

2009 Project Report
Developing a student-run community site for
Permaculture and Agroforestry

Dilmun Hill Student Farm, Cornell University

Presented to the Towards Sustainability Foundation

February 5, 2010

Principle Investigators and Cooperators:

Marvin Pritts	Professor and Chair Department of Horticulture 134A Plant Science Building, Cornell University, Ithaca, NY (607) 255-1778, mpp3@cornell.edu
Murray McBride	Professor Department of Crop and Soil Sciences 910 Bradfield Hall, Cornell University, Ithaca, NY (607) 255-1728, mbm7@cornell.edu
Kenneth Mudge	Associate Professor Department of Horticulture 13 Plant Science Building, Cornell University, Ithaca, NY (607) 255-1794, kwm2@cornell.edu
Melissa Madden	Organic Research Farm Coordinator Cornell University Agricultural Experiment Station (CUAES) 147D Plant Science Building, Cornell University, Ithaca, NY (607) 351-3313, mam233@cornell.edu
Davis Archer	Natural Resources, '11 dma83@cornell.edu
Kelley McCrudden	Natural Resources, '10 kmm236@cornell.edu
Neele Reimann-Philipp	Natural Resources, '09 nr75@cornell.edu
Wren Albertson-Rogers	College Scholar, '10 wra2@cornell.edu

Introduction

Several times over the past decade, students working at Dilmun Hill tried to diversify farm products and appeal by establishing permaculture plantings. These plantings are designed to illustrate lesser-demonstrated concepts in sustainability like forest gardening and vertically-stratified polycultures, and are often 2-5 years in establishing. Current Dilmun Hill students wished to both establish a functional permaculture design and plan for the turn-over inevitable on the student-run farm. In the fall of 2008, College Scholar ('10) Wren Albertson-Rogers presented the Dilmun Hill Steering Committee and community with his independent study inspirations and spurred the student organization to implement his permaculture-based design, which expanded on TSF-funded maple/hazelnut agroforestry framework (please see Dilmun's website for the "2008 Dilmun-GMG Report to TSF"). Much of Wren's work entailed understanding the goals of the Dilmun community and combining their hopes into a simple statement and design, resulting in a concise goal statement intended to guide current and future designs. Continued funding provides for student manager positions which ensure continuity and success for these long-term goals.

Our beautiful perennial forest garden is a self-sustaining, colorful sanctuary of seasonal and cyclical plant guilds complementary with the farm's established infrastructure and crops. The holistic permaculture design offers a diversity of saleable edible, medicinal,

and ornamental plants to demonstrate multiple sustainable agriculture models. With increased access, informational signage, and equal opportunities for peer involvement, the low maintenance, vibrant garden provides year-round educational opportunities for students and community members from multiple interest groups.

