* Pennell)	96.65	3.27	0.82	1.94	20.44	10.60	44.98	20.85	24.13	7.78	13.07	9.05
Lambsquarter (*Chenopodium album* L.)	94.87	2.95	0.47	1.58	18.44	7.34	26.88	18.09	8.79	4.39	13.71	5.41
Lupine (*Lupinus arcticus* S. Wats.)	96.25	6.13	0.66	1.06	38.31	7.02	27.76	17.03	10.73	2.26	14.78	5.48
Paper Birch (dewinged) (*Betula neoalaskana* Sarg.)	96.23	1.03	0.19	0.63	6.44	4.56	69.99	53.15	16.84	24.87	28.28	3.33
Polish Canola (*Brassica campestris* L.)	**96.96**	**3.92**	**0.88**	**0.76**	**24.50**	**41.04**	**33.19**	**12.63**	**20.56**	**5.02**	**7.61**	**5.07**
Red Clover (*Trifolium pratense*)	93.77	5.58	0.58	1.13	34.88	7.08	28.59	11.74	16.85	1.38	10.36	4.06
Sourdock (Rumex arcticus Trautv.)	94.44	2.39	0.40	0.90	14.94	4.08	14.53	8.02	6.51	5.14	2.88	3.51
Sunflower (hulled) (*Helianthus annus* L.)	**96.21**	**3.60**	**0.76**	**0.63**	**22.50**	**51.06**	**18.83**	**11.95**	**6.88**	**3.91**	**8.04**	**3.59**
Water Smartweed (*Polygonum amphibium* L.)	95.30	1.63	0.32	0.41	10.19	4.28	33.96	21.88	12.08	10.44	11.44	2.20
White Spruce (dewinged) (*Picea glauca* (Moench) Voss)	95.38	3.55	0.69	0.69	22.19	25.02	37.97	30.97	7.00	10.65	20.32	4.40
White Sweet Clover (*Melilotus albus* Desr.)	96.17	5.62	0.41	0.90	35.13	4.48	28.43	13.38	15.05	1.60	11.78	3.36
Yellow Alfalfa (*Medicago falcata*)	95.23	5.51	0.70	1.02	34.44	9.82	26.06	10.58	15.48	1.88	8.69	3.96
Yellow Oxytrope (*Oxytropis campestris* (L.) DC.)	95.51	5.44	0.73	1.13	34.00	4.12	30.44	18.50	11.94	3.61	14.88	5.24

Figure 2. Mature dragonhead mint plants as an understory weed in a harvested barley field. The plants in this photo are approximately 15 cm (0.5 ft) tall and have been dispersed out from an old spread-out berm pile (located in the lower right portion of the photo) with the spring tillage. The seed heads will still contain mature and viable seed (photo taken in early September 2004).

either an annual or biennial growth habit, growing anywhere from a few centimeters to close to a meter tall (a few inches to over three feet). The stems, as in all members of the mint family, are square in shape, purple in color, and very sturdy. They will often stand through the winter snows and high winds of the Delta Junction area until the following spring. The leaves are sharply toothed, dark green on the top with purple margins and veins. When crushed, they have a slight minty smell.

When the plant is mature, the leaves turn brown, dry up, and fall from the stems, leaving only the seed heads at the top of each stem. There are clusters of many small pink to violet flowers in whorls at the ends of many branching stems on each plant (Hulten 1974). It flowers from mid-July through mid-August and is pollinated by insects. The mature seed heads of dragonhead mint are dense with sharp, spiny bracts. The mature seeds are dark brown to black, oval, and small, about 2 mm (1/16 in) long. They are held in the seed head (old flower whorls) until the plant is disturbed, through tillage for example, or when the main stem has been broken. Native Americans outside of Alaska have used the seeds and leaves as a flavoring for foods and medicinally as a treatment for diarrhea in children, as an infusion for the treatment of fevers and headaches, and externally as an eyewash (Moerman 1998).

The potentially invasive hemphettle looks very similar to dragonhead mint. The leaves of both species are toothed; however, hempnettle will usually be taller, have hairy stems and leaves, and does not have spiny bracts on the seed heads when compared with dragonhead mint (Carlson et al. 2005).

