Evaluation of Herbaceous Perennials as Weed Suppressive Groundcovers for Use Along Roadsides or in Landscapes[1]

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Abstract

Fifteen herbaceous perennials were evaluated in field experiments in two New York State locations to determine their utility in roadside and landscape areas as weed suppressive groundcovers. Four species, *Alchemilla mollis*, *Nepeta* x *faassenii*, *Phlox subulata*, and *Solidago sphacelata* were strongly weed suppressive in both managed (weeds removed) plots and unmanaged (weeds not removed) plots. Weed suppressivity of perennial groundcovers was significantly increased in year two in both locations when perennials were well established. The most suppressive perennials showed several similar characteristics likely associated with their successful establishment. Successful groundcovers possessed dense foliage which strongly reduced light transmittance at the soil surface and emerged relatively early in spring. *Lamiastrum galeobdolon* and *Thymus praecox* proved to be more successful over a 2-year period when managed by weed removal in early spring. Although *Leymus arenarius*, a relatively tall monocot, also inhibited weed growth, this species demonstrated invasive characteristics due to its spread outside plots by fast-growing rhizomes.

Index words: perennial, ornamentals, herbaceous groundcover, weed suppressive, light transmittance.

Species used in this study: Wooly yarrow (*Achillea tomentosa*); Lady's mantle (*Alchemilla mollis*); Thymeleaf bluets (*Houstonia serpyllifolia*); Creeping lily turf (*Liriope spicata*); Creeping mazus (*Mazus reptans*); Moss phlox, (*Phlox subulata*); Stonecrop sedum (*Sedum reflexum*); Creeping thyme (*Thymus praecox*); Myrtle (*Vinca minor*); Flowering strawberry (*Fragaria* x); Yellow archangel (*Lamiastrum galeobdolon*); Blue lyme grass (*Leymus arenarius*); Moneywort (*Lysimachia nummularia*); Catmint (*Nepeta* x *faassenii*); and Dwarf goldenrod (*Solidago sphacelata*).

Significance to the Nursery Industry

Fifteen herbaceous perennials were evaluated for their ability to suppress weeds and their potential use as groundcovers in landscapes or along roadsides. Several groundcovers were identified as excellent choices for potential establishment in low maintenance landscapes or roadside settings. These groundcovers exhibited aesthetic appeal throughout the growing season as well as strong weed suppressive characteristics. Groundcovers tended to be more highly weed suppressive if they emerged in early spring and formed a dense canopy.

Introduction

Groundcovers are commonly used in many agronomic and landscape settings due to both their functional and aesthetic appeal. Groundcovers are used frequently for prevention of soil erosion and excess leaching of nutrients, to improve soil structure and fertility when used as a green manure, to reduce weed infestation and mowing, and also to enhance aesthetic appeal (5, 7, 8). Herbaceous groundcovers have been widely incorporated into the American landscape as new plant materials and are now widely available, and interest in low

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maintenance, pest resistant ornamentals has increased dramatically (7).

Groundcovers that are low growing, stress tolerant and pest resistant are also of interest to state and county departments of transportation as many of these plant materials may potentially be suitable for use along roadsides and in public access areas and widely visible landscape settings such as airports and city boundaries (2). The New York State Department of Transportation (NYSDOT) recently proposed to evaluate a large number of herbaceous groundcovers in field situations in an effort to determine which groundcovers might be suitable for use along roadsides as aesthetically appealing, low maintenance, weed suppressive alternatives to turfgrass. According to NYSDOT, constant maintenance of roadside turf with mowing and herbicide application can be expensive and laborious (9).

Establishment of appropriate groundcovers that can be sustained with no maintenance or periodic mowing is the preferred and current technique used within rights-of-way where mowing can be performed (16). However, periodic herbicide treatment is still the traditional management for vegetation where mowing is difficult or not possible to perform, such as under guiderails, around signs, and on slopes (9). Therefore, alternative strategies to maintain roadside vegetation are of interest not only to minimize costs, but also due to increasing public concern over environmental risk or mammalian exposure by herbicide application (6).

