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Medicinal Herb Trial 1996

BY LAURA J. W. BUTTERFIELD

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INTRODUCTION

Expanding interest in alternative medicine has increased the market for medicinal herbs throughout the United States. Today herbs are found not only in health food stores, but in the pharmacy sections of drugstores and supermarkets. Mail-order sales are also expanding. According to *Natural Foods Merchandiser*, a trade magazine for the health-food market, overall sales of medicinal herbs have been increasing by 18% annually, on average. Monica Emerich of New Hope Communications reports that the 1994 market for medicinal herbs in health food chain stores alone was valued at \$1.32 billion, and in 1995 *organically* grown herbs became the top growth category of the entire natural products market with a 33% increase in sales (Mergentime and Emerich, 1996). With over 380,000 acres of farmland, Connecticut is in a position to take advantage of this burgeoning market (National Agricultural Statistical Service, 1996). Growers of medicinal herbs, in particular herbs certified as organically grown, are in high demand by wholesale distributors and supplement manufacturers.

Our trial was designed to determine the suitability of some of these crops to the soil and climate conditions found in Connecticut. This assessment includes yield data and an analysis of active principles in field-grown samples compared to those sold over-the-counter. The first of these two objectives from the first year harvest are covered in the following text and graphics. The second is underway and will be reported at a later date.

GENERAL METHODS AND MATERIALS

Seed Germination

Eleven companies (Table 1) supplied seeds of twelve herb genera. The exact seed cultivar of each is specified in Table 2. Germination rates were determined for seeds from

nine of the companies. Seeds from the remaining two companies arrived too late to test germination in the greenhouse. Therefore, only the chamomile and borage seeds from these two companies were included in the trial, since these two species were directly field-sown. Seed lots of each species will be referred to as "samples" in the following discussion.

We evaluated germination rates by sowing 36 to 72 seeds per sample in flats containing potting soil (ProMix) according to package directions. When no instructions were provided, the general protocol from other packages was followed. Because of the wide variety of species, specific requirements of each species were accommodated as best as possible in the greenhouse. This included the use of supplemental halogen lighting for species requiring light for germination, and maintenance of an average 72F ambient temperature. Specific methods for each sample are described in the discussion of each species below.

Field Planting

Up to ten plants per sample, each plant representative of the average size, were transferred from the flat to 4.5 inch square or 5 inch diameter round plastic pots. Plants were allowed to grow for up to a month in the greenhouse, with biweekly fertilization using Hoagland's solution (Hoagland and Arnon, 1950). These were transferred to a cold frame on May 14, 10 days before field planting.

Analysis of a composite soil sample indicated that the herb field plot was a Wactaugh sandy loam (pH 5.9) with medium organic content and low nitrogen. Prior to planting, fertilizer (10-10-10) and lime were amended into the soil at 10 lb. per 1000 sq. ft. and 75 lb. per 1000 sq. ft., respectively. For the perennials and calendula, sheets of 10 ft. wide black landscape cloth (Agway) were laid down and holes cut at 1.75-2 ft. spacing in rows spaced 2 ft. apart. These plants were transferred into the field on May 24.

Seeds of chamomile and borage (both annuals) were planted within the next week in areas without landscape cloth. The plot received full sun. Sprinklers were set up for watering until the plants became established.

The open area in the landscape cloth around the seedlings was hand weeded. Walkways between species were sprayed twice toward the end of the season with glyphosate (Monsanto). Any weeds appearing between the rows of plants were hand-pulled. Hay was used to cover the landscape cloth when it began to break down in late July.

Harvesting and Drying

All perennial species were harvested lightly in 1996 so as to assure that the plants were well established before winter. Due to their variable growth rates, leafy perennials were harvested at different times. Most were harvested just at the onset of flowering, a procedure recommended by herbalists purportedly to maximize phytochemicals in the foliage (Dobelis, 1986). Sharp hedge clippers were used to top the plants, cutting them parallel to the ground 4-8 inches above the soil line. Bolt-type flower stalks, found in certain species, were cut at ground level and the remaining foliage was left to help rejuvenate the plants. Leafy annuals were cut at the soil line. Flowers from annuals were harvested at 3-6 day intervals over the flowering period to encourage continual flower induction. Specific details on each species are found below.

Harvested material from each sample plot was pooled and dried. Drying was done in one of two ways: 1) in an oven set at 45-60C for 3-14 days; or 2) in the greenhouse at ambient temperatures (75-110F) for up to 3 weeks. In either case, material was dried to just crispness so as to retain the original coloring and most of the essential oils and volatiles (Dobelis, 1986). Samples were weighed either on an analytical balance (for small amounts) or on a large capacity balance. Subsamples were taken from the composite mixture, placed into air-tight plastic bags, and labeled for future analysis

CONCLUSIONS

Medicinal herbs are suitable for cultivation in Connecticut. Interested growers are strongly encouraged to establish contacts, some of which are listed in Table 4, prior to capital outlay. For example, staff at New Mexico State University have completed a cost analysis for producing the final dried herb commodity from fresh field-grown plants. These data will prove valuable to Connecticut growers.

The data in this bulletin are meant to serve as a general guide on how these crops will perform in Connecticut climate and soil conditions. This information is the result of one year of observations and more detailed investigations into the cultivation of these and other similar species are appropriate.

Table 1. Participating seed companies.

Company	Address	City	State	Zip	Phone	Symbol ¹	Packed for ²
Companion Plants	7247 N Coolville Ridge R	Athens	OH	45701	614-592-4643	CP	'96
Comstock, Ferre & Co.	263 Main Street	Wethersfield	CT	06109	860-571-6590	CFC	'95
Goodwin Creek Gardens	PO Box 83	Williams	OR	97544	800-846-7359	GCG	'96
Horizon Seeds	PO Box 69	Williams	OR	97544	503-846-6704	HS	'96
Johnny's Selected Seeds	310 Foss Hill Road	Albion	ME	04910	207-437-4301	JSS	'96
Nichol's Garden Nursery	1190 Pacific Coast Hwy	Albany	OR	97321	541-928-9280	NGN	'96
Pinetree Garden Seeds	Box 300	New Gloucester	ME	04260	207-926-3886	PTGS	'96
Redwood City Seed Co.	PO Box 26	Redwood City	CA	94064	415-325-7333	RS	'96
Shepard's Garden Seeds	30 Irene Street	Torrington	CT	06790	860-482-3638	SGS	'96
The Thyme Garden	20546-H Alsea Hwy	Alsea	OR	97324	541-487-8671	TG	NA
Well-Sweep Herb Farm	317 Mt. Bethel Road	Port Murray	NJ	07865	na	WS	'96

¹The abbreviation by which the company is referred throughout this document.

²Some packages within a sample lot did not have "packed for" dates. These were assumed to be packaged for the same year as others within the same lot. NA = no "packed for" dates were indicated on any package in the sample.

Table 2. Herb species, common names, and seed donors.

