

**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%		5%	
132	Weather and Climate	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		50%	
204	Plant Product Quality and Utility (Preharvest)	20%		20%	
205	Plant Management Systems	50%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		5%	
213	Weeds Affecting Plants	5%		5%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	15.7	0.0	51.2	0.0
Actual Paid Professional	18.5	0.0	60.3	0.0
Actual Volunteer	66.0	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
537488	0	699887	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1835707	0	4760552	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
890283	0	5883017	0

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

**MAES** horticulture 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 a new Minnesota wine industry possible. But U of M horticultural research in 2013 has had impact on a wide range of horticultural crops. Some highlights:

- Work was completed on flowering initiation in native sedges. The knowledge is helping researchers propagate native plants that can be used to restore native ecosystems and difficult sites in urban landscapes.
  - U of M scientists confirmed a new invasive fruit fly in Minnesota, which threatens Minnesota's berry crops. Researchers recommended strategies to deal with the pest including monitoring traps and disposing of overripe fruit, which is most attractive to the pests.
  - Laboratory research into the behavior of viruses in Echinacea and its family of plants yielded unexpected insights into the formation of abnormal plant proteins. These abnormal forms have parallels with abnormal forms of protein that have been demonstrated in animals (for example, Alzheimer, scrapie and mad cow disease). As a result of this connection, researchers have focused on the biochemical and biophysical characterization of the disease-associated protein filaments in this plant family to establish the extent of their similarity to the amyloid proteins found in animals, with possible benefits to those researchers.
    - A study to determine if it was possible to predict the effect of the rate of Nitrogen fertilizer on potato tuber aclamide concentration, which negatively affects the quality of potato chips, was completed. The study showed that the concentration depended more on the cultivar than manipulating nitrogen rates.
    - A new plant virus infecting cultivated roses was transmitted, characterized and sequenced.
    - Researchers studying prairie diversity with the goal of prairie restoration found that increasing plant richness in natural prairie communities decreased bacterial species, while fungal species richness increased with increasing plant richness. Understanding the interaction of micro-organisms in prairie soils is important for understanding prairie plant health.
    - Some popular plant species are themselves invasive. To allow gardeners who enjoy those plants to continue to grow them, researchers have been researching the possibility of developing seedless cultivars of those plants. They are using irradiation treatments of seeds and unrooted cuttings to create a mutation that results in seedlessness. Researchers have determined the relative sensitivities of a species to

achieve maximum efficiency for mutagenesis, targeting long-lived woody perennial species. Mutagenized material from 2013 is being grown in the greenhouse and will be transplanted for further assessment and selection.

- Turf grass researchers are defining management systems using fine fescues that will reduce the inputs of pesticides and fertilizers. They are using the U of M golf course as a living laboratory for testing and teaching.
- The highest quality turf grass quality can be found in European germplasm; however, this germplasm lacks economically viable levels of seed production. Researchers have begun a program to cross the native and developing perennial ryegrass cultivars that are more winter hardy and have higher levels of resistance to rust disease. They have identified a number of lines of perennial ryegrass that show high levels of rust resistance.
- A study of various light sources for plant growth for use by home gardeners compared new LED lights with six other light sources on the germination and growth of nine different herbaceous species. The results of the research are helpful to home growers, and were publicized in the popular media, including an article in Fine Gardening.
- In a collaborative research project with Cornell and Washington State, Minnesota researchers have been developing genetic markers to allow more efficient apple selection. Genetic markers allow them to tell, even when a seedling is very young, if it's more likely to have crisp fruit several years from now or mushy fruit, if it's red or yellow, or if it's sour or not. In 2013, the power of marker-assisted parent selection was shown: crosses planned using only marker-assisted parent selection for skin color saved the U of M apple breeding program about \$20,000 in costs of caring for seedlings in the breeding orchard that would have no commercial potential due to undesirable skin color.
- Two new azalea varieties adapted for northern climates were released in 2013 along with a Kentucky coffeetree selection.

**Extension:** In 2013, commercial horticulture education in Minnesota reached commercial fruit and vegetable growers, influencing producers on 296,000 acres of land. Focused educational efforts addressed protecting crops from the threat of pests, effective application of pesticides, nitrate leaching from fertilized lawns, and education about hops production for Minnesota's burgeoning craft beer industry.

The Master Gardener program mobilized 2,722 volunteers throughout Minnesota. For these volunteers, Extension provided 27,126 hours of continuing education. In turn, the volunteers delivered 137,295 hours of service through contributions to community events, plant diagnostic workshops, publications, adult education venues, fairs and consultations.

