City Council
Goal Setting Session
Agenda
October 24, 2012 at 6:30 P.M
Police Department Training Room

1 **Call to Order**

2 **Police Department Yearly Review**

3 **Budget Direction - Fiscal Year ending 4-30-14**

4 **Cass Avenue and 75th Street Development**

5 **Specific Business Recruitment**

6 **Capital Improvements Plan Guidelines**

7 **Emerald Ash Borer-Treatment Options**

8 **Adjournment**

CITY OF DARIEN
MEMO

TO: City Council, City Clerk, City Treasurer

FROM: Kathy Weaver, Mayor
Bryon D. Vana, City Administrator

DATE: October 19th, 2012

SUBJECT: Goal Setting Agenda and Background –October 24th, 2012, 6:30pm, police training room

---

The agenda has been prepared for the goal setting session scheduled for October 24th, 2012. This memo includes a summary of these topics and additional background information on some of the topics. If a topic has an * next to it then additional material is included in the packet.

1 **Police Department Yearly Review***

Chief Brown will provide an overview of his first year with the department. He will focus on management changes that have been implemented and future items that will be reviewed. Included with the packet is a separate outline for this topic.

2 **Budget Direction - Fiscal Year ending 4-30-14***

The council prepared a number of goals for me to prioritize this year. One goal was to cut 10% from each department in next year's budget. Staff is asking the council to discuss this goal and provide additional clarification to the staff.

3 **Cass Avenue and 75th Street Development ***

The Council will be asked to discuss their thoughts on how to proceed with the development of the City owned property at 75th and Cass.

4 **Specific Business Recruitment**

Alderman Avci asked the Council to discuss if the City should be more proactive in aggressively recruiting certain types of businesses. He said that if the council agrees to do that then they can discuss reserving some of the revenue generated, by the sale of the parcel to Chase, for that purpose.

5 **Capital Improvements Plan Guidelines***

The council will review the capital projects listed in the CIP Guidelines to determine if any projects should be added or deleted during the upcoming budget preparation for FYE 4-30-14.

6 **Emerald Ash Borer-Treatment Options***

Staff will review Ash tree treatment options dealing with Emerald Ash Borer.

CITY OF DARIEN

MEMO

TO: Mayor, City Council, City Clerk, City Treasurer

FROM: Bryon D. Vana, City Administrator

DATE: October 19th, 2012

SUBJECT: October 24, 2012 Goal Setting- Police Department Review

---

The attached is an outline for the goal setting topic - *yearly review of the police department.* The Chief will cover the following:

1 **First year assessment**

   a. Work environment
   b. Policies
   c. Budget
   d. Staffing (allocation and scheduling)
   e. Community Engagement

2 **Looking forward**

   a. Future allocation of personnel
   b. K-9 unit donation – Lions Club

This outlines covers the topics identified by staff. Feel free to ask the chief questions on any aspect of the department even if they are not listed on the outline.

Darien Police Department

Annual Review

1 First Year Assessment

A Work Environment

1) competitive salary and benefit package
2) New vehicles
3) Great firearms training
4) Available on-duty work out period
5) Officers select days off
6) Guaranteed one weekend off per month
7) Uniform allowance
8) Tuition Reimbursement

B Department Policies

1) Implemented a policy that required officers who failed to meet the qualification requirement be assigned to administrative duties. Additionally, the officer would not be armed until such time as the officer successfully qualified.
2) Implemented a policy that logs every citizen complaint, formalizing the complaint process and standardizing the format by which all internal investigations are to be conducted.
3) Determined that gunshot residue testing was not used in incidents involving a firearm. Changed policy to include GSR testing.
4) Determined that detective division was not measuring clearance rates. Developed clearance rate document.
5) Implemented a policy changing the range qualification course of fire from a 50 round qualification course to a 30 round qualification course that is sanctioned by the State of Illinois and used by the Illinois State Police.
6) Implemented a distracted driving policy to address the use of cellular and other devices while operating police vehicles.
7) Implemented a traffic crash/damage to department vehicle oversight that provides supervisory feedback, documentation, corrective action and remedial driving instruction in a progressive manner.

C **Budget Review**

1) Improved monthly budget expense review process. Developed an expenditure tracking protocol using QUICK BOOKS software. The current review system is cumbersome, particularly for lower cost expenditures.
2) Identified and eliminated unnecessary purchases such as coffee, sun tan lotion used at shooting range, pagers, and reduced the range qualification course from a 50 round course to a 30 round (state approved) course.
3) Implemented a policy requiring training to be conducted within the construct of the individual officer's shift wherever practical.
4) Implemented a policy requiring monthly reports on overtime expenditure.
5) Implemented a policy requiring monthly investigative status to include individual and collective clearance rates, monthly reports from training indicating relative costs and overtime accruals

D **Staffing – Allocation and Scheduling**

(Allocation)

1) Conducted workload/data/call distribution analysis to determine formula for allocation and re-allocation of resources.
2) Determined that it was not the best means of allocating resources to staff all three shifts with the same staffing levels.
3) Implemented a power shift that increased staffing when call volume is highest
4) Split the detectives into 2 shifts covering a larger span of time that a detective is available.

(Scheduling)

The current scheduling method used is unique to Darien. Some of the uniqueness stems from the collective bargaining agreement and the other stems from previous police administrative direction.

1) Officer selection of days off creates several managerial problems including working many consecutive days per work period.
2) Contract mandates that officers be off duty the weekend before, and after a week of vacation.
3) Coupled with self-selection of days off all increase potential for overtime accrual.
4) The 28 day work rotation cycle disrupts the human body's circadian rhythm and statistically reduces the life expectancy by 15 years over the course of a career.

5) Sergeants create schedules, officers self-submitting days off each police period requires an inordinate amount of time being dedicated to an administrative function.
6) Call distribution analysis indicated an approximate 23% increase in citizen generated calls during peak season.
7) Currently 37.5% of employee vacation weeks are taken during peak summer months which is the department's busiest period.

E **Community Engagement**

1) Developed a monthly informational newsletter directed toward citizens.
2) In pilot phase crime mapping implementation.
3) Evaluating alternatives to D.A.R.E. while still maintaining an educational and law enforcement interface with students.
4) Community Engagement should not have one singular face, but should be part of the organizational and operational fiber of the entire agency. Developing a community policing component that utilizes all sworn officers as community engagement agents.
5) Met with a variety of community groups to discuss strategies and ideas.
6) Facilitated response protocol training for employees of the library.
7) Met with various city and city affiliates to discuss problems and problem solving, park district, library, school superintendents.
8) Participated with DCCA as chair of county wide Heroin Task Force.
9) Currently working on a committee with Hinsdale South to host a community drug awareness forum in early November.
10) Meeting with community groups from DuPage County to develop alternative strategies to arrest for "at-risk" youth.

2 Looking Forward

A. Future allocation of personnel

Staff will present a current organizational chart and an organizational chart illustrating ideas of future allocation of police personnel. The intent of this discussion is to focus on how we allocate personnel and to provide the basis for the number of personnel recommended at this time.

B. K-9 unit donation – Lions Club

The Lions Club attended a city council meeting with the idea of their organization collection donations to maintain a second K-9 unit. The staff will discuss the ongoing expense of maintaining a second K-9. Staff also requests the council discuss if the city should accept local donations for this purpose.

CITY OF DARIEN
Employee Information List

City of Darien *Salaries as of* *10/18/2012*

Hire Date	Position	Last Name	Rate	Annual Salary	Prior Year O/T	Total Pay	Health Insurance	Def Comp	Pension Match	Medicare	Total Comp
			*	2080 2160			$ 15,627.73 Family Coverage $ 6,475.20 Singl Coverage				
									20.00%	1.45%	
1/9/2002	Patrolman	BISCHOFF	40.3700	$ 87,199.20	$ 263.69	$ 87,462.89	$ 15,627.73	$ 1,200	$17,439.84	$1,268.21	$ 122,998.67
7/18/1991	Patrolman	BOZEK *	42.8000	$ 89,024.00	$ 6,801.53	$ 95,825.53	$ 6,475.20	$ 1,200	$17,804.80	$1,389.47	$ 122,695.00
11/16/2011	Chief of	BROWN *	60.7100	$ 126,276.80		$ 126,276.80	$ 15,627.73	$ 1,200	$25,255.36	$1,831.01	$ 170,190.90
4/22/1984	Sergeant	CAMPO	49.4200	$ 106,747.20	$ 20,415.23	$ 127,162.43	$ 6,475.20	$ 1,200	$21,349.44	$1,843.86	$ 158,030.93
10/2/1986	Sergeant	CHEAURE	50.0900	$ 108,194.40	$ 33,340.51	$ 141,534.91	$ 15,627.73	$ 1,200	$21,638.88	$2,052.26	$ 182,053.78
7/28/1988	Deputy Chief	COOPER *	56.3700	$ 117,249.60		$ 117,249.60	$ 15,627.73	$ 1,200	$23,449.92	$1,700.12	$ 159,227.37
9/7/2005	Patrolman	DEYOUNG	40.3700	$ 87,199.20	$ 1,106.90	$ 88,306.10	$ 15,627.73	$ 1,200	$17,439.84	$1,280.44	$ 123,854.11
6/17/1991	Patrolman	FOSTER *	42.8000	$ 89,024.00	$ 1,652.63	$ 90,676.63	$ 15,627.73	$ 1,200	$17,804.80	$1,314.81	$ 126,623.97
4/13/1995	Patrolman	FOYLE-PRICE	41.1800	$ 85,654.40	$ 6,253.80	$ 91,908.20	$ 15,627.73	$ 1,200	$17,130.88	$1,332.67	$ 127,199.48
9/27/2001	Patrolman	GLOMB	41.1800	$ 88,948.80	$ 18,419.57	$ 107,368.37	$ 6,475.20	$ 1,200	$17,789.76	$1,556.84	$ 134,390.17
1/12/1996	Patrolman	GREENABERG	41.1800	$ 88,948.80	$ 30,709.70	$ 119,658.50	$ 15,627.73	$ 1,200	$17,789.76	$1,735.05	$ 156,011.04
9/27/2000	Patrolman	HELLMANN	41.1800	$ 88,948.80	$ 1,506.80	$ 90,455.60	$ 15,627.73	$ 1,200	$17,789.76	$1,311.61	$ 126,384.70
8/18/2004	Patrolman	HRUBY	40.3700	$ 87,199.20	$ 24,035.31	$ 111,234.51	$ 15,627.73	$ 1,200	$17,439.84	$1,612.90	$ 147,114.98
3/25/2009	Patrolman	JUMP	32.9200	$ 71,107.20	$ 9,416.25	$ 80,523.45	$ 6,475.20	$ 1,200	$14,221.44	$1,167.59	$ 103,587.68
3/25/2009	Patrolman	KEOUGH	32.9200	$ 71,107.20	$ 585.70	$ 71,692.90	$ 6,475.20	$ 1,200	$14,221.44	$1,039.55	$ 94,629.09
9/28/1999	Patrolman	KOSIENIAK	41.1800	$ 88,948.80	$ 9,033.12	$ 97,981.92	$ 6,475.20	$ 1,200	$17,789.76	$1,420.74	$ 124,867.62
1/23/1992	Patrolman	LISKA-	42.8000	$ 92,448.00	$ 4,351.70	$ 96,799.70	$ -	$ 1,200	$18,489.60	$1,403.60	$ 117,892.90
8/4/1998	Patrolman	LISS	41.1800	$ 88,948.80	$ 28,089.60	$ 117,038.40	$ -	$ 1,200	$17,789.76	$1,697.06	$ 137,725.22
9/27/2001	Patrolman	LOREK	41.1800	$ 88,948.80	$ 19,284.03	$ 108,232.83	$ 15,627.73	$ 1,200	$17,789.76	$1,569.38	$ 144,419.70
12/8/2010	Patrolman	MILAZZO	29.2000	$ 63,072.00	$ 5,662.81	$ 68,734.81	$ 15,627.73	$ 1,200	$12,614.40	$996.65	$ 99,173.59
12/29/1997	Patrolman	MURPHY	41.1800	$ 88,948.80	$ 5,913.74	$ 94,862.54	$ 15,627.73	$ 1,200	$17,789.76	$1,375.51	$ 130,855.54
9/27/2001	Patrolman	NORTON	41.1800	$ 88,948.80	$ 14,014.40	$ 102,963.20	$ 15,627.73	$ 1,200	$17,789.76	$1,492.97	$ 139,073.66
8/2/1985	Sergeant	PICCOLI	50.0900	$ 108,194.40	$ 24,504.24	$ 132,698.64	$ 6,475.20	$ 1,200	$21,638.88	$1,924.13	$ 163,936.85
11/10/1978	Sergeant	REED *	50.0900	$ 104,187.20	$ 7,706.10	$ 111,893.30	$ 15,627.73	$ 1,200	$20,837.44	$1,622.45	$ 151,180.92
11/10/2004	Patrolman	RENNER	40.3700	$ 87,199.20	$ -	$ 87,199.20	$ 6,475.20	$ 1,200	$17,439.84	$1,264.39	$ 113,578.63
8/20/1993	Sergeant	RENTKA	50.0900	$ 108,194.40	$ 29,442.18	$ 137,636.58	$ 15,627.73	$ 1,200	$21,638.88	$1,995.73	$ 178,098.92
9/10/2008	Patrolman	RUMICK II	34.7900	$ 75,146.40	$ 9,911.38	$ 85,057.78	$ 6,475.20	$ 1,200	$15,029.28	$1,233.34	$ 108,995.60
9/25/2002	Patrolman	SIMEK	40.3700	$ 87,199.20	$ 1,506.98	$ 88,706.18	$ 15,627.73	$ 1,200	$17,439.84	$1,286.24	$ 124,259.99
9/25/2002	Patrolman	SKWERES	40.3700	$ 87,199.20	$ 16,097.80	$ 103,297.00	$ -	$ 1,200	$17,439.84	$1,497.81	$ 123,434.65
7/28/1988	Patrolman	STOCK	42.8000	$ 92,448.00	$ 7,490.79	$ 99,938.79	$ -	$ 1,200	$18,489.60	$1,449.11	$ 121,077.50
9/17/1998	Patrolman	STUTTE	41.1800	$ 88,948.80	$ 24,486.38	$ 113,435.18	$ 6,475.20	$ 1,200	$17,789.76	$1,644.81	$ 140,544.95
3/15/1985	Sergeant	TOPEL	50.0900	$ 108,194.40	$ 42,290.83	$ 150,485.23	$ 15,627.73	$ 1,200	$21,638.88	$2,182.04	$ 191,133.88
7/10/2001	Patrolman	YEO	41.1800	$ 88,948.80	$ 23,416.10	$ 112,364.90	$ 6,475.20	$ 1,200	$17,789.76	$1,629.29	$ 139,459.15
1/3/2007	Patrolman	ZIMNY	36.6500	$ 79,164.00	$ 11,502.80	$ 90,666.80	$ 6,475.20	$ 1,200	$15,832.80	$1,314.67	$ 115,489.47
						$ 3,547,329.40	$ 359,001.54	$ 40,800	$621,623.36	$51,436.28	$ 4,620,190.58

