What is New in Herb Agronomy: *The Saskatchewan Experience*

Jazeem Wahab (Horticultural Crops Agronomist)
Saskatchewan Irrigation Diversification Centre
Outlook, SASK. S0L 2N0

Introduction

Natural plant products are increasingly being used as pharmaceuticals, health food, food flavouring and cosmetics. Presently, there is widespread interest in alternate health care in many parts of the world including Europe and North America. The annual trade of medicinal plants is estimated to be in excess of $3 trillion globally and more than $100 million in Canada. The medicinal plant industry in North America is believed to be growing at a rate of 20% annually. The medicinal and aromatic plants production and processing industries are growing rapidly in Saskatchewan. With directions from the Saskatchewan Herb and Spice Association and financial assistance from the Agri-Food Innovation Fund, the Saskatchewan Irrigation Diversification Centre (SIDC) has expanded its herb research program to address the needs of this rapidly expanding industry. The project is conducted jointly between the following organizations:

- Saskatchewan Irrigation Diversification Centre (Field agronomy),
- Department and of Agricultural Bio-Resource Engineering, University of Saskatchewan (Mechanical harvesting and post harvest handling),
- Department of Plant Sciences, University of Saskatchewan (Quality analysis), and
- Saskatchewan Agriculture and Food (Extension).

SIDC Research and Development Program

Crops:

Agronomic studies are being conducted for several herb species that are considered to be commercially important. They include *Echinacea angustifolia*, feverfew, German chamomile, milk thistle, stinging nettle, and valerian.

Program Objectives:

- Evaluate the adaptability of promising medicinal and culinary herbs for Saskatchewan conditions.
- Develop management practices for mechanized commercial production.
- Develop labour saving agronomic practices.
- Compare dryland and irrigated production in relation to yield and quality.
- Assess the feasibility of direct seeding and transplanting under dryland and irrigated conditions.
- Determine stage and method of harvesting for maximum yield and optimum quality.
- Develop post-harvest handling practices (primary processing) to increase recovery and to maintain high quality.
- Develop optimal short and long term storage practices.
- Effects of production and post-harvest handling practices on quality and active ingredient profile.

Milk Thistle

Milk thistle grew successfully in 1997 and 1998. Milk thistle has an indeterminate growth habit. A considerable proportion of mature flower heads were harvested between 95 to 125 days from seeding. The indeterminate growth habit of milk thistle is a limitation for once-over mechanical harvesting. Studies are being conducted to determine the feasibility and potential for mechanical harvesting of milk thistle.

Seeding Rate and Row Spacing Study:

A 1997 study that examined the effects of seeding rate of milk thistle grown under dryland conditions. Mature heads were harvested manually for yield estimation. Higher plant population produced twice the seed yield but did not affect seed size (Table 1). Milk thistle appears to have greater yield potential than that observed in the 1997 study.

Table 1. Seed yield and average seed weight of milk thistle grown at two seeding rates: 1997

Harvest	Seed yield (kg/ha)		Average seed weight (g/1000 seed)	
	40,000 seed/ha	120,000 seed/ha	40,000 seed/ha	120,000 seed/ha
1	58	116	18.2	20.3
2	40	88	14.3	16.4
3	84	162	20.6	20.7
Total	182	366	-	-

In 1998, three seeding rates (50, 100, 200 seed/m^2) and three row spacings (20, 40, 60 cm) were compared for milk thistle grown under dryland conditions. Mature flower heads were hand harvested three times and the final harvest was taken using a small plot combine. The crop was desiccated with Reglone two weeks prior to combining.

Stand establishment and yield (total) in response to seeding rate and row spacing is presented in Table 2. Higher seeding rates resulted in a higher plant stand and produced higher seed yields. Increased plant stand due to higher seeding rates did not appear to be proportional to the seeding rate increase.

Row spacing had no effect on plant stand (Table 2). However higher seed yields were recorded at wider row spacings.

