EVALUATION OF CONTAINER PLANTINGS IN AN URBAN ENVIRONMENT

by Melinda K. Myers[1] & Helen C. Harrison[2]

Abstract. Two shrubs, *Viburnum opulus* 'Nanum' and *Juniperus chinensis procumbens,* and three mulch treatments, shredded bark, hardwood chunk bark and a control were evaluated for use in above ground plantings on city streets. Data taken included soil temperatures, soil moisture levels, plant growth, winter kill and subjective evaluations of plant appearances. Differences were found in spring and fall temperatures of mulched and unmulched treatments. The bare soil cooled faster in the fall and warmed slower in the spring than the mulched soil. Both shrubs performed best with hardwood mulch. Junipers appeared to be the better plant selection in this study.

Résumé. Deux arbustes, *Viburnum opulus* 'Nanum' et *Juniperus chinensis procumbens*, et trois traitements, l'application d'un paillis d'écorces déchiquetées, d'écorces de feuillus en morceaux et un traitement témoin, furent évalués pour des fins d'utilisation lors de plantations au-dessus du sol sur les rues. Les données prises incluaient la température de sol, le degré d'humidité, la croissance des plantes, la mortalité hivernale et des évaluations subjectives de l'apparence des plantes. Des différences furent trouvées dans les températures au printemps et à l'automne entre les traitements avec paillis et sans paillis. Le sol exposé a refroidi plus rapidement à l'automne et s'est réchauffé plus lentement au printemps que le sol avec paillis. Les deux arbustes ont mieux répondu avec le paillis d'écorces de feuillus. Les genévriers ont constitué la meilleure sélection de plante dans cette étude.

Above ground planters are becoming a significant part of the urban landscape. Lack of space and suitable soil make them the only viable option for many cities (3, 5, 8, 13).

Current plant selection and maintenance recommendations are based on the successes and failures of past programs. Detroit's year round planter program has been a source for plant selection recommendations for other cities (13). Montreal's successful program which overwinters planters in a centralized location covered with mulch was unsuccessfully duplicated by Cincinnati (5). Many of Cincinnati's plants and planters suffered moving damage and winter injury (3).

The many and varied environmental stresses of the city, make it difficult to adequately evaluate and make recommendations based on one communities success or failure. Each plant is subjected to unique conditions of wind, shade, temperature, pollution, traffic and vandalism which influences its survival in that particular location (2, 4, 9, 10).

The urban stresses and limited soil mass, waterholding capacity and root insulation make container culture difficult (3, 5). The high cost of insulation and maintenance make container plantings a large investment for the municipality. Suitable plants and cultural practices must be determined to insure success.

The city of Milwaukee, Wisconsin's growing containerized street planting program provided an opportunity to study several aspects of these problems. The objectives of this study were to: 1) determine the suitability of two shrub species for container culture and 2) evaluate mulch effects on maintenance practices and plant's health and winter survival.

Materials and Methods

Viburnum opulus 'Nanum' and *Juniperus chinensis procumbens* were the shrubs evaluated. Each species of shrub received the following mulch treatments: 1) bare soil, 2) chunk hardwood bark, and 3) shredded bark mulch. The shrubs were planted in containers along three major thoroughfares in downtown Milwaukee. Planters were located on the north and south side of an east-west street, on the east side of one north-south street and on the west side of another north-south street. Plants were subjected to the effects of heavy city traffic, high winds tunneling between the buildings, shade from surrounding building, and heavy pedestrian traffic. A randomized complete block design was used to help reduce the influence of these uncontrollable factors. No differences between replications were found in the factors measured.

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The planters used were designed by the Milwaukee Bureau of Forestry and Form Products to provide maximum space and support for the plant, root insulation, water holding capacity, resistance to damage and minimum maintenance within the limitations of available sidewalk space. Container design and features were based on past studies and experiences. The poured concrete planters are 1.2 meters in diameter and 0.8 meters tall and lined with 50mm thick styrofoam to insulate roots from temperature extremes (9). The container weight is restricted to 1365 kg/square meter due to the limited weight holding capacity of the hollow sidewalks.