Police Staffing Allocation Summary

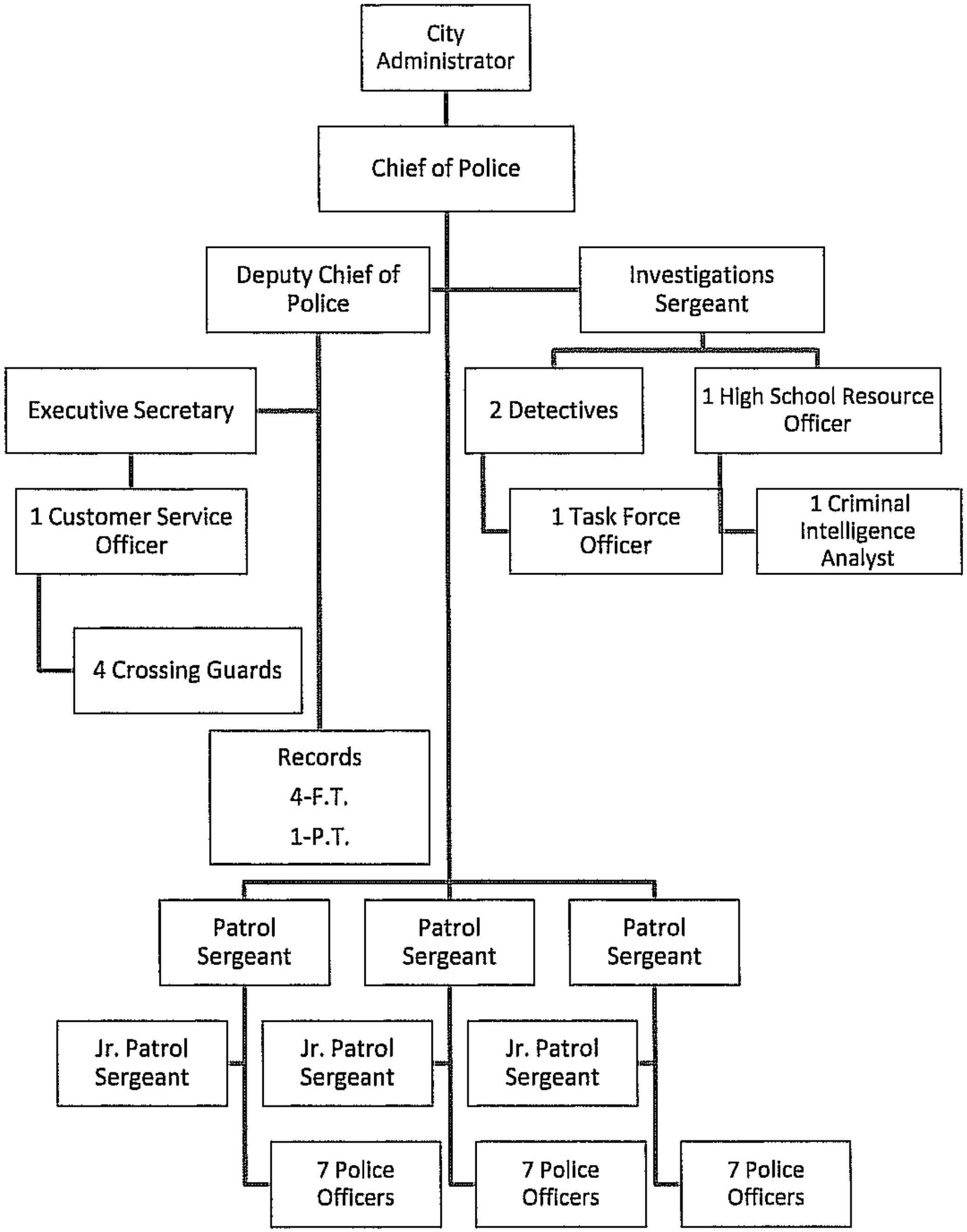
1 Sworn Police Staff

Position	Authorized Staff	Current Actual Staff	Projected Staff Allocation
Chief	1	1	1
Deputy Chief	1	1	1
Detective Sergeant	1	1	1
Patrol Sergeant	6	5	6
Patrol Officer	22	21	21
High School Resource Officer	1	1	1
Dare/Public Info Officer	1	1	0
Detective Officer	3	3	2
Task Force Officer	0	0	1
TOTAL	**36**	**34**	**34**

2 Civilian Police Staff

Position	Authorized Staff	Current Actual Staff	Projected Staff Allocation
FT Records Clerk	5	5	4
PT Records Clerk	1	1	1
Community Service Officer	1	1	1
Administrative Secretary	1	1	1
Crime Analyst	0	0	1
TOTAL	**8**	**8**	**8**

Projected Organization



EXPLANATION OF ORGANIZATIONAL CHART-2013 PROJECTION:

- 1 Chief of Police-responsible for directing all aspects of department operations
- 1 Deputy Chief-performs in absence of Chief and is responsible for ensuring implementation of policies and procedures.
  - a. 1 Executive Secretary who reports to both Chief and DC
  - b. 1 CSO, Community Service Officer
  - c. The records section consisting of:
    1. 4 full time records person
    2. 1 part time records person
- 1 Investigations sergeant- who reports directly to Chief and Deputy Chief, having dual responsibilities, leads investigations unit and manages activities of follow-up investigators. Investigations, serves as a support function to Patrol Operations. Responsible for identifying and disseminating crime patterns and developing and implementing crime strategies in conjunction with senior and junior sergeants on their respective shifts. Also responsible for the conduct of complex internal investigations alleging officer misconduct. Under the supervision of the investigations sergeant will be;
  - a. 2 Detectives
  - b. 1 TFO-Task Force Officer
  - c. 1 SRO- High School resource officer
  - d. 1 Civilian Criminal Intelligence Analyst
- 3 Senior Patrol sergeants who serve dual functions-responsible for all crime and disorder conditions on their respective shift including, crime awareness, situational awareness, pre-scheduling for planned events, managing overtime, collaborating with scheduling/schedules
  - a. 1 senior sergeant serving as **Training coordinator**
  - b. 1 senior sergeant serving as coordinator for **Auxiliary Officers**
  - c. 1 senior sergeant serving as Coordinator for **OEM coordinator**
- 3 Junior Patrol Sergeants who serve in conjunction with the Senior Sergeant to co-manage all affairs of the respective shift and to serve in the place of the Senior Patrol Sergeant in his absence. Additional duties as follows:
  - a. 1 Jr. sergeant as coordinator for **Canine Program**
  - b. 1 Jr. sergeant as coordinator for **Range Master**
  - c. 1 Jr. Sergeant as coordinator for **Traffic**
- 21 Patrol Officers who report directly to the Senior and Junior patrol sergeants and are responsible for traditional patrol functions, issuance of citations and all other duties associated with the Patrol Function including making arrests, processing offenders, attending court, traffic enforcement, attending community meetings, community engagement and other events during duty hours. Additional duties as follows depending on specialty:
  - a. FTO-Field Training Officers
  - b. Community Engagement
  - c. Canine
  - d. E.T-Evidence Technician

e. FIAT
f. RANGE

TOTAL DEPARTMENT STAFFING 42 PERSONNEL

- 8 CIVILIANS*
  a. 1 Executive Secretary
  b. 1 CSO
  c. 4 full time records personnel
  d. 1 part time records personnel
- 6 Patrol Sergeants
  a. 3 senior sergeants
  b. 3 Junior sergeants
- 1 Investigations sergeant
  a. 2 sworn detectives
  b. 1 sworn SRO
  c. 1 TFO
  d. 1 criminal intelligence analyst*
- 21 Patrol Officers- including officers with dual roles
  a. FTO
  b. EVIDENCE TECHNICIAN
  c. CANINE HANDLER
  d. FIREARMS INSTRUCTOR
  e. SWAT OPERATOR