Wren Albertson-Rogers, Fall 2008

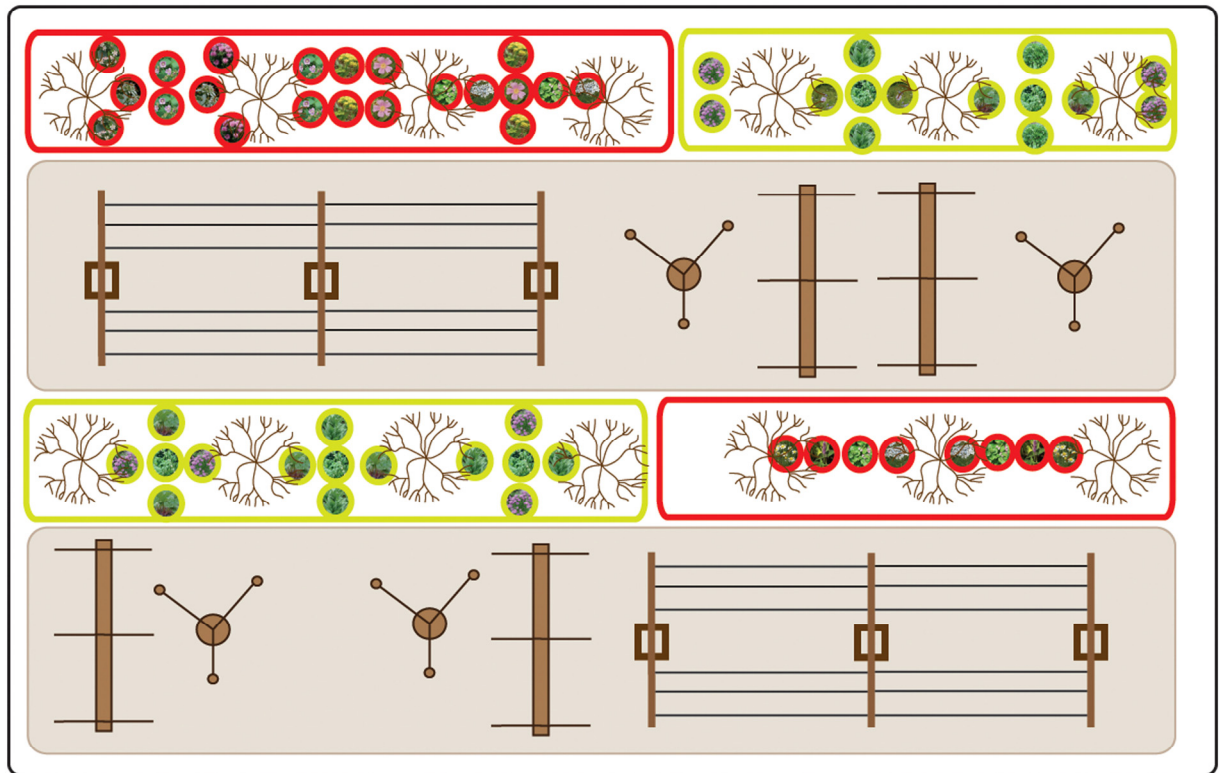
In late fall of 2008, Dilmun Hill students worked with faculty members and Melissa Madden to turn Wren's research and designs into a second grant proposal submitted to the Towards Sustainability Foundation (TSF). In January 2009, Dilmun Hill received a TSF grant to support implementation (staffing, materials, etc.). Soon afterwards, Melissa Madden hired the two spring managers (Neele Reimann-Philip and Ali Cakir), who cooperated in the initial phases of implementation.

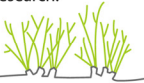
Following the semester's end Neele continued with summer management. Using the original design Neele planted over two dozen perennials in their corresponding polycultures to transform the space into one of beauty and diversity with ground covers, flowers, fruits, vines, and trellises (please see pages 4 and 5 for polyculture info). In the fall of 2009, Neele turned over management of the Growing Mosaics Garden (GMG) to students Wren Albertson-Rogers and Kelley McCrudden. Wren and Kelley continued to care for the plants and represented the garden in the many fall educational events for students and community at Dilmun Hill. The students also continued to build upon the original design of the garden.

Dilmun Hill Organic Farm
 Developing Agroforestry Options for
 Agriculture and Research:
 Alley Cropping



Agroforestry Plan





Medicinal Plants



*Chichorium
intybus*



*Agastache
foeniculum*



*Mentha
requienii*



*Accillea
millefolium*



*Aronia
melanocarpa*



*Pycnanthemum
virginianum*



*Monarda
fistulosa*



*Rubus
odoratus*



*Zizia
aurea*



*Rosa
palustris*

Edible Plants



*Rumex
scutatus*



*Rheum
australe*



*Polygonatum
biflorum*



*Allium
tricoccum*



*Allium
schoenoprasum*

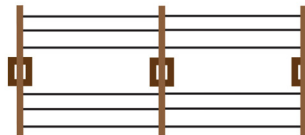


*Chichorium
intybus*

Trees and Trellis



*Acer
rubrum*



Hearty Kiwi Trellis



Hops Trellis



Wild Bean Trellis

Graphics by Dilmun volunteer Matt Doro, LA '09

Project outcomes for each 2009 TSF proposal objective

- 1) *Establish perennial polycultures in tree rows to demonstrate the potential for diverse yields from permaculture systems (food, fodder, fuel, fertility, "farmaceuticals" and habitat).*