Latin name	Common name	variety/cultivar	Min. Germ. ¹	Sources
<i>Borago officinalis</i>	borage	no designation	JSS, WS - 75	all 11
<i>Calendula officinalis</i>	pot marigold	no designation Pacific Beauty Mix Kablouna Bon Bon Mix	JSS - 75	CP, CFC, GCG, HS, TG JSS, PTGS SGS NGN
<i>Echinacea purpurea</i>	purple coneflower	Starlight no designation	JSS - 60	SGS CP, GCG, HS, JSS, NGN, PTGS, TG
<i>E. angustifolia</i>	prairie coneflower	no designation		HS
<i>Hyssopus officinalis</i>	hyssop	no designation	JSS - 65	CP, CFC, GCG, HS, JSS, NGN, PTGS, TG
<i>Matricaria recutita</i>	German chamomile	no designation	JSS - 65	CP, CFC, GCG, HS, JSS, NGN, PTGS, RC, SGS, TG
<i>Marrubium vulgare</i>	horehound	White no designation	JSS - 60	CFC, TG CP, GCG, HS, JSS, NGN
<i>Melissa officinalis</i>	lemon balm, melissa	no designation	JSS - 65	CP, CFC, HS, JSS, PTGS, SGS, TG
<i>Mentha</i>	mint	Common mint		PTGS
<i>M. spp.</i>	unknown mint ²	Peppermint ²		CFC, TG
<i>M. X spicata</i>	spearmint	Spearmint		NGN
<i>Monarda didyma</i>	bee balm, bergamot	no designation Panorama Mix	JSS - 50	GCG, HS, NGN, TG JSS
<i>Nepeta cataria</i>	catnip	no designation	JSS - 50	CFC, GCG, HS, JSS, NGN, PTGS, SGS, TG
<i>Tanacetum parthenium</i>	feverfew	White Wonder Double Flowered Single Golden Ball no designation	JSS - 60	SGS GCG TG PTGS CP, HS, JSS
<i>T. cinerarifolium</i>	pyrethrum	Pyrethrum		GCG
<i>Valeriana officinalis</i>	valerian	no designation	JSS - 50	HS, JSS, NGN, TG

¹Min. Germ. = minimum germination percentage printed on the seed package.

²Peppermint (*Mentha x piperita*) is a sterile hybrid and does not produce seed, therefore the species of the seed in these packages is unknown.

Table 3. Planting and yield estimates for dried herbs.

Latin Name	Variety/ cultivar	Annual/ perennial	Plant Out/ harvest date	Days in field	Dried Form	Est. average Yield/Acre, lb. Dry Weight±SD ¹
<i>Borago officinalis</i>	no designation	A	May 30/Aug 27	89	herb	5,799±1,603
<i>Calendula officinalis</i>	Bon Bon	A	May 24/Sept 11	104	whole flower ²	425
	Pacific Beauty Mix	A	"	"	"	513±147
	Kablouna	A	"	"	"	495
	no designation	A	"	"	"	349±90
<i>Echinacea purpurea</i>	Starlight	P	May 24/Oct 1	130	herb	1,350
	no designation	P	"	130	"	1,641±991
			not harvested	-	root	
<i>E. angustifolia</i>	no designation	P	not harvested	-	root	
<i>Hyssopus officinalis</i>	no designation	P	May 24/July 19	56	herb	457±133
<i>Matricaria recutita</i>	no designation	A	May 30/Sept 16	105	whole flower	496±236
<i>Melissa officinalis</i>	no designation	P	May 24/Oct 1	130	herb	2,946±1,175
<i>Marrubium vulgare</i>	White	P	May 24/Aug 28	96	herb	5,087±572
	no designation	P	"	"	"	3,935±491
<i>Mentha</i>	Common mint	P	May 24/Aug 28	96	herb	1,017
<i>M. spp.</i> ³	Peppermint ³	P	"	"	"	1,118±17
<i>M. X spicata</i>	Spearmint	P	"	"	"	1,386
<i>Monarda didyma</i>	Panorama Mix	P	May 24/Oct 1	130	herb	1,011
	no designation	P	"	"	"	1,130±452
<i>Nepeta cataria</i>	no designation	P	May 28/Aug 27	91	herb	4,708±599
<i>Tanacetum parthenium</i>	White Wonder	P	May 24/Aug 2	70	herb	842
	Double Flowered	P	"	"	"	776
	Single	P	"	"	"	515
	Golden Ball	P	May 24/July 16	53	"	105
	no designation	P	May 24/Aug 2	70	"	1,408±330
<i>T. cinerarifolium</i>	Pyrethrum	P	"	"	"	814
<i>Valeriana officinalis</i>	no designation	P	not harvested	-	sliced root	

¹ These figures are based on averaging the yield values from each of the samples contained in the table row. See Table 2 for suppliers of each sample. SD = standard deviation.

² Most calendula is sold as whole flower heads, calyx intact. The numbers in this table reflect petal weights with calyx removed, therefore actual yield can be expected to be higher.

³ *Mentha X piperita* is a sterile hybrid, therefore seeds labelled as "Peppermint" are of an unknown species.

Table 4. Prospective purchasers of fresh and dried herbs.

Company/Type	Address	City/State/Zip	Phone/Contact
RAW MATERIALS BROKERING/AGRICULTURAL CONSULTING			
Botanical Liaisons	1180 Crestmoor Drive	Boulder, CO 80303	303-494-1555 303-494-2555 fax Attn: Trish Flaster
LARGE MANUFACTURERS			
Nature's Herbs	600 East Quality Drive	American Fork, UT 84003	
Murdock, Madaus, Schwabe	10 Mountain Springs Parkway	Springville, Utah 84663	
Herb Pharm	PO Box 116	Williams, OR 97544	Attn. Ed Smith
Gaia	12 Lancaster County Road	Harvard, MA 01451	
LARGE RAW MATERIALS BROKERS			
Botanicals International	2550 El Presidio Street	Long Beach, CA 90810-1193	
Frontier Coop	Box 299	Norway, IA 52318	
Starwest	11253 Trade Center Drive	Rancho Cordova, CA 95742	
COST ANALYSIS RESEARCH			
New Mexico State University	Dept. of Agricultural Economics and Business Dept. 3169 Box 30003	Las Cruces, NM 88003	Dr. Connie Falk

Borago officinalis

(borage, burrage, common bugloss)

GERMINATION

Borage was direct-seeded into the field on May 31. Observations of seed germination showed a small amount of sporadic failure.

CROP YIELD (Figure 1)

Borage is a rather vigorous annual with large fleshy stems and leaves. The entire plant was harvested at ground level, weighed and subsampled in the field. These subsamples were dried in the greenhouse and weighed again to calculate the percent moisture in the sample. This number was used to calculate the average wet and dry weights of the total crop. The 1.75-2 ft. spacing between plants was judged inadequate as those plants on the edges of the plot provided a higher yield (up to 144%) than those in the center. A 2.5-3 ft. square spacing may be more appropriate for this species to produce a greater yield per plant.