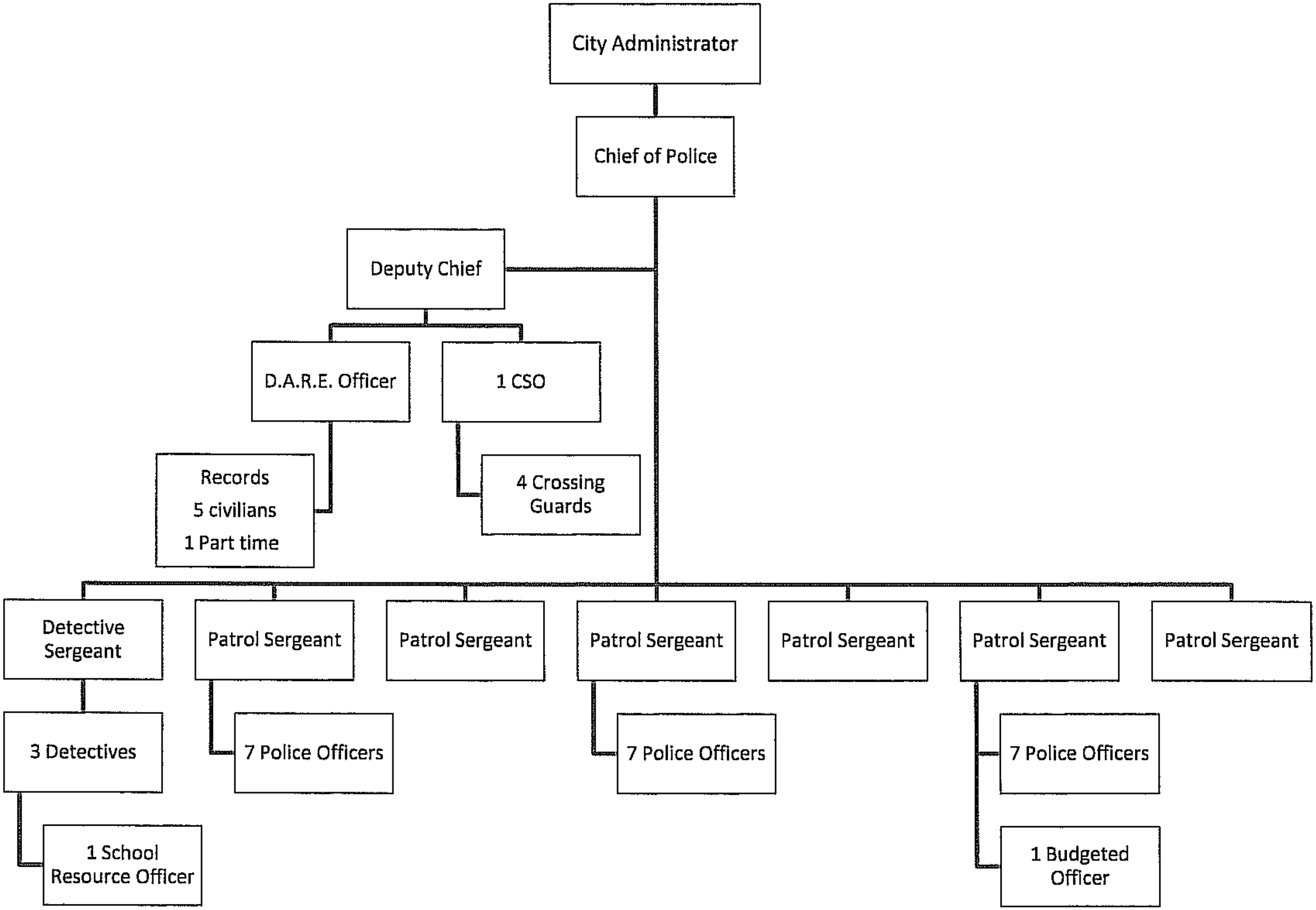
8 Civilian Positions

32 sworn non-exempt positions

2 sworn exempt positions

42 TOTAL POLICE DEPARTMENT POSITIONS-34 SWORN POSITIONS-8 CIVILIAN POSITIONS

Current Organization



EXPLANATION OF ORGANIZATIONAL CHART-Current 2012:

- 1 Chief of Police-responsible for directing all aspects of department operations
- 1 Deputy Chief-performs in absence of Chief and is responsible for ensuring implementation of policies and procedures.
    a. 1 Executive Secretary who reports to both Chief and DC
    b. 1 CSO, Community Service Officer
    c. The records section consisting of:
        1. 5 full time records person
        2. 1 part time records person
- 1 Investigations sergeant- who reports directly to Chief and Deputy Chief, having dual responsibilities, leads investigations unit and manages activities of follow-up investigators. Investigations, serves as a support function to Patrol Operations. Responsible for identifying and disseminating crime patterns and developing and implementing crime strategies in conjunction with senior and junior sergeants on their respective shifts. Also responsible for the conduct of complex internal investigations alleging officer misconduct. Under the supervision of the investigations sergeant will be;
    a. 3 Detectives
- 5 Patrol sergeants who serve dual functions-responsible for all crime and disorder conditions on their respective shift including, crime awareness, situational awareness, pre-scheduling for planned events, managing overtime, collaborating with scheduling/schedules
    a. 1 sergeant serving as **Training** coordinator
    b. 1 sergeant serving as coordinator for **Auxiliary Officers**
    c. 1 sergeant serving as Coordinator for **Range Instructor**
    d. 1 Sergeant serving as coordinator for **OEM/Canine**
    e. 1 Sergeant serving as **Traffic Coordinator**
- 21 Patrol Officers who report directly to the Senior and Junior patrol sergeants and are responsible for traditional patrol functions, issuance of citations and all other duties associated with the Patrol Function including making arrests, processing offenders, attending court, traffic enforcement, attending community meetings, community engagement and other events during duty hours. Additional duties as follows depending on specialty:
    a. FTO-Field Training Officers
    b. Canine
    c. E.T-Evidence Technician
    d. FIAT
    e. Range Officer
- 1 Dedicated D.A.R.E. Officer

TOTAL DEPARTMENT STAFFING 43 PERSONNEL

- 8 CIVILIANS
  a. 1 Executive secretary
  b. 1 CSO
  c. 5 full time records personnel
  d. 1 part time records personnel
- 5 Patrol Sergeants
  a. 1 D.A.R.E Officer
- 1 Investigations sergeant
  a. 3 sworn detectives
  b. 1 sworn SRO
- 21 Patrol Officers- including officers with dual roles
  a. FTO
  b. EVIDENCE TECHNICIAN
  c. CANINE HANDLER
  d. FIREARMS INSTRUCTOR
  e. SWAT OPERATOR
  f. FIAT

8 civilian positions

32 sworn positions

2 Chief's Positions

42 TOTAL POSITIONS

CITY OF DARIEN

MEMO

TO: Mayor, City Council, City Clerk, City Treasurer

FROM: Bryon D. Vana, City Administrator

DATE: October 19, 2012

SUBJECT: October 24, 2012 Goal Setting - Budget Direction - FYE 4-30-14

The council prepared a number of goals for me to prioritize this year. One goal was to cut 10% from each department in next year's budget. The council is asked to discuss this goal and provide additional clarification to the staff. For example:

- Does this apply to capital projects?
- Are we to compare FYE 14 budget request to approved FYE 13 budget or audited actual numbers?
- The capital improvements guidelines provide a framework to prepare budgets. What will be done with any surplus after a 10% cut?
- Some police department expenditures are scheduled for this year such as filling vacant positions, promotions, and adding a K-9 unit. Those expenses may be part of a reduction under a 10% general reduction since they have ongoing costs. Would we hold off on those expenses this year?

I am requesting that the council ask the staff to make any across the board reductions, if any, after the council has reviewed/discussed the draft FYE 14 budget next February. I believe my request s will provide for a more productive and meaningful budget review process. Additionally, the council has already given staff additional direction for the FYE 14 budget by approving the CIP guidelines.

Thank you for your consideration.

CITY OF DARIEN
MEMO

TO: Mayor, City Council, City Clerk, City Treasurer

FROM: Bryon D. Vana, City Administrator

DATE: October 19th, 2012

SUBJECT: October 24, 2012 Goal Setting-Town Center Development

---

At last year's goal setting meeting the council discussed options for future development of our Cass Avenue property. Since then we have closed on the sale to Chase. We have also placed a for sale sign on the property which has generated several calls to the staff.

This project needs to be discussed again to reach a consensus on the goals and priorities. Several discussion points include:

- Should the City consider a real estate broker to market and sell the remainder of the property not used by Chase?
- Should the City budget for temporary aesthetic improvements including building demolition and improvements to the grounds?
- Should the City sell the property out right for the highest price?
- Should we maintain/rehab the existing strip center as a revenue source?

If the council has other specific discussion points regarding this topic please forward those to me. We then will forward to the council to review prior to the meeting.

CITY OF DARIEN
CAPITAL IMPROVEMENTS PLAN GUIDELINES
FISCAL YEARS ENDING 4/30/14 TO 4/30/16

A capital improvement plan (CIP) is our multi-year plan identifying capital projects to be funded or identified during the 3-year planning period. These CIP guidelines identifies each capital project to be undertaken, the year the improvement project will be started, the amount of funds expected to be expended in each year of the CIP and the way the expenditure will be funded. A CIP also identifies non-core discretionary and expansion projects that a community may want to initiate if funding becomes available. A CIP is not a static document. It should be reviewed every year to reflect changing priorities, unexpected events and opportunities. The CIP should include the maintenance, repair and rehabilitation of existing infrastructure as well as the construction of new infrastructure. This may include capital items exceeding $75,000 such as buildings, water system, roadways, bridges, storm water systems, and sidewalks.

There are several benefits for developing and adopting a Capital Improvement Plan. Not only does the CIP become a management tool for the City Council and City staff, a CIP also provides valuable information to the citizens, developers and businesses who are interested in the development of the community. The CIP document will assist in leveraging available resources through improved timing of projects, and coordinating City projects with those of other public or private entities.

The CIP sets the general schedule within which public improvements are proposed to be undertaken. The first year reflects the adopted Budget for the fiscal year. The remaining years represent a schedule and estimate of future capital needs that may be funded given projected revenue estimates. A proposed CIP is presented to the Municipal Services Committee and the City Council as part of the annual budget process. A final CIP is presented to the City Council and is adopted concurrently with the annual operating budget effective May 1 of each year.

This plan will illustrate:

1. identified projects
2. project prioritization
3. funding plan for projects.

1 IDENTIFIED PROJECT LIST

The city of Darien identifies capital projects in three categories:

A. **Core projects**: This category includes maintenance required to maintain existing essential infrastructure in acceptable condition including streets (and related accessory curb/gutter, storm water structures/ditches), sidewalks, buildings and grounds. To meet the criteria of a core project, the project must be part of a multi year rating system such as the road maintenance program or an urgent repair.

B. **Non-core discretionary projects:** This category includes maintenance required to maintain existing non-essential infrastructure in acceptable condition including entranceway sign replacement, street sign replacement, beautification projects to existing buildings, rights of way, etc.

C. **Expansion Projects:** This category includes the construction of additional non-essential infrastructure bike paths, new roads, land acquisition, new beautification projects.

A. IDENTIFIED CORE PROJECTS

	PROJECT TITLE	PROJECT DESCRIPTION
1	Ditch storm water improvements – see multi year rating plan	Storm water ditches within the public rights of way need to be maintained on a scheduled basis to prevent them from silting up and forcing water back onto the travel way surface, into the sub base of the pavement, and onto private property. The city's ditch maintenance program is determined by the annual road maintenance program.
2	Sidewalk replacement – see multi year rating plan	Sidewalks are inspected on an annual basis. Sidewalks not in compliance with safety standards are replaced annually.
3	Road crack seal maintenance – see multi year rating plan	Filling or sealing pavement cracks to prevent water from entering the base and sub-base will extend the pavement life by an estimated three to five years. The city roads are inspected on an annual basis to determine the annual crack filling schedule.
4	Curb and gutter improvements – see multi year rating plan	The concrete curb and gutter along municipal roads play an important part of road maintenance. A functioning curb and gutter ensures proper drainage of a road. In conjunction with the annual road maintenance program the city inspects curb and gutter and replaces it as needed.
5	Building/grounds maintenance	The city maintains Approximately $21,000,000 in building value and 20 acres of land. The buildings and grounds need to be maintained on an as needed basis to ensure safety,

		aesthetics, and efficient operations.
6	Street maintenance program – see multi year rating plan	The city maintains 70 miles of roads as outlined in the road maintenance program guide. The average life of an improved roadway is 12 years with additional road life possible with additional preventive maintenance. The city's current annual road maintenance program includes approximately 4.5 miles per year. Due to additional preventive maintenance, the road program will be reduced overtime as conditions warrant.
7	Bond payment	Annual principal and interest payments on previous bond issues are paid annually.

