**Specialty Crops Grant 2012 Annual Report**

**Project Title:** Chicken Moat for Pest Management

**Grant Recipient:** Greyrock Commons Homeowner’s Association

**Project Coordinator:** Karen Spencer, 2232 Sun Rose Way, Fort Collins, CO 80521
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**Technical Advisor:** Matt Camper, Department of Bioagricultural Sciences and Pest Management, Colorado State University

**PROJECT SUMMARY**

The “Chicken Moat for Pest Management” project was designed to demonstrate and evaluate a non toxic and enduring pest management strategy to control deer, grasshoppers and other crop damaging insects. The newly constructed moat surrounds a 22,000 square foot community garden that had seen devastating crop damage the previous two years. 2012, the first year of this two year project, focused on the design, construction, and initial operation of the chicken moat as well as comparisons of crops grown on similarly planted ‘experimental’ (inside the moat) and ‘control’ plots (outside the moat). The chicken moat system with specialized fencing, gates, and a summer chicken coop were completed and operational 6/21/12 and served as home to a laying flock of 54 chickens who free ranged daily inside the moat. Multiple large and small “community work parties” provided extensive volunteer labor needed to construct the chicken moat system. Volunteer labor was supplemented by hired consultants with needed construction expertise, tools and equipment. Insect damage to crops plus harvest data were systematically collected through the season in both the experimental and control plots. Targeted crops included basil (Genovese), broccoli (Apollo) edamame (Butterbeans), and butternut squash (Waltham). These crops were planted and growing in the experimental and control gardens prior to final moat completion which limits interpretation of 2012 data. Following the first killing frost, the chicken flock was allowed to free-range for approximately 4 weeks in the experimental garden/ growing area to do “fall clean up.” No chicken “clean up” was done in the control plot. Of interest are the preliminary 2012 findings that crops in the experimental plot experienced less insect damage and greater yields when compared with crops in the control plot. These findings cannot be attributed entirely to the newly operational chicken moat, a variety of factors were likely in play. Project dissemination began in 2012 when the community garden was the final stop on the annual “Tour de Farms” sponsored by the local Sustainable Living Association.

**MATERIALS AND METHODS**

**How was the project done?**

The chicken moat system was constructed over 3 months starting in March largely by community members over many weekends. The project coordinator with the help of paid consultants and a few skilled community members completed preliminary infrastructure work (e.g. final design details, relocating compost and leaf piles, staging needed supplies and tools, trenching for the outer fence, auguring holes and setting gate posts, framing the moat-connected chicken coop, digging then building chicken underpass using a recycled culvert pipe and concrete), supervising multiple work parties to build the fence, install gates, and finish chicken coop details.

Four crops were evaluated throughout the season: Basil (Genovese), broccoli (Apollo), edamame (Butterbean), and butternut squash (Waltham). Equal numbers of each plant type was planted in an experimental and a control plot. The experimental plot was located inside the moat and the control plot was located approximately 75 feet outside the moat. Both plots received full sun, overhead sprinkled water through the season, regular weeding, and surface mulching with compost.
from the community’s compost system. The soil in the experimental plot had been gardened for 14 previous years with regular organic amendments. The control plot had been gardened the previous two years with some soil amendment. Prior to planting for this project, the control plot received an additional ~6” of added compost which was forked in by hand at two different times followed by deep watering. Because of a warm winter, control plot soil preparation were completed 1.5 months prior to planting. Despite soil amendment efforts, the amended soil in the control plot did not appear as loose/loamy as the soil the experimental plot. No formal soil testing was done.

Basil and broccoli plants used by the project were started indoors under lights then transplanted outdoors to the experimental and control plots. Butternut and edamame plants were started directly from seed outdoors. No plants became diseased or died from insect damage in the experimental garden. Broccoli and basil mortality did occur in the control garden: 1/6 broccoli plants died soon after planting and before any harvest—likely culprit was cutworm; 6/14 basil plants became diseased and died through the season in the control garden (unexplained yellowing leaves and full wilt/death within ~2 weeks).

No effort was made to interfere with insects in the experimental or control gardens. Abundant grasshoppers were visible on plants in and around the both gardens starting mid May, squash bugs appeared on the butternut squash in large numbers in the control garden in late August.

Methods and Materials:

Chicken moat construction: The following details and diagram will help the reader visualize the overall chicken moat project.