A galvanized steel or PVC pipe runs the height of the container for watering. These tubes are bolted to the side of the container and covered with a locked cap to prevent theft and vandalism. The 15 cm gravel filled resevoir is covered with a polypropylene fiber mat to keep soil out of the reservoir. Polypropylene wicks ran from the gravel reservoir through the soil surrounding plant roots. Excess water drains from the top of the reservoir through the weep hole. A plugged drainage hole on the container bottom is used to thoroughly drain the reservoir at the end of the growing season.

The shrubs were planted in May of 1983. Nine 30 cm container-grown viburnums and three 60 cm container-grown junipers were placed in each planter. The planting mix was 50% sandy loam, 25% horticultural grade perlite and 25% coarse sphagnum peat moss. A wetting agent was added to the medium at rate of 0.7 g per 0.8 l before planting. A 50 mm layer of each mulch was in place by late June.

Milwaukee City Forestry personnel used a small tank truck to water the containers twice a week. Water was added through the watering tube until excess ran out the weep hole. A soluble 20-20-20 fertilizer with micronutrients was used once every 7-14 days at a rate of 1.4 g/ 1.9 l of water through the end of September.

Soil moisture was measured twice a week throughout the growing season using bouyoucus blocks placed 15 cm below the soil surface. Soil temperatures were recorded monthly throughout the year. Temperatures over one 24 hour period were taken on December 29-30, 1983, to track diurnal variations in the medium.

Shrub growth was measured in the fall of 1983 and 1984. Growth was calculated by averaging the annual growth of ten randomly selected stems on each plant. Dieback was measured in the same manner after new growth began in the spring of 1984.

Aesthetic ratings were made in the fall of 1984. Visual ratings were made twice, one week apart, for all planters in this study. These ratings were then averaged according to kind of shrub and mulch treatment. An aesthetic rating scale of 100 points was used. The overall rating was based on freedom from pests, foliage color, foliage size, plant uniformity, plant size and plant vigor (See Table 2).

Results & Discussion

Soil Moisture. Soil moisture levels were 100% at each reading for all treatments (data not shown). The short soil column in the containers resulted in wet, poorly aerated soil. Past studies found that moisture in the bottom 15-30 cm was usually above field capacity with the volume of moisture saturation extending further for finer textured soils (8).

The past recommendations of twice weekly waterings for above ground planters was too often for the reservoir system (5, 7, 13). As a result of these findings the city is currently watering containers about once every 10 days. Handheld moisture meters are being used to determine

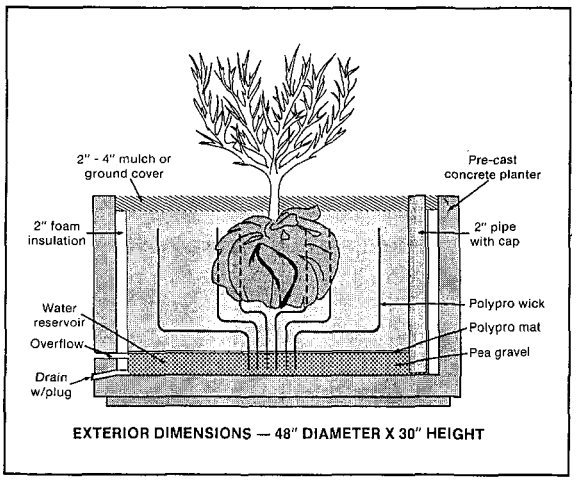

Figure 1. Diagram of above ground planter.

need for water and plants are showing less signs of moisture stress (11).

