Lavender: to grow or not to grow…

Selecting lavender cultivars for the Okanagan valley of British Columbia, Canada

Alex Lane and Soheil Mahmoud

UBC Okanagan, Kelowna, BC.

Summary:

Lavenders have great promise as specialty crops for British Columbia. However, some cultivars are not suited for propagation in this region, as they are not cold tolerant. In order to identify plants that can perform well in the Okanagan, we tested 12 established lavender cultivars (8 cultivars of *L. angustifolia*, 3 cultivars of *L. intermedia*, and one of *L.lanata*) in the UBC Okanagan experimental farm. After two seasons of growth, we measured several horticultural traits, including winter hardiness, plant size, flower characteristics, and essential oil yield and composition. Our results show that several lavender varieties do well in this area, producing essential oils comparable in quality to those produced in France. However, some varieties cannot withstand the somewhat harsh winter in this region.

Introduction:

Several varieties of *Lavandula angustifolia* and *Lavandula intermedia* are farmed throughout the Okanagan Valley in the interior of British Columbia. One of the main focuses of these farms is to produce high quality essential oils for incorporation in locally developed food and cosmetic products, and for use in applications such as aroma therapy. Also plant parts are sold for visual features of importance. Though few lavender species are known to be well suited to the climate found in the Okanagan Valley (i.e. warm, arid summers), to our knowledge there has been little in the way of formal evaluation of cultivars that can perform well in our region. To improve the competitiveness of the local lavender product industry, it would be advantageous to thoughtfully select cultivars that are suited for this geo-climatic zone. To date, the primary concerns of producers have been cold hardiness (ability to reliably survive the winter) and productivity (quality of plant material produced) of the lavenders grown. To address these concerns, we

constructed a test farm at the Kelowna campus of the University of British Columbia. The goal was to establish which cultivars of lavenders would be suitable for cultivation in the region, based on traits such as winter hardiness, plant size, flower characteristics, harvest date and visual and sensory features.

Methods and Materials:

Plant Cultivation

Four replicate plants for each of the 12 selected cultivars were field grown under standardized conditions. All stock plants were placed in the field during the spring of 2005 and irrigated regularly throughout the growing season. The *L.angustifolia* cultivars selected were: Brentwood Variegated, Royal Velvet, Royal Purple, Munstead, Bowles, Premier, Hidcote, and Mailette. The *L. intermedia* cultivars tested included Hidcote Giant, Grosso, and Super Lavender. Wolley Lavender was selected as a variety of *L.lanata*

Data Collection:

Following two seasons of growth, all plants were measured for the height and diameter of the dome shaped foliage, flower spike length, flower color, and flower density. Bloom (harvest) times for each cultivar were also recorded and photographs were taken of representative flowers of each cultivar. Harvest dates were determined by the proportion of flowers per spike that were open. The standardized harvest time between cultivars was defined as when two thirds of all flowers on a plant were open, which is congruent with industry practices. An average fresh weight (FW) of flowers collected from each cultivar was calculated based on the amount of fresh flower material harvested from each cultivar at the time of harvest.

Essential oil analysis:

Essential oil was isolated by simultaneous steam distillation / solvent extraction. Prior to extraction, 1mg of menthol was added to each sample to help with quantification calculations. Essential oil yield was calculated as mg/g FW. Essential oil analysis was performed using a Varian GC 3800 gas chromatographer coupled to a Saturn 2200 Ion

Trap mass detector. The GC/MS system was equipped with a 30 m x 0.25 mm capillary column coated with a 0.25 μm film of acid-modified polyethylene glycol (EC™ 1000, Alltech, Deerfield, IL). The temperature program was initiated at 40°C for 3min, increased to 170°C at 7°C/min, and to 230°C at 30°/min. The carrier gas (He) flow rate was set to 1mL/min. To improve the reliability of results, essential oil samples were replicated 6 times with average relative abundance and standard deviation for each compound can then be calculated based these replicates.

Results and Discussion:

A range of horticultural traits were assessed and measured at time of flower harvest, and average fresh flower weight was calculated for surviving plants (Table 1). In addition, photographs of representative flowers of each cultivar were taken in order to more accurately record flower color, size, and density (Figure 1). Finally, total essential oil was extracted and analyzed to produce an estimate of essential oil yield (Table 1).