A perennial polyculture is an agricultural system in which many crop species are planted in guilds (i.e. specific community plantings) in order to perform a variety of functions and produce a variety of yields. In permaculture, yields are not only saleable products, but describe functionality. Yields can be food, fodder, fiber, fertility, fuel, farmaceuticals, fun, etc. The initial Growing Mosaic Garden design consisted of two guilds (edible, medicinal) as complementary parts of a perennial polyculture.

In the spring of 2009 Neele and Ali made some substitutions to the original design, substituting plants that were either more accessible or more appropriate to site conditions. Neele and Ali ordered seeds from Johnny's Selected Seeds, FedCo Seeds, Wildflower Farm, and Krissy Faust at the Cornell Plantations. They received hop cuttings from Paul Cooper for rooting and transplanting, as well strawberry crowns from Hort Professor and Department Chair Marvin Pritts. Live plants were shipped by Tripple Brook Farm.

All of the seeding for the GMG was done in the certified organic greenhouse in the Guterman Greenhouse Complex. The project used ten bags of McEnroe Premium Lite organic potting mix throughout the spring. During the semester, interest in exploring other sources of potting mix lead to the adoption of a custom organic mix created by the Guterman crew. All Dilmun Hill planting activities in the organic greenhouse at Guterman, including those for the

GMG, were carefully documented in keeping with requirements for the organic certification process.

Plants were transplanted out as ready beginning with chicory, sorrel, and scarlet runner bean. Plants transplanted into the raised beds (compost) seemed to be significantly healthier than those planted in the tree rows (clay loam). While some compost was also applied to plants in the tree rows, the superior nutrient supply and drainage in the compost beds positively affected plant growth at the beginning of the season. Later, Wren and Kelley determined that the compost did cause some adverse effects and are investigating remediation options for 2010. All plants not planted in already sheet-mulched or the raised beds were sheets mulched soon after planting (applies to hops, Rose-of-Sharon, and chokeberry plantings).

Due to the incredibly wet spring season, extensive irrigation was not necessary. Watering of transplants and during drier weeks was done by way of a hose that was affixed to a riser below (i.e. South) of Block 3.

Table 3. Updated Specifics of Edibles Patch: the table displays the specifics of the edibles patch of the Growing Mosaic Garden. Substitutions/additions to the original design are denoted with an asterisk (*) and plants that are not yet planted are shown in red. The following labels are missing from the key (next page): N2 (nitrogen fixing), Nec (nectary plant), GC (ground cover), DA (dynamic accumulator).

Polyculture Patch I – Edibles															
Species Name	Common Name	Light	Moisture	Composition	Ht x W	Root	Habit	N2	Nec	GC	DA	Season of Yield	Spacing	Notes	
<i>Actinidia arguta</i>	Hardy kiwifruit	L	Med	fruit vine	20-100'	H	W vine					Late Summer-Fall	10-15'	live from Tripple Brook Farm	
<i>Allium cernuum</i>	Nodding Wild Onion *	LM	Med-Dry	S-M herb	18-24"x12-18"	B	Clmp		X	X		blooms Mid Summer-Early Fall	12-18"	Attracts wildlife, deer resistant	
<i>Allium schoenoprasum</i>	Chives	LM	Med	S-M herb	6-20"x6-20"	B	Clmp		X	X	X	Mid Spring-Late Summer	6-9"	Aromatic	
<i>Allium tuberosum</i>	Garlic Chives *	L	Med	S-M herb		B	Clmp		X	X					
<i>Aronia melanocarpa</i>	Black Chokeberry *	LM	Wet-Dry	S-M shrub	3-6'x3-6'	F, Sk	Clct		X			Fall		seeds from Krissy Faust (Native Plant Society)	
<i>Chichorium intybus</i>	Chicory	LM	Med	S-L herb	1-4'x1-2'	T	Clmp		X		X	Late Spring- Mid Fall	18-24"	Dispersive	
<i>Fragaria ananassa</i>	Strawberry *	L	Med-Dry	S-M herb		Fb/R	Clmp		X	X	X	Mid Summer	45 cm	crowns from Marvin Pritts	
<i>Phaseolus coccineus</i>	Scarlet Runner bean	L			4-6'x1-3'		R vine	X	X	X			6-9"	seeds poisonous if ingested	
<i>Polygonatum biflorum</i>	Solomon's Seal	L/D	Med-Wet	S-M herb	1-3'x2'+	R				X		Mid Spring-Early Summer	1-2'		
<i>Rheum australe</i>	Him. Rhubarb	LM	Med	VL herb	6-1'x6'	Fb	Clmp					Late Spring-Mid Summer	6-8'		
<i>Rumex acetosa</i>	French Sorrel	LM	Med	S-M herb	1-3'x10-12"	Fb	Clmp		X		X	Late Summer-Early Fall	9-12"	Dispersive	