MARKETABLE USES

The fresh herb, high in potassium, is used in salads by many Europeans and the dried herb is used as a fever

reducer and demulcent tea by herbalists (Dobelis, 1986; Medrano et al., 1992; Weiner, 1990). The bulk seed is processed for an oil rich in γ -linoleic acid which has shown evidence of reducing blood pressure (Engler et al., 1992). There may also be a limited market for the fresh or candied flowers for bake shops and gourmet stores.

INSECTS/DISEASES

There were no insect problems observed this season.

Borage is an excellent crop for anyone who also maintains a honey bee hive. Many members of the insect superfamily Apoidea (honey bees, carpenter bees, bumble bees) and the family Vespidae (yellow jackets and paper wasps) frequented the borage throughout the course of the summer. For this reason, harvesting was done outfitted with normal hive-operators clothing and apparatus.

An unidentified leaf spot was evident by the end of the season. While the disease did not appear to affect flowering, the foliar lesions were progressive and would have rendered most of the foliage unusable. Less watering and larger spacing may reduce the severity of this disease.

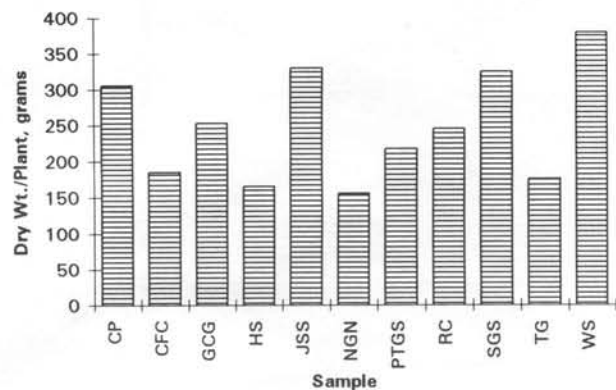


Fig. 1. *Borago officinalis* Yield

Calendula officinalis

(calendula, pot marigold, marybud, holi gold)

GERMINATION (Figure 2)

Seeds were sown in flats on April 1 under 1/4 in. soil, misted with tap water, and placed under halogen lights in the greenhouse. Seeds germinated within 3 to 5 days of sowing. For most samples, maximum germination was reached within 9 days of sowing. Because of this relatively rapid germination, calendula should be planted indoors less than 3 weeks prior to potting up or transfer to a cold frame. They will quickly become leggy and chlorotic if left inside. Direct seeding is always a possibility after the danger of frost is past.

CROP YIELD (Figure 3)

Although some herbalists use calendula foliage, this study focused on the more commonly used flower heads and petals (Ody, 1994). One sample, Bon Bon Mix from NGN, began to develop buds as early as June 10, and the first blossom opened on June 14. All other samples did not develop buds until June 21, blooming 5 days later. The first harvest occurred on June 28 when 6 of 9 samples had blossoms. The last sample to start blossoming was GCG on July 5. Thereafter, mature flower heads were harvested

every 3 to 6 days, depending on the maturation rate of the blooms. Blooms were dried as described above, and the petals removed from the calyx prior to weighing. The average daily petal weight peaked between July 25 and August 5 with per plant petal weights as high as 8.11 grams (data not shown). Average per plant weights began to decrease at this point due to aster yellows, a phytoplasma-mediated disease described below.

Yield per sample ranged from 215 to 617 lb. per acre. This difference is largely due to variation in flower type. Characteristics such as bloom size, rows of petals, and size of the disk flower portion of the bloom all added variation to the overall petal weight. Samples from CP, GCG, and SGS were internally uniform in shape and size while other samples showed much variation. Those from SGS were the only ones to have a single row of petals. The others, with double to multiple rows of white variegated to deep orange ray flowers and yellow to brown disk flowers, may have had higher yields due to the larger ray flower and petal number.

MARKETABLE USES

Calendula, containing triterpenoid saponins, is used topically as a principal component of antiseptic and anti-

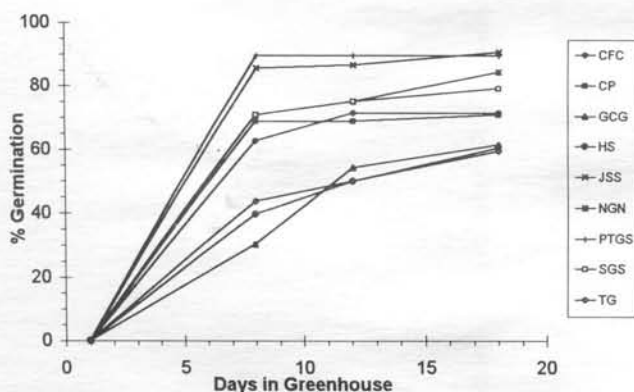


Fig. 2. *Calendula officinalis* Germ.

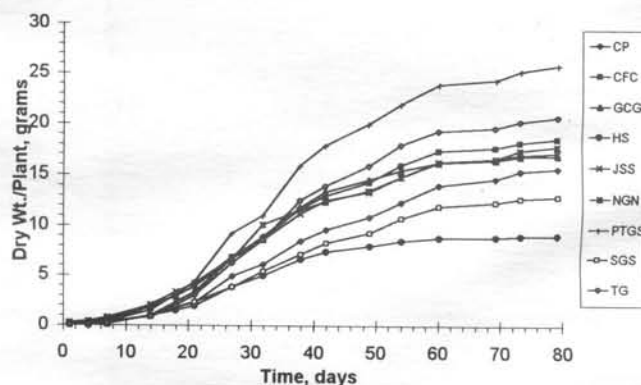


Fig. 3. *Calendula officinalis* Yield

Calendula officinalis (continued) (calendula, pot marigold, marybud, holigold)

inflammatory creams or salves (Della-Logia *et al.*, 1994; Weiner, 1990). The essential oil is an effective antifungal (Ody, 1993). Calendula petals are also used internally as a tea and as a garnish for salads and other dishes (Dobelis, 1986). The market price listed in Table 3 includes the calyx, which was removed prior to weighing in this study. Therefore, one could expect a higher yield than reported.

INSECTS/DISEASES

Two species of caterpillars damaged the calendula blooms. The damage occurred as the caterpillars burrowed into the center disk flowers, destroying ray flowers and calyx in the process. The most damage occurred, however, when the blooms were harvested. When the blooms were laid out to dry, caterpillars from infested blooms fed on surrounding blooms rendering the blooms unusable. This fact made harvesting more time consuming as caterpillar presence in the flower heads needed to be determined before picking. The tobacco budworm (*Helicoverpa virescens*)

occurred in low numbers early in the harvest season. The sunflower moth (*Homeosoma electellum*), which appeared later in the season, did the most damage. In some cases, more than 1/2 of the blooms in a harvest were infested.

There were also whiteflies (family Aleyrodidae) which were carried over from the greenhouse, and leaf hoppers (family Cicadellidae).

