Title: IPM Implementation on School Grounds

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Cooperators: William Stark and grounds staff at North Syracuse Central School District, Paula Shrewsbury, University of Maryland

Type of Grant: Research and Demonstration funded by NE IPM

Project Location: North Syracuse Central School District in Onondaga County, NY

Background: A three-year project at the North Syracuse Central School District is complete. In partnership with Paula Shrewsbury at the University of Maryland, we conducted systems comparisons to determine the efficacy and cost effectiveness of low risk treatments to manage weed, insect and disease pests on public school grounds. To reduce reliance on chemical applications, we chose alternative pest management practices that integrate cultural and biological treatments and emphasize use of low risk products. While the use of pesticides can provide timely, effective reduction of pest problems, they may also have a negative impact on the environment and the health of humans and other non-target organisms.

There is no longer any argument that pesticide use on school grounds can be a risk to children's health. By their physiological nature, children are more susceptible to pesticide exposure than adults when they work and play in school settings where pesticides have been applied. Public opinion varies in intensity regarding the reduction of pesticide use, but nationwide, legislators are increasingly supporting the process of Integrated Pest Management.

School districts throughout the northeast and nationwide are reluctant to use pesticides. With concern over health issues and the likelihood of future mandates on use, schools require the information to make informed decisions about the economic and environmental impacts of their choices.

Non-pesticide alternatives may require increased labor. Our project goal was to assess the success and costs involved in the reduction of chemical use including labor, equipment and low risk or alternative products, thereby increasing our ability to make recommendations regarding the time, cost and success of implementing IPM strategies.

We examined pest and cultural management practices and resulting quality on athletic fields, fencelines, lawns, curbs and sidewalks, ornamental beds and trees, and along building edges. In each of these settings, site areas were paired - one received conventional treatments (current standard practices at the discretion of staff) and the

other received alternative IPM treatments incorporating low-risk pest management methods.

Specific treatment recommendations were prescribed, and the actual implementation tracked. The difference between attaining all project goals and the practicality of day-to-day demands on school district labor and budget will vary from district to district.

Procedures and Results: Athletic Fields

Conventional Treatments

Continue to maintain fields with established methods
Occasional overseeding
Occasional aeration
Occasional watering
Mow at current height (1.5" during season, 2.5" off season)
Mow when possible
Normal fertility program (fertilizer application and topdressing at least 1 times each year, actual amounts TBD)
Pesticide use, if warranted

Alternative Treatments

Weekly overseeding at times of highest use impact
Consistent watering to reduce stress
Monitor and adjust soil pH
Move placement of lined athletic fields to reduce stress in center and goal area
Mow at highest height possible and follow the 1/3 rule
Fertilize at optimum growth periods
Aerate monthly
Topdress 1-3 time per year
No use of chemical pesticides, unless quality is threatened by pests and no other controls are feasible

Use of biologic organisms when possible to deter pathogens and other pests
The school district has outstanding athletic fields with multiple Level A and Level B sites. Each pair includes one conventional and one alternative treatment field. Level A fields are kept in prime condition for interscholastic sports. Level B fields are generally maintained as practice fields. All fields in the study receive periods of considerable use through physical education classes, interscholastic competitions and team practices (Figure 1) and were paired accordingly. Athletic fields were divided by six lengthwise transects with ten sampling points in each transect. Monthly examinations measured the percentage of weed cover, the weed species present and percentage bare ground within sample grid (4 ft^2). We also looked for insect damage throughout the season and checked specifically for grubs in August.

Figure 1: Pair 2 Conventional Field - goal mouth damage to turf.

The four Level A fields support high use during spring and fall sports seasons. The Pair 2 Conventional field showed a rise in weeds in both the 2003 and 2004 seasons, when moist, cool soil encouraged rapid crabgrass germination. This resulted in increased bare areas later each season. The Pair 2 Alternative field showed robust growth and maintained good coverage well into the fall 2003 season in part by its clover population that reduced bare spots. However, clover is not a safe sports surface. In 2004, it was not seeded, and went into the fall season with thin turf. Spot broadcasting late in the season was not able to improve quality (Figure 2). The Pair 1 Alternative field also has clover as its predominant weed, whereas the Pair 1 Conventional field has the lowest percentage of weeds in our study. This is most likely a result of herbicide applications in 2002 and 2003 (Figure 16). It also had the highest grub populations in 2003 and 2004. An herbicide treatment of Dylox over Labor Day weekend 2004, seemed ineffective based on a follow up grub count.

Athletic fields receiving herbicide treatments (conventional) continued to have fewer weeds than the alternative fields. However, we are confident alternative methods can show benefits when implemented consistently. Studies have shown that weekly overseeding in damaged areas results in better turf coverage, fewer weeds, and provide safer footing. Unfortunately, this was not practiced consistently by staff during this project.

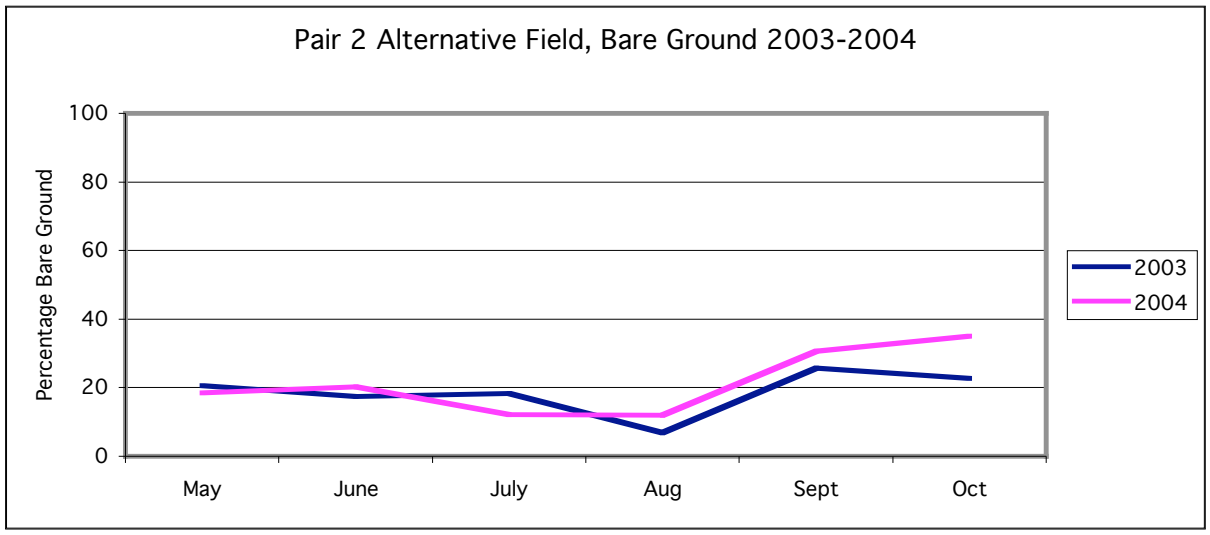


Figure 2: Absence of overseeding in 2004 may explain increased bare spots (22.67% bare by November 2003, 35% bare by November 2004).

Pair 3 included our Level B fields. Both have gone through renovations and neither turf established well initially. Both have large areas of problematic soil conditions, and therefore weak turf. The alternative field has poor drainage, while the conventional field is dry and compacted.

Both Pair 3 fields are subject to periods of intense pressure. In August each year, the Pair 3 Conventional field supports multiple pre-season football practices. In 2002, drought conditions and heavy foot traffic left this Level B field reduced to large bare patches and weeds, primarily broadleaf plantain (*Plantago major*) in an estimated 25% of the field. In both 2003 and 2004 it received no treatments other than regular mowing, but a rainy summer encouraged turf and weed growth and a reduction in bare ground. Treatments for the Pair 3 Alternative field in 2003 included topdressing, aeration (twice), slitseeding, and fertilization (twice) in an effort to improve its playability; in 2004: topdressing, aeration and two applications of fertilizer. It has improved both aesthetically and as a usable, consistent surface, supporting interscholastic sports in the fall of 2004 (Figure 3).