Manager note: Chicory, although planted in the raised-beds in the GMG, appears in the table in red (indicating plants not yet planted). The chicory planted in the beds is broad-leaved chicory, planted by accident as it is not the originally intended chicory species. Therefore, the next round of plantings should include the correct chicory species (listed above).

Table 4. Updated Specifics of Medicinals Patch: the table displays the specifics of the medicinals patch of the Growing Mosaic Garden. Substitutions/additions to the original design are denoted with an asterisk (*) and plants that are not yet planted are shown in red. The following labels are missing from the key (below): N2 (nitrogen fixing), Nec (nectary plant), GC (ground cover), DA (dynamic accumulator).

Polyculture Patch II – Medicinals														
Species Name	Common Name	Light	Moisture	Composition	Ht x W	Root	Habit	N2	Nec	GC	DA	Season of Yield	Spacing	Notes
<i>Achillea millefolium</i>	Yarrow	L	Med-Wet	M herb	2-3'x	Indef	Fb, R		X	X	X	Summer-Early Fall	18-24"	Aromatic seeds from Krissy Faust (Native Plant Society)
<i>Agastache foeniculum</i>	Anise Hyssop *	LM	Med-Dry	M-L herb	2-4'x		F		X			blooms Mid Summer- Early Fall	18-24"	seeds from Krissy Faust (Native Plant Society)
<i>Asclepias curassavica</i>	Butterfly Weed*	L	Med-Dry	M-L herb	28-40"		T		X			blooms Mid Summer- Early Fall	12-24"	some parts of plants toxic when ingested
<i>Asclepias tuberosa</i>	Milkweed *	L	Med-Dry	M-L herb	24-36"x				X			blooms Mid Summer- Early Fall	15-18"	some parts of plants toxic when ingested
<i>Chamaemelum nobile</i>	Roman Chamomile	LM	Wet	P Herb	3-6"x1' 15-30"x15-30'				X	X	X	Summer-Early Fall	3-6"	Invertebrate Shelter live from Tripple Brook Farm
<i>Humulus lupulus</i>	Hops	L	Med	Vine		R	R vine					Mid Summer	4-6'	cuttings from Paul Cooper
<i>Mentha requienii</i>	Corsican mint	MD	Med-Dry	P herb	1"x1'		R, St		X	X		Mid Summer	3-6"	Invertebrate Shelter live from Tripple Brook Farm
<i>Monarda didyma</i>	Bee Balm *	LM	Med	M-L herb	36-48"x		R	run	X			blooms Late Spring- Mid Summer	8-12"	aromatic, edible flowers
<i>Pycnanthemum pilosum</i>	Mountain Mint *	LM	Med-Dry	S-M herb	24-36"x		R	run	X	X		blooms Mid Summer- Early Fall	12"	

KEY- Root Patterns:
B: Bulb. Modified leaves forming a swollen base (Onions and garlic).
Fb: Fibrous. Dividing into a large number of fine roots immediately upon leaving the crown.
H: Heart. Dividing from crown into a number of main roots that both angle downward and spread outward
R: Rhizomatous. Underground stems that send out shoots and roots periodically along their length. They can travel great distances, or stay close to the crown.
St: Stoloniferous. Rooting from creeping stems above the ground.
T: Tap. A carrot-like root (sometimes branching) driving directly downward.
Tu: Tuberous. Producing swollen potato-like roots (actually modified stems).