- **Parallel fences** surrounded the entire garden (561 foot perimeter) and enclosed a narrow strip of land which became the “moat” used by chickens.
- The **inside and outside moat fences** were spaced 4’ apart on all sides with the exception of the south edge which was spaced at 5’. The narrow 4-5’ moat width was used to discourage chicken predation by large raptors. The 5’ width on the south edge provided sufficient room for people to work in this area where the chicken coop is tightly connected to the moat via a short “chicken tunnel” from the coop, through the fence and into the moat.
- 12.5 gauge utility fabric (welded wire) **fencing** was used throughout with T-posts and Wedge-Loc™ brackets on the corners. 6’ wide utility fabric was used for the outside fence and set 12” below-grade in a trench that was later backfilled. Buried fence was designed to prevent moat access by digging foxes or other predators. The final above grade exterior moat fence height measured 5’. The inside moat fence height was 4’ and placed at grade-its main function was to keep chickens from getting into the garden. A solar charged electric wire was installed near the top of the outer fence to deter climbing foxes and raccoons - no chickens were lost to predators in 2012.
- The **chicken “underpass”** was constructed from a 7.5’ length of recycled double walled perforated plastic culvert placed on a bed of gravel and insulating foam to protect from freezing the water line that runs below.
underpass traveled under the main garden gate. The top and sides of the culvert were draped with plastic sheeting before backfilling to prevent water and soil from entering culvert perforations from above. A thin layer of soil covered with Lumite™ weed cloth covered the plastic and provided a final walking surface over the chicken underpass that was flush with adjacent garden paths and allowed easy people and garden cart access. Hand applied concrete “chicken ramps” were “formed” with compacted soil and provided chicken access into and out of the underpass. Concrete “rims” were included around the ramps and slightly above grade to prevent surface water from flowing down and into the underpass.

- **Wire Filled “D” Gates** were installed in 3 locations around the moat. The main garden gate with a 6’ opening was located directly above the chicken underpass. Pairs of gates (one on the outer fence matched with one on the inner fence) were located near the chicken coop and a second pair near the irrigation pump. To prevent foxes from digging under gates, Lumite™ thresholds were installed/stapled at each gate and extended ≥ 18” outside the gate opening. All exterior D gates were covered with utility fabric to further prevent moat access by predators through any remaining gate openings.

- **Garden paths** were established around the entire garden perimeter adjacent to the inner moat fence. These were covered with Lumite™ fabric for weed control and to allow gardeners to get right up to the fence for maintenance purposes or to toss excess/damaged produce to chickens inside the moat.

- **Ten hops** were transplanted around the inside edge of the moat and against the inside fence. The hops grew up onto the fence and will eventually overhang the moat providing summer shade for the chickens. The base of each hop plant was protected by a small section of vertically mounted hardware cloth to prevent chickens from reaching through the fence and damaging hop crowns. Unplanned were the **volunteer sunflowers** which grew inside the moat (along with other grasses and weeds) and provided chicken shade, greens for the chickens, beautiful color around the garden perimeter, and wild bird food in the fall (e.g. abundant gold finches on dried sunflower heads).

**Chicken management**: Our existing flock of chickens was moved in several stages into the new chicken coop and moat system between early June and June 21. A first group of 8 chickens was relocated and received “training” with food enticements to move around the moat and through the underpass. They also received assistance from ‘humans clad in rain gear’ to travel back to their new coop when the ditch-supplied irrigation system was on. Sadly, the hens didn’t initially know how to avoid intermittent dousing from powerful rotating sprinklers. To their credit (and our relief), they soon learned to run for chicken coop cover as soon as they heard the initial sound of pressurizing sprinklers.
The eight pioneer hens then “trained” the next batch of about 12 hens that were relocated to the moat and new coop. With 20 hens now familiar with the moat set up, we felt comfortable moving the remaining 34 hens “chicken brigade” fashion at dusk on June 21. Within a day, all were moving about the moat, navigating the underpass, and gorging on the available greens or looking for handouts from nearby gardeners. Initially, the hens stayed in the vicinity of the coop. As they depleted greens and gained courage, they moved further around the moat. “Chicken dams” made of old feed bags were also used by the humans to “encourage” the chickens move further around the moat. By the end of the season, chickens could be found traveling easily and independently throughout the moat. It appeared that only a few hens were ever comfortable circumnavigating the entire garden - most seemed to travel half way around before returning to the coop by the same route.