Declining resources and an increased interest in vegetation management strategies with limited environmental impact have reinforced the need to examine alternative strategies for vegetation management along New York's highway system. Methods to manage planting areas along roadsides, such as use of fabric and organic mulches and installation of wild flower plantings, have previously been tested (13). Although these methods showed mixed success for weed suppression, their high cost and limited efficacy renders these cultural practices impractical for roadside use. In selecting a series of groundcovers for roadside establishment, those environmental conditions encountered along roadsides, including drought and high salt conditions, must be considered and materials selected with tolerance to such unfavorable extremes (4, 10, 11). In addition, groundcovers for usage along roadsides should be aesthetically appealing, require minimal maintenance, exhibit resistance to insects and diseases, suppress weeds, be minimally invasive, and maintain a relatively low, dense growth habit.

Groundcovers that exhibit allelopathic potential may also contribute to weed suppression through the production of inhibitory root exudates, volatiles or leachates from foliage, or decomposing residues (17). Certain herbaceous perennial groundcovers such as *Phlox subulata* and *Thymus serpyllum* have previously shown potent allelopathic effects on several weed species in in-vitro experiments (12).

Thus, our primary research objective was to evaluate the ability of selected groundcovers to suppress weeds under field conditions with moderate to heavy weed infestation and to determine their potential for use along roadsides or in low maintenance landscapes across the Northeastern United States. For these studies we utilized fifteen novel herbaceous perennial groundcovers and established them in a full-sun experimental area in Ithaca, New York, and Riverhead, Long Island, New York.

Materials and Methods

Fifteen herbaceous perennial groundcovers were propagated from cuttings or seed in greenhouses at Cornell University's Long Island Horticultural Research and Extension Center (LIHREC) located in Riverhead, NY in the spring of 2000 (Table 1). Plants were produced in individual root cells in plastic flats with cells of approximately 5 × 5 cm (2 in × 2 in). After a 4-month period of greenhouse growth followed by one week of hardening off outdoors by placement in a shaded site, groundcovers had established substantial root biomass and were transplanted at Cornell University's turf research farm in Ithaca, NY, and the Long Island Horticulture Research and Extension Center LIHREC in Riverhead, NY, in mid-September (September 15–20) of 2000. The soil type in Ithaca was a Hudson silt clay loam (pH 6.0–6.2) and in Riverhead was a Riverhead sandy loam (pH 5.5–5.8). The Ithaca site is located in hardiness zone 4–5 and the Riverhead site is in hardiness zone 6. Field plots were prepared by tillage of grass sod, after which N fertilizer was broadcast at a rate of 56 kg/ha before transplanting groundcovers based on soil analyses which showed adequate phosphorus and potassium to be present in both settings.

Table 1. Groundcover species evaluated in field experiments conducted in 2000–2002 in Ithaca and Riverhead, NY.

Scientific name	Common name	Spacing in field experiment[z]	Primary reproductive method	Hardiness zone
Achillea tomentosa 'King Edward'	Wooly Yarrow	S	Division/Seed	2–9
Alchemilla mollis	Lady's Mantle	S	Division/Seed	4–7
Fragaria x (*F. ananassa* x *Potentilla palustris*) 'Lipstick'	Flowering Strawberry	L	Division/Rooted runner	5–10
Houstonia serpyllifolia	Thymeleaf Bluets	S	Division/Seed	6
Lamiastrum galeobdolon 'Herman's Pride'	Yellow Archangel	L	Cutting/Division/Seed	4–9
Leymus arenarius 'Blue Dune'	Blue Lyme Grass	L	Division/Seed	2–9
Liriope spicata 'Majestic'	Creeping Lily Turf	S	Division/Seed	4–10
Lysimachia nummularia 'Aurea'	Moneywort, Creeping Jenny	L	Cutting/Division/Seed	3–9
Mazus reptans	Creeping Mazus	S	Division/Seed	3–9
Nepeta x *faassenii* 'Walker's Low'	Catmint	L	Cutting/Division/Seed	3–9
Phlox subulata 'Emerald Blue'	Moss Phlox	S	Cutting/Division/Seed	3–9
Sedum reflexum 'Blue Spruce'	Stonecrop Sedum	S	Cutting/Division/Seed	3
Solidago sphacelata 'Golden Fleece'	Dwarf Goldenrod	L	Division/Seed	3–8
Thymus praecox 'Albiflorus'	Creeping Thyme	S	Division/Seed	5
Vinca minor	Myrtle	S	Cutting/Division/Seed	4–8