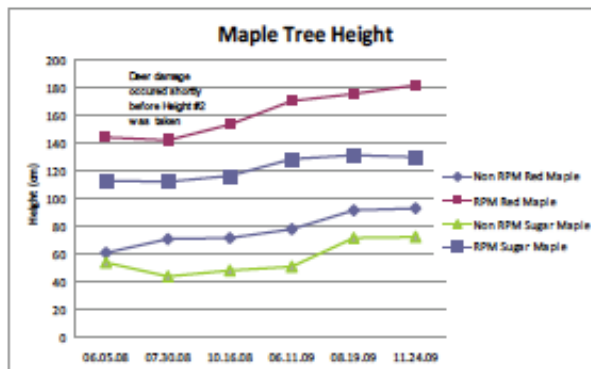
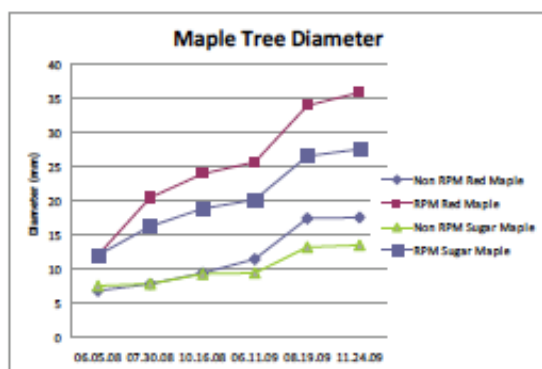
KEY- Habit
Clmp: Clumper. Spreading to a certain width and no wider.
Cmat: Clumping mat former. Makes a dense prostrate carpet that does not spread beyond certain size.
Ms: Multi-stemmed. Multiple shoots arising from the crown.
R vine: Herbaceous vine.
Run: Runner. Spreading indefinitely by stolons of rhizomes.
W vine: Woody vine.

Keys from Alberston-Rogers, Wren. 2008. TSF Grant Proposal 2009.

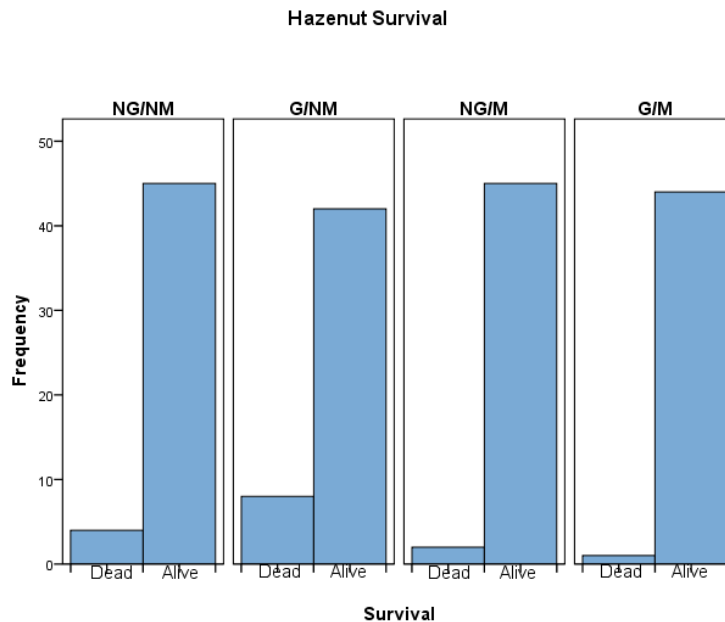
2) Collect data on novel crop species and systems (ongoing from 2008).