Cold Hardiness:

Royal Velvet and Bowles exhibited the greatest cold tolerance with 100% of plants surviving the winter (Table 1). Munstead, Premier, Hidcote, Mailette and Grosso were the second most hardy, with a 75% survival rate. Royal Purple, Hidcote Giant, and Super Lavender are considered to have poor winter hardiness due to survival rates of 25%-50%. Brentwood Variegated lavender plants did not survived the winter, and would therefore not be practical for growing in the Okanagan Valley. Based on our observations, members of *L.intermedia* (Hidcote Giant, and Super Lavender) are less cold tolerant than most *L.angustifolia* cultivars.

It is worth noting that the minimum temperatures during the early winter on 2006/2007 were particularly low. According to Environment Canada's historical climate data, November 27-29, 2006 saw temperature drop to as low as -25°C in Kelowna (http://www.weatheroffice.gc.ca). This is considered to be exceptionally cold for the region, and therefore, represents a fairly extreme test the cold hardiness of plants tested.

Plant Dimensions:

Hidcote Giant grew to be the tallest, at 90 cm, followed by Royal Velvet, Royal Purple, Grosso, Super Lavender (all 60cm in height). Munstead was found to be the shortest of the 11 cultivars tested, at 40cm. In contrast, Munstead grew to be the widest plant in dome diameter (60 cm), followed by Bowles, Hidcote and Mailette (all 50 cm in dome diameter). It should be noted that all lavenders continued to grow with each growing season. Therefore, these measures do not represent final plant size.

Flower Traits:

Hidcote Giant and Grosso were noted as having substantially longer flower spikes than other lavenders tested, with flower spikes reaching 70 cm and 55 cm respectively. Interestingly, flower color and density are slightly correlated, with dark flowered cultivars also exhibiting high flower density.

Biomass:

Total fresh weight (FW) of all flowers at harvest time was also measured as an estimate of the productivity of each cultivar. Given that fresh flowers are primary product harvested during lavender farming, this was the logical measure to observe. For 2007, Royal Purple and Grosso produce the largest amount of flower biomass, with an average of 630g and 530g of flowers per plant. In contrast, Bowles and Super Lavender produced considerably less (64g and 74g each) and were the least productive in terms of total flower biomass.

Bloom Time:

All cultivars were ranked in order of harvest date (Table 1). Munstead and Mailette bloomed first (on June 21st), while Grosso and Super Lavender were the latest varieties with bloom date three weeks later, on July 11th and 12th. Clearly, *L. intermedia* cultivars bloom later in the season than most *L. angustifolia* members.

Essential Oil Analysis:

Essential oil yield was estimated for each cultivar as an alternative measure of productivity. Grosso displayed the highest essential oil yield, at 34 mg/g FW, followed by Hidcote Giant which produced 29.6 mg/g FW. Inversely, Bowels and Hidcote produced the lowest amount of oil (7.7 mg/g FW and 9.2 mg/g FW). This result confirms previously established trends that *L. intermedia* cultivars tend to be more prolific essential oil producers than *L.angustifolia*. The essential oil profiles of the various lavender cultivars are quite diverse, with predictably high levels of camphor in the *L. intermedia* cultivars. The specific cultivar to cultivar differences will be addressed in future communications.

Conclusion:

We have studied 12 lavender cultivars belonging to three popular Lavender species (*L. angustifolia*, *L. lanata* and *L. intermedia*), as potential crops for the Okanagan valley. Our results demonstrate that several lavender cultivars grow well in this climate, producing an essential oil comparable to those produced by other counties such as France. However, some other cultivars do not survive the Okanagan winter.

Given that different cultivars rank differently for different visual and sensory traits, it would be better if lavender growers first decide on which traits are most important to them, and then select the cultivar accordingly. If the quality and the quantity of the essential oil are not important, then several *L. angustifolia* varieties that produce attractive and colorful floral tissues can be successfully grown in this area. If on the other hand, lavender is to be grown for the quantity of the essential oil, then the *L. intermedia* varieties can be selected. For this reason, it is difficult to define the "best" lavender cultivar. The choice simply depends on what the grower looks for. For example, if we prioritize cold hardiness and essential oil yield, then Hidcote Giant and Gross rank the highest. If dark flower color and high flower density are valued, then Hidcote or Premier would be the best candidates. Depending on a grower's priorities, different cultivars will be optimal.