Cultural treatments of athletic fields were tracked to compare changes in turfgrass quality; Hours include aeration, fertilizing, overseeding and topdressing but not mowing. The charts showing quality vs. labor hours show a general trend of improved quality following these cultural treatments (Figure 14).

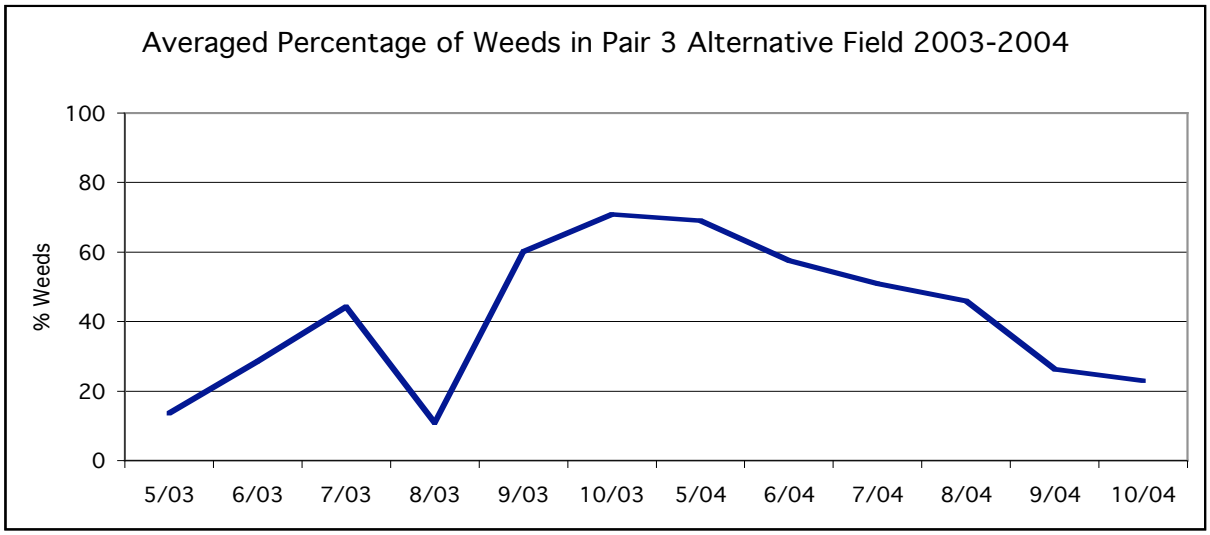


Figure 3: Turf improvement (weed reduction) with implementation of alternative cultural treatments.

One goal of the alternative treatments was monthly aeration. This is a major benefit to compacted soil, especially useful on athletic fields. Unfortunately, aeration occurred only one to two times per alternative field in 2003, and in 2004 one time only on two of the three alternative fields. Another aspect of our alternative treatments was moving field lines and goalmouths to reduce focused impact. This practice proved successful on the Pair 2 Alternative field in 2003 and 2004. Soccer goals were moved during the season, resulting in less damage and no need for re-sodding as in previous years.

Procedures and Results: Lawns

Conventional Treatments:

Continue to maintain lawn areas with established methods
Occasional overseeding
Occasional aeration
Occasional watering
Mow at current height
Mow when possible
Normal fertility program
Pesticide use, if warranted

Alternative Treatments (Lawns continued):

Over-seed turf once a year
Occasionally water to reduce stress
Regular mowing at optimum height of 3 to 3.5”
Follow 1/3 rule
Sharpen mower blades often
Fertilize in late fall

Aerate 1 to 2 times a year
No use of pesticides, unless quality is threatened by pests and no other controls are feasible
Use of biological organisms when possible to deter pathogens and other pests

Two lawn areas were monitored at each of four schools. Five random sampling points, along a diagonal transect were examined. We measured for percentage of weeds.

There was in actuality no difference in practices between alternative and conventional lawn areas, other than the use of herbicides on a conventional site. Lawn care was limited to mowing. Desired practices such as watering, aeration and overseeding would improve lawn appearance and texture, however lawn care remained a low priority.

Procedures and Results: Ornamental Beds and Trees

Conventional Treatments:

Continue to maintain ornamental beds and with established methods
Hand weeding, 2-3 times a year
String trimmer where possible
Spring mulching
Pesticide use, if warranted

Alternative Treatments:

Hot water treatment to suppress weeds as needed
Supplement with hand weed as necessary
Watering to prevent drought stress
Correct pruning and dividing of perennials
Correct pruning of trees
Use of low maintenance, pest-resistant plants, Natives preferred
No applications of pesticides, unless necessary- use low risk products such as horticultural oil when appropriate
Monitor and adjust soil pH
Proper fertilization
Use of biologic organisms when possible to deter pathogens and other pests
Manual or mechanical removal of pest insects
Scouting for early detection of pests

In the ornamental beds, we rated the aesthetics and health of the plant material as well as the percentage of bed covered by weeds. The ideal ornamental bed is aesthetically pleasing and adds to the overall appeal of school grounds. Each site had a pair of alternative and conventional bed groups that varied in size and plant material. Weed data was taken from four randomly placed grids (4 ft^2.) in each bed. We rated each bed as a whole, as well as individual plants for health and beauty each month. Our goal was to maintain healthy plants, remove failing plants, and monitor and treat pest problems.

Pair 1, located at an athletic complex, received less day-to-day attention than Pair 2, located directly in front of a school. There, the principal had a personal interest in weeding, planting annuals, and reducing foot traffic. Both sites had insect-infected plants removed and replaced with more resistant plants (Figure 4) as part of the alternative treatment goals in 2003.

Figure 4: Pair 2 Alternative – a diseased plant was removed and later replaced with attractive, low-maintenance ornamental grasses.

A large part of the alternative treatment of ornamental beds was the use of hot water applied through a machine sold under the product name Aquacide. In 2002, one of the two alternative beds in the Pair 1 site received hot water treatment three times and showed consistently less weed encroachment in 2003. The second, larger Pair 1 alternative bed received only one treatment in 2002, and became highly infested with weeds in 2003 because it was not hand weeded until very late in the season, prior to the purchase and use of the district's new machine (Figures 5, 6). By October, this substantial work and a heavy mulching dropped weed levels significantly. Total 2003 Labor hours reflect the time spent on renewal and the use of the Aquacide machine in alternative beds. Prior to the fall of 2003 when the school district purchased their own Aquacide machine, we were limited by availability of a machine on loan. In the spring of 2004, despite consistent availability of the new machine, heavy rainfalls and overly wet grounds restricted use. Labor hours for weed removal and bed maintenance were less on the alternative beds (Figure 7). Actual hours over a two year period were: Alternative – 55.8 hrs, Conventional – 30 hrs. Due to inequality in total bed areas, our chart presents the labor hours per 1000 square feet (Figure 15). It is our impression that use of the hot water machine on a consistent basis will greatly reduce the ability of weeds to take hold and flourish.

Figure 5: Large Pair 1 (alternative) ornamental bed overwhelmed with weeds, August 2003.

Figure 6: The same bed after hot water treatment and mulching have reduced weeds, July 2004. Labor hours for its renovation were part of the 2003 numbers.