With help from research support specialist Rachel Brinkman and Organic Farm Coordinator Melissa Madden, students collected data to differentiate seedling production methods (maples) and ground cover comparisons (hazelnuts) by evaluating each seedling for trunk diameter 2.5cm above ground level, height and survivorship.

For the maples, comparisons between two production systems (RPM and conventional bare-root) were evaluated to determine the effect of each treatment regimen and data is presented as statistical significance using analysis of variance.



The hazelnut trial provides landowners wishing to expand into nut production with survival and management information. Half of the hazelnuts grow in mulched rows, with little root zone competition. Half of these have spiral vinyl tree guards to protect from winter herbivory. The other half of the hazelnuts grow in cover cropped, now sod, ground and half of these have tree guards as well. Survival data helps growers determine best management practices for these hardy bushes.



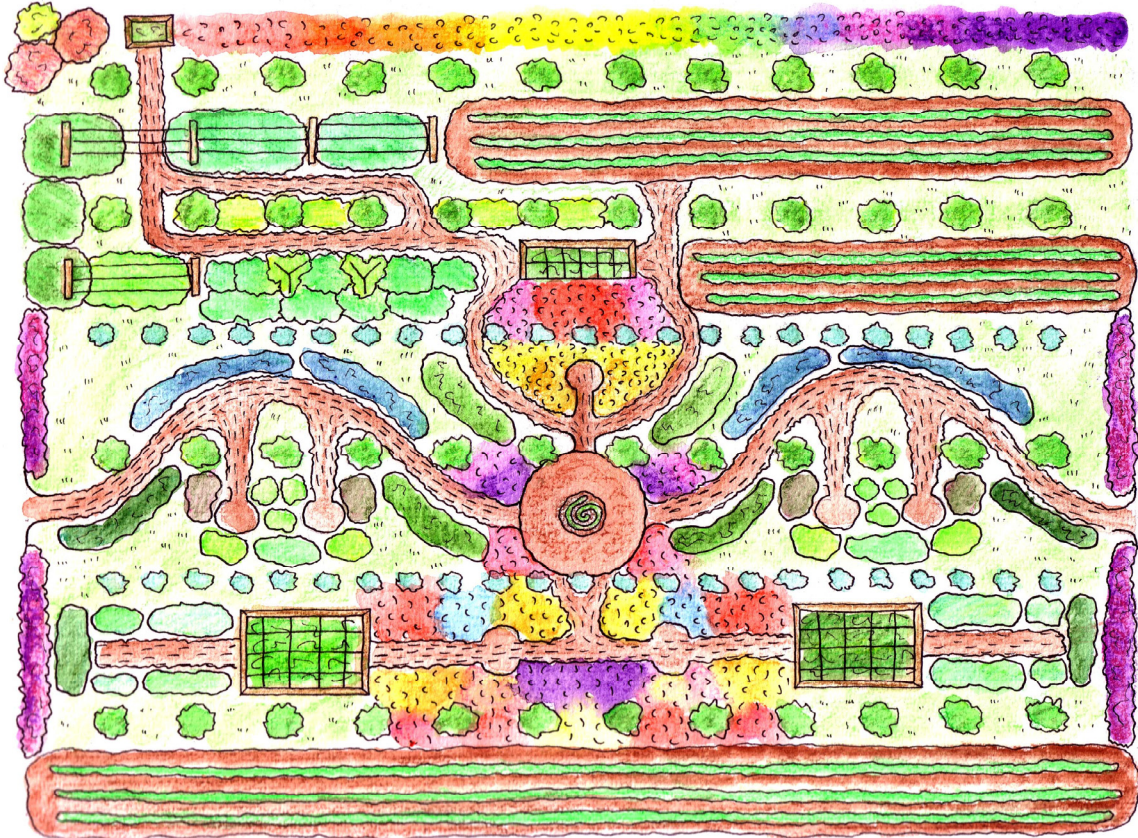
Maples and hazelnuts were established in June 2008 as the framework for the now blossoming Growing Mosaic Garden. Students created herbaceous polycultures around the tree rows, and used the tree elements to inform their design and plant selection. Evaluation of the trees will continue throughout the evolution of the GMG and is an important component to the whole-farm design.