Our preliminary evaluation of the essential oil composition indicates that lavenders grown in the Okanagan can yield high quality oils, comparable to those

produced in France and other countries (unpublished data). Future investigations will look at essential oil composition in detail and evaluate the inevitable differences between cultivars. With that data available, it will be possible to establish relationships between growth habit, and oil quality/ composition. Also, the effect of harvest time on essential oil composition could be explored. Since lavender essential oil is increasingly becoming an internationally produced commodity, the most liking way for local producers to retain viability is through the development of a recognized brand that is associated with high quality essential oil and related products. Land and labor cost are relatively high in British Columbia, therefore, it is unrealistic to compete internationally on a quantity basis. However, if cultivars of lavender can be found that are reliably winter hardy, highly productive, and capably of producing elite quality essential oil, then lavender farming for essential oil may have a bright future in the Okanagan Valley.

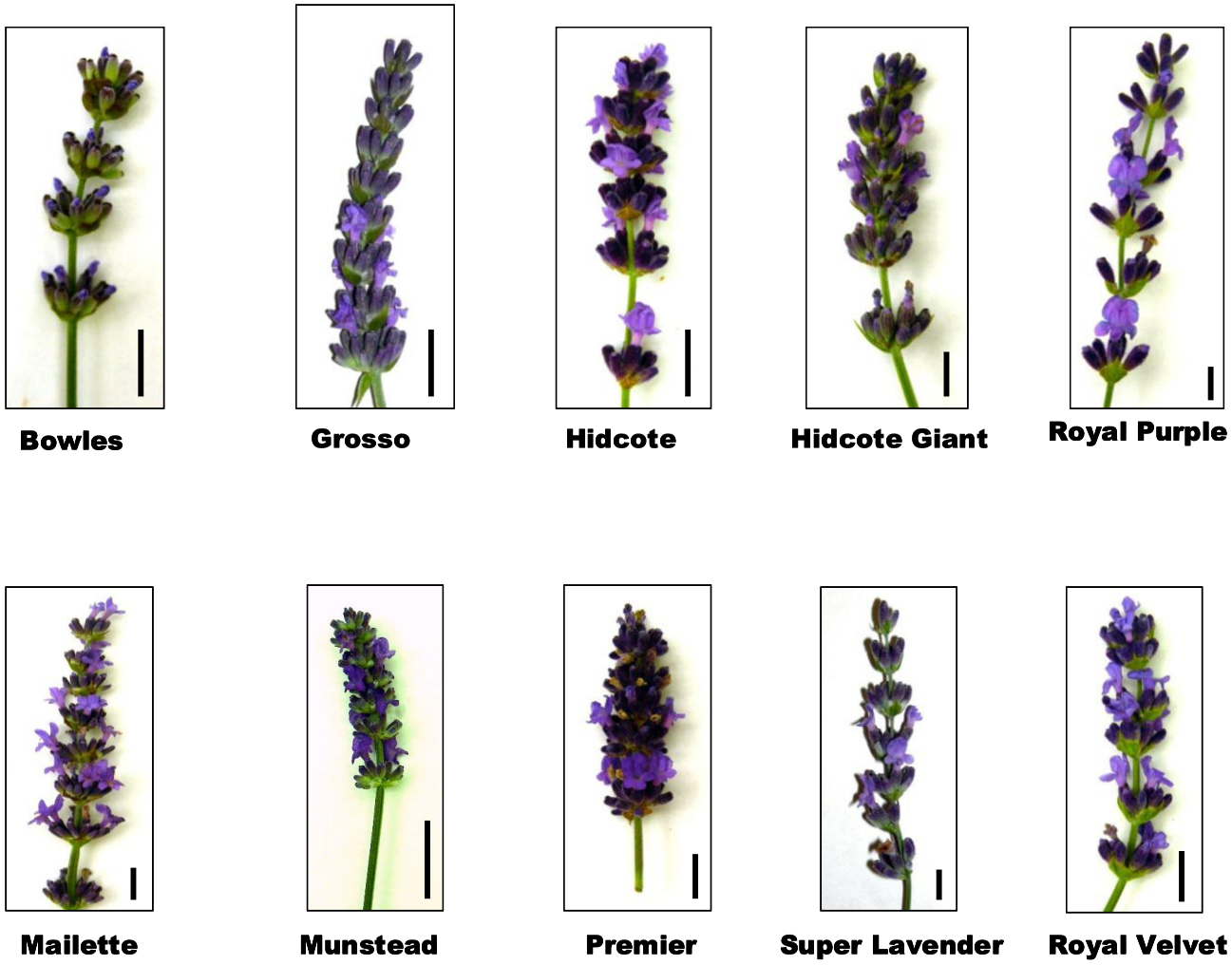

Figure 1: Photos of representative flowers of each surviving cultivar tested. Note: Brentwood Variegated Lavender, and Woolley Lavender are absent since no plant survived till harvest. Bar = 1 cm.

cultivar	survival rate	height (cm)	width (cm)	spike length	flower color	flower density	harvest date (dd/mm/yy)	essential oil yield (mg/g FW)	flower biomass
Mailette Lavender	75%	55	45-50	40	light purple	very low	21.06.07	21.6	282.9
Munstead Lavender	75%	40	40-60	15-20	mid purple	high	21.06.07	12.6	181.1
Bowels Lavender	100%	50	45-50	35	light purple	mid	27.06.07	7.7	64.1
Royal Velvet lavender	100%	60	50	25-35	dark purple	high	03.07.07	13.9	279.6