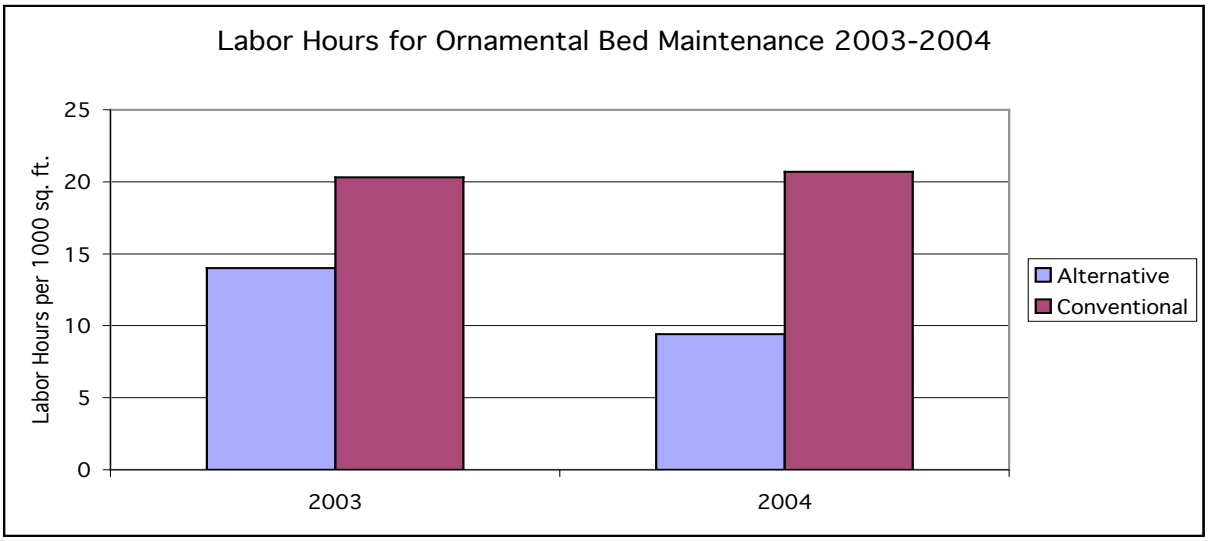


Figure 7: Labor hours for bed maintenance, per 1000 ft$^{2.}$

Four specific occasions of insect damage to plant material were noted in our ornamental bed sites. Cotoneasters were removed due to a severe infestation of lacebug *Corythucha cydoniae*, and replaced with transplanted daylilys that had overgrown an area in the same bed. We found scale, *Lepidosaphes ulmi*, on one of our Ash trees (2003) and treated it with horticultural oil at the most optimum time; it appears to have been successful. Two viburnums showed damage, including ovipositor scars, from Viburnum leaf beetle, *Pyrrhalta viburni*. Using the latest Cornell research, we replaced them in 2004 with a highly resistant Viburnum variety, *Cayuga*. A euonymus completely devastated by scale, *Unaspis euonymi,* was removed and replaced with clumping ornamental grasses.

We monitored weed encroachment into the mulched areas around tree bases. Data was taken from tree "beds," in both conventional and alternative area pairs. The percentage of weeds in he mulched circle was recorded. A layer of 4-6 inches of mulch is recommended, but is not insurance against weeds. Mulch that is piled higher and close to the tree trunk endangers tree health. Our major impact in this area is warning grounds crew to avoid injury to the bark and to be wary of using too much mulch. Weed removal in mulch is very difficult with a mechanical trimmer; we found the hot water applications (Aquacide) to be an effective option.

Procedures and Results: Fencelines

Conventional Treatments:

Continue to maintain fencelines with established methods
Weed trimming as necessary, typically every 2-3 weeks
Herbicide use, when warranted

Alternative Treatments:

Hot water treatments to suppress weeds
Weed trimming as necessary
No pesticides

Weed data was taken in five 25' fenceline segments at each site. We recorded the total inches of weeds or turfgrass above aesthetic threshold, determined by turf growth above the height of nearby turf, or encroachment into the gravel base. Our demonstration sites included chain link fence through a turfed area, as well fences that separate paved area from lawn area and have a gravel base.

The major difference in treatments was the use of the Aquacide hot water machine at various times during the school year along alternative fencelines (Figure 8). Our original intent was to apply hot water treatments every four weeks. However, because we had limited availability for most of 2002 and 2003, this did not occur. Reduced labor availability also affected manual and mechanical weeding. The athletic complex contains multiple chain link fences along its four ball fields, as well as wood fencing. When the school IPM project began, we were struck by the considerable labor hours spent on mechanical weed trimming. At the end of the 2004 season, we did show better weed control (Figure 9) and less labor hours with the hot water treatment than weed-trimmer use. It is worth noting that an unusually wet summer seemed to encourage rapid turf re-growth into fenceline areas. Quality varied greatly as seen in our charts tracking aesthetic quality and weed removal labor. No significant trends show a relationship between quality and labor under these circumstances (Figure 16). Further study on the impact of hot water on particular grassy and broadleaved weeds, as well as, dormant weed seeds is needed.

Figure 8: Athletic complex – Pair 2 Alternative. Aquacide 'Hot Water' Machine used in place of mechanical weed trimmer.

Figure 9: Pair 2 Alternative Fenceline. Weed reduction, one week after hot water treatment.

Procedures and Results: Curbs and Sidewalks

Conventional Treatments:

Continue to maintain curbs and sidewalks with established methods
Weed trimming as necessary
Use herbicides when warranted

Alternative Treatments:

Hot water treatments to suppress weeds
Seal cracks in sidewalks and curbs
Touch up trimming as needed
Remove collected soil from cracks and low spots
No pesticide use

Weed data is taken in five 25' segments of sidewalk and curbs at each site. We record the total inches of weeds or turfgrass that has encroached in each segment.

In the maintenance of curbs and sidewalks we found the failure of seams between sidewalks allows turf and weeds to take hold. For the most part, sidewalks in our studies are new or well maintained. The oldest sections in our demonstration were Pair 3 Alternative. Caulking applied early in the 2004 season prevented weed and turf growth between sidewalk sections. Curbs in our study also have a tendency to be infested by weeds. Gaps between sidewalk and curb are apt to pool rainwater, soil runoff and weed seeds. It is difficult to prevent this, despite design and construction to the contrary. Use of the Aquacide machine along curbs and sidewalks in an excellent use of its' features and gave good results.

Procedures and Results: Building Edges

Conventional Treatments:

Continue to treat building edges with established methods:
Hand weeding of gravel along building edges
Mechanical trimming of turf along building edges
Herbicides as needed

Alternative Treatments:

Ultimately remove turf and install gravel in hard to mow areas
Hand weed as needed
Mechanical trimming as needed
No pesticide use
Hot water treatment

Figure 10: Pair 2 Alternative Building Edge- gravel 'vole' strip along building

Four grids (4 ft^2) are used as random sampling points along five 25' segments of building edge. We record the percentage of area that has been encroached by weeds in each grid. In our original development of the project for North Syracuse, we planned to do alternative treatments at one school, and conventional at another. However, due to extreme differences between building edges at the two schools, we decided to have both conventional and alternative sections at each school. The Pair 2 building has a wide gravel and metal edging along the building edges (Figure 10) as a pest deterrent; this is referred to as a 'vole strip.' Pair 1's exterior is ideally maintained with a wide area of bare ground to deter rodents, but in reality is turfgrass. Therefore, as part of an alternative treatment, the Aquacide machine could be used at both schools. A strip of gravel is very hard to maintain without herbicide. Gravel can fly up when using a mechanical trimmer, and is difficult to hand weed effectively. Unfortunately, our Aquacide treatments at the Pair 2 school were suspended in 2003 because of the distraction to students in classrooms. In 2004, we scheduled use when students were not in attendance.