Seed Germination Studies

In the fall, a large quantity of dragonhead mint plants were hand harvested, dried for two weeks at 35°–40°C, (95°–104°F), hand threshed, and cleaned to obtain enough seed to plant in test plots the following spring. Before spring planting, we wanted to determine the germinability of the seed. A germination test on 100 seeds was done on moist filter paper at 25°C, (77°F), under eight hours per day of fluorescent light for 21 days. The resulting 10% germination led us to believe that some sort of seed treatment was needed to overcome dormancy and facilitate germination. This low percentage correlates with previous studies where scarification increased germination, (Conn and Farris 1987, Conn 1990, Conn and Beattie 2006). We therefore tested various methods of scarification, stratification, and seed treatment to determine the most effective method of increasing germination. These treatments were also evaluated for the ease of treating large quantities of seed and the ease of mechanical planting after treatment. Studies done on other species of dragonhead (for example *Dracocephalum thymiflorum*) have shown that they require light for germination (Kovrigo and Krastina 1968). Therefore, after each treatment method was performed, the seed was allowed to germinate as previously described.

Viability

In addition to the germination tests, a tetrazolium (3,000 ppm 2,3,5-triphenyltetrazolium chloride) test was performed to determine seed viability. Whole seed was soaked for two hours with no results, due to the hard seed coat surrounding the embryo. A test on 100 excised embryos with a two-hour tetrazolium soak resulted in 39% viable seed (Hartmann et al. 1990, Holloway, Pers. Comm. 1993[1]). Seeds were scored as viable when the embryo was either pink or red. Another treatment of 400 excised embryos resulted in 50% viable seed for an overall average of 44.5% viable seed. Note that these tests may not reflect the true percentage of viable seed. Dragonhead mint seed is very small and excising the embryos may have damaged many of them. The limited number of previous studies done on tetrazolium testing with dragonhead mint seed show a higher percent viability (70–90%) than that obtained in this study (Conn and Farris 1987, Conn 1990, Conn and Beattie 2006).

In these previous studies, seeds were scarified by piercing the seed coat with a dissecting needle and soaking in tetrazolium for seven days. When this method was used for this study, a higher percentage (74%) of the seed produced a color change. However, it was difficult to determine in many cases if the color change was due to a true viable embryo or some sort of contamination from inexperience with the method. The accuracy of determining the results in both methods may also have contributed to a significant error in estimating the percentage of viable seed. Therefore, the germination percentages expressed within this paper for all treatments are calculated based on percent of total seed and not the percent of viable seed. A general measure of viability should be taken into account when interpreting the germination results as that will determine the amount of seed to be sown per unit area.

1. Phone discussion with Dr. Pat Holloway, Director, Georgeson Botanical Garden, School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks, Fairbanks, AK.

Scarification

Since most of the mature dragonhead mint seed remains in the seed head during the rainy season of fall before first frost, we thought that a form of natural scarification was occurring. The hypothesis was that the seed would imbibe water and then the frost would crack the seed coat. To duplicate this in the lab, mature seed was allowed to imbibe water for 24 hours, then spread on moist filter paper in petri dishes and placed in the freezer at 0°C (32°F) for 30 days and 60 days (Hartmann et al.1990). At the end of each treatment the seed was removed from the freezer and allowed to germinate for 21 days at room temperature. The 30-day treatment resulted in only 5% germination of total seed and the 60-day treatment just 2% germination of total seed (Table 2). The 24-hour soak period to imbibe water may have been too short for water to penetrate the seed coat. However, the standard germination test of dry seed on moist filter paper produced a higher germination percentage. Therefore, no additional times for water imbibitions were added to test this method.

In conjunction with the frost treatments, acid scarification (soaking in concentrated sulfuric acid, H_2SO_4) was tried with treatment exposures of 10 minutes, 20 minutes, and 30 minutes (Hartmann et al. 1990). After the soak seeds were liberally washed with distilled water for 10 minutes, placed on moist filter paper, and allowed to germinate for 21 days. The resulting germinations were even less than those for the frost scarification treatments. The 10-minute soak had 4% germination of total seed, the 20-minute soak had 1% germination of total seed, and the 30-minute soak produced 0% germination (Table 2). Each of the acid treatments also produced more fungal growth than any other treatment or the control. With an increase of the soaking time there was a corresponding decrease in germination and an increase in fungal growth. These results could possibly be due to the strength of the acid during scarification, and even the 10-minute soak may have been too long. However, no further acid scarification treatments were attempted because this method produced large quantities of acid that required neutralizing for proper disposal.