By far, the largest detriment to the calendula crop was aster yellows (proposed classification as a *Phytoplasma* spp.), a phytoplasma-mediated disease that alters the flower structure and renders flowers of Asteraceae and other plant families unusable. It is carried by leafhoppers, so control of the insect early in the season is critical. There is no known cure for aster yellows. If an infection is discovered early, the suspect plants should be pulled up and destroyed. Also, tools and hands should be cleaned with soapy water before handling other plants.

Powdery mildew (*Erysiphe cichoracearum*) infected plants until late in the season, but did not affect flower yield.

Echinacea purpurea and *angustifolia* (purple coneflower)

GERMINATION (Figure 4)

Seeds for both *E. purpurea* and *E. angustifolia* were sown into flats on March 6, lightly covered with potting mix, watered, and wrapped in a plastic bag before being placed in a dark 40F cold room. Flats were misted once per week and removed to the greenhouse after 12 days. The first seedlings of *E. purpurea* emerged after 5 days in the greenhouse. For most samples, maximum germination was reached after 11 days.

One sample of the notoriously difficult to germinate *E. angustifolia* seed was obtained. Only 19% germination was observed after 21 days in culture (data not shown).

CROP YIELD (Figure 5)

Some plants in all samples of *E. purpurea* flowered in the first year. The bolt stalks, with accompanying cauline leaves and terminal flowers, were harvested on October 1, 130 days after planting out into the field. The variation in yield may be due to differences in the number of blooms per bolt stalk, the height of the bolt stalk, and number of bolt stalks per plant. The number of blooms per stalk varied widely, from a high of 23 to a low of 1, with some plants not producing a bolt stalk at all. These latter plants were included in the yield per acre averages because they were viable and should produce bolt stalks next year.

The *Echinacea* genus is well known for the medicinal

value of the root, which was not harvested this year. Normally 3 to 5 years are allowed for the root to develop before the entire plant is harvested.

None of the four surviving *E. angustifolia* seedlings flowered. Their growth was minimal, and no plants were harvested.

MARKETABLE USES

Although the root of *Echinacea* is highly valued for its antiviral and immunostimulant properties (Bauer et al., 1988; Weiner, 1990), the aerial part of the plant also contains the active alkamide compounds and is used in teas (Bauer et al., 1989). Therefore, the bolt stalks will give some return on the initial investment until the roots develop sufficiently to be harvested.

INSECTS/DISEASES

Because *Echinacea* is a member of the aster family it is susceptible to the same insects and diseases as calendula and chamomile. Sunflower moth caterpillars were either present or there was evidence of their damage in greater than 80% (estimate) of blooms at harvest. This would render the blooms unusable for sale as a dried cut flower or to be ground for tea mixtures. No other pests or diseases were found on *Echinacea*.

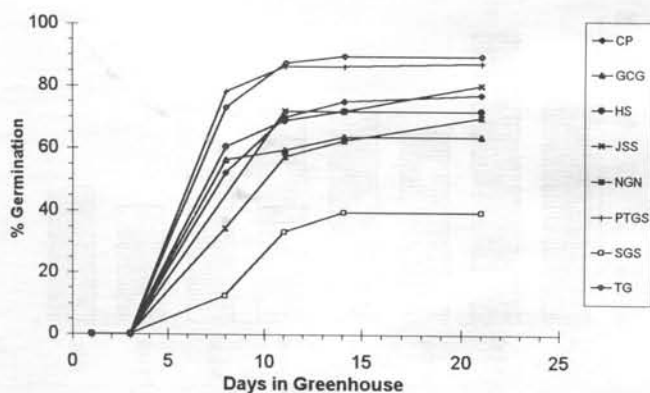


Fig. 4. *Echinacea purpurea* Germ.

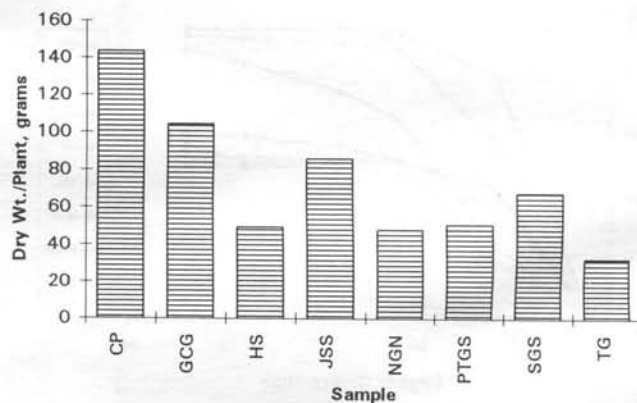


Fig. 5. *Echinacea purpurea* Yield

Hyssopus officinalis (hyssop)

GERMINATION (Figure 6)

Seeds were sown into flats on March 8, barely covered with potting mix, and misted with water. The first of these seeds germinated within 3 days, and full germination was reached by day 11.

CROP YIELD (Figure 7)

Hyssop was harvested on July 19, 53 days after planting out. Most plants were just beginning to flower. Herbaceous stems were cut 4-5 in. above the soil line. Stems with leaves intact were dried in brown paper bags in a 45C oven. Although this species was harvested once this year, up to three harvests may be possible in future seasons.

MARKETABLE USES

Hyssop, with its camphor-like fragrant leaves, is used medicinally as an expectorant and to soothe sore throats (Ody, 1993). A large number of monoterpenes are found in the foliage-derived essential oil, including pinocamphone, isopinocamphone, and limonene (Lawless, 1995). A polysaccharide from an aqueous extract of hyssop has shown activity against HIV-1 in cell cultures (Gollapudi et al., 1995).

INSECTS/DISEASES

No pests or diseases were observed on hyssop.

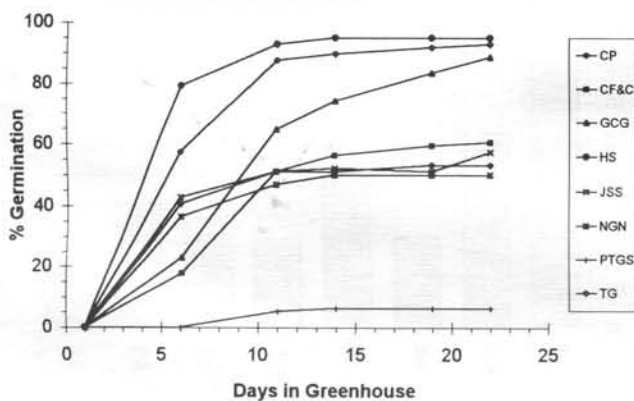


Fig. 6. *Hyssopus officinalis* Germ.

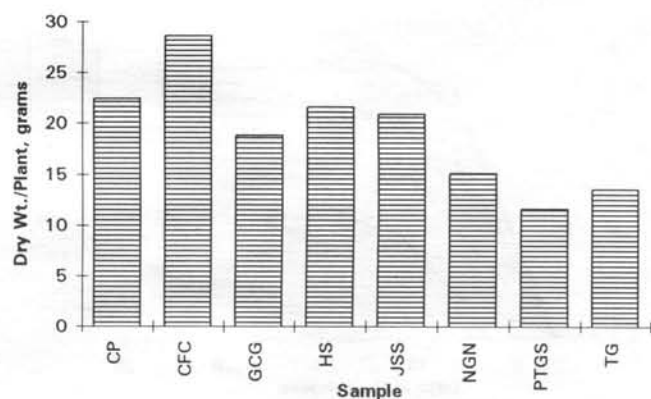


Fig. 7. *Hyssopus officinalis* Yield

Marrubium vulgare (horehound)

GERMINATION (Figure 8)

Seeds were sown in flats on March 8, covered with 1/4 in. fine soil, and misted with water. Germination began after 7 days, and most samples reached full germination percentage at about day 14.