[z]S = Small spacing: plugs were transplanted into field at 9" on center. L = Large spacing: plugs were transplanted into field at 12" on center.

Table 2. Percent light transmittance under groundcover canopy in weed free plots.

Species	Ithaca		Riverhead	
	Sept. 2001	Sept. 2002	Sept. 2001	July 2002
Achillea	69[y]b[z]	35a	75b	13bcdef
Alchemilla	0g	0b	0e	1f
Fragaria	36cd	25b	50cd	12cdef
Houstonia	70a	50b	69bc	7def
Lamiastrum	22ef	4b	98a	22bcd
Leymus	10fg	2b	6e	7def
Liriope	40c	1b	7e	5ef
Lysimachia	45c	2b	100a	19bcde
Mazus	55c	19ab	14e	52a
Nepeta	0g	0b	4e	4ef
Phlox	1g	2b	6e	22bcd
Sedum	11efg	4b	41d	22bcd
Solidago	12efg	2b	1e	3ef
Thymus	9fg	0b	13e	29b
Vinca	23de	3b	53cd	24bc

[z]Letters next to means within columns indicate significance based on Fisher's LSD analysis at 5%.

[y]Percent light transmittance represents the difference between light readings outside each plot under no plant canopy and readings within each plot under the groundcover canopy. A reading of 0 indicates no light transmittance to the soil surface, whereas a reading of 100 indicates total or 100% transmittance to the soil surface.

Four replications were arranged in a randomized complete block design. Each plot consisted of 15 plants transplanted in 5 rows of 3 columns at standard planting densities of either 23 × 23 cm (9 inch centers) or 38 × 38 cm (12 inch centers). The two planting densities were selected based on the groundcover's rate of spread and potential size at maturity, according to standard recommendations for herbaceous ornamentals (1, 14, 15). Species planted at the smaller spacing at each site included *Achillea tomentosa*, *Alchemilla mollis*, *Houstonia serpyllifolia*, *Liriope spicata*, *Mazus reptans*, *Phlox subulata*, *Sedum reflexum*, *Thymus praecox*, and *Vinca minor*. Species planted at the larger spacing included *Fragaria* x, *Lamiastrum galeobdolon*, *Leymus arenarius*, *Lysimachia nummularia*, *Nepeta* x *faassenii*, and *Solidago sphacelata* (Table 1).

During year one in Ithaca, water was supplied initially during the first week of planting and the experiments were not watered further for the course of the growing season. In Riverhead, the experiment was irrigated as needed throughout the two-year trial. Weeds around the exterior of plots in both locations were regularly removed by hand hoeing, mowing, string trimming or herbicide application of glyphosate (Round-up).

Herbaceous perennial species are relatively susceptible to weed competition immediately after planting because they are often slow to establish (3). Thus, complete weed removal of winter annual weeds was required to encourage sufficient groundcover establishment, so groundcovers were initially weeded by hand in spring of 2001 in both locations. Following initial weed removal, three weed management regimes were followed to evaluate the influence of weed competition on groundcover establishment and growth. Management regimes included the following: [1] weed free: weeding performed regularly throughout the season to remove weeds from plots; [2] weed to establish: weeding performed during establishment in year 1 for a period of 6 weeks and subsequently not weeded for the remainder of year 1 and throughout year 2, and [3] non-weeded: no weeding whatsoever in year 1 and 2 after initial plot clean up in spring 2001 to remove winter annual weeds.