Figure 11: Pair 2 School - arrow shows where hot water treatment along building edge (vole strip) ended five months earlier.

When budget issues reduced staff availability in 2003, the gravel vole strips showed obvious neglect, as indoor facility maintenance needs became the priority. Weeds and grass are established along much of the Pair 3 Conventional site, while conditions vary at the Pairs 1 and 2 and the Pair 3 Alternative. For example, the Pair 3 Alternative building edge data varied greatly over the 2003 season. Hot water treatments slow the return of weeds, as evidenced in Figure 11 where, in September 2003, we were able to see noticeably less weeds where hot water treatment ended abruptly in May 2003. Overall, the aesthetic quality (% of area below threshold) remained higher on alternative sites than conventional sites (Figure 17).

Procedures: Education

Education of staff has been integral to our project. We held one formal workshop for building and grounds maintenance personnel in April of 2003 (Figure 12). Staff learned the basics of IPM, soil and plant health, as well as signs and symptoms of plant diseases and insect pests. The workshop included outdoor "hands-on" learning. We looked for evidence of insect and disease damage, as well as practiced pruning techniques. Workshops are an excellent opportunity for staff to learn new management practices and ask questions. However, they are not the only way.

In the course of our three seasons, we have had many one-on-one discussions of turf, plant and tree health and maintenance. These interactions are invaluable. NSCSD staff have assisted in the application of horticultural oil on a Scale infested Ash tree, thereby learning an alternative and less toxic method of treatment other than chemical

insecticide. They have learned to watch for evidence of Viburnum Leaf Beetle, a recent invader to the Syracuse area. After we held a pruning day, staff members agreed they looked at trees and shrubs with a more critical eye. One member of the grounds crew worked alongside us and learned how to check for grub infestation and determine treatments based on thresholds. Their increased knowledge is an asset to the school and will affect their day-to-day decision-making and value to the school for years to come.

Discussion:

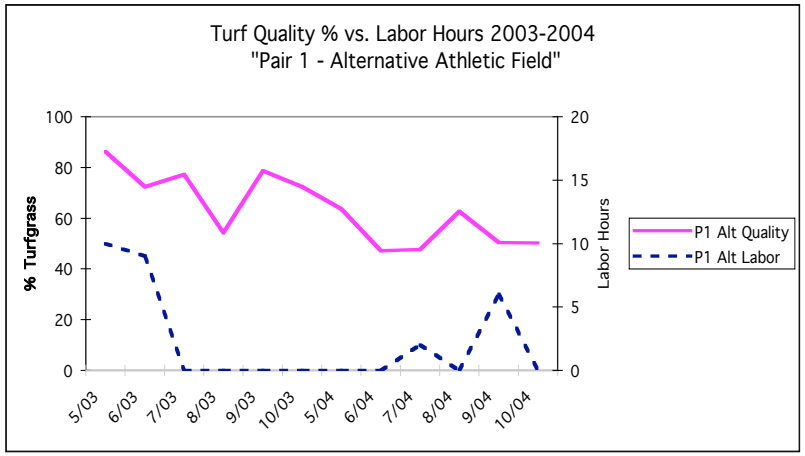
The goals of the original School IPM project were adjusted as we learned more about the actual use of pesticides in schools today. It is not only important to find ways to reduce pesticide use and keep pest management costs down, but to raise the awareness of school employees. Alternative practices, and most importantly why we choose to use them, is a long-term benefit when IPM is practiced on school campuses.

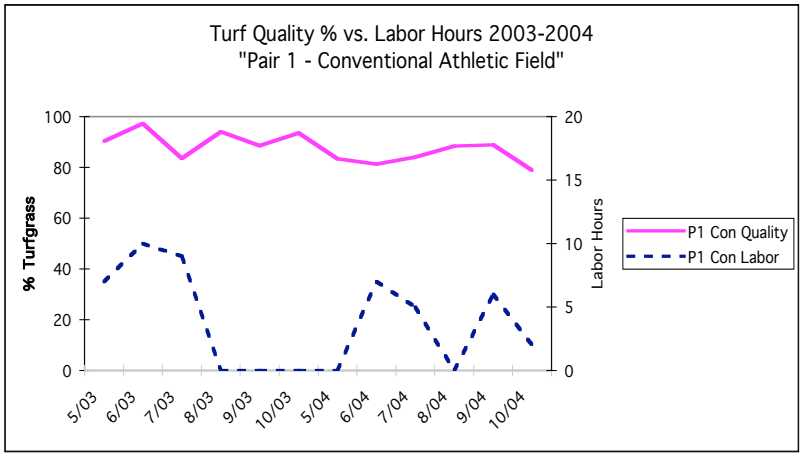
Figure 12: Maintenance and Operations staff participates in an on-site spring workshop, April 2003.

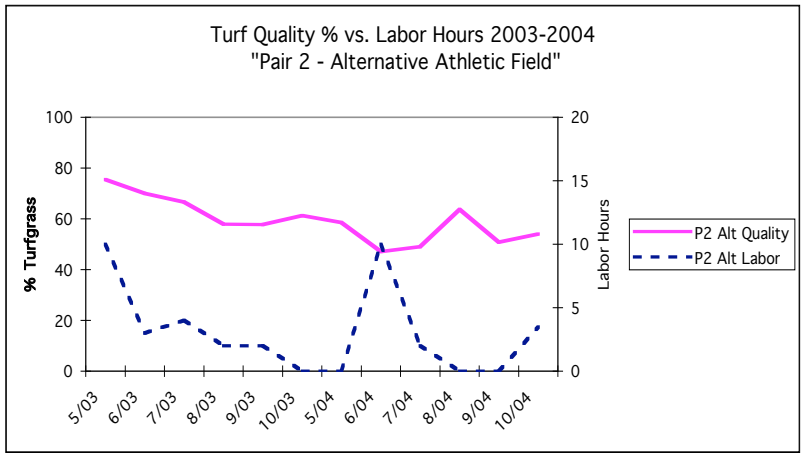
At North Syracuse, hot water weed control was an effective alternative treatment. There was less need of hand weeding and mechanical trimmer use. Because of problems with availability and function of the Aquacide machine, it was not used at all sites, or at the most suitable times in 2002 and 2003, yet its favorable results prompted the district to purchase its one machine. Although Aquacide use takes time, we believe that repeated applications reduced labor hours in the long run because of the pronounced reduction of weeds. Due to the extensive rains we encountered throughout the 2004 season, grasses were especially aggressive to return compared to our previous, drier summers. Broad-leaved weeds also flourished but did show considerable knock-back in vitality along side those removed by weed trimmers. There is great opportunity to study the effectiveness on hot water treatment against specific weeds and grasses in the future.

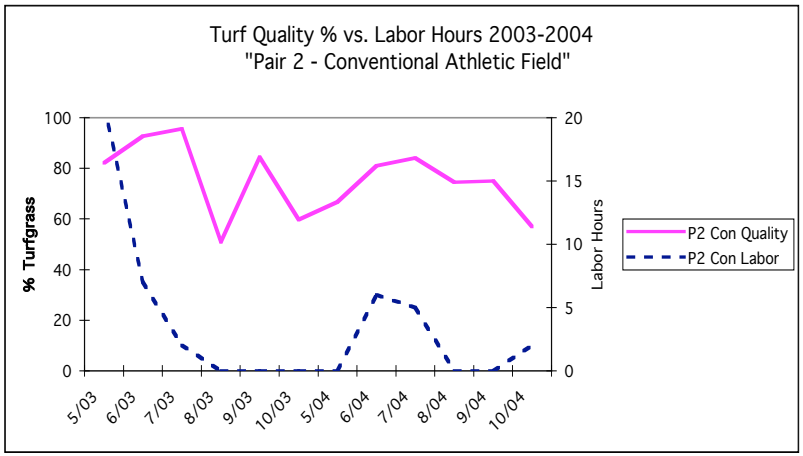
Besides the success with hot water weed control, another benefit of this project was heightened awareness of alternative practices and some basic knowledge of the needs of turf, trees and ornamental plants. The building and grounds personnel participated in workshops and one-on-one discussions on plant and turf health, cultural practices and new ideas for management. Increased knowledge is a major component of an Integrated Pest Management system; scouting for disease and insects leads to early intervention and therefore less plant loss, turf injury and ultimately less need for pesticides. Proper pruning reduces plant injury and will prolong the life of many ornamentals. Healthy plants are less susceptible to insects and pathogens, and NSCSD personnel have learned new "tools" for treatments.