## 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. New initiatives with tribal communities are educating volunteers and creating community projects.

## 3. How was eXtension used?

Among U of M Extension's horticultural contributions to eXtension in 2013 was educational content about bed bugs. U of M Extension's most popular factsheets were translated into Arabic, Hmong, Somali

and Spanish and are available on eXtension.

Minnesota also contributes education and parters for the Bee Health topic area on eXtension.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	258033	306389	55486	0

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

**Patent Applications Submitted**

Year: 2013

Actual: 3

**Patents listed**

2 new deciduous azalea selections: UMNAZ 493 and UMNAZ 502

New Kentucky coffeetree selection: UMN720283

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2013	Extension	Research	Total
<b>Actual</b>	13	66	79

**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.

Year	Actual
2013	475

**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.)

<b>Year</b>	<b>Actual</b>
2013	137295

**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	Through research, educational and media outreach, the public is becoming aware of the importance of protecting bees.
4	Research will provide knowledge to support better understanding of the biological mechanisms for plant improvement
5	Research will develop new fruit varieties to increase consumer choices.

## **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.)

### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	73

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Consistent messaging about yard and garden care through a league of volunteers statewide mobilizes the entire state to protect plants, conserve water, protect watersheds, stimulate active living,

#### **What has been done**

Over 5,000 educational workshops were delivered in community settings. Evaluations measured learning after the program.

#### **Results**

An example of learning outcomes come from Vegetable Growing Basics. In this case, participants reported the most learning and projected behavior change in: mulching vegetables to control weeds and retain moisture (64 percent gain); watering vegetables from below (60 percent gain); reading the instructions on a packet of seed (54 percent gain); and using integrated pest management practices (53 percent gain).

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

213 Weeds Affecting Plants

**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
- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	32

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Those who care for yards and green space are in a unique position to prevent plant diseases, nurture healthy plants, conserve water, protect watersheds, and prevent the spread of invasive species.

**What has been done**

Master Gardeners are trained to convey eight key messages as they help Minnesotans. They are: 1) Grow fruits, herbs and vegetables to assure active living; 2) Reduce overhead watering; 3) Protect bees by reducing pesticide use; 4) Plant more native plants and install rain gardens; 5) Reduce use of fertilizers to curb toxic runoff; 6) Manage yard waste through composting; 7) Proactively plan for Emerald Ash Borer; and 8) Reduce premature decline of trees through proper watering, planing and pruning.

**Results**

A survey of yard and garden keepers taught by Master Gardeners in one major metropolitan county showed that consistent messages impacted behavior and, thus protected resources and plants: 44 percent of respondents had reduced overhead watering; 40 percent used two or fewer fertilizer applications; 37 percent used chemical-free options to deal with pests; 35 percent removed invasive weeds from their property; 30 percent improved their tree care; 30 percent planted disease resistant or native plants; 28 percent planted more fruits, herbs or vegetables; 28 percent started watering in the morning; 23 percent composted; 21 percent reduced the quantity and frequency of watering. While this evaluation was not conducted statewide, it suggests probable impact from Master Garderners' volunteers statewide.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
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

Through research, educational and media outreach, the public is becoming aware of the importance of protecting bees.

##### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Given that bees pollinate fruits, vegetables and nuts, and pollination is required for about one-third of all food production, recent concern and focus on declining bee populations have highlighted the importance of saving this essential agricultural resource. Beekeepers, food scientists and entomologists are worried throughout North America, Europe and other continents as bees keep dying. About one-third of bee colonies each year have been dying for the past six years.

###### **What has been done**

Few people have contributed as much to understanding the life and health of the honeybee in recent decades as Marla Spivak, the U of M entomologist who is a world leader in bee research. She developed the "Minnesota Hygienic" bee which has resistance to disease. Her research has helped identify several culprits to bee decline, called "colony collapse," but the use and timing of insecticide applications have been identified as chief suspects. Neonicotinoid

insecticides are used by both crop growers and urban gardeners and are lethal to bees. In addition to long-standing short courses and on-line courses, national and international conversations like the recent TED Talk on the subject, and downloadable fact sheets, two new important programs have been added to Extension Programming.