A final scarification treatment used a boiling water soak to crack the seed coat. In this method, water is brought to a boil (100°C or 212°F), removed from the heat source, and the seed immediately immersed and allowed to soak for 24 hours while the water returned to room temperature (25°C or 77°F) (Hartmann et al. 1990). The seed was then removed, placed on moist filter paper, and allowed to germinate for 21 days. First visible germinations occurred at 5 days and increased dramatically at 11 days, exceeding the totals for many of the other treatments. This treatment produced the best germination percentages of all the methods at 63% of total seed (Table 2). The one major drawback to this method is that it produces wet seed after treatment, which would necessitate drying the seed before planting with mechanical planters.

Table 2. Percent germination results for scarification trials on dragonhead mint seed using freezing temperatures (0°C or 32°F) for 30 and 60 days, sulfuric acid for 10, 20, and 30 minutes, and a hot water (100° C or 212°F) soak for 24 hours.

# of Days	Control	30 Days 0° C	60 Days 0° C	10 min. Acid	20 min. Acid	30 min. Acid	Hot Water Soak
1	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
5	0	0	0	0	0	0	3
7	4	1	2	4	0	0	5
9	0	0	0	0	0	0	2
11	4	0	0	0	0	0	22
13	2	4	0	0	0	1	0
15	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
% Germination	10	5	2	4	1	0	63

Table 3. Percent germination results for heat treatment trials (105°C or 221°F) on moist and dry dragonhead mint seed for one-half hour, one hour, two hours, and four hours.

# of Days	Control	1/2 hour		1 hour		2 hours		4 hours	
		wet	dry	wet	dry	wet	dry	wet	dry
1	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
5	0	0	1	0	0	0	0	0	0
7	4	0	1	0	4	0	0	0	0
9	0	0	1	0	5	0	0	0	1
11	4	0	0	0	1	0	2	0	9
13	2	0	0	0	0	0	1	0	1
15	0	0	0	0	0	0	0	0	2
17	0	2	0	0	1	0	0	0	0
19	0	0	1	0	1	0	0	0	2
21	0	0	0	0	0	0	0	0	2
% Germination	10	2	5	0	12	0	3	0	17

Table 4. Percent germination results for gibberellic acid trials on dragonhead mint seed using 100, 200, 500, and 1,000 ppm GA3 concentrations.

# of Days	Control	100ppm GA3	200ppm GA3	500ppm GA3	1000ppm GA3
1	0	0	0	0	0
3	0	0	0	0	0
5	0	9	14	13	12
7	4	2	3	2	7
9	0	2	1	3	2
11	4	0	0	1	0
13	2	1	1	6	3
15	0	0	0	0	0
17	0	0	0	0	0
19	0	0	0	0	0
21	0	2	1	1	1
% Germination	10	16	20	26	25

Heat Treatment

Most dragonhead mint found in agricultural fields occurs where old berm piles have been burned and rolled over or moved in some way (Knight 1992). Dragonhead mint seed is also found in soil cores from intact forests (Conn and DeLapp 1983, Conn et al. 1984). These seeds remained after the forest last burned, suggesting that this species is a successional species following forest fires. This fact, along with the results of the previous treatment, led to the conclusion that some sort of heat treatment might be the best way to reduce dormancy and still allow for ease in handling during planting.

A seed treatment was devised to place moist and dry seed in an oven at 105°C (221°F), for one-half hour, one hour, two hours, and four hours (Hartmann et al. 1990). Moisture was maintained with periodic watering using distilled water (approximately every half hour). After each treatment, the seed was cooled to room temperature (25°C or 77°F), placed on moist filter paper in petri dishes, and allowed to germinate for 21 days. The dry treatments were definitely better than the moist treatments for all time periods. The best moist treatment was the half-hour period, with germination of 2% of total seed. All other moist treatments produced 0% germination.