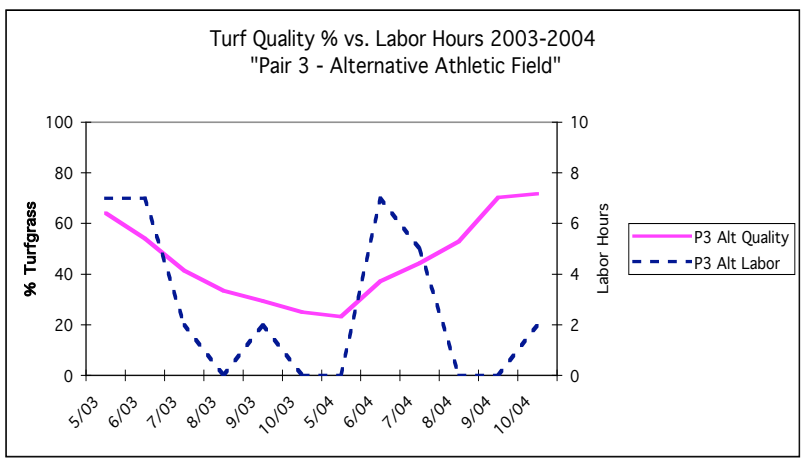
As all the weed data, labor hours and treatment costs are analyzed, the project will provide information on the efficacy and cost effectiveness of both alternative and conventional treatments. This, combined with information from the Maryland sites, will be useful to school districts throughout the Northeast in determining their pest management strategies.











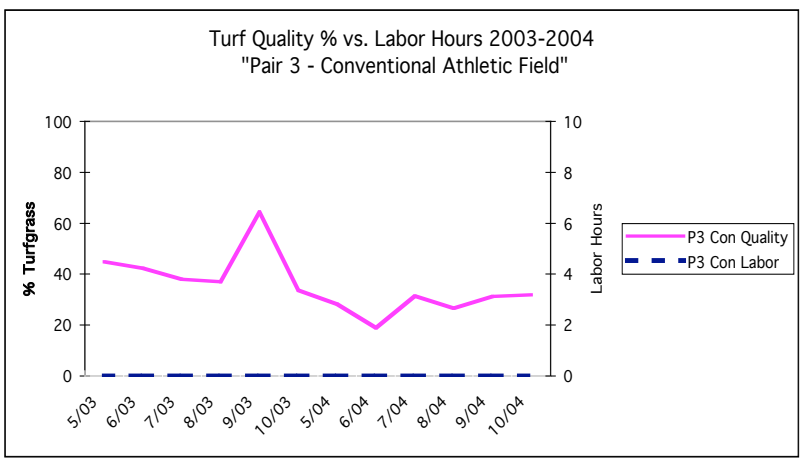
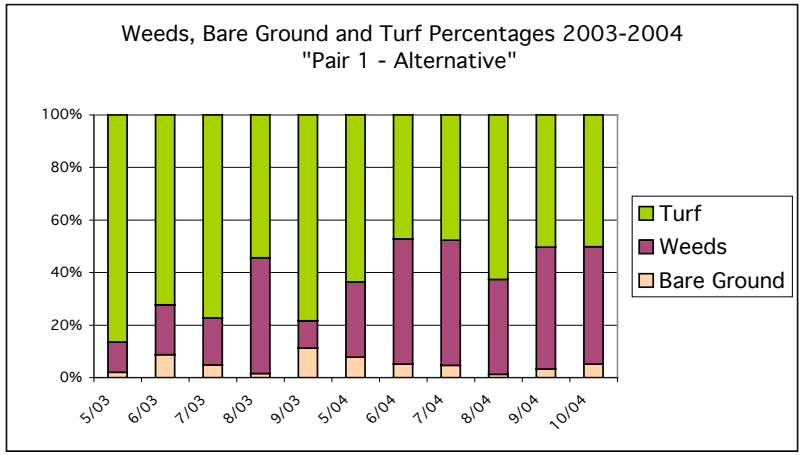
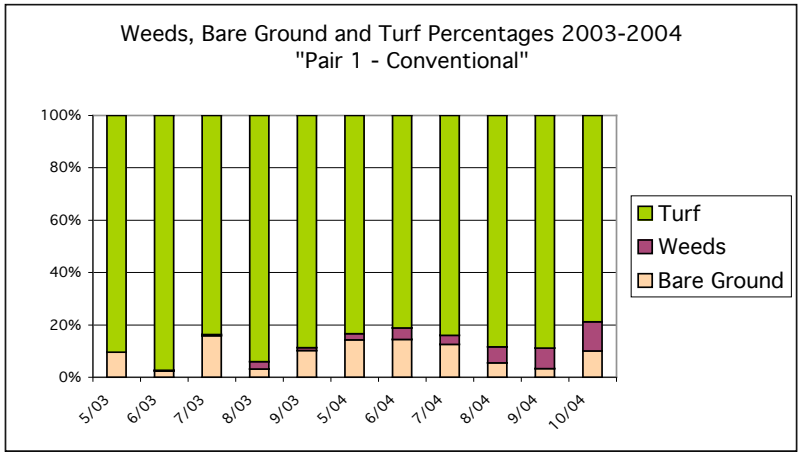
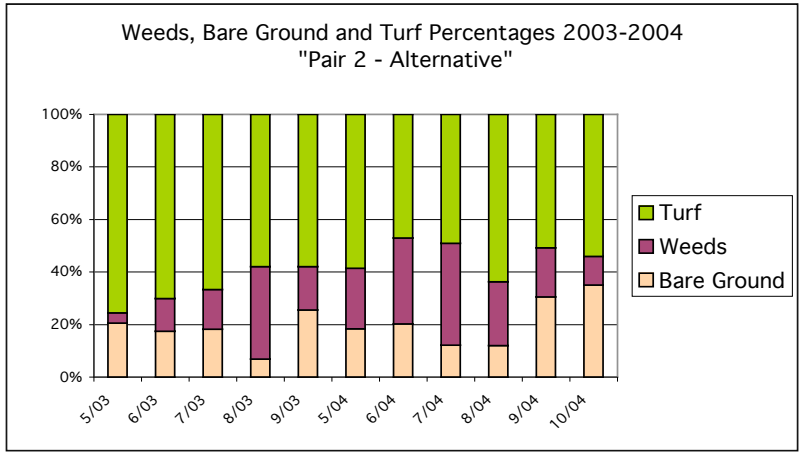
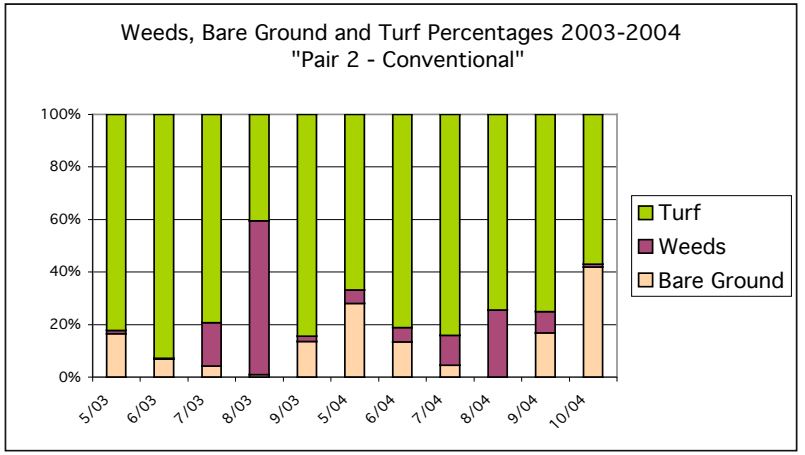