CROP YIELD (Figure 9)

Horehound, a member of the mint family, grows well in typical New England conditions. Plants were harvested on August 28, 96 days after transplanting seedlings into the field. The samples were well into bloom at harvest, and could have been harvested 2 weeks earlier. Only one harvest was made to allow plants to rejuvenate before winter. In future seasons it may be possible to have multiple harvests.

MARKETABLE USES

Horehound is commonly found in hard candies which are reported to have cold-soothing properties (Dobelis, 1986). The cut dried herb is also used in teas for the same purpose (Wiener, 1990).

INSECTS/DISEASES

Horehound was frequented by large numbers of bees. Detrimental insects were not detected. An unidentified disease that caused sporadic yellowing and subsequent necrosis of a small number of leaves on main stems did not reduce the harvest, as there were very few leaves affected.

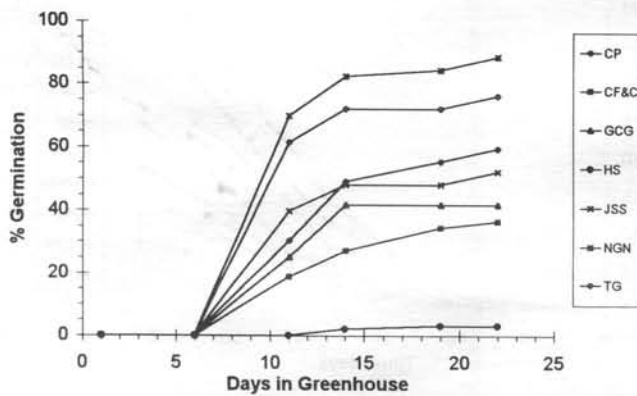


Fig. 8. *Marrubium vulgare* Germ.

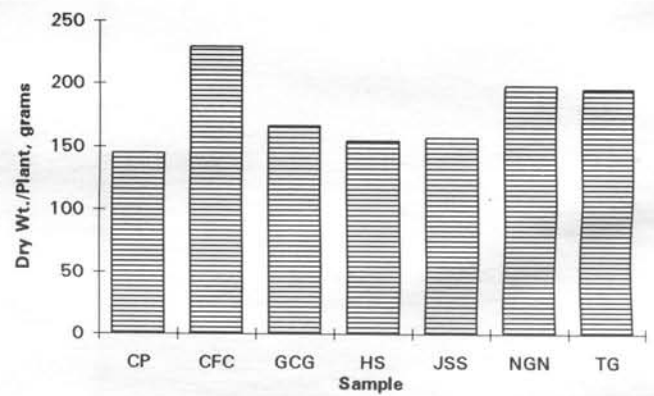


Fig. 9. *Marrubium vulgare* Yield

Matricaria recutita

(German or Hungarian chamomile)

GERMINATION

Chamomile was direct seeded into the field on May 29 and 30. Seeds from NGN did not germinate at all over the course of the entire season. Seeds from PTGS generated 45 plants. The average was 15.3 plants per seed package, all seeds in the package being sown. Samples were thinned to a maximum of 10 plants as the first flowers began to bloom.

CROP YIELD (Figure 10)

Flower heads from chamomile were harvested at 3-7 day intervals during the season. The last harvest occurred on September 16, 105 days after sowing. Samples segregated into two different growth habits: 1) tall, somewhat leggy stems with sparse, large blooms (CP, GCG, JSS, RC, SGS, and TG); and 2) short, compact stems with dense, small blooms (CFC, HS, and PTGS). Because chamomile flowers need to be picked by hand for a high-quality product, the taller samples with the large blooms were much easier to harvest than their shorter counterparts. However, the yield from the low growing varieties (753 lb. per acre) was 105% greater than that for the tall (367 lb. per acre).

MARKETABLE USES

Chamomile is known for its sedative and antispasmodic effects because of its high content of azulene (Lawless, 1995; Weiner, 1990). It is currently produced in high quantities and good quality in Mexico and Egypt where labor is inexpensive. This makes it virtually impossible for growers in Connecticut to compete on the open market. However, a small plot grown under organic practices for local sale could prove profitable if labor costs are kept to a minimum.

INSECTS/DISEASES

Chamomile is a member of the aster family and is susceptible to similar pests and diseases as calendula. The sunflower moth was present in moderate numbers, as well as powdery mildew and aster yellows.

A variety of other insects were observed on chamomile. These included lady beetles (family Coccinellidae), soldier beetles (*Chauliognathus pennsylvanicus*), and various types of bees. Aphids (family Aphididae) were also found on some roots.

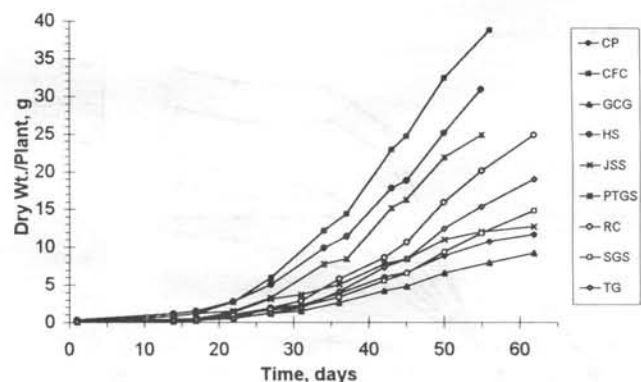


Fig. 10. *Matricaria recutita* Yield

Melissa officinalis (lemon balm, balm, or melissa)

GERMINATION (Figure 11)

Seeds were sown on March 6 onto the surface of wet potting mix and misted with water. Flats were placed under halogen lights in the greenhouse. Lemon balm was one of the slower and more sporadic germinators of the seeds tested. Low germination was recorded after 8 days. Significant germination was observed after 13 days in 3 of 7 samples.

CROP YIELD (Figure 12)

Lemon balm did not flower in 1996. Harvest was completed late in the season, leaving enough time for the plants to rejuvenate before winter. This resulted in a uniform mix of herbage. The high standard deviation in Table 3 may have been caused in part by differences in growth habit between samples. The TG and CFC samples tended to be low and spreading, with lower yields, while the rest of the

samples had more upright growth (data not shown).

MARKETABLE USES

Lemon balm is used as a filler for many medicinal tea mixes. It helps to hide unpleasant flavors while adding a general fever-reducing and anti-depressant action (Ody, 1993; Weiner, 1990). Externally, it is used on skin eruptions and as an insect repellent (Greive, 1992; Lawless, 1995).