B. IDENTIFIED NON CORE DISCRETIONARY PROJECTS

	PROJECT TITLE	PROJECT DESCRIPTION
1	Welcome to Darien signs at ***Community Gateways***	Construction of between 5 to 9 Community Gateway signs placed at entranceways to the community.
2		
3		
4		
5		
6		

C. IDENTIFIED EXPANSION PROJECTS

	PROJECT TITLE	PROJECT DESCRIPTION
1	Streetscape Improvements	The City's Comprehensive Plan promotes improving the 75th Street and Cass Avenue town center area by constructing a number of streetscape improvements, including paved crosswalks, landscaping in medians, and other design treatments.
2	Bike Plan	In 2002 TranSystems Corporation prepared a feasibility study on developing a municipal bicycle route system. The study identified approximately twenty five miles of bicycle **paths** that would create a network of on-street and off-street bikeways that could be used by Darien residents.
3	Informational Sign	Electronic message board that would provide information on City activities similar to the sign at Hinsdale South.
4	New Sidewalk Construction	Identify priority areas where new sidewalks should be constructed along critical pedestrian walkways

5	Utility Line Burial	Move power lines underground for those areas with overhead electric lines
6		

2 PROJECT PRIORITIZATION

Capital projects will be prioritized in the following order:

1. **Core projects**
2. **Non-core discretionary projects**
3. **Expansion Projects**

When prioritizing projects the following guidelines will be used:

Consistent with city goals
Linked to other projects
Planned as part of a multi year plan
Included in city comprehensive plan and other planning documents
Eligible for grant or special funding such as a special service area
Reduces liability
Results in more efficient operations
Promotes economic development
Improves public health and safety
Reduces operating budget
Facilitates intergovernmental cooperation
Specific ranking criteria within specific project categories

3 FUNDING PLAN

When developing a funding plan we analyze past, present and future trends in revenue generation, debt levels, general economic factors, new and increased revenues, and project reduction. The objective of the analysis is to determine the amount of funds available from existing and future revenue sources to pay for capital projects. When looking at the cost of doing a project we look at all the project costs; capital, operating and maintenance as well as looking at the cost of not doing a project. If a project or maintenance is delayed, what will the cost of construction be in the future, what are the current yearly operating and maintenance costs and what is the lost opportunity cost to the municipality. Specific criteria we use when developing a funding plan include:

- Project funding will be planned over a three-year period in conjunction with the approval of the annual budget

- Surplus from the general fund, in excess of 3 months operating reserve, will be transferred to the capital projects fund annually

- The capital projects fund shall maintain a minimum fund balance of $500,000 in each year of the three-year plan to be available for emergency projects

- Core projects will be funded prior to approving any non-core discretionary or expansion projects over the 3-year planning process

- Revenue shall be estimated if it is reasonably planned to be received over the 3-year period

- Revenue shall be considered sufficient for the 3-year plan when core projects are funded and $500,000 is available for emergency projects

- Bonds will only be issued for projects once the core projects are funded and for projects over $1,500,000 and have a useful life of at least 15 years.

If revenue is not sufficient for the 3-year period then the city shall have the option to:

- Reduce the scope of core projects
- Reduce operating expenses and transfer the savings to the capital projects fund
- Increase revenues (examples include, but are not limited to, gas tax, real estate tax, home rule sales tax)

3/21/2012

CAPITAL PROJECTS FUND BUDGET
FOR THE YEAR ENDING 4/30/2013

ACCOUNT	FYE 11 ACTUAL	FYE 12 BUDGET	FYE 12 ESTIMATED ACTUAL	FY 13 REQUEST	DEPT MAINT BUDGET REQUEST	COUNCIL DISCRETIONARY EXPENDITURES	FY 14 FORECAST	FY 15 FORECAST
REVENUE								
TRANSFER from GEN. Fund	$ 1,600,000	$ 3,000,000	$ 3,000,000	2,800,000		$ 2,800,000	$ 1,500,000	$ 1,300,000
Transfer from Debt Fund	$ 43,285	$ -	$ -	-	$ -	$ -		
Transfer from Road Fund	$ 30,000	$ -	$ -	-	$ -	$ -		
BOND LEVY	$ 200,770	$ 200,770	$ 200,770	202,194	$ 202,194		$ 202,320	$ 202,256
GRANTS	$ 24,177	$ -	$ 150,000	-	$ -	$ -		$ -
sale of property			$ 658,875	1,800,000		$ 1,800,000		
BONDS	-	-	-	-	-	-	-	-
INTEREST	4,639	-	10,000	4,000	-	4,000	-	-
TOTAL REVENUES	$ 1,802,871	$ 3,200,770	$ 4,017,645	$ 4,806,194	$ 202,194	$ 4,604,000	$ 1,702,320	$ 1,502,256
CAPITAL								
DITCH PROJECTS	405,516.12	456,400	403,000.00	884,543	-	884,543	750,000	750,000
SIDEWALK REPLACEMENT	75,653	79,300	61,678.00	67,630	67,630	-	75,250	78,850
CRACK SEAL PROGRAM	40,020.80	74,250	56,700.00	82,400	82,400	-	85,172	98,027
CURB & GUTTER PROGRAM	44,625	341,450	323,827.00	319,127	319,127	-	243,245	248,520
Bld/equipment repairs	227,169	-	-	135,600	-	135,600	-	-
STREET RECONSTRUCTION	1,308,889	1,234,928	1,237,077	1,506,250	1,328,250	178,000	1,474,250	1,524,250
BOND PAYMENT	200,769	200,770	200,770	202,194	202,194	-	202,320	202,256
SUB-TOTAL	2,303,442	2,387,098	2,283,052	3,207,744	2,009,601	1,198,143	2,840,237	2,901,703
PURCHASE OF PROPERTY	-							
TOTAL EXPENDITURES	$ 2,303,442	$ 2,387,098	$ 2,283,052	$ 3,207,744	$ 2,009,601	$ 1,198,143	$ 2,840,237	$ 2,901,703
FISCAL YEAR BALANCE	(400,571)	813,672	1,734,593	1,598,450	(1,807,407)	3,405,857	(1,137,917)	(1,399,447)
BEG FUND BALANCE	515,264	114,693	114,693	1,849,286	1,849,286	1,849,286	3,447,736	2,309,819
ENDING FUND BALANCE	114,693	928,365	1,849,286	3,447,736	41,879	5,255,143	2,309,819	910,372

Item 6

CITY OF DARIEN

M E M O

TO: Mayor, City Council, City Clerk, City Treasurer

FROM: Bryon D. Vana, City Administrator

DATE: October 18th, 2012

SUBJECT: October 24, 2012 Goal Setting-Emerald Ash Borer Insect (EABI)

Attached is a report that Director Gombac sent to the Municipal Services Committee for review. The report provides options for the city to address the Emerald Ash Borer insect that has killed an estimated 30 million ash trees to date. To date, we have identified 12 city owned ash trees that have been infested with the EABI. There are an estimated 2600 ash trees in the City's parkways which makes up an estimated 30% of our City owned trees. When an ash tree becomes infested the canopy of the tree begins to thin above infested portions of the trunk and major branches. This happens because the insect destroys the water and nutrient conducting tissues under the bark. One-third to one-half of the branches may die in one year. Most of the canopy will be dead within 2 years of when symptoms are first observed.

In summary, communities are attempting to eradicate the insect by removing or applying insecticides to ash trees owned by the city. The cost for either option is expensive. If the city chose to apply insecticide to all of the city owned ash trees, we estimate a total expense of $531,800 over a six year period. The cost to remove and replace all of our ash trees is estimated at approximately $2,800,000. The cost detail for both options is shown in the attached report.

TO: Municipal Services Committee
Bryon Vana-City Administrator

FROM: Daniel Gombac, Municipal Services Director

DATE: July 23, 2012

SUBJECT: Emerald Ash Borer-Executive Summary Update-Program Treatment Cost Analysis

EXECUTIVE SUMMARY

Background

The Emerald Ash Borer (EAB) is an invasive species from Asia that arrived in the United States in wood packing material. The pest was first detected in Michigan in 2002 and has subsequently spread to Canada and a number of other states including northern Illinois. The pest kills all species of North American ash trees and has killed an estimated 30 million trees to date. To date, the EAB has affected 12 Ash trees in the City of Darien. When it comes to the potential devastation of EAB, there is a lot at stake for the City. There are an estimated 2600 ash trees in the City's parkways and makes up an estimated 30% of urban trees.

This updated plan identifies new strategies based on the science that has been advanced since the original response plan was developed several years ago. With this new information and plan, staff is being proactive to the long-term management of the EAB.

Effectiveness

The effectiveness of the Tree-Age product is well above the 92 percentile. Attached and labeled as Attachment D is a study conducted through the International Society of Arboriculture. The study evaluates the effectiveness of injections and drenching during a period of 2005-2010.

When the researchers talk about percent effectiveness they are referring to number of larvae controlled. For example, say it takes 1000 larvae to kill a tree over time. Inject the tree in 2012 and kill 990 of the insects who tried to feed leaving only 10. If the 2nd year was only 92 % effective, there would still not be enough larvae to kill the tree.

Regarding the analysis for 3 cycles/applications or in 6 years, it is highly anticipated that the EAB would be eradicated due to the food chain being depleted. This assumes that all untreated ash trees within private residences, neighboring towns, forest preserves have died off due to not being treated.

Attached and labeled as Attachment E is an additional study conducted for insecticide options for protecting ash trees. The study was conducted through the Ohio State University, Michigan State University, Purdue University, University of Wisconsin-Madison, and University of Illinois.

Attached please find two colored brochures provided through Arborjet providing information on management and treatment facts for the Emerald Ash Borer.

The Response Plan

The staff has devised a response plan for emerald ash borer, or EAB. The plan was created through updated industry information and the proposed plan includes a program to apply the Tree-Age insecticide. The plan is based on the application of the abovementioned insecticide once every two years for three cycles.

Goal

The goal of the Department is to treat the entire City owned inventory of healthy ash trees. The City will also continue to educate residents with private property trees and review potential treatment programs. The City will also work with the Darien Park District to establish goals. The Staff is cognizant to the fact that there will be Ash trees that will not be able to be saved and will require removal. The goal of the department was to begin the treatment in April of 2013, pending budget allocation.

Objective

The objective of the plan is to eliminate the destructive effects of EAB on Darien's Ash trees. Ash trees are a quality of life benefit and provide a cost benefit of approximately $185.00 per year, based upon a 20-inch diameter tree.

Program Costs

Attached is a cost analysis spreadsheet labeled as Attachment A. The analysis provides cost comparisons as they relate to treatments, removals, benefits, and a program cost summary. Staff is requesting to move forward with the program as outlined under Column B-F Rows 22-27. The cost for the program has been estimated as follows:

Cycle 1 Year 2012/13	$179,400.00
Cycle 2 Year 2014/15	$176,200.00
Cycle 3 Year 2016/17	$176,200.00
Total Cost over 6 years	$531,800.00

The proposed funding for the program was not budgeted for FYE13. Staff is currently reviewing fund balances through the Capital Projects Fund and Motor Fuel Tax Funds. Staff has been in contact with IDOT regarding the use of MFT funds for EAB. The MFT funds may not be currently used for the insecticide treatment of parkway trees. The Illinois Department of Transportation will be discussing the proposed funding use during the next several months for MFT funding consideration. This item has been discussed with the City Administrator and will be forwarded for Budget consideration at the October workshop.

Please let me know if there are any further questions or comments.

Below, please find the summary descriptions as they relate to the attached spreadsheet.

Spreadsheet Summary Descriptions

Column B - Rows 2-9 *Inventory* Identifies 5 tree sections. The City is broken down into 5 quadrants for tree maintenance programs. See Map labeled as Attachment B.

Column C - Rows 2-9 Identifies the *Total No of Trees* per section

Column D - Rows 2-9 Identifies the No *of Ash Trees* per section

Column E - Rows 2-9 Identifies the *Difference of Other Tree Species*

Column F - Rows 2-9 Identifies the *Percentage of Ash Trees to Total Trees* per section

Column G - Rows 2-9 Identifies the *Total Tree Diameter Inches* (Diameter By Height-DBH) of ash trees per section. The measurement is based on a window survey and limited ash trees have been field measured.

Column H - Rows 2-10 Identifies the amount of *Tree-Age Application Rate* in liters required to treat the tree for the first cycle per section.

Column I - Rows 2-9 Identifies the *Cost Per Liter* per section for the first cycle.

Column J - Rows 2-9 Identifies the total no of *Arbor Plugs* required to be placed into the tree after the injection

Column K - Rows 2-9 Identifies the costs for the plugs

The following items relate to equipment required to complete the program.