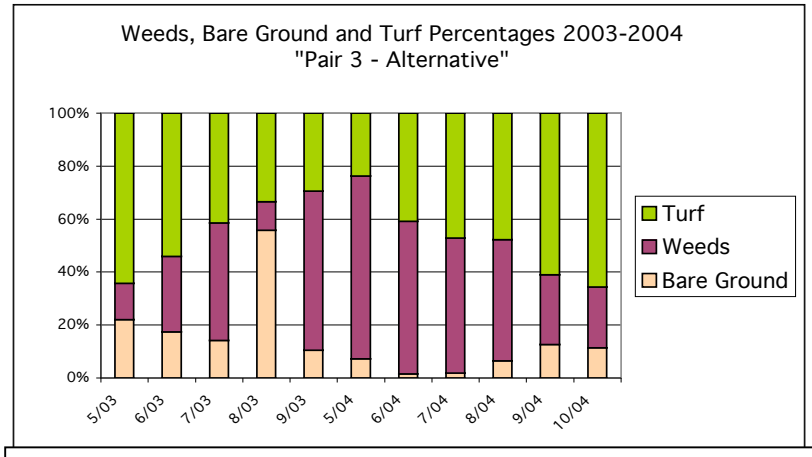
Figure 13: Turf Quality vs. Labor Hours on Athletic Field Pairs











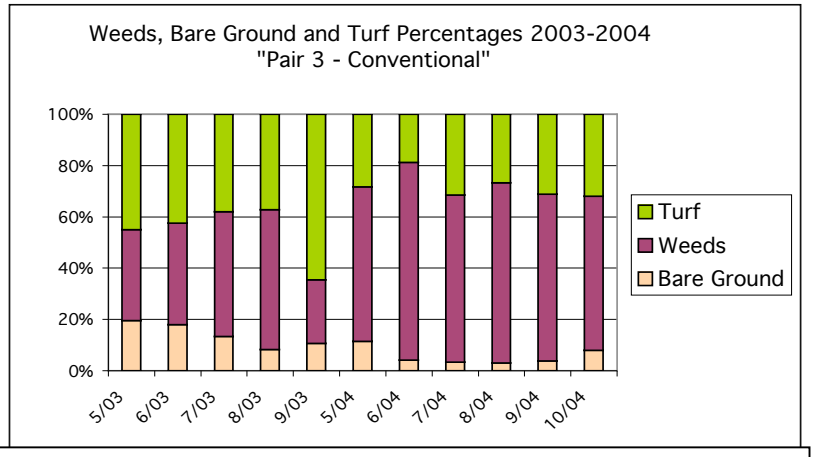
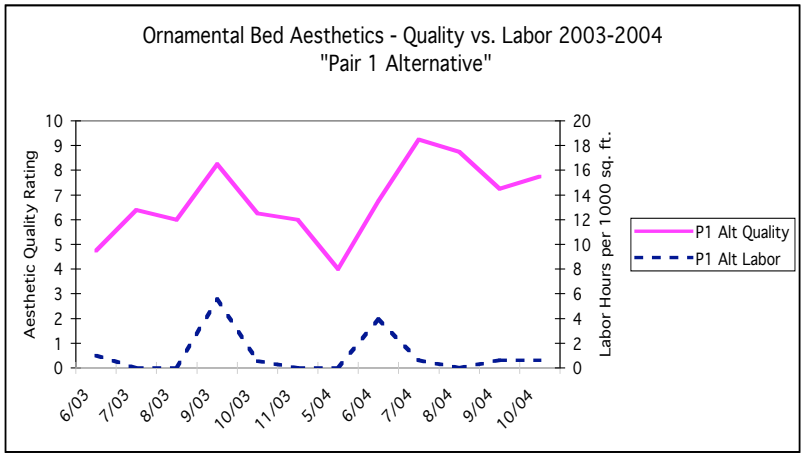
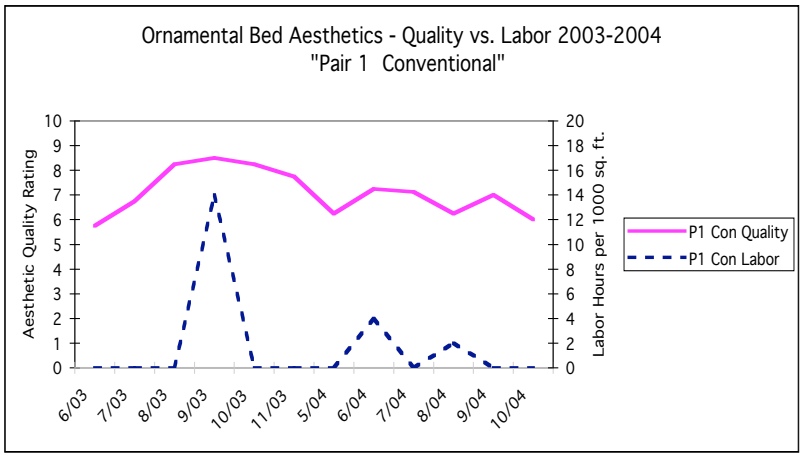
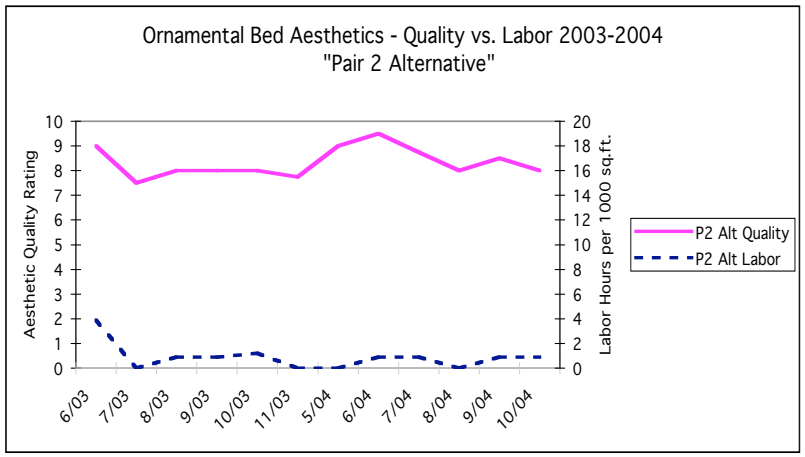


Figure 14: Percentage of Healthy Turf, Weeds and Bare Ground on Athletic Field Pairs







