NH Horticultural Endowment
2014 Annual Report

NH Plant Grower's Association • New Hampshire Horticulture Endowment
The Grant-Making Resource for New Hampshire's Horticulture Industry

Optimizing the Ecological Value of Ornamental Perennials: Are Native Cultivars as Valuable to Bees and Butterflies as Straight-Species Native Flowers?

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I. SUMMARY

This research sought to understand how beneficial insect pollinators, such as bees and butterflies, interact with native flowers. A controlled field study was used to determine if cultivars of native flowering plants (also known as "nativars") are as attractive to beneficial insect pollinators as straight species or "true natives."

A partnership grant from the Northeast Sustainable Agriculture Research and Education Program(SARE) enabled two field plots and two educational gardens to be designed and installed at three farms in Vermont in 2012. These gardens were monitored and maintained through the 2013 growing season. Additional support from the New Hampshire Plant Growers Association enabled the research to continue and to be expanded during the 2014 season.

A selection of native herbaceous flowers, and cultivars of the same species, were chosen following research about each plant's form, habits, and availability. Effort was made to choose flowers that bloomed at different times throughout the season and varied in size, color, and flower structure. Fourteen straight species and 16 native cultivars were included in the study. One native cultivar of each species was selected for the study, except for *Echinacea purpurea*, which was paired with three cultivars.

Preliminary observations were made on pollinator diversity and abundance in and around the study plots in 2012. Between May and October of 2013 and 2014, weather, flower, and pollinator data were collected weekly at the field plots. This data included temperature, cloud cover, wind speed, flower bloom stage, flowers per plant, plant height, time of observation, and pollinator visits. Field methods for nectar sampling were tested during 2014 and utilized for three species.

Throughout the two seasons of data collection, the flowering plants were monitored to determine the mean rate of insect pollinator visits. Of the 13 plant pairs being evaluated, seven of the native cultivars attracted significantly fewer bee pollinators than the straight species. (Two additional *Echinacea purpurea* cultivars also attracted significantly fewer native pollinators than the species.) There was no significant difference in pollinator visits in five of the pairs. One native cultivar, *Veronicastrum virginicum* 'Lavender Towers' attracted significantly more native bee pollinators than the straight species.

II. INTRODUCTION

The recent trend towards ecologically sensitive landscaping presents a strong opportunity for the New Hampshire horticulture industry to breed, propagate, and market perennial plants with high ecological value for bees, butterflies, and other wildlife. This research, broadly, seeks to highlight the ecological value potential of flowering perennials, and specifically, to understand the differences between open-pollinated straight-species native flowers and cultivars of native flowers in terms of attracting and supporting beneficial pollinators.

Pollinating insects—bees in particular—play a critical role in ensuring the pollination of food crops, the production of seed in flowering plants, and maintaining natural plant communities and ecosystems. Bee communities, both wild and managed, have declined dramatically in recent years, and habitat loss has been identified as one of the factors attributing to their decline. Numerous efforts are underway to encourage the restoration of pollinator habitat into agricultural lands, natural areas, and landscape gardens, but little research exists to quantitatively justify plant selection decisions.

This study examined the interactions between insect pollinators and herbaceous flowering perennials. It evaluated native wildflowers and native cultivars that are commonly grown and marketed in the green industry. The attractiveness of floral resources to beneficial insect pollinators were evaluated and flower characteristics such as flower size, number of flowers, flower color, bloom period, nectar quantity, and nectar sugar concentration were analyzed. This determined which flowers and flower characteristics are most attractive and provide the most foraging resources for insect pollinators.

Public awareness and interest in ecologically sensitive landscaping and landscaping for wildlife is increasing. Prominent national agencies such as the National Wildlife Federation, the Environmental Protection Agency, and the U.S. Green Building Council are actively promoting the use of native plants in garden design to provide the most beneficial habitat for birds, bees, butterflies, and other wildlife. The nursery and landscape industry is responding to the increase in native plant interest and demand by making native plant material commercially available and marketing their ecological benefits.