Column B - Rows 11-16 Identifies the *Equipment Required* and is considered a one-time expense with the exception of the needles and cleaner.

Column C - Rows 11-16 Identifies the *Quantity Required*

Column D - Rows 11-16 Identifies the *Unit Cost* for each item

Column E - Rows 11-16 Identifies the *Total Cost* for each item

The following items relate to the labor force required to complete the program. Staff has reviewed outsourcing the service and has determined that with the City Arborist on staff and the ability to hire on a temporary employee there is an economy of executing the program in-house. The City Arborist would be committed to leading and performing the applications with the assistance of a temporary employee. The following items relate to the workforce required to complete the program.

Column B - Rows 17-18 Identifies the *Workforce Summary* required

Column C - Rows 17-18 Identifies the totals for the *No of Trees* targeted

Column D - Rows 17-18 Identifies the *Hours Per Tree* for the application

Column E - Rows 17-18 Identifies the *Total Hours Required* for the program

Column F - Rows 17-18 Identifies the *No of Working Weeks Required* for the program

Column F - Rows 17-18 Identifies the *No of Working Days Required* for the program

The next item reviews the cost of the treatment program. The program will require a total of three applications/cycles. The application/cycle shall be applied once every two years. The program would be scheduled as follows:

Cycle 1 - 2012/13 Application

Cycle 2 - 2014/15 Application

Cycle 3 - 2016/17 Application

The following items relate to the Cost Summary required to complete the multi-cycle program and would be completed In-House by staff.

Column B - Rows 22-27 Identifies the items required to complete the program and include equipment, supplies and temporary labor.

Column C - Rows 22-27 Identifies the costs to complete the program for Cycle 1 and is anticipated to be completed in 2012 or 2013. Cycle 1 cost is estimated at $179,400

Column D - Rows 22-27 Identifies the costs to complete the program for Cycle 2 and is anticipated to be completed in 2014 or 2015. Cycle 2 cost is estimated at $176,200

Column E - Rows 22-27 Identifies the costs to complete the program for Cycle 3 and is anticipated to be completed in 2016 or 2017. Cycle 3 cost is estimated at $176,200

Column F- Rows 22-27 Identifies the costs to complete the program for Cycles 1-3 at a total cost of approximately $531,800

The next item relates to the benefits of mature Ash trees and provides the following benefits:

- Stormwater
- Electricity
- Air Quality
- Property Values
- Natural Gas
- CO2

The average Ash tree in the city provides a cost benefit of approximately $185.00 per year. The following items relate to the Cost Benefit of Ash Trees.

Column B - Rows 28-29 Identifies the Cost Benefit of Ash Trees and Support Documentation. The Support Documentation is labeled as Attachment C.

Column C - Rows 28-29 Identifies the *No of Trees*

Column D - Rows 28-29 Identifies the *Cost Benefit Per Tree*

Column E - Rows 28-29 Identifies the *Total Cost Benefit*

The next item compares removal costs if an EAB infestation affected the City of Darien. The following exercise demonstrates the cost of removal, restoration and replacement costs.

Column B - Row 31-38 *Removal Costs* Identifies 5 tree sections. The City is broken down into 5 quadrants for tree maintenance programs.

Column C - Rows 31-38 Identifies the *Total No of Ash Trees* per section

Column D - Rows 31-38 Identifies the *Total Tree Diameter Inches* (Diameter By Height-DBH) of ash trees per section. The measurement is based on a window survey and limited ash trees have been field measured.

Column E - Rows 31-38 Identifies the *Removal Cost* based upon a current contract unit price of $30.00 per inch.
Column F - Rows 31-38 Identifies the *Stump Grinding Cost* based upon a current contract unit price of $90.00 per stump.

Column G - Rows 31-38 Identifies the *Landscaping Restoration Cost* as lump sum cost of $50.00 per location.

Column H - Rows 31-38 Identifies the *Replacement Cost for a 4-inch Caliper Tree* at a unit cost of $350.00 per location.

Column I - Rows 31-38 Identifies the *Total Replacement Cost* for each section.

Column J - Rows 31-38 Identifies the *5 Year Total Replacement Cost* based on a yearly cost.

The next item provides program Outsourcing costs of the 3 cycles based on the existing inventory. Again, each cycle is completed once every two years. Below is the breakdown of the spreadsheet.

Column B - Rows 40-47 *Inventory* Identifies 5 tree sections. The City is broken down into 5 quadrants for tree maintenance programs.

Column C - Rows 40-47 Identifies the No *of Ash Trees* per section

Column D - Rows 40-47 Identifies the *Total Tree Diameter Inches* (Diameter By Height-DBH) of ash trees per section. The measurement is based on a window survey and limited ash trees have been field measured.

Column E - Rows 40-47 Identifies the *Treatment Cost* per section

Column F - Rows 40-47 Identifies the *Cycle One Cost 2012/13*

Column G - Rows 40-47 Identifies the *Cycle Two Cost 2014/15*

Column H - Rows 40-47 Identifies the *Cycle Three Cost 2016/17*

Column I - Row 47 Identifies the *Total Outsourced Program Cost* over the life of the program.

A	B	C	D	E	F	G	H	I	J	K
2	Inventory	Total No of Trees	No of Ash Trees	Difference (Other Tree Species)	Percentage of Ash Trees to Total Trees	Total Tree Diameter Inches (DBH) (Average is 20 inch DBH)	Tree-Age Chemical-Application Rate 48.2 Milliliters Per Inch	Cost Per Liter	Arbor Plugs - 9 Per Tree	Plug Costs
3							5.40	$ 494.00		$ 0.45
4	Section No 1	1594	20	1574	1.25%	400.00	2,160.00	$ 1,067.04	$ 180.00	$ 81.00
5	Section No 2	1869	631	1238	33.76%	12,620.00	68,148.00	$ 33,665.11	$ 5,679.00	$ 2,555.55
6	Section No 3	1577	507	1070	32.15%	10,140.00	54,756.00	$ 27,049.46	$ 4,563.00	$ 2,053.35
7	Section No 4	1994	659	1335	33.05%	13,180.00	71,172.00	$ 35,158.97	$ 5,931.00	$ 2,668.95
8	Section No 5	1922	796	1126	41.42%	15,920.00	85,968.00	$ 42,468.19	$ 7,164.00	$ 3,223.80
9	Totals	8956	2613	6343	29.18%	52,260.00	282,204.00	$ 139,408.78	$ 23,517.00	$ 10,582.65
10	Liters Required						282.20			
11	Equipment Costs	Quantity	Unit Cost	Total Cost						
12	Arborjet Hydraulic Kit	1	$ 2,900.00	$ 2,900.00						
13	Secondary Air Pack	1	$ 255.00	$ 255.00						
14	Arborjet Viper Needle (2 Pack)	1	$ 28.45	$ 28.45						
15	Clean-Jet Cleaner	12	$ 7.92	$ 95.04						
16	Total Equipment Cost			$ 3,278.49						
17	Workforce Summary	No of Trees	Hours Per Tree	Total Hours Required	No of Working Weeks Required	No of Working Days Required				
18	City Arborist	2613	0.5	1306.5	32.6625	163.31				
19	Labor-Temp	No of Temp Help	Total Hours Required	Rate of Pay	Unit	Total Cost				
20	Temporary Helper	1	1306.5	20	Hourly	26,130.00				
21	Proposed In House program									
22	Cost Summary for 2013-2019	Cycle 1-Year 1 2013	Cycle 2 - Year 3 2015	Cycle 3 - Year 5 2017	Total Program Cost	YEAR 2019				
23	Insecticide	$ 139,408.78	$ 139,408.78	$ 139,408.78	$ 418,226.33	TO BE DETERMINED				
24	Plugs	10582.65	$ 10,582.65	$ 10,582.65	$ 31,747.95					
25	Equipment	$ 3,278.49	$ -	$ -	$ 3,278.49					
26	Labor-Temporary Help	$ 26,130.00	$ 26,130.00	$ 26,130.00	$ 78,390.00					
27	Cost	$ 179,399.92	$ 176,121.43	$ 176,121.43	$ 531,642.77					
28	Cost benefit of Ash Trees	No of Trees	Cost Benefit Per Tree	Total Cost Benefit						
29	*See Supporting Documentation*	2,613.00	$ 185.00	$ 483,405.00						
30	B	C	D	E	F	G	H	I	J	K
31	Removal Costs	No of Ash Trees	Total Tree Diameter Inches (DBH) (Average is 20 inch DBH)	Removal Cost	Stump Grinding Cost	Restoration Cost	Replacement Cost 4-inch Calliper	Total Replacement Cost	5 Year Replacement Cost Cost per Year	
32				$ 30.00	$ 90.00	$ 50.00	$ 350.00			
33	Section No 1	20	400.00	$ 12,000.00	$ 1,800.00	$ 1,000.00	$ 7,000.00	$ 21,800.00	$ 4,360.00	
34	Section No 2	631	12,620.00	$ 378,600.00	$ 56,790.00	$ 31,550.00	$ 220,850.00	$ 687,790.00	$ 137,558.00	
35	Section No 3	507	10,140.00	$ 304,200.00	$ 45,630.00	$ 25,350.00	$ 177,450.00	$ 552,630.00	$ 110,526.00	
36	Section No 4	659	13,180.00	$ 395,400.00	$ 59,310.00	$ 32,950.00	$ 230,650.00	$ 718,310.00	$ 143,662.00	
37	Section No 5	796	15,920.00	$ 477,600.00	$ 71,640.00	$ 39,800.00	$ 278,600.00	$ 867,640.00	$ 173,528.00	
38	Totals	2613	52260	$ 1,567,800.00	$ 235,170.00	$ 130,650.00	$ 914,550.00	$ 2,848,170.00	$ 569,634.00	
39	OUTSOURCED COSTS									
40	Inventory	No of Ash Trees	Total Tree Diameter Inches (DBH) (Average is 20 inch DBH)	Treatment Cost	Cycle One 2013 Cost	Cycle Two 2015 Cost	Cycle Three 2017 Cost	Total Program Cost		
41				$ 5.50		$ 5.50	$ 5.50			
42	Section No 1	20	400	$ 2,200.00	$ 2,200.00	$ 2,200.00	$ 2,200.00			
43	Section No 2	631	12,620	$ 69,410.00	$ 69,410.00	$ 69,410.00	$ 69,410.00			
44	Section No 3	507	10,140	$ 55,770.00	$ 55,770.00	$ 55,770.00	$ 55,770.00			
45	Section No 4	659	13,180	$ 72,490.00	$ 72,490.00	$ 72,490.00	$ 72,490.00			
46	Section No 5	796	15,920	$ 87,560.00	$ 87,560.00	$ 87,560.00	$ 87,560.00			
47	Totals	2613	52260		$ 287,430.00	$ 287,430.00	$ 287,430.00	$ 862,290.00		

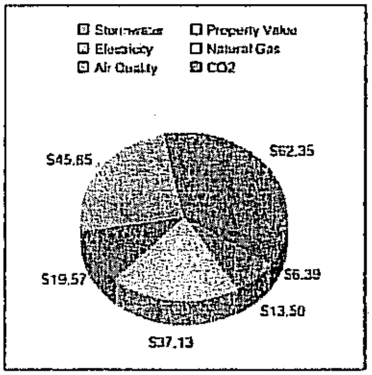
Attachment C

Home   Calculate another tree

National Tree Benefit Calculator

Beta

Overall Benefits | Stormwater | Property Value | Energy | Air Quality | CO2 | About the model



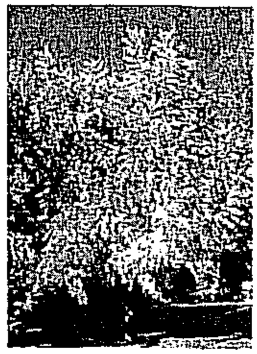
Breakdown of your tree's benefits
Click on one of the tabs above for more detail

This 20 inch Ash provides overall benefits of:
$185 every year.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure is highly variable and makes precise calculations that much more difficult. Given these complexities, the results presented here should be considered initial approximations—a general accounting of the benefits produced by urban street-side plantings.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance.

If this tree is cared for and grows to 25 inches, it will provide **$219** in annual benefits.



