winter months. Its glossy needles are curved and are dark green. Another feature is its branch and needle configuration. Most umbrella pines are somewhat loosely branched with both their stems and needles visible. 'Cynthia Waxman' has shorter stems and is more densely branched. As a result, you see a solid barrier of needles while the stems are hidden. Its annual growth rate is approximately 9 to 10 cm compared to other umbrella pines nearby whose growth rates are 11 to 14 cm. At 22 years it is 3 m tall and 1.5 m wide at the base in contrast to a tree close by and planted at the same time, which is 15.5 ft tall and 11 ft wide at the base. Overall, 'Cynthia Waxman' is a slow-growing umbrella pine with glossy dark green foliage and is perfectly pyramidal

***Pinus densiflora* 'Vibrant'.** A witches'-broom seedling that is a low irregular mound 60 m tall and 2.5 m wide. Its foliage is very bright yellow-green and its needles are 2 cm long. Its annual growth is approximately 5 cm. 'Vibrant' offers a bright contrast when planted among other conifers.

Commercially Available Organic Mulches as a Weed Barrier for Container Production©

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INTRODUCTION

For many Canadian nurseries, weed control can be a very time-consuming and costly process. Unlike the United States of America, Canada has limited access to effective chemical herbicides (Chong, 2003; Chong et al., 1989; Chong, 2003). Herbicide phytotoxicity and surface water and ground water contamination issues have renewed interest in nonchemical methods such as weed barriers (Mervosh, 1999). Growers are constantly striving to find nonchemical methods of weed control that reduce the frequency of hand weeding in our container nurseries (Calkins, et al. 1996; Chong, 2003; Chong et al., 1989; Mervosh and Abbey. 1999; Mathers, 2003). Over the past decade, mulch has increased in popularity for weed suppression in the landscape industry (Borland, 1990). Organic mulches such as wood chips and bark are attractive and effective methods of weed suppression when applied properly (Mervosh, 1999). Studies have shown that hardwood chips and pine bark mulches are effective weed barriers in container production (Calkins, et al. 1996; Mervosh and Abbey. 1999). Our research was initiated to determine the efficacy of various organic weed control barriers that are available for Ontario growers. Costs of application, materials, and supplemental hand weeding also plays an important role in selecting the most appropriate weed-control strategy.

Table 1. Physical and chemical properties.

Physical Description	Recycled wood pallet, wood pallets ground to 2-inch size	Economulch yard waste ground to 2-inch size	Shredded pine mulch, red and white pine bark ground to 2-inch size
pH	6.7	8.0	4.0
Total salts (E.C.) (mmho·cm^{-1})	0.59	1.10	0.54
Organic matter %	97.6	72.5	93.2
Carbon : nitrogen	78.7	52.5	133

Table 2. Cost of weed control per pot.

	3 gal	5 gal	25 gal
RWP	$0.34	$1.41	$2.70
Econo	$0.35	$1.44	$2.78
SPM	$0.32	$1.25	$2.50
Coco	$0.40	$1.15	$1.84
Hand-Weeding	$0.32	$1.58	$2.65

(Includes materials, placement, and supplemental hand weeding)

MATERIALS AND METHODS

This trial took place during the growing season of 2003. Three organic mulches [Recycled Wood Pallet (RWP), Econo mulch (Econo), shredded pine mulch (SPM) (Table 1)], and one weed disc product [TE#TM Weed Prevention Coco Disc (Coco) (Timm Enterprises Ltd., Milton, Ontario)] were selected for comparison to a barrier-free treatment (Control). Weed suppression was then assessed in container-grown *Buxus* 'Green Velvet' (3 gal), *Quercus palustrus* (15 gal), and *Betula utilis* 'Jacquemontii' (25 gal). All mulch treatments were applied at 1.5 to 2 inches in depth on 27 May to weed-free pot surfaces (Coco Discs were applied one per pot). Weed populations were recorded at monthly intervals, during hand weeding practices (June, July, August, and September). Growth measurements (height, spread, and caliper) were recorded in May and September.

Least significant differences between treatment means were calculated using standard errors for each mean (means with the same letters are not statistically different). In the interest of time, results will be reported for *Buxus* 'Green Velvet' (3 gal) only.

Costs for each treatment were calculated according to costs of material (e.g., Coco Disc or amount of wood mulch per pot), placement costs (labour), and supplemental weeding costs (labour) (Table 2). All labour costs were based on models used by the co-operating nursery.