The majority of native plants sold through garden centers are cultivars of native plants (also known as "nativars") as opposed to the straight species, which grow naturally in wild areas and are more commonly grown from seed by ecological restoration nurseries. The propagation of straight species is a specialized field, requiring access to local seed sources and knowledge about seed collection, pre-treatment, and germination techniques. These propagation challenges, combined with a desire for more predictable plant habits, have led to the selection and breeding of native cultivars. Landowners seeking to restore pollinator habitat to their agricultural or garden landscapes will find native cultivars more readily available than open-pollinated natives.

The debate over whether native cultivars provide the same ecosystem services as straight species is beginning to emerge as a contentious topic. There is a tremendous amount of variation in the origin of native cultivars, how they are propagated, and the desirable traits for which they are maintained. This makes the distinction between straight species and native cultivars a little-understood and confusing topic for growers, retailers, designers, home gardeners, and land owners alike.

Because cultivars have been selected primarily based on ornamental traits, it is not clear whether or not they perform the same ecological roles as straight species, which are open-pollinated and evolved naturally in the landscape. This research will help to determine if native cultivars are the ecological equivalents of straight native species in terms of attracting and supporting native pollinator populations. 'Improved' cultivars of native plants are sometimes better suited visually

for a designed landscape than a straight-species native, but it is important that we fully understand the ecology of these plant selection decisions.

As residential developments continue to sprawl into previously natural and agrarian landscapes, the ornamental plants installed in home gardens are of increasing importance for pollinators and other wildlife. It is critical for the sustainability of pollinators and biodiversity in general that we better understand the interactions between plants and pollinators in our built landscapes, as well our agricultural landscapes. This research sought to identify the potential tradeoffs of using native cultivars in place of straight species in landscape projects aiming to maximize habitat value for pollinators.

III. MATERIAL AND METHODS

Plant Selection. The project began with an informal survey of plant nurseries in New England to assess native plant availability and the prominence of straight species versus native cultivars. Most nurseries in New England selling native plants, sell native cultivars, and no straight species.

A selection of native herbaceous flowers and cultivars of the same species were chosen following research about each plant's form, habits, and availability. Effort was made to choose flowers that bloomed at different times throughout the season and varied in size, color, and flower structure. Thirteen straight species and 15 native cultivars were included in the study. One native cultivar of each species was selected for the study, except for *Echinacea pururpea*, which was paired with three cultivars because of the high use and availability of *Echinacea* cultivars.

Plant List:
Achillea millefolium
Achillea millefolium 'Strawberry Seduction'
Agastache foeniculum
Agastache foeniculum 'Golden Jubilee'
Aquilegia canadensis
Aquilegia canadensis 'Corbett'
Asclepias tuberosa
Asclepias tuberosa 'Hello Yellow'
Baptisia australis
Baptisia australis 'Twilite Prairie Blues'
Echinacea purpurea
Echinacea purpurea 'Sunrise' Big Sky
Echinacea purpurea 'Pink Double Delight'
Echinacea purpurea 'White Swan'
Helenium autumnale
Helenium autumnale 'Moerheim Beauty'
Lobelia cardinalis
Lobelia cardinalis 'Fried Green Tomatoes'
Monarda fistulosa
Monarda fistulosa 'Claire Grace'
Penstemon digitalis
Penstemon digitalis 'Husker Red'
Symphyotrichum novae-angliae
Symphyotrichum novae-angliae 'Alma Poetschke'
Tradescantia ohiensis
Tradescantia ohiensis 'Red Grape'
Veronicastrum virginicum
Veronicastrum virginicum 'Lavender Towers'

Plants were purchased as landscape plugs from North Creek Nursery in spring 2012 and transplanted into an organic potting soil from Vermont Compost in quart-size pots. The potted plants were irrigated and allowed to mature outdoors through the summer before being planted in the research plots in the early fall of 2012.

Study Sites: Research plots were established at River Berry Farm in Fairfax, Vermont, and Maidstone Plant Farm in Maidstone, Vermont. The research plots were established in 2012 and maintained through the 2014 season.

The study sites were chosen for the diversity in their immediate surroundings (fruit and vegetable crops, plant nursery), diversity in the greater surroundings (agricultural, and residential/forested), and their ability to support the educational objectives of the study.