Data collection: Two types of data were collected: Leaf damage and crop yields for basil, broccoli, edamame and butternut squash. Leaf damage assessments were generally completed
once a week by two independent raters June 14th through September 20th. Leaf damage data were not collected during the project coordinator’s 2 week vacation in mid July. The project coordinator was trained by Advisor Matt Camper in leaf damage assessment using a 0-5 point scale. The project coordinator then trained a second rater who also had a plot in the community garden. Several “practice” rating sessions were held to allow the two raters to calibrate and establish consistency. Following training, all damage ratings were done independently by each rater on the same day. Data collection forms are presented in Appendix A.

More informally, gardens were routinely inspected for deer damage. No evidence of deer (or raccoon) was detected inside the chicken moat (no foot prints, droppings, chewed plants) and fellow gardeners successfully grew corn for the first time - previous crops had been destroyed by raccoons. Interestingly, no deer (or raccoon) damage occurred in the control plot- possibly due to the high level of human activity in this area during moat construction. It will be interesting to see if deer find the control plot in 2013.

All harvesting and harvest weighing was done by the project coordinator to assure consistency. Experimental and control plot harvests were kept separate but done on the same day. Basil and broccoli were harvested throughout the season. Edamame and Butternut were harvested all at once when the fruit was fully ripe.

OUTREACH

A major dissemination event occurred on August 25th when the chicken moat and Greyrock Community Garden participated in the annual “Tour de Farms” sponsored by the Sustainability Living Association. Approximately 40 people visited and toured the garden and chicken moat. Appendix C presents the “fact sheet” provided to tour participants.

More informally, numerous Greyrock Commons visitors toured the community garden and chicken moat. Greyrock gardeners were enthusiastic tour guides for any and all visitors! After her visit, one person immediately returned to her own rural Fort Collins home and built a much smaller chicken moat around her family’s vegetable garden which had been damaged several consecutive years by deer and grasshoppers.

RESULTS

Appendix B graphically summarizes crop data including leaf damage and crop yields.

Overall, control plot crops sustained more insect damage and had smaller yields when compared with crops grown on the experimental plot. Many factors likely account for the differences (soil, less overall grasshopper pressure compared with previous years, possible impacts of the chicken moat). It is worthwhile noting that grasshoppers were very evident in the experimental and control gardens between mid May and early July. Because the grasshoppers were initially small, leaf damage was limited. By the end of June, however, we appeared to be on track for yet another
bad grasshopper year with heavy crop damage. To our surprise, grasshopper numbers and damage seemed to drop significantly following 2.9 inches of rain which fell between July 7 and 9. After the July rain, all plants put on much new growth and the grasshopper population seemed to drop. Grasshopper numbers increased again in mid August in the control garden more so than in the experimental garden. Squash bugs also appeared on the butternut plants in the control garden in mid August with no squash bugs appearing in the experimental plot.

**CONCLUSIONS AND DISCUSSION**

Project objectives for 2012 were accomplished to include moat construction, operation, crop damage and yield assessments, and initial project dissemination.

Differences in early season leaf damage in both the experimental and control plots was minimal and by the end of June, many small grasshoppers were very evident in both gardens. The community gardeners felt they were on track for “yet another bad grasshopper year” given the number of observed grasshoppers. This prognosis changed following what was a surge in plant growth and an apparent decline in grasshoppers after 2.9” of rain that fell on site between July 7 and 9. It is unclear what allowed the plants in both plots to rebound during July- possibly the greening of grasses outside the moat which attracted grasshoppers away from our gardens and/or other unknown factors. It is unlikely that the moat contributed to the July garden rebound since leaf damage remained fairly equivalent in the experimental and control plots.

Interestingly, in mid August when the moat was fully operating, the grasshopper activity and damage on broccoli and basil became much more evident in the control garden when compared to the same crops in the moat protected experimental garden. Additionally, squash bugs appeared on the butternut squash in the control garden while no squash bugs were evident in the experimental garden.

Plant loss in the control plot (broccoli and basil) affected harvest yields. No plants were lost in the experimental garden which produced a better than expected harvest. By the end of the season, very little could be harvested from the control broccoli or basil because grasshopper damage rendered the basil leaves and broccoli florets inedible. Other possible explanations for the differences in harvest yields between the experimental and control plots may include differences in soil quality and a possible soil borne disease affecting the control basil plants.

The lack of deer in the unprotected control garden is hard to explain. It may have been due to the high level of human activity in the area during moat construction. Many deer were observed in the adjacent fields throughout the growing season however they did not “find” the control garden. Deer were observed near the moat fence but did not find a way to enter the community garden.

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### YEAR ONE BUDGET SHEET

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Project Coordinator: Karen C. Spencer

Signature: 

Date: 11/30/12