These weeding regimes were followed to determine the ability of groundcovers to tolerate different levels of management, which influenced weed competition for resources. The first regime was utilized to evaluate the ability of groundcovers to establish under optimal conditions. The second regime ensured groundcovers would establish successfully in 2001 and evaluated the impact of later emerging weeds on groundcover development. This regime imitated a likely situation where groundcovers installed along a roadside or in a low-maintenance landscape would be weeded only until they were established early in the first year of planting. The third regime evaluated the ability of groundcovers to compete under heavy weed infestation without intervention.

Data collected monthly during the growing season, which was May through October each year, included light transmittance, weed biomass from weeded plots, and weed numbers. Light transmittance through the groundcover canopy was determined by measurement using a light meter (LI-COR model LI-250, USA) sensor placed at the soil surface in each plot on cloudy days to avoid dramatic changes in light due to cloud cover changes. Light readings were collected from five locations within weed free plots underneath the groundcover canopy by placing the sensor at the soil surface immediately adjacent to a groundcover located in the central row of establishment, and five locations directly outside the plot area to evaluate the average light differential between groundcover established plots and areas without any foliar canopy present. In this manner, a relative difference between total light available and that present in each groundcover treatment could be determined, based on 5 separate readings per plot. Weed bio-

Table 3. Weed biomass under two weeding regimes in both trial locations in September 2002 at experimental termination.

Species	Weed biomass[y] (g)			
	Ithaca		Riverhead	
	Weed to establish	Non-weeded	Weed to establish	Non-weeded
Achillea	379b	387bcde	112bcd	102cde
Alchemilla	0c	0f	0d	0f
Fragaria	283b	560abc	224ab	182b
Houstonia	410b	574ab	100bcd	124cd
Lamiastrum	29c	338de	291a	292a
Leymus	298b	210def	3d	1f
Liriope	33c	252de	0d	4f
Lysimachia	712a	609a	191abc	136bcd
Mazus	344b	390bcde	68cd	149bc
Nepeta	0c	0f	8d	0f
Phlox	0c	1f	0d	0f
Sedum	466b	420abcd	88bcd	90de
Solidago	45c	29f	0d	1f
Thymus	280b	348cde	95bcd	7f
Vinca	42c	196ef	46d	69e

[z]Letters next to means within column indicate significance based on Fisher's LSD analysis at 5%.

[y]Biomass values represent one time harvest of above-ground weed weight collected at experimental termination. Data collected in Ithaca represent weeds harvested from entire plot, taken as dry weight. Data collected in Riverhead represent weeds harvested from a portion of the plot (1.7 ft^2 or 4.7 ft^2 for small or large spacing), collected as fresh weight.

Table 4. **Groundcover biomass compared by species within each weeding regime at two trial locations at experimental termination in September 2002 after 2 years of establishment.**

	Groundcover biomass [y](g)					
	Ithaca			Riverhead		
Species	Weed free[z]	Weed to establish	Non-weeded	Weed free	Weed to establish	Non-weeded
Achillea	95hij	11h	0e	106de	34g	20ef
Alchemilla	254def	275de	293cd	363cde	393cde	278def
Fragaria	68hij	70gh	57e	292de	73fg	69ef
Houstonia	0j	9h	0e	10e	46g	14ef
Lamiastrum	203efg	210efg	119de	16e	7g	2f
Leymus	836b	912b	746b	1281a	2053a	1893a
Liriope	106ghi	89fgh	78de	489de	422cde	394cd
Lysimachia	295de	217ef	110de	266de	376def	317de
Mazus	61ij	19h	0e	105de	131efg	79ef
Nepeta	1424a	1499a	1586a	791bc	688c	756b
Phlox	410c	381c	352c	502cd	515cd	679bc
Sedum	325cd	174efg	99de	351cde	208efg	169def
Solidago	734b	606c	734b	990ab	1085b	892b
Thymus	269def	230ef	133de	278de	139efg	147def
Vinca	166fgh	198efg	74de	79de	74fg	44ef

[z]Letters next to means within column indicate significance based on Fisher's LSD analysis at 5%.