German Chamomile

Cutting Height and Stage of Harvesting Study (1997):

This study was done with transplanted German chamomile grown under irrigation. The plants were spaced 60 cm between row and 30 cm within the row. The crop was harvested at 2.5 and 10 cm from the top of the canopy.

Table 2. Seeding rate and row spacing effects on stand establishment and seed yield for milk thistle.		
Treatment	Plant stand (plants/m^2)	Total seed yield (kg/ha)
Seeding rate (seed/m^2)		
50	9.4	521.9
100	12.1	689.9
200	17.2	805.1
Row spacing (cm)		
20	11.8	531.4
40	14.1	757.5
60	12.8	727.9

Lower cutting height produced more than double the herbage yield at both harvests (Table 3). Quality characteristics will be evaluated for samples obtained from the two cutting treatments.

Table 3. Cutting height and harvest date effects on fresh herbage yield: (1997)		
Cutting height	Fresh herbage (flower + stem) yield (kg/ha)	
	August 26	September 11
Flower + 2.5 cm stem	2473	2356
Flower + 10 cm stem	4932	6328

Fertilizer Study (1998):

Yield responses to nitrogen, phosphorus, and potassium application were evaluated for transplanted German chamomile grown under irrigation.

The yield differences between fertilizer application and the zero fertilizer control were not statistically significant. However, positive yield responses were observed for phosphorus and potassium application. The response to nitrogen application was negative (Figure 1).

Feverfew

Spacing Study (1998):

Yield responses to two plant spacings, 60 x 30 and 60 x 15 cm (approximately 55,000 and 111,000 plants/ha) were studied for feverfew grown under dryland and irrigated conditions. The crop was harvested at around 70% bloom.

Higher plant population produced higher herbage yields compared to the lower plant density under both growing conditions. The corresponding yield advantages were 45% under dryland and 64% under irrigation (Figure 2). Further studies are being carried out to examine the

the interactive effects of plant population, and stage of harvest for irrigated and dryland feverfew studies are needed to confirm the influence of fertilizer application on chamomile yield.

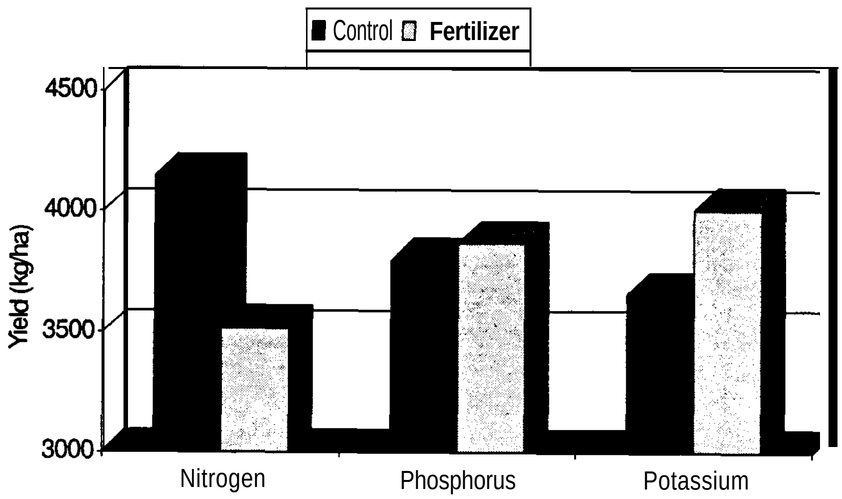

Figure 1 Nitrogen, phosphorus, and potassium effects fresh herbage yield of German chamomile