3) Determine and demonstrate best management options for contaminated agricultural soils.

The Growing Mosaic Garden is located in an area of the farm that is high in lead arsenic levels. Prior to 1950's the land that is now Dilmun Hill was an orchard managed with pesticides containing lead and arsenate. Faculty, staff and students recently re-evaluated portions of Dilmun for annual vegetable production and determined that soil metals prevented cultivation and sale of produce from specific locations. Starting in the fall of 2008, student Angela DeFelice and coordinator Melissa Madden tested soils in the plateau portion of the student farm and began designing Best Management Practices (BMP's) for contaminated soils. In Dilmun's 2009 TSF application, students proposed to begin tissue testing of both perennials and annuals grown on contaminated soil, thereby providing outreach material for like locations.

Since then, students Bonnie Cherner and Emma Landau expanded this research project to be separate from GMG operations. In 2009, Bonnie grew annual vegetables for tissue analysis and designed for an integrated raised bed design for soil contamination BMP research within GMG area. Soil and tissue testing continue in order to determine low-technology remediation options.

For 2010, Bonnie and Emma will work with GMG managers to integrate BMP research into GMG goals, following Wren Albertson-Rogers' new design.



Dilmun's Growing Mosaic Garden, November 2009 Vision Plan

-design by GMG manager Wren Albertson-Rogers

4) *Effectively use permanent raised beds in alleyways for annual vegetable production.*

Building raised beds was a preparatory step not specific to the Growing Mosaic Garden. Although not intended for perennial crops as part of the original design, experimenting with and incorporating raised beds is important to Dilmun Hill as a whole.

The first step towards creating the raised bed system at the Growing Mosaics Garden was sheet-mulching, a method central to many permaculture-based systems for weed suppression and moisture retention. Previous weed control efforts included the sheet-mulching around the base of the maples and hazelnuts (not located in rows in GMG, but elsewhere in Blocks 2,3,4) in Blocks 3 and 4. Sheet mulching allowed managers to avoid the use of materials such as plastic mulches, which are costly to produce and require disposal, and the rigor of hand weeding in planted areas. Sheets of a biodegradable material (e.g. cardboard, newspaper) are layed on freshly weeded sod surrounding plantings of future planting sites. The beds were then constructed out of pure compost, available to Dilmun Hill through Cornell Farm Services, and then covered with approximately 6 inches of tree bark mulch. Eventually, the material used for the mulching decomposes and becomes part of soil structure, adding organic matter. After compaction due to weather and activity, the beds stand some 2 ft tall. The method requires initial effort, but labor input can decrease over time if successful weed control happens in the first seasons.

Sheeting mulching before building beds also addresses the soil contamination issues on site, which is discussed in more detail in the preceding objective.

5) *Continue to provide diverse opportunities for community networking.*

The Growing Mosaic Garden hosted a number of lively events in 2008 and 2009 in collaboration with other Dilmun projects, the MacDaniels Nut Grove (MNG) and other campus and community groups.

In October 2008, Dilmun Hill co-hosted a free evening talk by permaculture teacher Dave Jacke, which drew over 80 regional farmers, foresters, native plant collectors and homesteaders.

In 2009, outreach was more extensive and included a more diverse audience than in previous years, ranging from a CCE Nutrition Educators conference breakout session to the New York Nut Growers design activities to the nature awareness-based afterschool program Primitive Pursuits. Throughout, GMG student managers effectively developed appropriate activities for their audiences' age and interest levels. At the annual field day in August 2009, each Dilmun project offered special activities and the turnout at the GMG polyculture design forum was large and actively engaged. GMG managers and the Organic Farm Coordinator Melissa Madden consistently use GMG concepts in classroom presentations to Cornell undergraduates, during onsite activities and in discussion with community groups.