INSECTS/DISEASES

An unidentified necrosis affected a few of the plants not sampled for this study. The necrosis was similar to that reported above for horehound, but more severe, affecting the centermost stems and leaves. Symptoms began as a purpling of the leaves, then quickly progressed to yellowing and death of entire stems. Foliage on the perimeter of the plant was not affected.

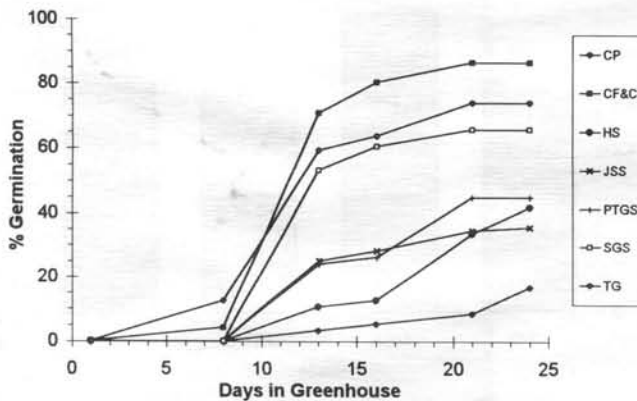


Fig. 11. *Melissa officinalis* Germ.

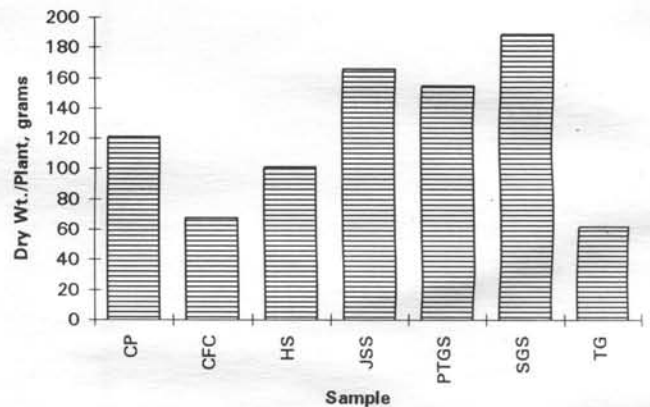


Fig. 12. *Melissa officinalis* Yield

Mentha species (mint)

GERMINATION

Peppermint is actually a 99% sterile hybrid that is normally reproduced from cuttings (Tucker, 1993). Other mints, such as *M. x spicata*, do produce seed, but the resulting plants are usually inferior. The only true description of mint seed came from PTGS, whose package was labeled "common mint". The seed catalog instructions suggested to plant the entire package of seed and select a few of the best plants for the garden. If true peppermint and spearmint are desired, cuttings can be obtained from reputable sources.

Mint seeds are extremely small and difficult to handle. No quantitative analysis of germination was made; however, seed germination appeared to be excellent. Seeds were sown on April 1 onto wet potting mix in flats and barely covered with soil. The flats received ambient greenhouse light. Seedlings were thinned heavily after 28 days. Remaining seedlings were directly transferred to the field from flats after another 3 weeks in the greenhouse.

CROP YIELD (Figure 13)

The various mints are similar in their growth habits and therefore produced similar yields. Some sporadic flowering

was observed toward the end of the season, and plants were harvested shortly thereafter (on August 28), 96 days after planting out into the field.

MARKETABLE USES

Both peppermint and spearmint are common flavoring agents in a wide variety of household products, especially those used in oral hygiene and for cold and flu treatment. Both are also known for their digestion-settling properties (Erichen-Brown, 1979, Weiner, 1990). The principal component of peppermint is menthol, a volatile monoterpene (Lawless, 1995). Spearmint contains less menthol but has high levels of carvone, a related compound (Lawless, 1995). In addition to the dried product, sales of the fresh herb to manufacturers of essential oils may also provide income.

INSECTS/DISEASES

Mints are generally hardy, vigorous growers and quick spreaders. Isolated plants showed a similar type of leaf necrosis and decline as the horehound and lemon balm. The causative agent is currently unknown.

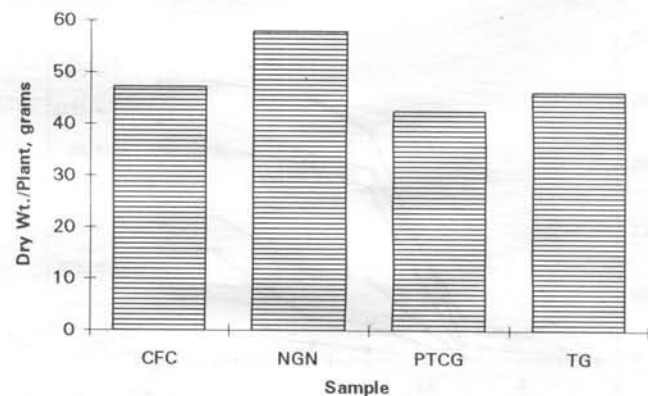


Fig. 13. *Mentha* Species Yield

Monarda didyma

(bee balm, bergamot, Oswego tea)

GERMINATION (Figure 14)

Seeds were sown into wet potting mix in flats on March 6, lightly covered with soil, misted with water, and placed under halogen lights in the greenhouse. The first seedlings began to emerge after 8 days, with the germination rate leveling off after 16 days. As Figure 14 shows, there were large differences between the percent germination in this species, ranging from 93% to no germination at all.

CROP YIELD (Figure 15)

Bee balm did not flower in 1996. This fact allowed for a longer growing season (130 days) as foliage is normally harvested as the plants begin to bloom. Instead, plants were cut with hedge clippers 5-6 in. above the soil line approximately 2 weeks before the first projected frost date.

MARKETABLE USES

Both the foliage and flowers of Bee Balm are marketable. The foliage, cut and dried, is used as a tea to aid

in digestion and for respiratory ailments (Erichsen-Brown, 1979, Grieve, 1992). Thymol, an active compound in *Monardas*, is a powerful antiseptic for both internal and external use (Grieve, 1992). The showy blooms of *M. didyma* can be used as cut-flowers in arrangements and bouquets.

INSECTS/DISEASES

Although no insect pests were observed on *Monarda*, there were two diseases which may have been enhanced by a high amount of rainfall. The first was powdery mildew (*Erysiphe* spp.), a common problem on *Monardas* grown for ornamental use. The second disease was more difficult to pinpoint. At mid-season the lower leaves of some plants developed black necrotic spots which progressed slowly into a yellowing of the leaf and eventual leaf drop. Leaf spot has been reported on *Monarda*, usually during periods of high moisture.