Experimental Design: The two research gardens are 3,000 sq. ft. each with 15 native herbaceous flowering perennial species represented. Within each species, one straight species and one (or more) native cultivars of the same species are represented. Six plants of each plant type were grouped in a randomized complete block experimental design with three replicates at each site, totaling 1,008 plants in the study.

Data Collection: The study sites at River Berry Farm and Maidstone Plant Farm were visited a minimum of four times per month between late May and early October of 2013 and 2014.

Pollinator visit data were collected in 2013 during favorable weather conditions for maximum pollinator activity: >60°F, <50% cloud cover, <10 mph wind and between 9:00 AM and 4:00 PM. In 2014, we collected data in all weather conditions (except during precipitation) and at earlier and later times of day to investigate how these variables affected pollinator abundance and diversity.

Pollinator visits to individual flowers were observed and recorded during 5-minute visual scans of each 1x1.5 meter (6 plants) block from a distance of 1 meter. If a pollinator was present or landed on a flower in the block during the 5-minute scan, it was counted as one visit. If a pollinator moved from flower to flower within the block, it was still counted as one visit. In some cases, a pollinator may have been counted twice (or more) if it left the block and returned a second time within the 5-minute scan period.

To minimize error in the data collection, a single graduate student collected the data in 2013. In 2014, two interns were trained alongside the graduate student to collect data.

Measures were taken to minimize the impact of the observers on the pollinator activity. Upon approaching a block for observation, the observer would sit or stand quietly for one minute prior to starting the five-minute scan. The observer avoided wearing perfumed cosmetics, bug repellent, shiny jewelry or glasses, and colorful or bright clothing. Bright white paper is very attractive to some pollinators, so data sheets were printed on dark green paper.

All pollinators were classified into 14 visually identifiable groups: honey bee (*Apis mellifera*), bumblebee (*Bombus sp*.), other large bees, other small bees, green sweat bee (Halictidae), blue orchard bees (*Osmia sp*.), butterfly/moth (Lepidoptera), wasps (other Hymenoptera), beetles (Coleoptera), bugs (Hemiperta) and flies (Diptera).

Additional data were collected during each observation outing on air temperature, cloud cover, wind speed, flower bloom stage, number of flowers per plant, and plant height.

Nectar Analysis: At the visually-observed peak of each plant's bloom period in 2014, microcapillary tubes (0.5 µl, 1µl and 5 µl) were used to extract nectar from flowers. This method (Comba et. al. 1998 and Morrant et. al. 2009) proved very difficult given the small flower sizes and morphology of the flowers and was only somewhat successful for *Penstemon digitalis*, *Monarda fistulosa* and *Lobelia cardinalis*. On three separate days in July and August, a 24-hr. study was conducted to quantify the standing crop and secretion rate of nectar and to measure the sugar content of the nectar in these species. Twelve hours prior to the first sample, mesh bags were tied over 10 flowering stalks of the straight species and 10 flowering stalks of the cultivar to prevent nectar loss to insects. At two-hour intervals from sunrise to sunset, nectar was extracted using the appropriately sized micropipette. Flowers were tagged and re-bagged for resampling to measure secretion rate. If >1 µl could be collected, the sugar content was measured using a handheld refractometer.

Data Analysis: The data was compared using analysis of variance and mean separation to determine if pollinator preference differed between straight species and native cultivars. Without significant variations between sites, the sites were analyzed together. To answer the primary research question of whether beneficial insect pollinators were equally attracted to straight species of native flowering plants and cultivars of the same species, the mean visitation rates of all bee pollinators were compared for each straight species/native cultivar pair. Additional and more rigorous analyses are underway to investigate the preferences of each pollinator group and to incorporate the data on time of day, weather conditions (temperature, cloud cover, and wind), and differences in floral characteristics (i.e. flower color, flower size, number of flowers per plant, pollen availability, plant height, etc.). These additional analyses will be completed in 2015 and discussed in the forthcoming peer-reviewed journal article.

IV. RESULTS AND DISCUSSION

Pollinator visits: Throughout the two seasons of data collection, the flowering plants were monitored to determine the mean rate of insect pollinator visits. Of the 13 plant pairs being evaluated, seven of the native cultivars attracted significantly fewer bee pollinators than the straight species. (Two additional *Echinacea purpurea* cultivars also attracted significantly fewer native pollinators than the species.) There was no significant difference in pollinator visits in five of

the pairs. One native cultivar, *Veronicastrum virginicum* 'Lavender Towers' attracted significantly more native bee pollinators than the straight species.