The complete list for 2009 GMG outreach is as follows:

1. New York Nut Growers Association
2. CCE Nutrition Break-Out Session
3. Finger Lakes Permaculture Institute apprentice exchange
4. 4-H Day Camp session
5. Dilmun-MacDaniels Fall Field Day
6. Primitive Pursuits afterschool sessions
7. Visits from classes including HORT 1101 and 2200

6) *Support students through funding for manager positions and materials.*

Throughout 2009 three students managed the Growing Mosaic Garden- Neele Reimann-Phillips, Wren Albertson Rogers, and Kelley McCrudden. Each manager took part in various stages of the implementation and design. Although individual responsibilities varied, by managing the site each student pursued their personal interest in the farm and can testify to the positive influence of Dilmun's experiential approach.

2009 Student manager personal testimonies:

"I was first introduced to Dilmun Hill by an incredible group of upperclassmen volunteers in my Organic Foods and Agriculture Class in my sophomore year at Cornell. I was absolutely blown away by their passion and dedication to this beautiful sliver of land and knew I had to be a part of it! With little to no agricultural experience, other than an infatuation with food, I was embraced into the community. I had the pleasure of taking part in a number of independent projects at Dilmun; in 2009 I created the McBerry Patch, taking part in the Sustainable Ag Scholars Program, and eventually took on the role of manager of the Growing Mosaic Garden.

It has been an incredible learning experience working with Dilmun, I truly believe there is no greater way to learn about agriculture without getting your hands dirty. My work at Dilmun has exposed me to some of the benefits and challenges of small scale-environmentally-focused agricultural systems, and provided an opportunity for me to develop a more systems-based way of thinking. The Dilmun community is a wonderful support system of people, the ideal environmental to learn through sharing experiences and thinking through issues. Working with student visitors, professors, the steering committee, and our coordinator Melissa Madden has been an incredibly enjoyable experience.

My time at Dilmun has played a major role influencing my future career aspirations working to protect farmland and farmers."

Kelley McCrudden '10

"I began volunteering with Dilmun Hill in the Spring of 2008, doing the usual - pulling weeds, harvesting veggies, and helping out where help was needed. I began with an incredibly limited knowledge of agriculture but, with the help and cooperation of my fellow classmates I began to learn more and, in turn, became more interested and attached to the very process that sustains us. Coupled with my Cornell courses in sustainable agriculture and the permaculture course I took during the summer, my interest, knowledge, goals and devotion all reached a new plateau - I knew that I wanted to be a bigger part of the Dilmun family. Over the last year I worked continually with Melissa, the Steering Committee, Dilmun volunteers, professors, and the community to broaden the scope of Dilmun's project through a new installment - the permaculture research plot called the Growing Mosaics Garden. Through this partnership, research, and the freedom that Dilmun gave me to do something completely original and beneficial for the farm, I became only further invested in Dilmun's future and thus my continuing interest in organic, sustainable agriculture. Thanks to my involvement with Dilmun Hill, I can proudly say that I will forever be fascinated and involved in working the land - helping cultivate the very products that sustain us and our planet - and continue to learn and teach others how to do the same. I plan to start as soon as possible - right after I graduate."

Wren Alberston Rogers '10

Budget Summary

Student Salary	\$ 4434.00
Plant Material	\$ 559.00
Outreach	\$ 5.00
Indirect Costs	\$ 502.00
Total	\$ 5500.00

Next Steps for the Growing Mosaic Garden

In December 2009 students Kelley McCrudden, Wren Albertson-Rogers and Hanna Broback collaborated with faculty members Michael Hoffmann and Ken Mudge and permaculture designer Dave Jacke to expand GMG design and goals for 2010. New plans, submitted to the Towards Sustainability Foundation for funding, include adding salable flowers to GMG to prepare for self sufficiency and a complex research project focusing on the role of yarrow in perennial polycultures. Students expect to manage this project over the course of 2010 to enhance Dilmun Hill as a demonstration site for permaculture design and to provide vital data on individual plants and varieties to the permaculture and farming community. Many thanks to TSF for their support in past years as Dilmun looks forward to adding another layer to the Growing Mosaic Garden story.