Of the dry treatments, the half-hour period resulted in 5% germination of total seed, the one-hour period produced 12% germination, the two-hour treatment 3%, and the four-hour treatment produced 17% germination (Table 3). The dip in the germination percentage at two hours for the dry treatment might be due to an experimental or procedural method error. The best of these dry heat treatments, four hours, was still not close to the hot water scarification treatment. Therefore, no further dry heat treatments were attempted.

Gibberellic Acid Treatment

A seed treatment using PROGIBB, a commercial solution of 4% gibberellic acid (GA_3), was next tried to increase germination. Four concentrations were prepared at 100 ppm, 200 ppm, 500 ppm and 1,000 ppm of gibberellic acid (Hartmann et al. 1990, Holloway, Pers. Comm. 1993[2]). Seed was soaked for 24 hours in each concentration, then placed on moist filter paper and allowed to germinate for 21 days at room temperature. The results were dramatic when compared with the control. First visible germinations occurred within five days compared with seven days for the control. Final germination percentages were 16% of total seed for the 100 ppm treatment, 20% for the 200 ppm treatment, 26% for the 500 ppm treatment, and 25% for the 1,000 ppm treatment (Table 4). These treatments produced acceptable germinations, especially the 500 ppm treatment, but like the hot water soak treatment they resulted in wet seed, which would require drying prior to planting.

Soaking seed in a potassium nitrate solution is another accepted method of increasing seed germination. Previous studies with the thymeflower dragonhead (*Dracocephalum thymiflorum*) have shown a germination percentage of 84% when soaked in a 1:1 combination of 0.1 N solutions of potassium nitrate (KNO_3) and potassium sulfate (K_2SO_4) (Kovrigo and Krastina 1968). This also reduced the light requirement during the germination test. However, we decided not to attempt this method on dragonhead mint because the main study goal

2. Phone discussion with Dr. Pat Holloway, Director, Georgeson Botanical Garden, School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks, Fairbanks, AK.

Table 5. Percent germination results for stratification trials on dragonhead mint seed for 30 and 60 days at 4°C (40°F).

# of Days	Control	30 Days 4° C	60 Days 4° C
1	0	0	0
3	0	0	0
5	0	12	2
7	4	4	0
9	0	2	0
11	4	0	0
13	2	4	0
15	0	0	0
17	0	0	0
19	0	0	0
21	0	0	0
% Germination	10	18	2

was to identify simple and quick methods of seed preparation. These chemicals may be difficult to obtain and prepare for the average seed producer and their disposal (similar to the sulfuric acid method) would be a problem.

Stratification

The previous results led us to conclude that the gibberellic acid treatment was possibly replacing the need for a stratification period, so a stratification treatment was devised. Because dragonhead mint seed is small, it would be difficult to separate it from the moist sand media normally used in stratification trials. Therefore, the seed was layered between moist filter paper in petri dishes, then sealed inside plastic bags, then placed in the refrigerator at 4°C (40°F), for 30 days and 60 days (Hartmann et al. 1990, Holloway, Pers. Comm. 1993[3]). At the end of the treatment period they were removed from the refrigerator and allowed to germinate for 21 days at room temperature. As with the gibberellic acid treatment, first visible germinations occurred within five days. The final germination percentage of 18% of total seed for the 30-day stratification period was only slightly better than that for the 100 ppm gibberellic acid. The 60-day stratification period was only 2% of total seed (Table 5). Unfortunately, both stratification treatments did not equal the best of the gibberellic acid treatments.

Dormancy and Older Seed

A final germination test was done on seed collected two years before this study and stored at outside ambient temperatures to determine if dormancy increased during storage. A germination test identical to the control in this study was performed at the time of collection with a result of 7% germination. A germination test done identically to the previously mentioned tests on the two-year-old stored seed resulted in 0% germination. This means that dormancy increases or that viability decreases with time. Therefore, a tetrazolium test was done on 100 excised embryos of the two-year-old seed to determine the true seed viability. The result was a rather poor 21% viable seed. Since no viability test was done at the time of collection two years before, it is unknown if viability decreased over time. One possible explanation for this difference in viability between the harvests could be that the seed harvested originally was not quite at total maturity in mid-September.