[y]Biomass values represent weight in grams of above ground portion of groundcovers harvested at soil line at experimental termination. Data collected in Ithaca represent dry weight of 15 plants harvested per plot. Data collected in Riverhead represent fresh weight of 3 plants harvested per plot.

mass was evaluated in each treatment by counting numbers of weeds present per plot on a monthly basis. Weed infestation in both Ithaca and Riverhead locations consisted mainly of annual weeds which included crabgrass species (*Digitaria spp*.), foxtail species (*Setaria spp*.), fall panicum (*Panicum dichotomiflorum*), carpetweed (*Mollugo verticillata*), dandelion (*Taraxacum officinale*), lambsquarters (*Chenopodium album*), pigweed spp. (*Amaranthus spp*.) and purslane (*Portulaca oleraceae*) among others. Weed biomass was obtained by removal of weeds at the soil surface at the end of the growing season in the weed to establish and unweeded plots. Groundcover biomass was collected in October of year two by harvesting groundcover plants cut at the soil surface for all three weeding regimes.

Data were analyzed using SAS for ANOVA and Mini-tab for correlation analysis. Significant mean differences were determined using Fisher's protected LSD at $\alpha = 0.05$.

Results and Discussion

Percent light transmittance. Percent light transmittance under each groundcover canopy (Table 2) was measured in weed free plots, directly adjacent to the base of established plants in the plots' center row, to determine how much light transmittance was reduced by canopy coverage in each species, in comparison to exterior readings taken adjacent to each groundcover planting. Ability to reduce light transmittance was an excellent predictor of weed suppressiveness, as would be expected. With a dense foliar canopy blocking light transmittance to the soil surface, weeds were unable to establish among some groundcover species. In general, the groundcover species that exhibited greatest reduction in light transmittance had lower weed biomass (Table 3). Four groundcover species reduced light reaching the soil surface by greater than 80% in both the first and second year of the trial at both trial locations. These were *Alchemilla*, *Leymus*, *Nepeta*, and *Solidago*. *Phlox*, *Thymus*, and *Liriope* also produced dense canopies that intercepted light.

Species that reduced light reaching the soil surface by greater than 80% in both the first and second year in Ithaca included *Alchemilla*, *Solidago*, *Nepeta*, *Leymus*, *Phlox*, *Sedum*, and *Thymus*. Species that reduced light transmittance by greater than 80% during the second year only were *Lamiastrum*, *Liriope*, *Lysimachia*, and *Vinca*.

Species that reduced light reaching the soil surface by greater than 80% both the first and second year in Riverhead were *Alchemilla*, *Solidago*, *Nepeta*, *Leymus*, and *Liriope*. Species that reduced light greater than 80% the first year of establishment but not the second year were *Phlox*, *Thymus*, and *Mazus* while species which reduced light by greater than 80% the second year only were *Houstonia*, *Fragaria*, *Achillea*, and *Lysimachia*.

Weed biomass. Several groundcover species allowed for little weed growth regardless of weeding regime as illustrated by low weed biomass in these plots (Table 3). In both trial locations, in both the weed to establish and non-weeded regimes, weed biomass in plots of *Alchemilla*, *Nepeta*, *Phlox*, and *Solidago* were statistically equal to zero. For the weed to establish plots, *Alchemilla*, *Nepeta*, and *Phlox* had the low-

Table 5. **Pearson's correlations among weeding regimes from data collected in September 2001.**

	Weed free	Weed to establish	Non-weeded
% light vs. weed biomass		0.44	0.59*
% light vs. weed number		0.18	0.45
% light vs. % cover	–0.84***[z]	–0.80***	–0.84***
% cover vs. weed biomass		–0.32	–0.63*
% cover vs. weed number		–0.39	–0.49
Weed biomass vs. weed number		0.78**	0.91***

[z]*, **, *** indicate that means among groundcovers are significantly different at the 5%, 1%, or 0.1% level, respectively.