Native cultivars that attracted significantly fewer bee pollinators than the straight species:
Achillea millefolium 'Strawberry Seduction'
Aquilegia canadensis 'Corbett'
Baptisia australis 'Twilite Prairie Blues'
Echinacea purpurea 'Sunrise Big Sky'
Echinacea purpurea 'Pink Double Delight'
Echinacea purpurea 'White Swan'
Helenium autumnale 'Moerheim Beauty'
Symphyotrichum novae-angliae 'Alma Poetschke'
Tradescantia ohiensis 'Red Grape'

Native cultivars that attracted the same number of bee pollinators as straight species:
Agastache foeniculum 'Golden Jubilee'
Asclepias tuberosa 'Hello Yellow'

Lobelia cardinalis 'Fried Green Tomatoes'
Penstemon digitalis 'Husker Red'
Monarda fistulosa 'Claire Grace'

Native cultivar attracted significantly more bee pollinators than the straight species:
Veronicastrum virginicum 'Lavender Towers'

Additionally, differences in bloom time, bloom duration, plant height, flowers per plant, and flower color were observed between the straight species and native cultivar. This data suggests that many native cultivars exhibit different characteristics than the true native equivalents, attracting a different, and sometimes smaller, set of pollinators.

Many native cultivars are selected for a more compact growth habit that is favorable in ornamental gardens and landscapes. However, these compact varieties typically produce fewer flowers per plant, ultimately providing less nectar and pollen resources, and attracting fewer pollinators per plant. The majority of the native cultivars that attracted significantly fewer bee pollinators per plant than the straight species also had significantly fewer flowers per plant.

When choosing and purchasing plants for pollinator habitat enhancement, farmers, landscapers, and gardeners should be aware that most native species sold in commercial nurseries are native cultivars, not "true" natives. This research shows that there can be significant differences between straight species and their cultivars, but the differences vary and are species/cultivar specific. This research should be expanded to study more species and more cultivars of each species.

If using a cultivar of a native plant in a garden with the goal of maximizing floral rewards for pollinators, the best option is to choose a cultivar that is closest in form and in color to the straight species.

Nectar Analysis: Our field technique proved to be largely ineffective for the low nectar volumes (< 1 microliter) and low nectar production rates of native wildflowers. The technique is successful for measuring nectar standing crop in *Monarda sp.* and standing crop and secretion rate in *Lobelia cardinalis*. There was no significant difference in the standing crop of nectar available in *Monarda fistulosa* and *Monarda fistulosa* 'Claire Grace.' *Lobelia cardinalis* and Lobelia cardinalis 'Fried Green Tomatoes' had significantly different bloom periods, which didn't allow for a side-by-side comparison of nectar production, which is largely influenced by weather conditions. An additional nectar analysis study is planned for summer 2015, investigating nectar production in three different cultivars of *Lobelia cardinalis*.

V. IMPACT OF RESULTS

The results of the quantitative research will encourage further research into the ecological differences between straight species and native cultivars when choosing native flowering plants for pollinator habitat enhancements. This research showed that there can be significant differences between straight species and their cultivars, but the differences vary and are species/cultivar specific. This research should be expanded to study more species and more cultivars of each species. 'Improved' cultivars of native plants are sometimes better suited visually for a designed landscape than a straight species, but it is important that we fully understand the ecology of these plant selection decisions.

This research has sparked an ongoing dialogue in the horticulture industry and a considerable amount of interest among growers and gardeners alike. Gardeners who have attended our seminars express an interest in planting more pollinator-friendly plants and growers are eager to meet this demand for plant material.

VI. AREAS NEEDING ADDITIONAL STUDY

This was the first scientific research project to evaluate straight species of native flowering perennials to native cultivars and has laid the groundwork for future studies. This study evaluated 14 species and cultivars, and because the results suggest that every species and cultivar is different, many more species and multiple cultivars of each species should be evaluated. It would also be valuable to the horticulture industry to study non-native introduced species and cultivars, as they comprise the majority of the plants in the industry.