To determine if dormancy increases with time, we tried to increase germination of the two-year-old seed using the best treatment methods (described previously). Treatments with 500 ppm and 1,000 ppm gibberellic acid

Table 6. Percent germination results for the control, gibberellic acid, and hot water treatments on two-year-old dragonhead mint seed.

# of Days	Control (at collection)	Control (after storage for 2 years)	500 ppm GA3	1000 ppm GA3	Hot Water Soak
1	0	0	0	0	0
3	0	0	0	0	0
5	0	0	0	0	10
7	2	0	1	0	28
9	1	0	0	0	32
11	2	0	0	0	7
13	2	0	0	0	2
15	0	0	0	0	2
17	0	0	0	0	0
19	0	0	0	0	2
21	0	0	0	0	2
% Germination	7	0	1	0	85

3. Phone discussion with Dr. Pat Holloway, Director, Georgeson Botanical Garden, School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks, Fairbanks, AK.

Figure 4. A one-year-old dragonhead mint plant showing the biennial growth habit. This plant will come back from the base to flower and produce mature seed during the next growing season. The plant in this photo is approximately 15 cm (0.5 ft) tall and is growing along the edge of a barley field approximately 2 m (6.6 ft) from an old spread-out berm pile (photo taken in early September 2004).

and the hot water soak were tried. The 500 ppm treatment resulted in a germination percentage of only 1% of total seed, and the 1000 ppm treatment had 0% germination. The hot water soak produced 85% germination of total seed (Table 6). This is a much better result than for either the control or the fresh seed. For seed left in the soil for five years, previous studies have shown no real reduction in viability, just a change from deep dormancy to one of seedcoat-restricted dormancy (Conn 1990). Also, seed from *Dracocephalum moldavica* L. has been shown to have 95.5% germination when stored between 5° and 10°C (41°–50°F) for three years (Mraz and Spitzova 1988).

Drying Following Treatment

The best germination results came from the hot water soak (63%) and the 500 ppm gibberellic acid treatment (26%). Both methods produce wet seed that is very difficult to handle with traditional mechanical drills. Wet seed would stick to the sides of the seed boxes, bridge up over the openers and plug up the feeder tubes. It would also require planting immediately after treatment to avoid any drying out that could further reduce germination.

There are seeders that use a water or gel injection system to plant moist or pre-germinated seed, but they are expensive and rare in interior Alaska. To avoid this expense, additional fine-tuning of the hot water soak treatment was researched by adding a method of drying the seed before planting time. After treatment the seed was blotted dry to remove any excess water to a point where the seeds were no longer sticking to each other. They were then left to dry further at 25°C (77°F) for two hours before the germination test started. It was assumed that this would be the average time between treatment and seeding, at least for the parameters of this study. The resulting 60%

germination compares favorably to the hot water soak treatment. This means that the seed can still be treated with the best method for increasing germination and then be dried to a point where it can be mechanically planted without any significant loss in germination.

Field Studies

Seed treated with the hot water soak method followed by drying was planted in six rows 30 cm (1ft) apart in four plots at the Fairbanks Experiment Farm, at a rate of 33 kg total seed/ha (29 lbs/a). An Almaco 6 row plot cone seeder was used to plant on May 20. There were no fertilizer or pesticide applications to this area during the length of the study. Before planting, the soil was tilled with an eight-foot Lely Roterra rotary harrow and packed with a six-foot Brillion pulverizer to obtain the firmest seedbed possible. Even with a firm seedbed and the cone seeder set to the shallowest depth, the dragonhead mint seed was planted too deep for good germination. This was evident after one month, when there was no significant emergence on the entire plot area, except for various weed species.

In late June, we decided to remove the weeds from the plot area to prevent them from going to seed and to reduce competition for the few dragonhead mint seedlings that had emerged. The process of pulling the weeds by hand and knocking the soil from the roots turned over a significant amount of the top few centimeters of soil within the plot. This had the unexpected result of exposing the dragonhead mint seeds to the surface and thus to the sunlight required for germination.