RESULTS AND DISCUSSION

In general, weeds species in this trial included various broadleaf seedlings [e.g., common chickweed (*Stellaria media*), dandelion (*Taraxacum officinale*), annual

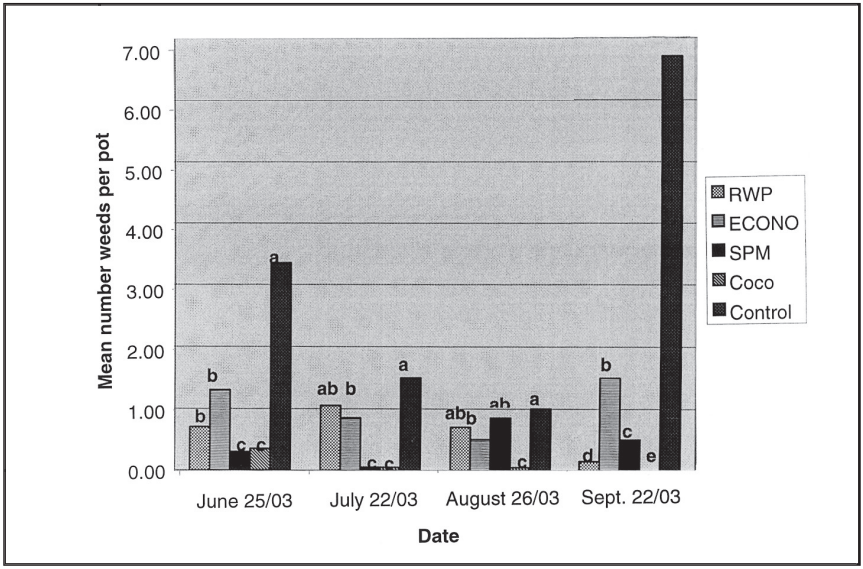

Figure 1. Mean number of weeds per pot *Buxus* 'Green Velvet'.

grasses, and tree seedlings (e.g., *Populus tremuloides*)]. All weed barrier treatments were seen to reduce weed germination and growth when compared to the control, throughout the trial (Fig. 1).

Overall, the TE™ Weed Prevention Coco Discs provided the most consistent weed suppression (Fig. 1). Weed control effectiveness increased steadily over the 17-week trial period for this product. SPM performed second best overall, producing the most consistent weed suppression when compared to the other wood-derived mulches. Both RWP and Econo mulch performed less adequately at most sampling dates, but usually significantly better than the control. Reduced performance of these two wood-derived mulches was due to exposed surfaces between pieces (e.g., RWP), slight breakdown (e.g., Econo), and losses due to tip-over.

All treatments gave significance in growth (height only) between dates. Treatment differences were also significant as all plants showed overall growth in height, with RWP and TE™ Weed Prevention Coco Discs showing most growth between dates (data not shown).

Costs for each treatment were quite similar to one another (Table 2). However, actual labour costs of supplemental hand weeding may vary greatly between nurseries. Based on weed barrier performance, it was estimated that Coco Discs would require the least amount of supplemental weeding, followed by SPM. This means that the actual costs associated with these two treatments may be more stable from nursery to nursery, when compared to the other three treatments. Also, it should be noted that although smaller pots require less cost per unit (materials, placement, and supplemental hand weeding), there are more of these pots per production area than the larger pot sizes.

CONCLUSIONS

Both the TE™ Weed Prevention Coco Discs and organic mulches (e.g., SPM) have proven to be cost-effective weed control methods. When compared to other weed discs, TEô Weed Prevention Coco Discs sit flatter and are less likely to lift upon container tip-over and wind exposure. Mulches also offer an excellent weed barrier, however they can spill out from a tipped container and some of them (e.g., Econo) do break down somewhat over the growing season. From purely a weed-suppression standpoint, the Coco Discs and SPM are close rivals. Coco Discs outperformed SPM in weed control (at the last two dates) yet the SPM may be a more attractive option to the consumer.

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Decreasing the Production Time of Seed-grown *Lilium* and *Dodecatheon*©

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INTRODUCTION

One drawback of growing some species from seed is the length of time required to produce a plant large enough to plant out. *Lilium* and *Dodecatheon* are two species where this is the case. At the Chicago Botanic Garden we have an extensive *Lilium* breeding program requiring the growing of *Lilium* from seed. We also have natural areas where the genetic diversity of seed-grown *Dodecatheon* is desired. In order to produce plants of these two species in less time, two growing cycles were compacted into 1 year.

METHODS AND MATERIALS

Manipulating the day length and temperature in the greenhouses where the seedlings were grown shortened the growing cycles. Seeds were given the warm and cold stratification required for germination. After germination occurred, the seedlings were put through a cycle including growth in the greenhouse, conditions to induce dormancy, and a dormant period. This sequence was repeated until the plants were large enough to plant out. The process for both *Lilium* and *Dodecatheon* is as follows.