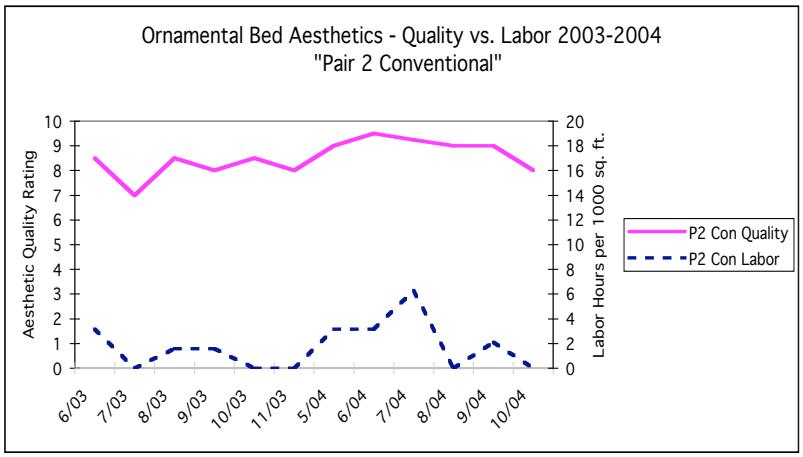
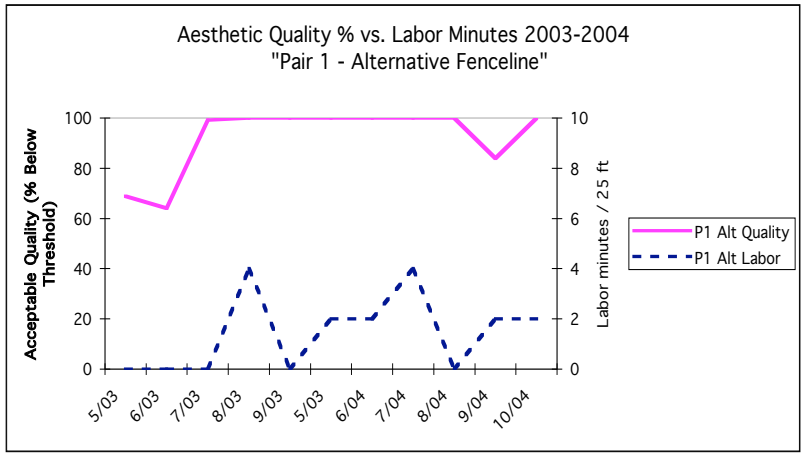
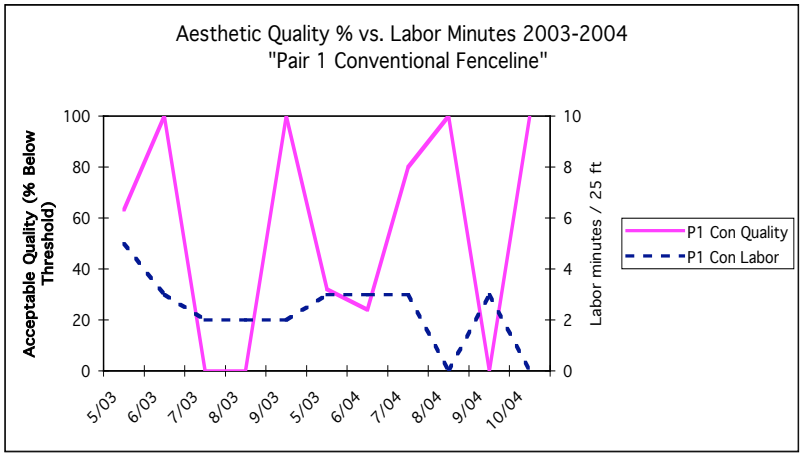
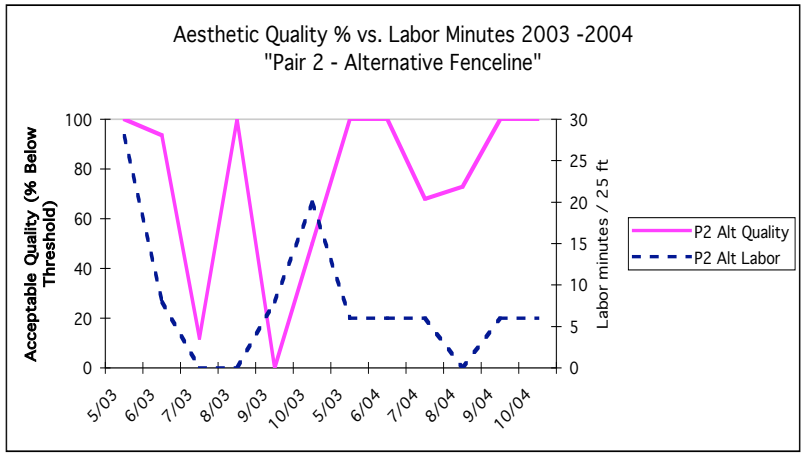
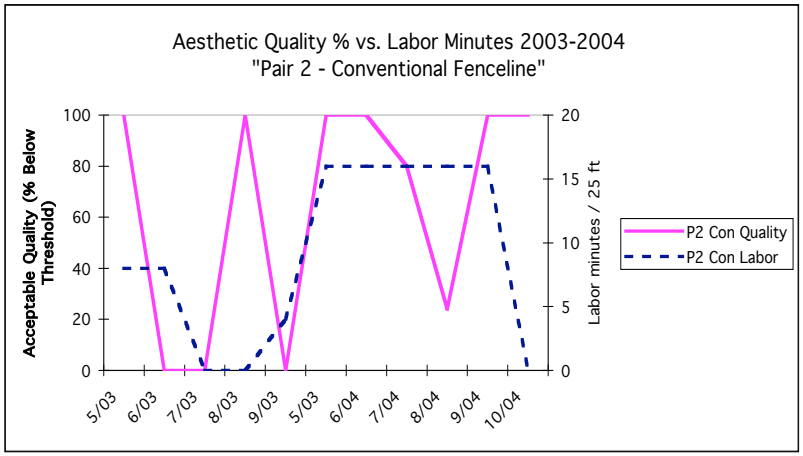


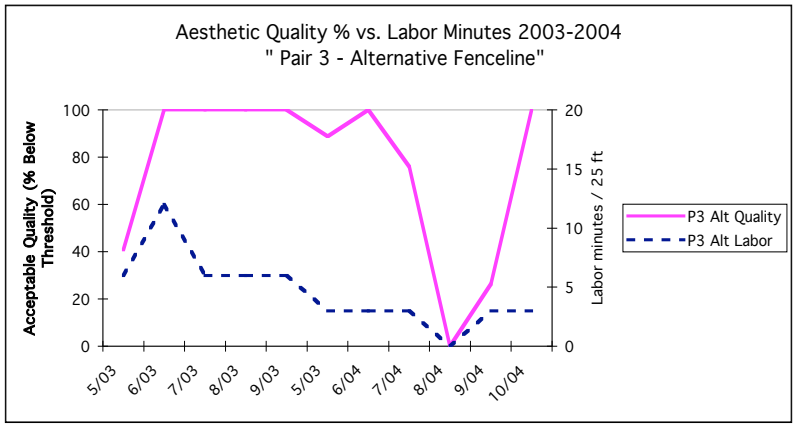
Figure 15: Ornamental Bed Aesthetics - Quality vs. Labor