In the Delta Junction area, dragonhead mint has been observed at the seedling stage (one to two weeks after germination) late in the season (late August to early September) in agricultural fields that had not been re-disturbed since that spring. This suggests that the seed can germinate over time when the conditions are right, which might explain some of the germinations observed in the Fairbanks test plot at the end of the growing season.

By the end of the growing season the plant cover in the plot areas was almost 95% dragonhead mint. It was a very healthy stand, with plants at about 44–61 cm (1.4–2.0 ft) tall, with some in first flower by the first killing frost in late September (Figure 4). Since these plants did not have time to produce much viable seed due to the late start, we decided to leave the plot as it was and observe plant suvival and whether more germination would occur during the next growing season.

Plant cover during the next growing season was about 75%. Many of the plants appeared to be the same ones as the previous year, which supports the reports of a biennial growth habit. The plots were again hand weeded throughout the growing season with a few more new germinations resulting. The plants reached full maturity with an abundance of seed-producing flowers by the end of September. They were then harvested with a Winterstiger plot combine equipped with a 5-ft reel header with concave clearances, screens, and airflow settings similar to canola seed settings. The harvested seed was then hot force-air dried at 35°–40°C (95°–104°F) for two weeks and hand cleaned using a series of sieves. The final yield was 1,589 g of clean seed per 148.4m2 or around 107 kg/ha (96 lbs/a). This yield works out to three times the original seeding rate. If we can assume an average percent germination of 65% using the hot water soak method, then we would have about 63 lbs of pure live seed to plant the following year, or about enough to plant two acres at 30 lbs of seed/acre. Assuming that we could duplicate the yields the next season, that would yield close to 200 pounds of dragonhead mint seed.

The test plot was tilled the following season and was maintained under fallow conditions throughout the remainder of the third growing season. Since this time the area has been planted to a barley/fallow rotation. No more dragonhead mint has shown up, either as a weed in the barley crop or as a volunteer plant when the field is left fallow. This suggests that a rotation of spring tillage effectively controls the spread of dragonhead mint. The likelihood of this plant ever becoming invasive like hempnettle is very small if traditional tillage practices are utilized.

We do not feel that this short study shows the maximum potential of dragonhead mint. Higher yields could be obtained. Preliminary data by Knight (1992) states that in that year 30 tons of wild bird seed was sold in the Fairbanks area alone. Dragonhead mint could provide a fair portion of that seed to feed wild birds throughout a winter. Therefore, these results indicate that dragonhead mint may have potential as an agronomic crop in Alaska. Additional research is needed on improving methods of seeding (broadcast vs. drill), seeding rates, fertilizer interactions, herbicide effectiveness and tolerance, plant growth (annual vs. biennial), as well as harvest and cleaning methods to provide greater and more detailed information on this potential new crop for Alaska.

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Brittlestem hempnettle in Alaska.
—Tom Heutte, USDA Forest Service, www.forestryimages.org

About the Agricultural and Forestry Experiment Station

The federal Hatch Act of 1887 authorized establishment of agricultural experiment stations in the U.S. and its territories to provide sicence-based research information to farmers. There are agricultural experiment stations in each of the 50 states, Puerto Rico, and Guam. All are part of the land-grant college system. The Morrill Act established the land-grant colleges in 1862. While the experiment stations perform agricultural research, the land-grant colleges provide education in the science and economics of agriculture.

The first experiment station in Alaska was established in Sitka in 1898. Subsequent stations were opened at Kodiak, Kenai, Rampart, Copper Center, Fairbanks, and Matanuska. The latter two remain. None were originally part of the Alaska land-grant college system. The Alaska Agricultural College and School of Mines was established by the Morrill Act in 1922. It became the University of Alaska in 1935. The Fairbanks and Matanuska stations now form the Agricultural and Forestry Experiment Station of the University of Alaska Fairbanks, which also includes the Palmer Research Center.

Early experiment station researchers developed adapted cultivars of grains, grasses, potatoes, and berries, and introduced many vegetable cultivars appropriate to Alaska. Animal and poultry management was also important. This work continues, as does research in soils and revegetation, forest ecology and management, and rural and economic development. Change has been constant as the Agricultural and Forestry Experiment Station continues to bring state-of-the-art research information to its clientele.

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