

V(A). Planned Program (Summary)

Program # 15

1. Name of the Planned Program

Horticulture

- Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	5%		15%	
132	Weather and Climate	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		20%	
204	Plant Product Quality and Utility (Preharvest)	20%		15%	
205	Plant Management Systems	50%		20%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		15%	
213	Weeds Affecting Plants	5%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	13.1	0.0	59.7	0.0
Actual Paid	17.5	0.0	49.7	0.0
Actual Volunteer	66.7	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
565519	0	449823	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1852511	0	4419595	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
803827	0	4801486	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

MAES horticultural research supports a growing and diversified sector of Minnesota agriculture, including fruit and ornamental crops, vegetables, potatoes, forages, and grasses. U of M horticultural research is perhaps best known by its "stars" - the Honeycrisp apple, and the Frontenac, Marquette and La Crescent wine grapes that made the Minnesota wine industry possible. But U of M horticultural research has had impact on a wide range of crops and management practices with a recent increased focus on organic cropping systems, and the effects of pesticides.

One new project began in 2014 exploring the effects of high tunnel environments for organic horticultural crops. Beyond extending our local growing season, high tunnel systems can improve fruit and vegetable crop quality, while protecting vulnerable plants from bad weather, pests, and diseases.

Research highlights for 2014 include:

- Grape breeders have been working hand-in-hand with enologists to breed new cold-hardy grape cultivars with lower sugar and acidity levels. Several new selections within the breeding program are showing promise in this area.
- Two of five grape cultivars (MN 1220 and MN 1258) that were released for trials in nine other states have been determined to have excellent fruit and wine quality. They will be considered for commercial release in the near future.
- The University's first pink blueberry, Pink Popcorn™ (formerly MNPINK1) was released and licensed in 2014. It is the first pink blueberry hardy to zone 3.
- Six apple selections are in advanced testing at multiple sites throughout the U.S. and one completed testing and was released in 2014.
- A new DNA test was developed to predict apple scab resistance, moving forward this will be used to assist with the selection of parents, and seedlings in the apple breeding program.
- Two potato varieties, MonDak Gold and Runestone Gold are now being grown as certified seed, and tested in various markets.
- Research conducted on increasing the red color of potatoes discovered future research in this area should concentrate on increasing biosynthesis of anthocyanins rather than on soil conditions.
- A gene expression study on wild potatoes has identified cold tolerance genes that can be transferred from wild species to crop plants for improved resistance.
- A study on the effect of insecticides used for tree disease management on nearby perennial plants found that the use neonicotinoid imidacloprid reduces the survival of some insects including lady bugs and butterfly larval.

- U of M scientists exploring the connection between golf course turf and pesticides discovered that a clothianidin insecticide application to bluegrass resulted in 171 ppb clothianidin in clover nectar. This is a sufficient number to reduce bumblebee colony health (which in previous research was found to be as low as 20 ppb).
- Two new cultivars of perennial ryegrass were licensed to growers in northern Minnesota (Green Emperor and Royal Green).
- A new breeding program was initiated in hairy vetch (*Vicia villosa*) for use as a cover crop with breeding objectives to improve winter hardiness, and early maturity.
- Twenty-six fine fescue varieties were subjected to heat stress tests. Overall, the varieties exhibited superior tolerance to heat stress, and maintained high quality throughout the tests.
- A survey with land managers identified management and aesthetic characteristics as the most important for consumers when considering alternative low-input grasses.
- A new dwarf phenotype of interspecific *Gladiolus* x hybridus with a compact inflorescence was discovered 2014. This new plant has potential for use for both indoor potted plants, and containers.
- A 13-month field experiment comparing the growth and genotypes of reed canarygrass in both wetland, and upland conditions found a significant genetic variation that researchers plan to explore further.
- Using LC-MS University plant researchers have discovered a quick way to screen for IAA conjugates and identify novel indolic compounds in plants.
- A lawn care survey was conducted in July 2014 with homeowners in the Twin Cities area. Of the 359 respondents, 31.8% had inaccurate perceptions of the path that water travels when it left their yard. Those with inaccurate perceptions were found to water, fertilize, and apply pesticides at higher rates, and be less aware of the potential environmental impacts of their lawn maintenance.
- A three-year survey in the Prairie Pothole region of ND was conducted on native bees. Over 160 species were identified, and conclusions on the requirements for forage and nesting habitats will help policymakers protect native bee populations.
- A long-term experiment was completed on enemy exclusion in prairie plots. It found that fungicides receive the greatest benefits (increases in plant productivity) in high diversity as compared to low diversity plant communities.