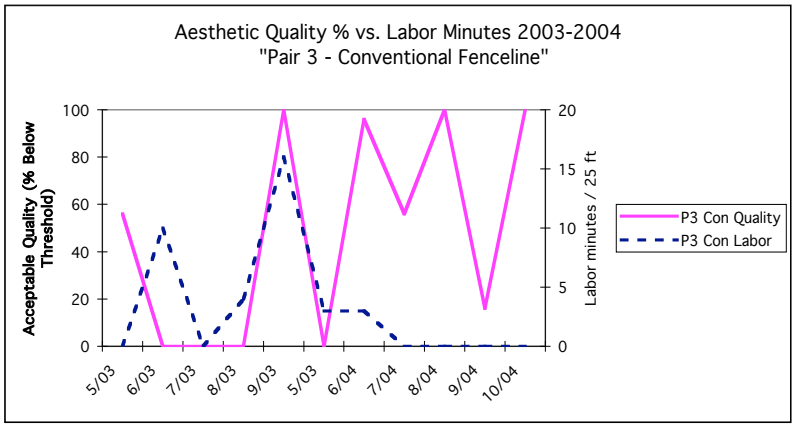
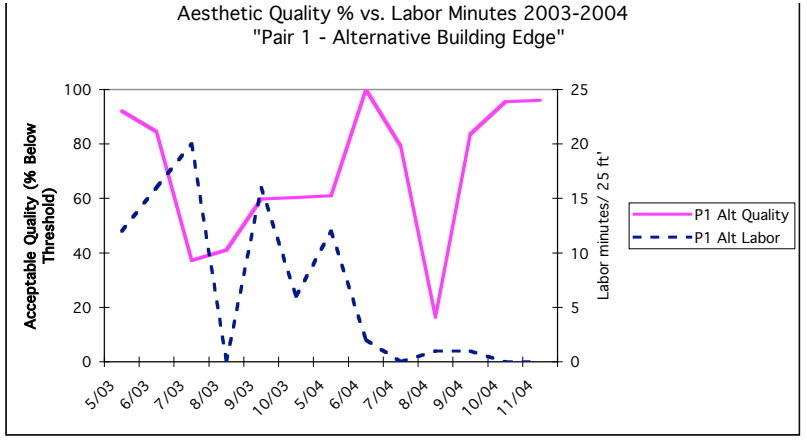
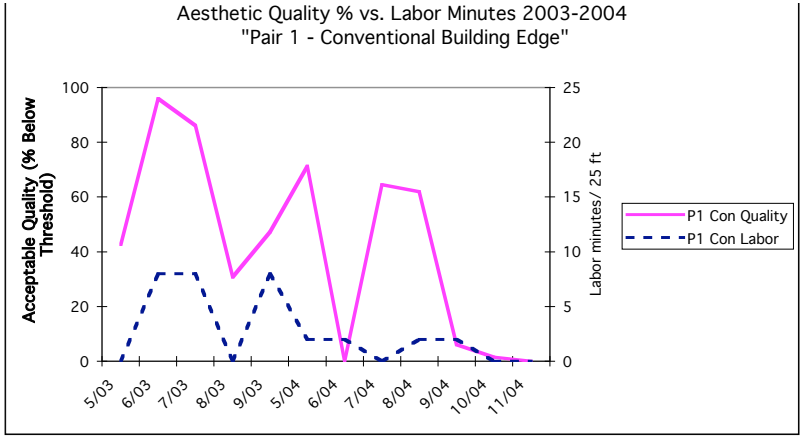
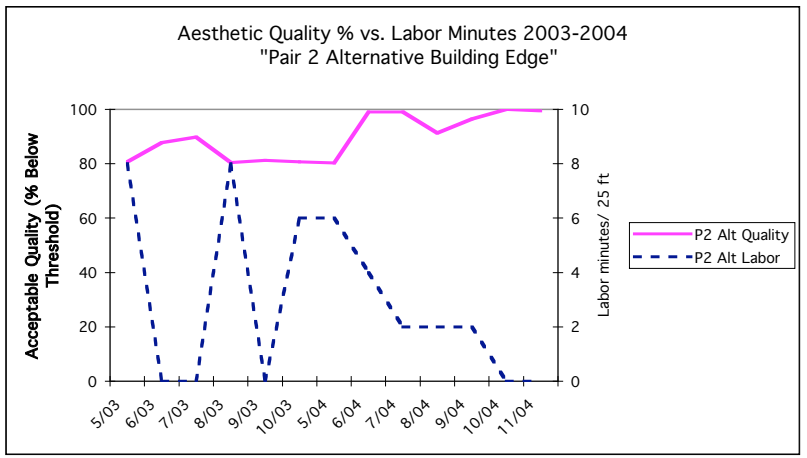
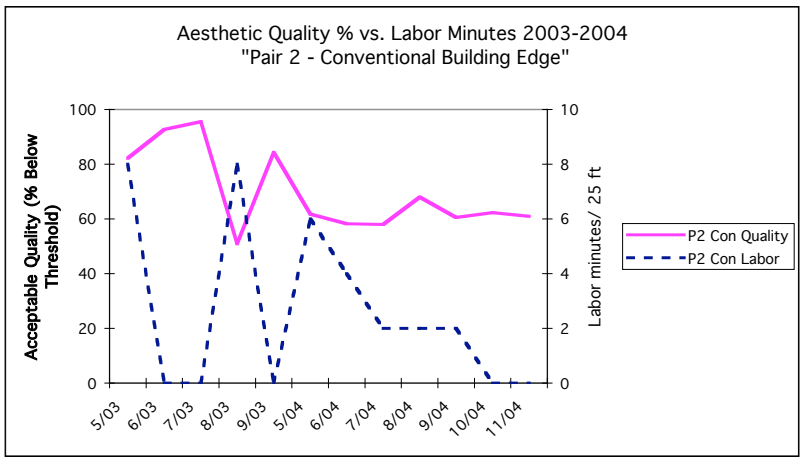


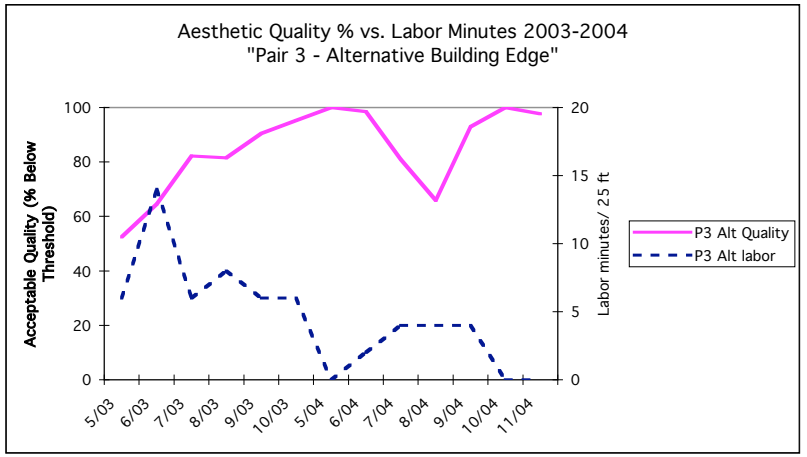
Figure 16: Aesthetic Quality vs. Labor Minutes in Fenceline Pairs











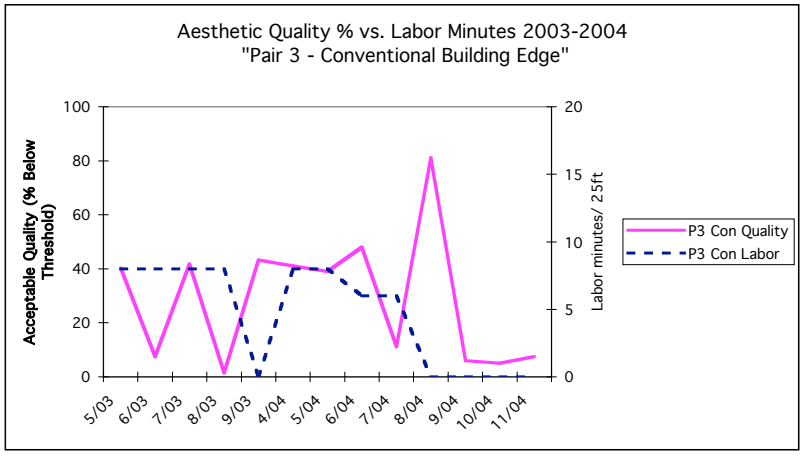


Figure 17: Building Edge Pairs -Aesthetic Quality vs. Labor Hours