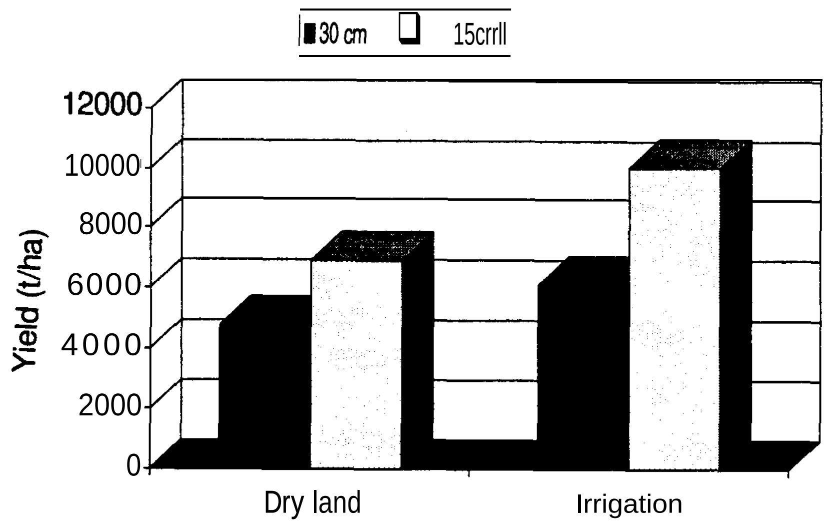

Figure 2 Plant spacing effects on herbage yield for transplanted feverfew grown under dryland and irrigation.

Stinging Nettle

Comparison of planting material over-wintered under different conditions:

Herbage yield of the following types of planting material were compared under dryland and irrigated conditions

- Transplants produced in 1997 and overwintered in the greenhouse (97-OW-GH)
- Transplants produced in 1997 and overwintered in straw-covered pit (97-OW-PIT)
- Transplants produced in 1998 (98-TP)

Under both irrigation and dryland, stinging nettle grown from transplants raised in 1997 produced approximately double the fresh herbage yield compared to the crop grown from 1998 transplants. (Table 4). Similar yield responses were also obtained for dry herbage yield. This yield increase can be attributed to better stand establishment for the older transplants compared to current year's planting material (Table 4).

Table 4. Stand establishment and herbage yield for stinging nettle grown under dryland and irrigation using different types of planting material.

Treatment[z]	Dryland			Irrigation		
	Stand estab. (%)[y]	Fresh yield (kg/ha)	Dry yield (kg/ha)	Stand estab. (%)[y]	Fresh yield (kg/ha)	Dry yield (kg/ha)
97-OW-GH	87.5	13081	3458	89.6	10960	2466
97-OW-PIT	86.1	15922	4229	79.2	10035	2154
98-TP	75.7	7288	2518	55.2	5520	1358

[z] 97-OW-GH: Transplants produced in 1997 and overwintered in a heated greenhouse,
97-OW-PIT: Transplants produced in 1997 and overwintered in a straw-covered pit
98-TP: Transplants produced in 1998.

Plant Spacing and Cutting Height:

This study examined the effects of plant spacing and cutting height on herbage yield for transplanted stinging nettle grown under irrigation and dryland. The treatments included two plant spacings (60 x 30 cm and 60 x 15 cm), and three cutting heights (ground level, 10 and 15 cm from ground level).

The crop was harvested at the 100% flowering stage. The irrigated crop produced higher herbage yields than the dryland crop. The higher plant population produced higher herbage yields under both irrigation dryland conditions (Table 4). Under irrigation, the higher plant population outyielded the lower plant density by 19%, and under dryland, the corresponding yield increase was only 6% (not statistically significant) .

Cutting the crop at ground level produced almost double the herbage yield compared to the 15 cm cutting height (Table 4). The 10 cm cutting height produced higher yield than the 15 cm cutting height. The yield differences were 30% under dryland and 18% under irrigation. Further work is being carried out to determine the quality aspects of stinging nettle in relation to plant density and cutting heights.

Table 4. Plant spacing and cutting height effects for stinging nettle grown under irrigation and dryland

Treatment		Fresh Herbage yield (kg/ha)	
		Dryland	Irrigation
Plant spacing:	60 cm x 15 cm	6316	9661
	60 cm x 30 cm	5961	8092
Cutting height:	Ground level	8437	12670
	10 cm above ground	5634	7540
	15 cm above ground	4344	6419