Extension

The Extension Horticulture program is broad, including programming for commercial fruit and vegetable producers, the landscape and greenhouse industry, and Minnesota home gardeners. It is best known statewide by the general public for its Master Gardener program, which in 2014 received new energy and impetus with a new statewide director, 2.5 FTE's added, and its home base moved to the University of Minnesota Arboretum in Chaska, Minnesota. More than 2,300 trained Master Gardener volunteers give 130,400 hours of service in their communities each year.

In 2014, the Horticulture program was on the front line addressing home gardeners and horticultural industry growers about the changing climate. Questions related to the increase in dramatic weather events, plant growth zone shifts, changes in plant selection, and cultivation practice adjustments. Change in action impacts are reported in the Outcomes section.

Some activities and impacts from Horticulture programming in 2014 include:

- Landscaping education for home owners showed them how to use native and heirloom plants to reduce erosion along lake shorelines.
- Extension educators identified new lawn disease problems resulting from a cold and wet spring. The team helped owners manage the disease without the use of fungicides.
- An Extension horticultural specialist worked with the Minneapolis Parks and Recreation board to restore the turf around a city lake.
- A Colorful Growers project in one community provided youth with business experience growing

produce and selling it at local venues.

- Horticultural specialists promoted pesticide reduction with the use of biorational insecticides that are compatible with the conservation of beneficial insects and pollinators at integrated pest management program workshops for turf growers, landscapers, greenhouses, nurseries, and retail garden centers.
- An Arboretum and Extension learning garden hosted a "Smart Snacks" event. The Smart Snack garden concept grows healthy snacks (edible plants) for both people and bees. Master Gardeners shared information about how to create community gardens at schools, churches, libraries and other public places.
- A multimedia ebook released in 2014 has been accessed by more than 1,000 Minnesota strawberry growers.
- Master Gardeners represented Extension at the Gichi Manidoo Giizus Pow Wow in 2014, and told the story of the Fond du Lac Extension Master Gardeners who volunteer on behalf of the tribal community.
- Summer classes sponsored by Master Gardeners in two urban counties called Evenings in the Garden hosted a group of teens from the local juvenile alternative facility, offering them a look at opportunities for jobs in landscaping and the world of gardening.

2. Brief description of the target audience

The audiences are:

- 1) Fresh market producers, including growers of fruits and vegetables for processing, the processing industry, associated agribusiness turf professionals, nurseries and garden centers, and landscape professionals. Several of these groups have high representations of new immigrants.
- 2) Consumers of horticultural information for yards, gardens and landscapes. These include audiences where information is needed in a timely fashion and those who want to build basic knowledge about horticulture and environmental stewardship over time. Community-based initiatives mobilize schools, neighborhoods, and non-profit organizations to create and maintain green spaces.

3. How was eXtension used?

Extension Horticulture specialists shared expertise and information; Master Gardeners accessed horticultural information.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	263252	2163949	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014
 Actual: 3

Patents listed

13/999,110 1/14/2014 Rhododendron plant named UMNAZ 493
 13/999,113 1/14/2014 Rhododendron plant named UMNAZ 502
 ROII29159138 12/11/2014 Antibacterial and Antifungal Flavanone-3-alkyl Esters for Use in Agriculture and Human Health

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	9	36	45

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops, classes and seminars that provide information to professionals in the commercial horticulture industry.
 Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of volunteer hours leveraged by Master Gardeners, trained by Extension, will deliver hours of educational service to the residents of Minnesota. (Target expressed as the number of volunteer hours committed by Master Gardeners in a year.)

Year	Actual
2014	130400

Output #3

Output Measure

- Number of horticultural educational and training events offered to professional and home gardeners and Master Gardeners

Year	Actual
2014	24117

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Participants of Horticulture program events will achieve significant learning gains regarding horticulture. (Target expressed as the percentage of participants who achieved learning gains.)
2	Participants of Horticulture program events intended to improve participant horticulture practices will improve practices as a result of attending events. (Target expressed as a percentage of participants that changed one or more horticulture practice.)
3	Research will support niche horticultural crops' growth.
4	Education will create opportunity for change in horticultural practices to support community environmental health. (Target is the number of municipal golf courses changing management behaviors to protect bees.)
5	Research and Extension will support change in horticultural practices to reduce pesticide use that affects bee health.
6	Research will develop new hardy plant varieties with desirable qualities for consumers.
7	Research will develop new fruit varieties to increase consumer interest and extend growing seasons for producers.