#### **Results**

The focus on bee health has led the Minnesota Legislature to pass a pollinator habitat bill. It appropriates \$150,000 a year to improve bee habitat and increase public awareness of pollinators. The legislation also requires state agencies to create a report on pollinator habitat and to establish a process for reviewing the safety of neonicotinoid insecticides. Working in collaboration with this research, U of M Extension has developed a Bee Squad for urban residents, and Bee Tech Transfer Teams for commercial beekeepers, to teach strategies to support the health of bees and bee colonies, and to raise awareness of the threat to bees. Nurseries and garden centers are beginning to offer substitutes to neonicotinoid insecticides based on public concern and demand.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

#### **Outcome #4**

##### **1. Outcome Measures**

Research will provide knowledge to support better understanding of the biological mechanisms for plant improvement

##### **2. Associated Institution Types**

- 1862 Research

##### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

##### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

##### **3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

For many years, Minnesota plant breeders have been breeding for cold tolerance. This has allowed, for example, new hardy blueberries to be grown in northern Minnesota, for hardy azaleas to grace an urban garden in Minnesota, and has made it possible for other new fruits and flowers to enrich the urban landscape and local farmers' markets. But researchers have had to do this piecemeal, step-by step. The evolutionary pathways of plants have not been understood.

#### **What has been done**

An interdisciplinary team of researchers has assembled the largest dated evolutionary tree, using it to show how flowering plants evolved specific survival strategies, such as the seasonal shedding of leaves, to move into areas with cold winters. They created a database of over 49,000 species, studying their adaptive strategies and compared it with a global climate database, allowing them to model the evolution of species' traits and climate surroundings. They developed a 'timetree' that is the most comprehensive view yet into the evolutionary history of flowering plants. The findings were published in a December 2013 edition of Nature.

#### **Results**

The research shows the whens, hows and whys behind plant species trait evolution and movements around the globe. Researchers will use the timetree to explore other aspects of the evolutionary history of plants, especially to examine how plants respond to additional environmental pressures besides just freezing. It may be possible in the future to breed cold tolerance in a different way than we do today.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate
201	Plant Genome, Genetics, and Genetic Mechanisms

#### **Outcome #5**

##### **1. Outcome Measures**

Research will develop new fruit varieties to increase consumer choices.

##### **2. Associated Institution Types**

- 1862 Research

##### **3a. Outcome Type:**

Change in Action Outcome Measure

##### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
-------------	---------------

2013

0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Back in 1996, 60 percent of the apples sold in the U.S. were either Golden Delicious or Red Delicious. Neither is overly sweet or tart, neither is especially crisp and neither inspires nearly as much enthusiasm today. Today, consumers reap the benefits of advances in apple breeding, and their options are much broader.

#### What has been done

Honeycrisp apple, released by U of M fruit breeders in 1991, has become a nationwide success story. The apple, which is now grown around the country and in other countries, was the result of a 15-to-20 year development process. Between 10,000 and 15,000 new varieties are grown each year by U of M apples breeders, of which roughly 15 percent make the cut and are cloned into orchards that are observed for five more years. There is no guarantee any of them will become a sellable variety. The Honeycrisp is now used as parentage in a lot of the breeding selections in the Minnesota breeding program, and well as in breeding programs in other states. The offspring of Honeycrisp are now bearing fruit.

#### Results

Sweetango apple is the first apple with Honeycrisp parentage released by U of M. New York has one that's soon to be released to be marketed under the name Snapdragon that has Honeycrisp as a parent. Washington has an apple under development with Honeycrisp parentage that will be released in the next five years. Another that's coming out of the Midwest Apple Improvement Program will be called Evercrisp, which is a Honeycrisp-by-Fuji cross. There is a whole group of Honeycrisp children coming that, in the next 10 years will really change what kind of apples are available, and continue to increase consumer's appetite for this healthy fruit.

### 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

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes
- Populations changes (immigration, new cultural groupings, etc.)

#### Brief Explanation

The growing popularity of locally-grown foods, facilitated by Extension's outreach to growers, has grown interest in gardening at home and in fields. As a result, participation in horticulture education grew by 49 percent in 2013.

### V(I). Planned Program (Evaluation Studies)

## **Evaluation Results**

Evaluations of horticulture programs examine the degree to which participants in program have adopted processes to enhance the health of their plants, increased their gardening activity, protected or conserved water, or made appropriate use of pesticides. In at least two program evaluations, participants reported that they were adopting important practices. Most significant impacts were had in the reduction of overhead watering, decreased use of fertilizer and other chemicals, management of invasive or noxious weeds, and growing and maintaining more native plants or trees.

## **Key Items of Evaluation**

A study of the Master Gardener program in a major metropolitan county of Minnesota demonstrated that the program was effectively changing behaviors in gardens, especially with regard to reducing overhead watering, decreasing use of fertilizer and other chemicals, managing of invasive or noxious weeds, and growing and maintaining more native plants or trees.