Soil temperature. The monthly temperature readings (Table 1) revealed no significant difference between the various mulch treatments in terms of coldest soil temperature taken 12/8/83 and warmest recorded soil temperature taken 7/15/84. There were significant differences between the bare soil and mulched treatments during the fall cooling period from 9/21 to 11/21. The bare soil treatments cooled off faster than the mulched treatments. Significant differences were also seen between the mulched treatments and bare soil in the spring warming period from 3/15 to 5/21. Temperatures under the mulches were warmer than that under bare soil.

The 24 hour temperature readings (Figure 2) showed a drop in soil temperatures of all treatments between 7 am and 1 pm with a corresponding drop in air temperature. Soil temperature under the shredded bark mulch rose during the 1 to 7 pm period while the temperature of the bare soil remained the same and soil temperature under hardwood bark dropped. The air temperature dropped 4°C over this period. Temperatures under all treatments rose during the 7-11 pm period while the air temperature dropped by 2°C. Reradiating heat from the sidewalks, buildings and containers themselves could have provided the heat for increasing the medium temperatures (1). Drops in temperatures under all treatments were seen in the 11 pm to 3 am period with a 1°C drop in air temperature, followed by an increase in soil temperatures of all treatments in the 3 to 7 am period with a 1°C rise in air temperature. The slightly warmer medium temperatures under the mulches between 11 pm and 7 am show the characteristic buffering effect of mulching.

Shrub Growth & Dieback. Mulch treatments did not have an effect on shrub growth. No significant difference was found between growth and dieback rates under various mulch treatments. Mulch treatments did not influence winter injury; an equal amount of dieback was seen on all treatments. The mulch may have enhanced the overwatering problem and delayed the development of hardiness counteracting any benefit (8).

The unusual fall and winter weather may have also counteracted the benefits of mulching. The fall of 1983 was very mild. The viburnums retained their foliage through November. Cold temperatures arrived before plants were totally defoliated. The winter of 1983/84 had some of the coldest temperatures on record. Winter temperatures dropped as low as −32°C. Soil temperatures recorded when air temperatures were −17°C had already dropped as low as −11°C. The mulches may not have modified the extreme cold temperatures enough to prevent

Table 1. Effect of three different mulches on container soil temperature in °C[z].

	Dates 1983					
Mulch treatment[y]	*7/25*	*8/30*	*9/21*	*10/30*	*11/21*	*12/8*
Control	24.1a	25.0a	14.1b	8.7b	5.9b	−6.8a
Hardwood bark	23.8a	25.8a	14.8ab	9.8a	6.7a	−6.7a
Shredded bark	24.8a	26.6a	16.2a	10.1a	7.2a	−6.9a

	Dates 1984						
	1/4	*2/15*	*3/15*	*4/25*	*5/21*	*6/25*	*7/15*
Control	−2.1b	0.1a	1.9b	11.4b	14.9b	23.5a	24.0a
Hardwood bark	−1.1a	−0.1a	2.7a	12.2a	16.0ab	23.8a	24.2a
Shredded bark	−1.8ab	−0.2a	3.2a	12.4a	16.8a	24.3a	24.8a

[z]Mean separation within columns within dates by Duncan's multiple range test, 5% level.
[y]Soil temperature recorded 15 cm below soil surface.

root injury which may have contributed to the dieback observed (6).

Aesthetic Rating. The junipers had an overall higher aesthetic rating than the viburnums (Table 2). They had few pest problems and showed only a slight decline in overall size. The viburnums had problems with spider mites, aphids and leafspot. The viburnum foliage was generally undersized and light green. The plants had deteriorated in size.

Both shrub species had a higher aesthetic rating with the hardwood bark mulch. The plants under this treatment had fewer pest problems, dark green foliage and maintained their size. Plants with the shredded bark mulch had the second highest, but significantly lower, aesthetic rating.