Fig. 1. Photos of the most successful groundcovers evaluated under full sun conditions, exhibiting excellent suppression of weed biomass and weed number. From left to right; *Alchemilla mollis, Nepeta* x *faassenii, Phlox subulata*, and *Solidago sphacelata.*

est weed biomass. For the non-weeded plots, weed biomass was lowest in *Alchemilla*, *Nepeta*, *Phlox*, and *Solidago* treatments.

Effects of different weeding regimes on groundcovers. In Ithaca, groundcover biomass of nine out of fifteen species was not significantly different when comparisons were made among biomass collected in each of the three weeding regimes by species evaluated (Table 3). Both *Alchemilla mollis* and *Nepeta* x *faassenii* produced slightly increased shoot biomass in the unweeded regime compared to the weed free regime, although this was not statistically different. In Riverhead, only *Achillea* and *Fragaria* saw a significant increase in groundcover biomass in response to continual weeding in the weed free plots (data analysis not presented).

Groundcover biomass. Groundcovers with the greatest biomass at both sites and all three weeding regimes were *Nepeta*, *Liriope*, *Solidago*, and *Phlox* (Table 4). Groundcovers with the greatest biomass in Riverhead, regardless of weeding regime were *Leymus*, *Solidago*, *Nepeta*, *Phlox*, and *Liriope* (in that order). The Ithaca location saw similar results with *Nepeta*, *Liriope*, *Solidago*, and *Phlox* (in that order) exhibiting greatest biomass regardless of weeding regime.

Plants with the greatest biomass were also among the taller groundcovers observed, and not surprisingly, were often vigorous in growth. However, biomass alone is generally a poor predictor of weed suppressive ability because it does not accurately indicate the ability of short and dense species to cover the ground, block light, and successfully compete with weeds.

Correlation between data points. In the non-weeded plots, light transmittance was negatively and very strongly correlated (–84.2%) with the visual estimation of percent groundcover soil coverage (Table 5). Light transmittance was also negatively correlated with weed biomass and number of weeds in 2001, with a 59.2 and 45% correlation, respectively.

Superior groundcover performers for weed suppression. After two years of field evaluation, the most effective and attractive weed suppressive groundcovers included *Alchemilla mollis*, *Nepeta* x *faassenii*, *Phlox subulata*, and *Solidago sphacelata* (Fig. 1). Generally, these plants strongly inhibited light penetration to the soil surface, most reducing light transmittance by greater than 80% in both years and at both trial sites. They also exhibited early and dense growth resulting in substantial biomass formation early in the growing season. These plants generally maintained their attractive foliage during the entire growing season, and were also resistant to insects and pathogens as well (data not presented).

Alchemilla mollis, commonly called lady's mantle, is propagated either by division of roots or seed germination. In previous work, *Alchemilla mollis* was cited as potentially invasive in field settings due to prolific seed dispersal (14). However, we did not observe any signs of invasive growth habit during the two years in which this experiment was conducted. The dense canopy of broad scalloped leaves resulted in little light reaching the soil surface, which helped to suppress weed seed germination. Attractive pale yellow-colored flowers were present for several months during the growing season as well. Lady's mantle is becoming markedly more popular in recent years and adapts well to both full sun and shaded sites.

Nepeta x *faassenii* 'Walker's Low', commonly called catmint, is propagated by seed, cuttings, and division. The foliage of catmint grows very rapidly and produces a dense cover by late spring. The light blue flowers produced by 'Walker's Low' are present from late June to mid September in hardiness zone 4–6. Catmint was relatively tall compared to other groundcovers (60 cm in height) and could potentially be damaged by heavy winds. However, the plant easily recovered by formation of new shoots from axillary stems.