Additionally, the challenges experienced in collecting nectar samples in the field highlight the need for a methods study on field techniques for sampling nectar in flowers with very low nectar volumes. It would also be useful to evaluate methods for laboratory analyses of nectar quantity and quality and pollen nutrition, which may yield more accurate data. This information would help us understand not only how attractive a flower is to a pollinator, but also how beneficial the floral reward is to the pollinator.

VII. WEB RESOURCES

To learn more, visit the research website: www.pollinatorgardens.org.

Listen to a podcast with Researcher Annie White and Garden Speaker and Founder of EcoBeneficial, Kim Eierman. www.youtube.com/watch?v=HTmuDcEzTOw

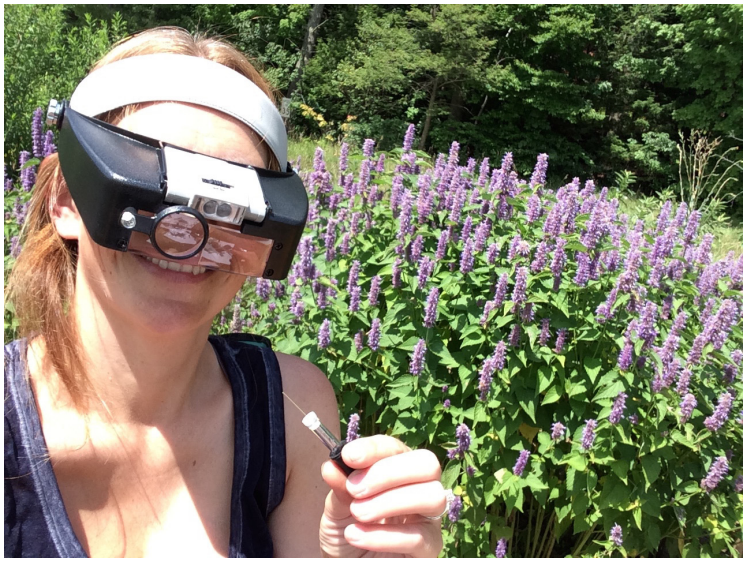
Watch a series of YouTube videos about the research filmed by Kim Eierman's crew at River Berry Farm.
www.youtube.com/water?v=xEkGjnbDvHE
www.youtube.com/water?v=lcgHBrIHALc
www.youtube.com/water?v=h0rHknFB_Rk

Citations:

COMBA, L., S.A. CORBET, L.V. HUNT AND B. WARREN. 1999. Flowers, nectar and insect visits: evaluating British plant species for pollinator-friendly gardens. Annals of Botany 83:369-383.

KLEIN, A., VAISSIERE, B.E., CANE, J.H., STEFFAN-DEWENTER, I., CUNNINGHAN, S.A., KREMEN, C., AND TSCHARNTKE, T. 2007. Importance of pollinators in changing landscape for world crops. Proceedings of the Royal Society B: Biological Sciences 274:303-313.

MORRANT, D.S., SCHUMANN, R. AND PETIT S. 2009. Field methods for sampling and storing nectar from flowers with low nectar volumes. Annals of botany 103:533-542.



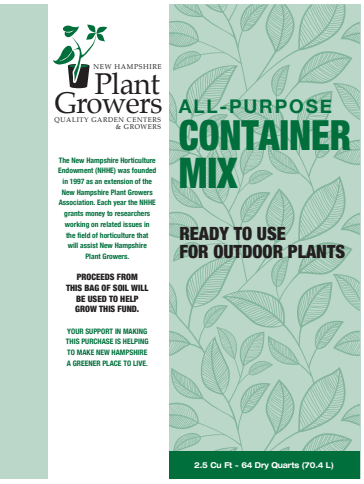
2014 NH HORTICULTURE ENDOWMENT FINANCIAL REPORT