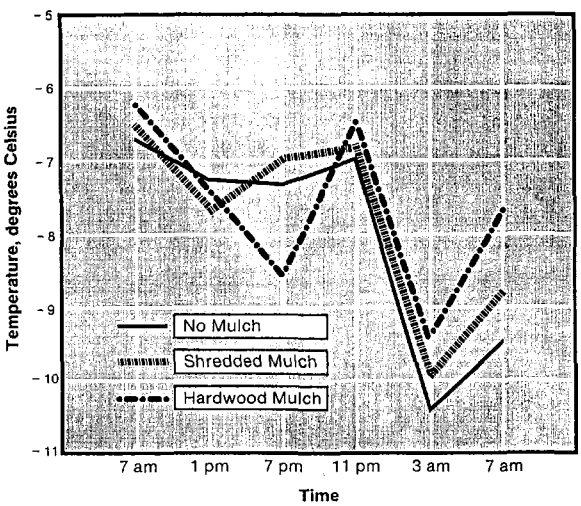

Figure 2. Mulch effects on diurnal range of soil temperatures, December 29, 1983, as measured 15 cm below soil surface.

Table 2. Visual rating of aesthetics for juniper and viburnum grown using three mulch treatments.[z]

Qualities evaluated	*J. chinensis* Mulches			*V. opulus* Mulches			*Maximum value*
	C	*S*	*H*	*C*	*S*	*H*	
Freedom from pests	17	25	25	10	10	20	25
Foliage color	4	7	7	4	5	10	15
Foliage size	3	7	8	2	3	8	15
Plant uniformity	4	7	9	3	4	10	15
Plant size	6	10	12	3	10	8	15
Plant health/vigor	3	9	11	3	6	9	15
Total	37	65	72	25	38	65	100

[z]C = No mulch, S = Shredded bark, H = Hardwood bark (2-3" chunks).

Recommendations

Junipers were the superior shrub in this study. Their past success, drought tolerance and root hardiness, make them suitable for container culture (5, 6, 14). Viburnums should only be used when proper watering and pest control can be provided. They appear to be less tolerant of the adverse conditions common to many urban setting.

Mulching did result in healthier more attractive plantings which required less frequent watering. The hardwood mulch showed the best results in this study. The better performance and lower flammability warrants it's use. (Shredded bark mulch caught fire when a lit cigarette was tossed into several Milwaukee street planters which were not part of this study.) Further study is needed to adequately evaluate mulching effects on soil temperature and root survival.

The high soil moisture levels in the Milwaukee study indicate maintenance programs should be carefully developed and established after evaluating the local growing conditions. Past practices in other communities may not transfer. Sun and shade patterns, wind tunneling effects, soil mix, container design and other factors must be considered when selecting plants and a maintenance program.

More work needs to be done in plant selection and cultural care of container plantings. Attention should be given to selection and cultural practices that increase above and below ground plant hardiness. Further study may reveal a wider range of plants tolerant of container culture than currently known.

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Abstract

KNODEL, J.J., H.G. LAREW, & D.F. MARION. 1987. **Exotic neem seed extract battles birch leafminers.** Am. Nurseryman 166(4): 149, 152, 154.

Chances are good that you have never heard of neem. It has recently come to the US from India, where it has been used in a variety of ways: as an insecticide and medicine and in religious rituals for centuries. Neem, *(Azadirachta indica)* grows in India, Africa, the Caribbean and Florid. It requires a frost-free climate, but it is surprisingly fast grower under a variety of conditions. Why all the interest in neem? In large part, it is because of the public's cry for effective insecticides with low mammalian toxicity. Neem, although no panacea or cure-all, does kill and repel a wide variety of insects. And, as far as we know, it does so without the disruptive side effects and hazards of some synthetic pesticides. Most experiments with the extract have been conducted in laboratories under controlled conditions. We conducted the trial using paper birches in an infested commercial nursery in upstate New York. We found that, regardless of spraying time, the solution of 1 percent neem seed extract caused about as much leafminer death as did Metasystox-R. The test confirms that neem seed extract may have a place in future insect control programs in commercial nurseries.