Premier Lavender	75%	40-50	25-45	25-45	dark purple	high	03.07.07	10.1	130.6
Royal Purple Lavender	50%	60	40	45	mid purple	low	03.07.07	9.7	630.3
Hidcote Giant Lavender	25%	90	35	60-70	light purple	mid	03.07.07	29.6	340.3
Hidcote Lavender	75%	45	45-50	20-35	very dark purple	very high	04.07.07	9.2	198.5
Grosso Lavender	75%	60	40	45-55	light purple	mid-high	11.07.07	34.0	506.8
Super Lavender	25%	60	20	30-50	light purple	low	12.07.07	23.9	74.9
Brentwood Varigated	0%	na	na	na	na	na	na	na	na
Woolley Lavender	0%	na	na	na	na	na	na	na	na

Table 1: 2007 field trial data

survival rate	height	width	spike length	flower color (dark to light)	flower density	harvest date (early to late)	essential oil yield
Super	Hidcote Giant	Munstead	Hidcote Giant	Hidcote	Hidcote	Munstead	Grosso
Hidcote Giant	Royal Velvet	Mailette	Grosso	Premier	Premier	Mailette	Hidcote Giant
Royal Purple	Grosso	Bowels	Super	Royal Velvet	Royal Velvet	Bowels	Super
Mailette	Royal Purple	Hidcote	Premier	Royal Purple	Munstead	Premier	Mailette
Grosso	Super	Royal Velvet	Royal Purple	Munstead	Grosso	Royal Velvet	Royal Velvet
Hidcote	Mailette	Premier	Mailette	Hidcote Giant	Hidcote Giant	Hidcote Giant	Munstead
Premier	Premier	Grosso	Bowels	Grosso	Bowels	Royal Purple	Premier
Munstead	Bowels	Royal Purple	Hidcote	Super	Royal Purple	Hidcote	Royal Purple
Bowels	Hidcote	Hidcote Giant	Royal Velvet	Mailette	Super	Grosso	Hidcote
Royal Velvet	Munstead	Super	Munstead	Bowels	Mailette	Super	Bowels
Brentwood Varigated	Brentwood Varigated	Brentwood Varigated	Brentwood Varigated	Brentwood Varigated	Brentwood Varigated	Brentwood Varigated	Brentwood Varigated
Woolley	Woolley	Woolley	Woolley	Woolley	Woolley	Woolley	Woolley

Table 2: 12 lavender cultivars ranked in descending order for the traits: survival rate, plant height, plant width, flower spike length, flower color, flower density, harvest day, and essential oil yie