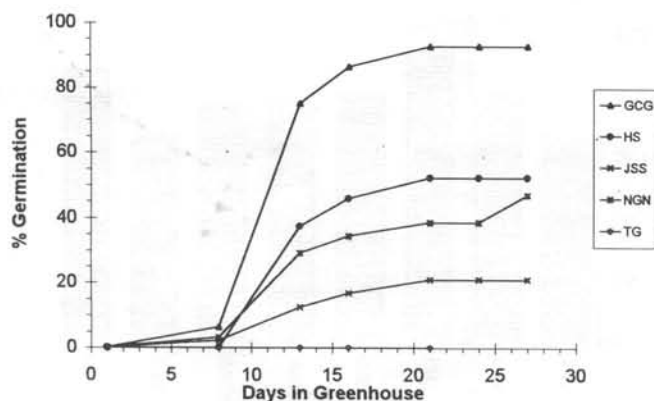


Fig. 14. *Monarda didyma* Germ.

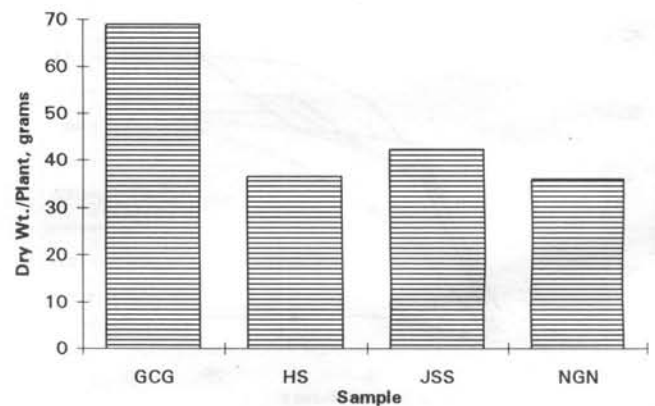


Fig. 15. *Monarda didyma* Yield

Nepeta cataria (catnip)

GERMINATION (Figure 16)

Catnip has been called a weed by many gardeners. However, the relatively high germination rates normally associated with weedy species were not evident in this trial. Seeds were sown in flats on March 7 onto wet potting mix and lightly covered with soil. The flats were misted with water and placed in ambient lighting in the greenhouse. The first seedlings began to emerge after 7 days, and germination rate leveled off after 20 days, rather late compared to other species.

CROP YIELD (Figure 17)

Catnip grew vigorously. The initial leggy stems, some almost 2 ft. tall, were clipped shortly after transplanting into the field to encourage bushier growth. After 91 days in the field, all plants were in full flower with seed set occurring on the larger specimens. The 2 ft. spacing between plants

may not have been sufficient, as the central plants appeared more leggy than those on the edges of the plot. Increasing the spacing to 3 ft. may encourage fuller growth and higher yields.

MARKETABLE USES

Catnip has been used traditionally as a sedative and as an aid in respiratory ailments and stomach pains (Dobelis, 1986; Greive, 1992, Weiner, 1990). It contains nepetalactones, a class of volatile monoterpene compounds with antiseptic properties (Bourrel, 1993). Most common preparations use the dried leaves and herbaceous stems in tea.

INSECTS/DISEASES

No pest or disease problems were associated with catnip. However, various types of bees were abundant.

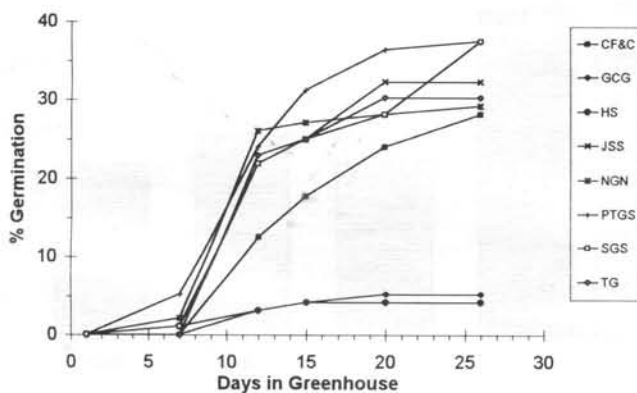


Fig. 16. *Nepeta cataria* Germination

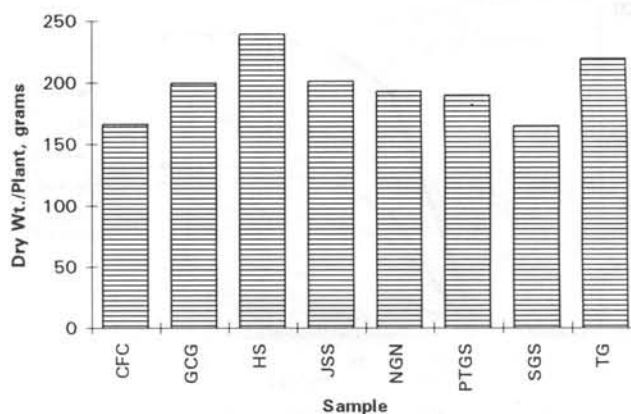


Fig. 17. *Nepeta cataria* Yield

Tanacetum parthenium

(feverfew)

Tanacetum cinerarifolium

(pyrethrum)

GERMINATION (Figure 18)

Feverfew seeds were sown on March 7 into moist potting soil, barely covered with soil, and placed under halogen lights in the greenhouse. The first seedlings began to emerge in 3 days, with the percentage leveling off at day 12.

CROP YIELD (Figure 19)

Samples of feverfew arrived with various Latin names. The aster family has undergone some major changes in classification during the last few years, and labels have not kept up with the latest nomenclature. The current Latin name for feverfew is *Tanacetum parthenium*. However, packages were labeled *Chrysanthemum parthenium* and *Matricaria parthenium*, both older synonyms for feverfew. One company (GCG) sent seeds of pyrethrum (*Tanacetum cinerarifolium*) in addition to feverfew. Name changes notwithstanding, there was a large variation in yield between samples. The lowest yield came from Golden Ball (PTGS), which is cultivated more for ornamental rather than medicinal use. Its short stature (under 2 ft.) left little room for foliage. Other samples, divided into single flowered (yellow disk flowers and white rays) and double flowered (yellow disk flowers and white rays) and double flowered

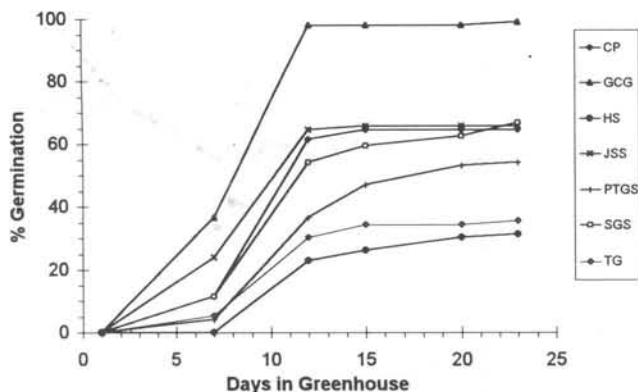
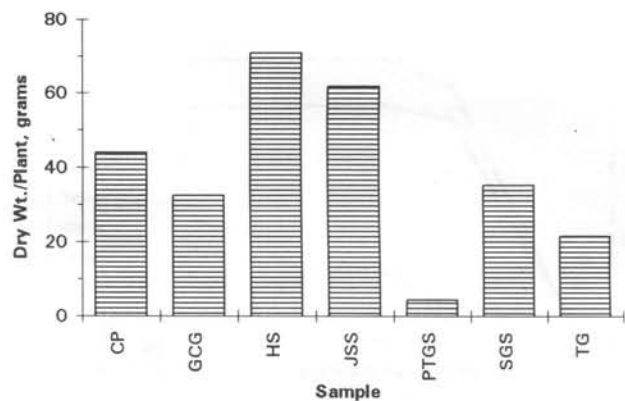
(few yellow rays in center of head, rest white rays), produced much more foliage on a 2-3 ft. high plant. The pyrethrum sample from GCG was also double flowered. The single flowered varieties averaged 1,267 lb. per acre \pm 391 lb. and the double 646 lb. per acre \pm 185 lb. (data not included Table 3). The 2 ft. spacing worked well for this species.