Phlox subulata 'Emerald Blue', commonly called moss phlox, is propagated either by seed germination, division, or cuttings. Weed infestation in moss phlox was predominantly grass weeds rather than broadleaf weeds. Moss phlox allowed very little light penetration from spring until summer, although canopies were less dense in the fall season, due to leaf senescence. *Phlox subulata* is a US native and has evergreen foliage.

Solidago sphacelata 'Golden Fleece', commonly called dwarf golden-rod, is propagated either by seed or root division. *Solidago sphacelata* is also a US native and generates attractive yellow flowers and dark green foliage. This groundcover is exceptionally stress tolerant, judging from our stress greenhouse experiments (data not presented).

Other potentially useful groundcovers for roadside or landscape. Certain species, such as *Lamiastrum galeobdolon*, *Liriope spicata*, and *Thymus praecox* also showed potential for use along roadside areas or in the landscape as weed suppressive groundcovers if they were densely planted or maintained with minimal weeding.

Lamiastrum galeobdolon 'Herman's Pride' (yellow archangel) forms a dense canopy and was generally fast growing, particularly in year two, once well-established. According to Armitage, this plant spreads by stolons and is difficult to keep from spreading (1). However, in our experiments, this plant spread relatively slowly. Weed suppressivity may be improved with denser planting. This groundcover maintained attractive, yellow green foliage throughout to growing season.

Thymus praecox 'Albiflorus' (creeping thyme) is a vigorous spreader, forming compact new foliage at ground level in the early fall after flowering has been completed. This plant can be used in relatively dry conditions in full sun areas or well-drained sloped sites, but not in wet areas. During the first year, it needs continual weed management because of its low growth habit which renders it less competitive with weeds. Once shaded by other plants, creeping thyme generally declined in vigor. However, once established fully, weeds were generally suppressed by its dense canopy. *Thymus praecox* initially required weed management for optimal establishment and some weeding on the plot edges as well.

Liriope spicata 'Majestic' (creeping lilyturf) was fairly successful at reducing light transmittance and produced great biomass considering that it is a relatively short plant. It emerged later in the spring than the more successful groundcovers. Creeping lily turf has attractive grass-like foliage and forms attractive purple inflorescences.

Potentially invasive plants. Three groundcovers, *Fragaria* x, *Leymus arenarius*, and *Vinca minor*, showed potentially invasive growth habits and were not easily maintained within a designated area. Although not densely established, *Fragaria* x (*F. ananassa* x *Potentilla palustris*) 'Lipstick' or flowering strawberry spread out quickly from its planting site to aisle ways, with serious weed infestation occurring in plots. Although attractive in terms of its pink inflorescence, it was susceptible to an undiagnosed bacterial pathogen which resulted in spotting and necrosis of foliage.

Leymus arenarius 'Blue Dune' (blue lyme grass) formed a dense, tall canopy early on and exhibited potential as a weed suppressive groundcover. However, in year two this plant exhibited strong invasive characteristics, with fast growing rhizomes resulting in spread of plants in areas surrounding established plots.

*Vinca minor (*periwinkle), although slow to establish in full sun conditions, gradually spread outside of the planting area after two years, and was generally unsightly due to weed infestation. This groundcover is listed as a potentially invasive species.

Less competitive groundcovers. *Achillea tomentosa* 'King Edward', *Houstonia* serpyllifolia, *Mazus reptans*, *Lysimachia nummularia* 'Aurea', and *Sedum reflexum* 'Blue Spruce' showed poor growth under weedy conditions as well as within managed plots. Their poor overall growth may be due to inadequate environmental conditions encountered in full sun field settings or their characteristically slower establishment and growth.

In summary, several groundcovers proved to be strong performers in full sun conditions, when challenged with weed infestation in field conditions across New York State. The ability to form a dense foliar canopy was associated with reduction in weed infestation over time. Groundcovers that formed dense canopies, suppressed weed infestation and maintained their aesthetic appeal over the course of two growing seasons included lady's mantle, catmint, moss phlox and dwarf goldenrod.

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