Outcome #1

1. Outcome Measures

Participants of Horticulture program events will achieve significant learning gains regarding horticulture. (Target expressed as the percentage of participants who achieved learning gains.)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Participants of Horticulture program events intended to improve participant horticulture practices will improve practices as a result of attending events. (Target expressed as a percentage of participants that changed one or more horticulture practice.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Currently, there are 2,000 to 2,500 Minnesota high tunnels operating in Minnesota. Growers have now successfully used high tunnels long enough to experience disease issues associated with lack of rotation, density in planting, and humid, warm conditions in tunnels. Surveys in previous years revealed that growers are unaware of or unable to diagnose disease of their high tunnels. Resolving this problem is vital for the sustainability of the Minnesota high tunnel industry.

What has been done

Extension Horticulture specialists surveyed more than 18 high tunnels throughout the year and provided disease diagnostic services to Minnesota high tunnel growers. They used the data to determine which diseases were important to high tunnel vegetable production and delivered that information to growers at site visits, conferences, and individual consultations.

Results

Follow up showed that growers are not only better able to identify several of the most important and most common diseases but several are rotating and changing management practices to manage disease.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants

Outcome #3

1. Outcome Measures

Research will support niche horticultural crops' growth.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Demand for locally grown produce, including strawberries, is high in Minnesota. However, our cold winter temperatures make it hard to grow perennial strawberries. And even when Minnesota growers are successful, local berries are only available for a short three-week period in June.

What has been done

University of Minnesota scientists are working with day-neutral strawberry varieties, which are annuals that do not need to survive Minnesota winters or require the long-days of June to bear

fruit. While typically these varieties have not performed well in cold climates, researchers have been experimenting with the addition of low tunnel systems to decrease issues connected to poor weather, climate, and even pests.

Results

In 2014, an e-book was created for commercial strawberry growers providing general guidance and information on new management techniques being discovered at the University. While day-neutral berries do not fruit until late-July, when combined with a low tunnel system, they can continue to fruit through October. Not only does this extend the season by up to four months for growers, but it also allows consumers to enjoy locally produced fresh produce for a much longer period.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #4

1. Outcome Measures

Education will create opportunity for change in horticultural practices to support community environmental health. (Target is the number of municipal golf courses changing management behaviors to protect bees.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The decline of honey bees and wild bee pollinators continues to attract attention and concern worldwide. People want to help honey bees and native bees by planting bee-friendly flowers and

reducing the use of insecticides that harm bees, as well as herbicides that kill floral resources for bees.

What has been done

Extension Bee Squad programming trains beekeepers and provides ways for the public and organizations to help bees. The Bee Squad program grew significantly over the past three years. In 2012, The Bee Squad began keeping bees at a local golf course. In 2014, the program was widely celebrated, and they met with the executive director of the Minnesota Golf Course Superintendents' Association to talk about how golf courses could make their grounds friendlier to bees. This information was shared with the superintendents of Minnesota golf courses.

Results

The Bee Squad is now in conversation with six additional golf courses in the Twin Cities area which are interested in the Hive to Bottle program. More importantly, the golf courses have made decisions about managing their grounds that are in the best interest of bees and other pollinators. They have reduced pesticide input and are willing to pay more for pesticides that are safer for bees.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #5

1. Outcome Measures

Research and Extension will support change in horticultural practices to reduce pesticide use that affects bee health.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

When insecticides were first developed, their use in protecting plants was embraced because they were not toxic and were applied to soil rather than sprayed, reducing nontarget effects on beneficial insects. Neonicotinoid insecticide imidacloprid was registered in 1994 and is now the second most widely used agrochemical in the world. A problem with the use of systemic insecticides is that they remain in the plant and are expressed in pollen and nectar. This translocation of systemic neonicotinoid insecticides into pollen and nectar could be a factor contributing to decline in honeybees and bumble bees. However, how much insecticide was translocated from soil to pollen and nectar in flowering plants was not known.