Checking Account #1 balance: 1/01/14		$7,744.29
Income:		
Donations to Endowment	$1,800.00	
Sungrow Soil Bag Fundraiser	$2,848.00	
	$4,648.00	
Expenses:		
Univ. of New Hampshire Grant	$3,000.00	
Univ. of Vermont Grant	$3,000.00	
Admin. Asst. 2014 hours	$555,00	
Printing and Mailing	$284,35	
Transfer to Checking Account #2	$100.00	
	$6,939.35	
Income less Expenses:	($2,291.35)	
Checking Account #1 Balance: 12/31/14		$ 5,452.94
Checking Account #2 Balance: Opened 10/7/14		$0.00
Income:		
Transfer from Checking Account #1	$100.00	
Expenses:	$0.00	
Income less Expenses		$100.00
TOTAL CHECKING ACCOUNTS BALANCE: 12/31/14:		**$5,552.94**

MFS Mutual Fund Value: 1/01/14	$24,381.66	
MFA Mutual Fund Value: 12/31/14	$26,413.95	
Net Gain (loss)	$2,032.29	
NH Charitable Foundation: 1/01/14	$135,363.88	
Net Investment Return	$7,271.71	
Foundation Fees	($847.14)	
Ending Balance: 12/31/14	$141,788.45	
Net gain (loss)	$6,424.57	
Total Assets as of 1/01/14	$167,489.83	
Total Assets as of 12/31/14		**$173,755.34**

NHPGA Container Mix Program:

NHPGA members raised $2,848.00 dollars in the past year for the NHHE Endowment fund. One dollar from the sale of every bag goes to research that benefits NH Growers. To learn more about selling the container mix please contact Peter Gagnon, Sungro Horticulture, 413-523-3370, peterg@sungro.com.



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First Pioneer Farm Credit
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*Van Berkum Nursery
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*Champions of NH Farms/ NH Dept. Of Agriculture
*Deerfield Gardens
*Demers Garden Center
Durham Garden Club
Edgewater Farm
*Garrison Hill Florists, Inc.
*Goldstar Wholesale Nursery, Inc.
*Hortica *(formerly known as Florist's Mutual Insurance Company)*
*Nancy Carlisle Interior Plantings
*Outdoor World
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*Rimol Greenhouse Systems, Inc.
*Rolling Green Nursery
*Round Table Farm Greenhouse
*Stratham Circle Nursery and Landscape
*Trugreen Landcare *(Formerly *Coronis Landscaping, Inc.)*
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Windsock Gardens

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*Barrett Greenhouse and Nursery
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*Blackberry Farm
*Colby Hines Contracting
*Davis Engineering
*Deer Cap Greenhouse
*Fred C. Gloeckner Company
*Gillyflower Glen
J.P. Bartlett, Co.
*Johnson's Flower & Garden
*Ledgeview Greenhouses
Mason Hollow
Margaret Hagen
Merrymeeting Garden Center
*Neva Dun Farm
NH Association of County Extension Agents
*Portsmouth Gardens
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*Sunderman Manufacturing Company
*The Green Thumb of North Haverhill
*Uncanoonuc Mt. Perennials
*Weir Tree Farm

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2 Blooming Sisters Garden Center
4 J's Earth Works
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*A Growing Concern
Ann & Dave Hilton
Apple Ridge Growers
Bay 19 Gardens
Benson's Lumber & Hardware
Bob Parker
*Blue Star Peat Moss
*Bly Farm
*Boulder Farm
Brookhill Lighting & Landscape
*Callahan's Greenhouse
*Calvin Schroeder
*Cannon Equipment Co.
Canterbury Plantation
Chris Schlegel
*Claussen's Greenhouses
*Colebrook Nurseries
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D.S. Cole Growers- Jason Ginn
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Jill West
Johnson & Dix Fuel Corp.
Jungle Drop Garden Center
*Konjonian's Floriculture Education Services
Lake Street Garden Center
L'Annscapes
Leslie Doherty
Let It Bee Garden
Longacres Landscaping
Mason Hollow Nursery
Mathew Kobs
*Meredith Gardens
Miltimore's
Nancy Carlisle Interior Landscape
New England Heather
Northeast Landscaping
Northeast Nursery, Inc.
Parkwood Farm
Perennial Design Landscaping
Pure Barnyard
*Putnam's Flowers & Gifts
*Revay's Garden Center
*Ronald B. Laurence, P.E. Consultant
*Rosemont Farm
*Salmon Falls Nursery
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Spring Ledge Farm
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Willowmist Grasses
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