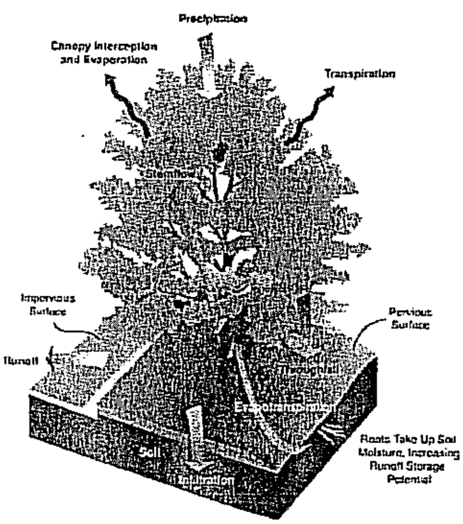
Ash
Fraxinus species

Home   Calculate another tree

National Tree Benefit Calculator

Beta

Overall Benefits | Stormwater | Property Value | Energy | Air Quality | CO2 | About the model



Your 20 inch Ash will intercept 2,301 gallons of stormwater runoff this year.

Urban stormwater runoff (or "non-point source pollution") washes chemicals (oil, gasoline, salts, etc.) and litter from surfaces such as roadways and parking lots into streams, wetlands, rivers and oceans. The more impervious the surface (e.g., concrete, asphalt, rooftops), the more quickly pollutants are washed into our community waterways. Drinking water, aquatic life and the health of our entire ecosystem can be adversely effected by this process.

Trees act as mini-reservoirs, controlling runoff at the source. Trees reduce runoff by:

- Intercepting and holding rain on leaves, branches and bark
- Increasing infiltration and storage of rainwater through the tree's root system
- Reducing soil erosion by slowing rainfall before it strikes the soil

For more information visit: The Center for Urban Forest Research

Home Calculate another tree

National Tree Benefit Calculator

Beta

| Overall Benefits | Stormwater | Property Value | Energy | Air Quality | CO2 | About the model |

Located in front of a single family home, this 20 inch Ash will raise the property value by $46 this year.

Trees in front of single family homes have a greater property value benefit than those in front of multi-family homes, parks or commercial properties. Real estate agents have long known that trees can increase the "curb appeal" of properties thereby increasing sale prices. Research has verified this by showing that home buyers are willing to pay more for properties with ample versus few or no trees.

This model uses a tree's Leaf Surface Area (LSA) to determine increases in property values. That's a researcher's way of saying that a home with more trees (and more LSA) tends to have a higher value than one with fewer trees (and lower LSA). The values shown are annual and accumulate incrementally over time because each tree typically adds more leaf surface area each growing season. The amount of that increase depends on the type of tree – some add more, some less.

The 20 inch Ash you selected will add 190 square feet of LSA this year. In subsequent years it will add more, and the property value will increase accordingly.

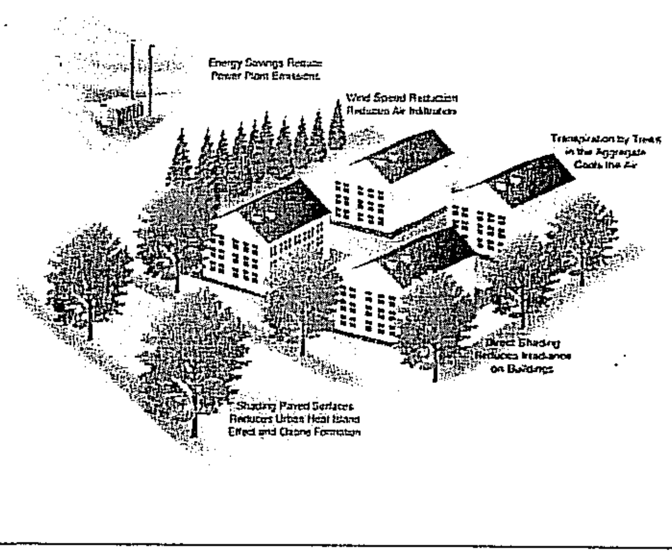
For more information visit: The Center for Urban Forest Research

Home Calculate another tree

National Tree Benefit Calculator

Beta

| Overall Benefits | Stormwater | Property Value | Energy | Air Quality | CO2 | About the model |



Your 20 inch Ash will conserve 258 Kilowatt / hours of electricity for cooling and reduce consumption of oil or natural gas by 38 therm(s).

Trees modify climate and conserve building energy use in three principal ways (see figure at left):

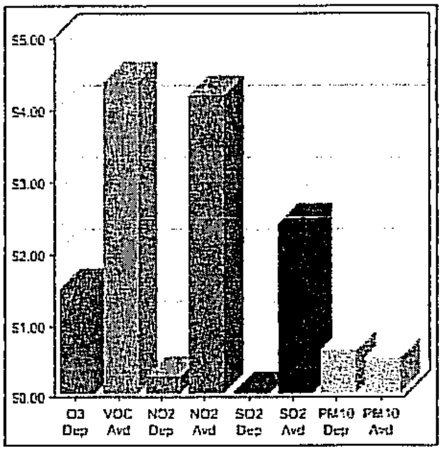
- Shading reduces the amount of heat absorbed and stored by buildings.
- Evapotranspiration converts liquid water to water vapor and cools the air by using solar energy that would otherwise result in heating of the air.
- Tree canopies slow down winds thereby reducing the amount of heat lost from a home, especially where conductivity is high (e.g., glass windows).

Strategically placed trees can increase home energy efficiency. In summer, trees shading east and west walls keep buildings cooler. In winter, allowing the sun to strike the southern side of a building can warm interior spaces. If southern walls are shaded by dense evergreen trees there may be a resultant increase in winter heating costs.

For more information visit: The Center for Urban Forest Research

National Tree Benefit Calculator

Beta



"Dep" stands for deposition. This is your tree absorbing or intercepting pollutants. "Avd" stands for avoided. This is your tree lessening the need for creation of these pollutants in the first place by reducing energy production needs.

Air quality benefits of your 20 inch Ash shown in the graph at left.

Air pollution is a serious health threat that causes asthma, coughing, headaches, respiratory and heart disease, and cancer. Over 150 million people live in areas where ozone levels violate federal air quality standards; more than 100 million people are impacted when dust and other particulate levels are considered "unhealthy." We now know that the urban forest can mitigate the health effects of pollution by:

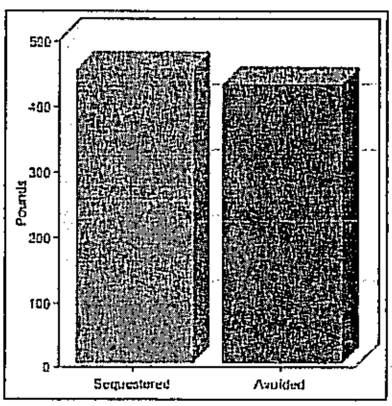
- Absorbing pollutants like ozone, nitrogen dioxide and sulfur dioxide through leaves
- Intercepting particulate matter like dust, ash and smoke
- Releasing oxygen through photosynthesis
- Lowering air temperatures which reduces the production of ozone
- Reducing energy use and subsequent pollutant emissions from power plants

It should be noted that trees themselves emit biogenic volatile organic compounds (BVOCs) which can contribute to ground-level ozone production. This may negate the positive impact the tree has on ozone mitigation for some high emitting species (e.g. Willow Oak or Sweetgum). However, the sum total of the tree's environmental benefits always trumps this negative.

For more information visit: The Center for Urban Forest Research

National Tree Benefit Calculator

Beta



This year your 20 inch Ash tree will reduce atmospheric carbon by 887 pounds.

How significant is this number? Most car owners of an "average" car (mid-sized sedan) drive 12,000 miles generating about 11,000 pounds of CO2 every year. A flight from New York to Los Angeles adds 1,400 pounds of CO2 per passenger. Trees can have an impact by reducing atmospheric carbon in two primary ways (see figure at left):

- They sequester ("lock up") CO2 in their roots, trunks, stems and leaves while they grow, and in wood products after they are harvested.
- Trees near buildings can reduce heating and air conditioning demands, thereby reducing emissions associated with power production.

Combating climate change will take a worldwide, multifaceted approach, but by planting a tree in a strategic location, driving fewer miles, or replacing business trips with conference calls, it's easy to see how we can each reduce our individual carbon "footprints."

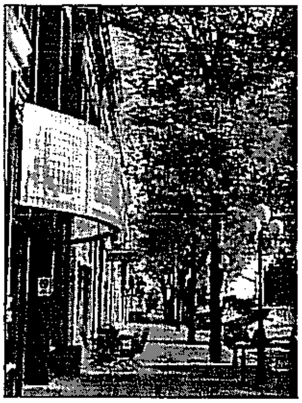
For more information visit: The Center for Urban Forest Research

Home   Calculate another tree

National Tree Benefit Calculator

Beta

Overall Benefits | Stormwater | Property Value | Energy | Air Quality | CO2 | About the model



The Tree Benefit Calculator allows anyone to calculate a first-order approximation of the benefits individual street-side trees provide. This tool is based on i-Tree's street tree assessment tool called STREETS. With minimal inputs of location, species and tree size, users will get an understanding of the environmental and economic value trees provide on an annual basis.

The Tree Benefit Calculator is intended to be simple and accessible. As such, this tool should be considered a starting point for understanding trees' value in the community rather than a scientific accounting of precise values. For more detailed information on urban and community forest assessments, visit the i-Tree website.

Credits:

- The National Tree Benefit Calculator was conceived and developed by Casey Trees and Davey Tree Expert Co.
- This tool is powered by i-Tree; the data generating the results comes from the i-Tree Tools CD ROM: http://www.itreetools.org/
- Significant text and graphical content was originally published by the USDA Forest Service's Center for Urban Forest Research through their Tree Guide series of publications. Credit should be given to authors of these publications.
- Facts about personal carbon production based on driving and flying courtesy of Conservation International
- For questions about this tool, contact Mike Alonzo (Casey Trees) or Scott Maco (Davey Tree Expert Co.)

CaseyTrees

The National Tree Benefit Calculator was conceived and developed by Casey Trees and Davey Tree Expert Co.

DAVEY

Attachment D

ISA

Arboriculture & Urban Forestry 2010. 36(5): 206–211

ARBORICULTURE URBAN FORESTRY

Multiple-year Protection of Ash Trees from Emerald Ash Borer with a Single Trunk Injection of Emamectin Benzoate, and Single-year Protection with an Imidacloprid Basal Drench

David R. Smitley, Joseph J. Doccola, and David L. Cox

Abstract. Green ash (*Fraxinus pennsylvanica* Marsh.) street trees ranging in size from 25 to 45 cm dbh were trunk injected with emamectin benzoate at rates of 0.10–0.60 g ai/2.54 cm dbh at three Michigan, U.S., locations in 2005 or 2006. Tree health was monitored by annual canopy thinning and dieback ratings for up to four years after a single treatment. Branch samples were collected in the autumn and the bark removed to count emerald ash borer larvae for most treatments over the same period of time. A single trunk injection treatment of emamectin benzoate at the 0.1, 0.2, or 0.4 g ai rate gave 100% control of emerald ash borer larvae in 98 of 99 treated trees for 2–3 years. Canopy ratings for treated trees remained similar for 2–4 years following trunk injection, while >50% of the control trees died during the same period of time. Ash trees that received a combination of an imidacloprid trunk injection and an imidacloprid basal drench or an annual imidacloprid basal drench had similar canopy ratings, but more larvae were found in branches from trees receiving the annual basal drench.

Key Words. *Agrilus planipennis*; Ash; Emerald Ash Borer; Emamectin Benzoate; Fraxinus; Trunk Injection.