What has been done

In 2014, a UMN researcher and Extension horticultural specialist demonstrated that flowers of nursery and greenhouse plants contained levels of systemic neonicotinoid insecticides that alter behavior and killed off foraging beneficial insects such as lady beetles, lacewings and bees. She brought her research to Master Gardeners, home gardeners, and horticultural industry groups. Master Gardeners shared information in meetings and consultations. People began to realize that insecticides might influence bee and beneficial insect health and decided to alter their insecticide use.

Results

Engaged citizens brought concern to local community officials and local ordinances were developed to reduce systemic insecticide use in favor of shorter acting insecticides. The specialist testified at the Minnesota State Legislature and, convinced by this testimony, Minnesota state bee labeling laws were established to protect bees by reducing the use of systemic neonicotinoid insecticides on flowering plants that bees visit. As of July 1, 2014, a new plant labeling law is now in effect in Minnesota to protect pollinators from exposure to toxic levels of insecticides. The new law requires that plants advertised as "beneficial to pollinators" must be free of detectable levels of certain systemic insecticides.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #6

1. Outcome Measures

Research will develop new hardy plant varieties with desirable qualities for consumers.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Azaleas are highly desired for their showy, colorful blossoms. While landscape staples in more temperate regions, historically azaleas have not been hardy passed -4°F. Even when northern gardeners could find a cold hardy variety, they have had to settle for shades of pinkish-mauve.

What has been done

Researchers first began crossing northern hardy azaleas with their more colorful southern versions in 1957. Through these initial crosses, a discovery was made. Crossing plants from the northern and southern zones results in a plant that in its second generation is hardier than the original northern parent. Twenty-one years later, the first cold hardy azaleas were introduced to the nursery industry.

Results

Since the initial release in 1978, U of M plant breeders have focused on expanding the line with new colors, increased disease resistance, attractive fall foliage, increased fragrance, and even extended bloom periods. New technology allows breeders to eliminate crosses with undesirable characteristics much earlier in the process saving breeders time, resources, and money. In total, 16 azaleas have been released by the University of Minnesota (including two new releases which will be available Spring 2015) that feature cold hardiness to zone 3 and flower bud hardiness of -30° to -45° F. The "Lights Series," as they are known, feature hues from traditional pink-mauves to red, orange, white, lemon yellow, peach, and lilac.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)

Outcome #7

1. Outcome Measures

Research will develop new fruit varieties to increase consumer interest and extend growing seasons for producers.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Minnesota is home to around 150 apple growers and produces millions of apples every year. Expanding the apple growing season for these and other northern growers is a complicated process since the season cannot be pushed back without risking frost damage.

What has been done

University of Minnesota apple breeders have been utilizing the strong genetic stock available in our breeding program to develop new cold-hardy apple varieties that offer (1) great crisp texture, and taste and (2) earlier ripening dates than varieties now on the market. In the late 1990s, they set out to develop an apple that would combine the wonderful texture and flavor of Honeycrisp with the desired earlier ripening date found in more southern varieties. In total, approximately 14,000 varieties were considered and discarded with one hitting the mark.

Results

In 2014, MN55 was officially released to the market. A cross between Honeycrisp and MonArch, MN55 promises a crisp, juicy taste that will ripen up to four weeks before Honeycrisp, thus extending the Minnesota apple season into late August and opening northern orchards up to Labor Day weekend visitors. Notably, MN55 is also the fastest apple variety to complete the breeding cycle in the University's 100 year apple breeding history. It took only 17 years from start to finish.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (No factors)

Brief Explanation

Horticulture programs leverage the interest of volunteers and the science of research to tackle specific challenges. Several challenges were addressed in 2014.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Horticulture programs leverage the interest of volunteers and the science of research to tackle specific challenges. Several challenges were addressed in 2014. Evaluation of horticulture programs examine the degree to which behaviors are changed or organizational or policy changes are made as a result of education. In 2014, horticulture programs effectively changed behaviors that support bee health and further the role of high tunnels in increasing the season for growing vegetables in Minnesota's cold climate.

Key Items of Evaluation

Evaluation of horticulture programs examine the degree to which behaviors are changed or organizational or policy changes are made as a result of education. In 2014, horticulture programs effectively changed behaviors that support bee health and further the role of high tunnels in increasing the season for growing vegetables in Minnesota's cold climate.