MARKETABLE USES

Feverfew is one of the many herbs that are making the crossover from traditional herbalism to mainstream medicine. Parthenolides, a class of sesquiterpene lactones found in the flowers and foliage, have been shown to reduce the incidence and severity of migraine headaches (Ody, 1993; Voyno-Yasenetskaya, 1988; Weiner, 1990). For these reasons, the demand for feverfew is predicted to increase.

INSECTS/DISEASES

There were no pest or disease problems associated with feverfew.

Fig.18. *T. parthenium* Germ.Fig. 19. *T. parthenium* Yield

Valeriana officinalis (valerian)

GERMINATION (Figure 20)

Valerian seeds were subjected to a cold treatment in a similar manner to the *Echinacea*. Seeds were sown on March 6 in moist potting mix and covered with 1/4-1/2 in. soil. Flats were wrapped in plastic and placed in a dark 40F cold room. After 6 days they were removed to the greenhouse and placed under halogen lights. Cotyledons first became visible 5 days after transfer, with germination plateauing after 10 days for all but one seed lot (HS).

CROP YIELD

The medicinally useful root needs 3-5 years to mature and therefore was not harvested. The herbage is not used medicinally.

MARKETABLE USES

Valerian contains valepotriates, a class of compounds known to have sedative and tranquilizing properties (Weiner, 1990). Demand for this root is projected to increase as clinical trials for its use in the treatment of insomnia and depression progress.

INSECTS/DISEASES

No pest or disease problems were found associated with valerian.

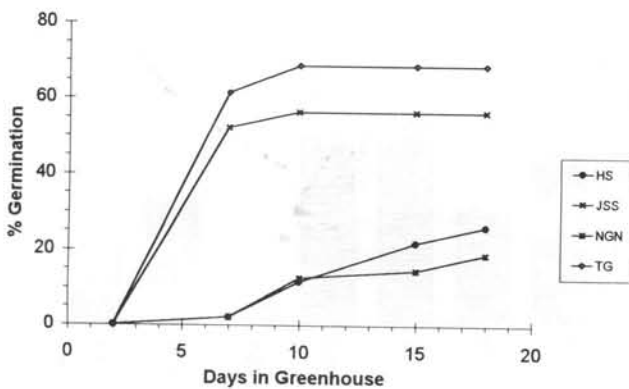


Fig. 20. *Valeriana officinalis* Germ.

REFERENCES

- Anonymous. 1995. "Medicinal Herbs Market." (c) New Hope Communications, Boulder, CO.
- Bauer, R., Jurcic, K., Puhlmann, J., and Wagner, H. 1988. Immunological in vivo examinations of *Echinacea* extracts. *Arzneim-Forsch*, 38(2):276-281.
- Bauer, R., Remiger, P., and Wagner, H. 1989. Alkamides from the roots of *Echinacea angustifolia*. *Phytochemistry* 28(2):505-508.
- Bourrel, C., Perineau, F., Michel, G., Bessiere, J. M. 1993. Catnip (*Nepeta cataria* L.) essential oil: analysis of chemical constituents, bacteriostatic and fungistatic properties. *J. Essent. Oil Res.* 5(2):159-167.
- Della-Loggia, R., Tubaro, A., Sosa, S., Becker, H., St-Sarr., and Issac, O. 1994. The role of triterpenoids in the topical anti-inflammatory activity of *Calendula officinalis* flowers. *Planta Med.* 60(6):516-520.
- Dobelis, I. N., ed. 1986. Magic and Medicine of Plants. Reader's Digest Association, Inc. USA. 484 p.
- Emerich, M. 1996. "Industry Growth: 22.6%." Natural Foods Merchandiser, June 1996, (c) New Hope Communications, Boulder, CO.
- Engler, M. M., Engler, M. B., and Paul, S. M. 1992. Effects of dietary borage oil rich in gamma-linoleic acid on blood pressure and vascular reactivity. *Nutr. Res.* 12(4/5):519-528.
- Erichsen-Brown, C. 1979. Medicinal and Other Uses of North American Plants. Dover Publications, Inc. New York, NY. 512 p.
- "Farm Numbers and Land in Farms". 1996. National Agricultural Statistics Service, United States Department of Agriculture. Washington, DC.
- Gollapudi, S., Sharma, H. A., Aggarwal, S., Byers, L. D., Ensley, G. E., Chabard, J. L. 1995. Isolation of a previously unidentified polysaccharide (MAR-10) from *Hyssop officinalis* that exhibits strong activity against human immunodeficiency virus type 1. *Biochem. Biophys. Res. Commun.* 210(1):151-154.
- Grieve, M. 1992. A Modern Herbal. Dorset Press. Great Britain. 912 p.
- Hoagland, D.R. and Arnon, D.I. 1950. The water culture method for growing plants without soil. Univ. Calif. Agric. Expt. Stn. Cir., No. 347.
- Lawless, J. 1995. The Illustrated Encyclopedia of Essential Oils. Barnes and Noble Books. New York, NY. 256 p.
- Medrano, A., Masoud, T. A., and Martinez, M. C. 1992. Mineral and proximate composition of borage. *J. Food Compos. Anal.* 5(4):313-318.
- Mergentime, K. and Emerich, M. 1996. "Widening Market Carries Organic Sales to \$2.8 Billion in 1995." Natural Foods Merchandiser, June 1996, (c) New Hope Communications, Boulder, CO.
- Ody, P. 1993. The Complete Medicinal Herbal. Dorling Kindersley. New York, NY. 192 p.
- Tucker, A. O. 1993. Is this plant a hoax? A lecture in honor of Otto Richter. in *Proceedings of Herbs '93: The Eighth Annual Herb Growing and Marketing Conference*, July 8-11, Bellevue, WA.: The International Herb Growers and Marketers Association, Mundelein, Ill. p. 177-183.
- Voyno-Yasenetskaya, T.A. 1988. Effects of an extract of feverfew on endothelial cell integrity and on cAMP in rabbit perfused aorta. *J. Pharm. Pharmacol.* 40:501.
- Weiner, M.A. 1990. Weiner's Herbal: The Guide to Herb Medicine, 2nd ed. Quantum Books. Mill Valley, CA. 284 p.



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