Emerald ash borer (EAB), *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) is native to China, Korea, Taiwan, Japan, Russia, and Mongolia (Haack et al. 2002; Bray et al. 2007). It was first discovered in North America in 2002 after urban ash trees near Detroit, Michigan, U.S., were observed to decline and die at an unprecedented rate (Cappaert et al. 2005; Smitley et al. 2008). As of March 2010, EAB has been found in 13 U.S. states (Michigan, Ohio, Indiana, Illinois, Pennsylvania, Kentucky, Wisconsin, West Virginia, Maryland, Virginia, Missouri, Minnesota, and New York), and two Canadian provinces (Ontario and Québec) (USDA 2010). Unfortunately, EAB is causing nearly 100% mortality of ash (*Fraxinus* spp.) trees in any growing environment unless they are treated with efficacious insecticides (Cappaert et al. 2005; Poland and McCullough 2006; Smitley et al. 2008). As EAB continues to spread, an increasing number of municipalities and private property owners face difficult decisions about the removal of ash trees or investment in insecticide treatment of selected trees. Trunk injections of imidacloprid or emamectin benzoate, and basal soil applications of imidacloprid were adequately efficacious against emerald ash borer when applied every year, but little information is available on more than one year of control following a single treatment (Cappaert et al. 2005; Herms et al. 2009; Smitley et al. 2010). Up until this time, very few private property owners and a small proportion of municipalities have chosen to treat ash shade trees with insecticides, most likely because they believe insecticide treatments are more expensive than tree removal, or are not reliable for saving ash trees. During the past five years, trunk injections of emamectin benzoate have dramatically changed the cost/benefit analysis for treating ash trees to protect them from EAB. Data presented in this paper detail extremely efficacious and consistent protection over multiple years from a single application. This results in a lower annual cost than previous treatments, less injury to trees, and improved environmental safety because all of the insecticide is contained within the tree, with the exception of any residue that may be found in shed leaves (Kreutzweiser et al. 2008).

MATERIALS AND METHODS

Trunk injection of emamectin benzoate was evaluated for control of EAB larvae for 2–4 years following a single treatment of green ash (*Fraxinus pennsylvanica* Marsh.) street trees at three locations: Troy, East Lansing, and Adrian, Michigan. Emamectin benzoate treatments were compared with a control (nontreated) treatment at each location, and also with a standard treatment (imidacloprid trunk injection plus imidacloprid basal soil drench) at the Adrian site. Efficacy against EAB larvae was determined by collecting branch samples each autumn and removing the bark to count larvae and new galleries. Branches were pruned from the upper one-third of the tree canopy between September 15 and November 4 each year. Three branches, at least 1.0 m long and with a diameter between 4 and 12 cm, were removed from each tree by city arborists using a bucket truck, while additional crew provided assistance from the ground. Branches in this size range were chosen because in previous surveys the greatest density of EAB larvae was found in branches with a diameter of 8–12 cm (Marshall et al. 2009). All of the trees in this study were healthy at the start of testing, dead branches were rarely encountered with the exception of the control trees. When the canopy thinning of control trees exceeded 65% in July, some branches of these trees were found to be entirely dead during branch sampling in autumn. In September and early October, dead branches were avoided by only sampling branches with live leaves. In late October or early November, after leaf abscission, dead branches in control trees were avoided by scraping a patch of bark before cutting a branch to make sure it was alive. In some cases when it was not possible to find three live branches, only one or two branches were sampled. If no live branches were found then the tree was excluded from branch sampling and the number of replications was reduced accordingly. The first live branch found in the upper one-third canopy with a diameter of 4–12 cm was removed, and the remaining two branches were chosen to be as far away as possible from the first branch, and from each other, to maintain canopy balance. Bark splits and emergence holes were not considered in branch sampling. Branch samples were dropped to the ground where side branches and twigs were removed.

The branches were bundled and labeled for transport to Michigan State University's Entomology Field Research Farm in East Lansing for processing. When branches were processed, a 0.65 m-long section in the center of each branch was marked for scraping. The circumference of each branch was recorded at both ends of the scraped area. Surface area of each branch sample was determined by averaging the circumference of both ends, and using the formula for the surface area of a cylinder (L2πR). EAB galleries and larvae were counted after clamping branch sections between the ends of a modified saw-horse and removing the bark with a drawknife and chisel. Branch samples were processed in a heated shed at the Entomology Field Research Farm. Annual canopy thinning and dieback ratings were made in July each year by comparing the canopy of each tree with photographs in various stages of decline from 0% (healthy) to 100% (dead) in 10% increments (Smitley et al. 2008). Each tree was rated by two or three individuals and averaged across observations to obtain an annual defoliation rating. When study trees were rated at >90% canopy thinning and dieback in July, they were excluded from branch sampling, and the trees were removed by the city during the winter.

Treatment means were compared at each test site using the general linear models procedure (PROC GLM) of SAS 9.1 (SAS 2003). Levene's test was used as part of the GLM procedure to test for homogeneity of variance. Percent data were transformed to arcsine square root (x) before analysis. Means were separated at the $P = 0.05$ level using Tukey's option in the MEANS statement. This performs a Tukey's studentized range test (HSD) when group sizes are equal and a Tukey-Kramer test when group sizes are unequal (SAS 2003).

Troy Site 2005–2006

Street trees in a neighborhood in the northern part of Troy, MI, were used for this test. These trees were between 12 and 26-years-old and ranged in size from 18–61 cm diameter at breast height (dbh). The mean dbh was 35.6 cm. Trees in this test were planted and maintained by the City of Troy. The trees were located between the street and the sidewalk, and were spaced a minimum 15 m apart and in no case did they overlap. Tree trunks were measured and marked with a metal tag during the final two weeks of April 2005. Lawns in the neighborhood were well-maintained and received natural rainfall, but very few were irrigated. Trees were grouped into 10 blocks of six trees based on location in the neighborhood. Each treatment was replicated 10 times with each replicate consisting of an individual tree. The treatments at this site consisted of five rates (0.10, 0.20, 0.40, 0.48, and 0.60 g ai/2.54 cm dbh) of emamectin benzoate formulated by Arborjet, Inc. (Woburn, MA, U.S.) and Syngenta Crop Protection, Inc. (Greensboro, NC, U.S.) as a 4.0 % ME. All trees receiving an emamectin treatment were trunk-injected on May 25, 2005 using the Arborjet Tree IV™ system. The formulated insecticide was diluted 1:1 with water and put into a bottle pressurized to 3.16 kg/cm² before being injected through four evenly spaced sites on the lower trunk of each test tree. All treated trees received a single trunk injection treatment on May 25, 2005, with the exception of trees receiving the 0.1 g ai/2.54 cm rate, which were injected again May 23, 2006, at the same rate. Control trees were not injected or treated with any insecticide. Canopy thinning and dieback ratings were made for each tree on June 27, 2005, and June 15, 2006, as previously described. Upper branches were sampled using a bucket truck in October 2005, and the bark scraped as described.

East Lansing Site, 2005–2009

Green ash street trees in East Lansing, MI, between 14 and 28-years-old with a trunk diameter between 25 and 61 cm (mean = 35.6 cm) were maintained by the City of East Lansing. Trees were located between the street and the sidewalk in seven different neighborhoods and spaced a minimum of 15 m apart to prevent canopy overlap. Tree trunks were measured and marked with a metal tag during the first week of August 2005. Study trees were located in well-maintained lawns, but very few were irrigated. Treatments were replicated 10 times with individual tree replicates. A description of each of the four treatments in this test follows, including the formulation, type of application, rate, and application date.

(1) TREE-äge (emamectin benzoate, Syngenta Crop Protection, Inc.) was applied once at 10 ml/2.54 cm dbh (0.4 g ai) on September 27, 2005. To apply using the Arborjet Tree IV system, emamectin benzoate was diluted 1:1 with water and the solution was placed into a single pressurized 3.16 kg/cm² bottle connected to four injection needles. At four evenly-spaced distances around the trunk at a height of 20–40 cm above the ground, four holes were drilled into the sapwood and a plastic septum (Arborjet #4 plug) was inserted, through which needles were placed for injection. (2) Emamectin benzoate was applied once in spring 2007 at 2.5 ml/2.54 cm (0.1 g ai) dbh. Trunk injections were made with the Arborjet QUIK-jet™ micro-injector. The number of injection sites was determined by the formula: trunk cm dbh/5.08. Undiluted emamectin benzoate was injected in equal amounts through plastic septa. A rate of 0.1 g ai/2.54 cm dbh was injected on May 21, 2007. (3) Emamectin benzoate was trunk injected in spring 2007 at 5 ml/2.54 cm dbh (0.2 g ai). Injections were made once on May 21, 2007 with the micro-injector as previously described. One tree was dropped from the test after the first year because the homeowner applied an additional insecticide treatment. (4) Control treatment, these trees were not treated.

Annually in early July, and as previously described, canopy thinning and dieback ratings were made for each tree. When branch sampling was included, the branches were pruned from the upper one-third of the tree canopy between September 19 and 26, 2006, October 8 and 12, 2007, or November 4 and 10, 2008. Branches were collected, the bark removed, and EAB larvae counted as previously described.

Adrian Site, 2006–2009

Green ash street trees in Adrian, MI, between 14 and 28-years-old and from 15–65 cm dbh (mean dbh = 43 cm in 2008), were selected for this test. Test trees were located between the street and the sidewalk in five different neighborhoods. All of the green ash street trees in these neighborhoods were used in the study if they had at least a 15 cm dbh, appeared to be relatively healthy (less than 25% canopy thinning and dieback in September 2005), and were spaced at least 15 m apart. Tree trunks were measured and marked with a metal tag during the first week of September 2005. Study trees were located in low-maintenance lawns, and very few were irrigated. Each treatment was replicated 10 times with each replicate consisting of an individual tree. Four insecticide treatments and two control treatments were evaluated from June 2006 to July 2009. A description of each treatment follows, including the formulation, type of application, rate, and application date.

(1) Emamectin benzoate was applied once at 10 ml/2.54 cm dbh (0.4 g ai) on June 22, 2006. Trunk injections were made as previously described in the East Lansing test. (2) Emamectin benzoate, trunk injected as described in treatment (1). The only difference among these two treatments is that branch samples were collected and scraped to count larvae for treatment (1) but not for treatment (2).

Unlike the previous two studies sites, (3) Imidacloprid 75 WP, was applied as a basal drench at a rate of 1.42 g ai/2.54 cm dbh. Annual treatments consisted of the appropriate amount of imidacloprid mixed in 5.7 l of water and poured around the base of the tree within 70 cm of the trunk on June 27, 2006, May 24, 2007, and June 3, 2008. (4) Imidacloprid 5% SL, formulated by Arborjet and Bayer, was trunk-injected using the Arborjet Tree IV system at a rate of 0.2 g ai/ 2.54 cm trunk dbh. The formulated insecticide was diluted 1:1 with water and put into a bottle pressurized to 3.16 kg/cm^2 before being injected through four sites on the lower trunk of each test tree on June 22, 2006. In addition, trees in treatment (4) also received an imidacloprid basal drench at a rate of 1.42 g ai/2.54 cm dbh on June 6, 2007, and June 10, 2008. Trees in treatments (5) and (6) were left as untreated controls.

Canopy thinning and dieback ratings were made for each tree in early July of each year as previously described. Upper branches from trees in three treatments were collected between October 15 and 19, 2007. The bark was removed and EAB larvae counted as previously described.

RESULTS

Results from all three locations indicate a single trunk injection treatment of ash trees up to 45 cm dbh in size, made in May or June with emamectin benzoate at 0.1–0.4 g ai/2.54 cm dbh consistently gives nearly 100% control of EAB larvae even under intense pressure from EAB. Control trees declined rapidly at test sites due to EAB infestation, going from canopy thinning ratings of 19% to 54% in one year at Troy, 15% to 58% in four years at East Lansing, and from 15% to 87% in three years at Adrian, while canopy thinning ratings for ash trees that were trunk-injected with emamectin remained similar throughout the test period.

The death and removal of some trees decreased the number of replications in the third and fourth year of this study at the East Lansing and Adrian sites. Two trees at the Troy site and one tree at each of the East Lansing and Adrian sites were prematurely removed by city arborists during the winter by mistake. The average area of bark sampled per tree was 1067 cm^2, and ranged from 691 cm^2 to 3,741 cm^2, depending on the size of the tree.

Troy Site, 2005–2006

Green ash street trees in Troy were of a uniform size at the beginning of the test in June 2005 (29.2–30.5 ± 6.5 cm dbh) (Table 1). Initial tree health ratings as measured by canopy thinning were also similar, with no differences among treatments with the exception of trees receiving the highest rate of emamectin benzoate. Ash trees in that treatment started the test in June 2005 with a significantly higher level of canopy thinning (41.5 ± 26.0%) compared with control trees (19.0 ± 14.7%). This happened despite a random assignment of trees to treatments.

All rates of emamectin benzoate (0.1–0.6 g ai/2.54 cm dbh) were extremely effective when applied as a trunk injection in late May 2005. No larvae were found in any of the branch samples (30 branch sections per treatment) collected in October 2005, despite evidence of a moderate level of EAB tunneling injury from the year before (11.2 old galleries/m^2) and intense pressure from EAB in 2005 (59.2 live larvae/m^2 in control trees). Complete protection of ash trees from the trunk injections of emamectin at all tested rates in May 2005 was expressed the following summer (July 2006) in canopy thinning ratings that were as good or better than the initial ratings in June 2005 (16.7%–34.3% canopy thinning). Meanwhile, control trees declined rapidly in response to the extensive damage caused by 59.2 larvae/m^2, deteriorating to a mean rating of 59.2% canopy thinning and dieback in June 2006 (Table 1).

East Lansing Site, 2005–2009

Trees in the East Lansing site were of similar in size (28–38 ± 10 cm dbh) as those evaluated in Troy, but trunk injection treatments were initiated at an earlier stage of EAB infestation, when trees were still in excellent health based on average ratings of 7% to 17% canopy thinning (Table 2). EAB density increased four-fold in control trees from autumn 2007 to autumn 2008, going from 6.9±9.4 to 28.7±21.5 larvae/m^2, respectively. In stark contrast, no larvae were found in branch samples collected from trees that were trunk injected with emamectin benzoate three years earlier at a rate of 0.4 g ai/2.54 cm in September 2005. The same trees continued looking healthy through August 2009, when they were rated as having 13.8 ± 14.1% canopy thinning, compared to a mean rating of 58.1 ± 33.2% for control trees (Table 2). Emamectin trunk injections made in May 2007 at the 0.1 or 0.2 g ai/2.54 cm dbh rate also provided excellent protection, with no EAB larvae being found in branches collected from treated trees in October 2007 or October 2008.

Adrian Site, 2006–2009

Green ash street trees in all treatments were healthy at the beginning of the test in July 2006 (14.2%–16% canopy thinning, Table 3). Trees in the two control treatments remained healthy in 2007 (10.3%–12% canopy thinning), but declined rapidly in 2008 (58.3%–64 % canopy thinning and dieback) in response to intense pressure from EAB. Nearly all the ash trees in both control treatments were dead by July 2009 (84.6%–89.5% canopy thinning and dieback). During the same time period (2006–2009), trees that were trunk-injected with emamectin benzoate at 0.4 g ai/2.54 cm dbh in June 2006 remained healthy (Table 3). Trees receiving an annual basal drench of imidacloprid or a combination of imidacloprid basal drenches and an imidacloprid trunk injection also remained healthy during the test. Canopy ratings made in July 2009 and branch samples in October 2008 indicate ash trees receiving a single trunk injection of emamectin benzoate were well-protected for at least two years. Some EAB larvae were found in branch samples from one emamectin-treated tree in October 2007, but no larvae were found in any samples from emamectin treated trees in October 2008 (Table 3).

DISCUSSION

The authors of the study did not determine how important adult mortality was compared with larval mortality for trunk-injected trees in this study. However, when the bark was removed from branches in September and October live larvae in the emamectin-treated trees were not found, while dead EAB larvae were rarely found, suggesting that adult mortality, reduced egglaying, and mortality of young larvae are the most likely mechanisms of EAB control. Also, no EAB larvae were located in emamectin-treated trees, even when the trees were surrounded by heavily infested ash (28–45 EAB larvae/m²). It is likely that under these conditions some EAB females would fly from surrounding ash to deposit eggs on the study trees, yet no larvae in the emamectin treated trees were found. This suggests emamectin is toxic to EAB larvae that tunnel into treated trees.

Trunk injections of emamectin benzoate reduced the density of EAB larvae found in treated trees by nearly 100% compared with control trees at all three sites. In the longest-running test at the East Lansing site, a single trunk injection of emamectin benzoate at the 0.4 g ai/2.54 cm dbh rate applied to ash trees with a 41 cm dbh gave 100% control of EAB larvae for three years. This suggests ash trees of this size could be adequately protected by making a trunk injection treatment at the 0.4 g ai rate once every three or four years. Our results also showed trunk injections at the 0.1 or 0.2 g ai/per 2.54 cm dbh rate gave excellent protection of 38 cm dbh trees for two years. Ash trees could be protected with trunk injections made at the 0.1g ai rate once every two years. This is half the amount of ai that would be required to treat trees once every four years at the 0.4 ai rate.

Table 1. Troy, Michigan: emerald ash borer larval density in green ash street trees and canopy thinning ratings of the same trees for 1.5 years after trunk injection of emamectin benzoate at rates of 0.10–0.60 g ai/2.54 cm dbh. Data are means ± SD. Each treatment has 10 replications unless indicated otherwise under mean ± SD as (n).

Treatment	Treatment Dates	2005 dbh (cm)	2005 Canopy thinning (%)	2005 Larvae per m²	2006 Canopy thinning (%)
Emamectin 0.10 g/2.54 cm dbh	5-25-05 + 5-23-06	30.0 ± 3.6	16.5 ± 13.4 A	0 ± 0 A	16.7 ± 8.8
Emamectin 0.20 g/2.54 cm dbh	5-25-05	30.0 ± 3.6	25.0 ± 11.1 AB	0 ± 0 A	26.7 ± 25.0
Emamectin 0.40 g/2.54 cm dbh	5-25-05	30.5 ± 5.8	30.8 ± 22.1 AB	0 ± 0 A	28.2 ± 27.9
Emamectin 0.48 g/2.54 cm dbh	5-25-05	26.4 ± 6.4	26.8 ± 13.2 AB	0 ± 0 A	21.0 ± 14.5
Emamectin 0.60 g/2.54 cm dbh	5-25-05	30.4 ± 6.5	41.5 ± 26.0 B	0 ± 0 A	34.3 ± 40.2 (9)
Control	-	29.6 ± 4.8	19.0 ± 14.7 A	59.2 ± 72.0 B	54.3 ± 33.9 (9)

Means followed by the same letter are not significantly different at $P = 0.05$, by the Tukey-Kramer test.

Table 2. East Lansing, Michigan: emerald ash borer larval density in green ash street trees and canopy thinning ratings of the same trees for one to three years after a single trunk injection of emamectin benzoate at a rate of 0.4 g ai/ inch dbh on September 27, 2005, or at 0.2 or 0.1 ai/2.54 cm dbh on May 21, 2007. Data are means ± SD. Each treatment has 10 replications unless indicated otherwise under the mean ± SD by (n).

Treatment	Treatment Dates	2006 dbh (cm)	2006 canopy Thinning (%)	2007 canopy thinning	2007 Larvae per m²	2008 canopy Thinning (%)	2008 larvae per m²	2009 canopy thinning (%)
Emamectin trunk injection 0.4 g ai/inch dbh	Sept. 2005	39.9 ± 11.4	7.3 ± 8.9	12.8 ± 14.8	0 ± 0 A	19.3 ± 17.9A	0 ± 0 A	13.8 ± 14 A
Emamectin trunk injection 0.2 g ai/inch dbh	May 2007	29.2 ± 4.1	11.8 ± 1.6	17.3 ± 13.5 (9)	0 ± 0 A (9)	12.8 ± 8.8 A (9)	0 ± 0 A (9)	13.1 ± 13.3 A (9)
Emamectin trunk injection 0.1 g ai/inch dbh	May 2007	38.2 ± 7.3	17.0 ± 10.5	11.4 ± 15.9	0 ± 0 A	29.8 ± 29.4 A	0 ± 0 A (6)	10.4 ± 9.1 A (7)
Control		28.7 ± 10.6	16.0 ± 21.0	28.5 ± 27.9	6.9 ± 9.4 B	51.3 ± 30.2 B	28.7 ± 21.5 B	58.1 ± 33.2 B

Table 3. Adrian, Michigan: emerald ash borer larval density in green ash street trees and canopy thinning ratings of the same trees for 3–4 years after a single trunk injection of emamectin benzoate on June 22, 2006. Data are means ± SD. Each treatment has 10 replications unless shown under the mean ± SD as (n).

Treatment	Treatment dates	2008 dbh (cm)	2006 canopy thinning (%)	2007 canopy thinning (%)	2007 larvae per m²	2008 canopy thinning (%)	2008 larvae per m²	2009 canopy thinning (%)
Emamectin trunk injection 0.4 g ai/inch dbh	June 2006	45.0 ± 8.1 A[z]	14.4 ± 3.1 A	11.1 ± 6.0 A	-	12.3 ± 10.4 A	-	7.2 ± 6.7 A
Emamectin trunk injection 0.4 g ai/inch dbh	June 2006	43.1 ± 12.2A	16.0 ± 5.0 A	11.6 ± 6.5 A	2.4 ± 7.1 A	13.0 ± 12.7 A (9)	0 ± 0 A (9)	20.0 ± 8.0 A
Imidacloprid trunk injection + soil imidacloprid	June 2007 + June 2007, 2008	38.4 ± 9.8 A	14.9 ± 3.6 A	12.0 ± 4.9 A	-	13.5 ± 12.0 A	-	23.9 ± 10.1 A
Soil imidacloprid	June 2006, 2007, 2008	39.6 ± 15.0 A	14.2 ± 5.7 A	8.4 ± 4.0 A	3.6 ± 6.8 A	33.0 ± 25.8 AB	5.7 ± 5.6 AB (4)	30.3 ± 22.0 A
Control 1	-	43.4 ± 16.9 A	-	12.0 ± 15.1 A	-	58.3 ± 26.5 BC	23.6 ± 39.4 B (8)	89.5 ± 13.4 B
Control 2	-	44.7 ± 11.2 A	15.6 ± 5.4 A	10.3 ± 7.0 A	6.2 ± 6.6 A	64.0 ± 29.3 C	27.7 ± 28.9 B (7)	84.6 ± 12.0 B

[z] Means followed by the same letter are not significantly different at $P = 0.05$, by the Tukey-Kramer test.

Ash trees receiving an annual basal drench of imidacloprid or a combination of an imidacloprid basal drench and an imidacloprid trunk injection also appeared healthy as determined by canopy thinning ratings at the end of the Adrian test, but significantly more EAB larvae (5.7 per m²) were found in imidacloprid-treated trees compared with emamectin benzoate-treated trees (0.0 per m²).

Protection of ash trees for 2–4 years following a single insecticide treatment completely changes the prognosis for ash street trees and shade trees in North America after invasion of emerald ash border. Up until this time, insecticide treatment was reserved for only the most valuable trees because of the high cost of making frequent trunk injections. The multiple-year protection documented in this study reduces the projected cost of saving ash trees by at least 50%, bringing treatments well within the range of many homeowners and some cities or other municipalities. For example, one can compare the cost of hiring an arborist to treat a 31.4 cm dbh ash tree with annual trunk injections of IMA-jet (imidacloprid) at the 8 ml/2.54 cm dbh rate, to the cost of hiring the same arborist to treat every other year or every fourth year with TREE-äge (emamectin benzoate) at the 0.4 g ai/2.54 cm dbh rate. At the time of this writing the cost of the imidacloprid insecticide to the arborist is USD $23.92 per year, the cost of the emamectin benzoate insecticide is $26.13 per year when treating every third year, and $17.42 when treating every fourth year. Labor costs vary depending on the arborist, the number and size of trees being treated, and the location of the property. If one adds a labor charge of $50.00 per treatment-visit for the 31.4 cm dbh tree, then the total average cost per year over a three-year period would be $73.92/year for annual imidacloprid trunk injections, $51.13/year for emamectin benzoate injections made every third year, and $34.09/year for emamectin benzoate injections made every fourth year. This brings the cost of trunk injections into a much more practical range for homeowners, especially when weighed against the cost of tree removal which may be more than $1,500 for a large tree (62.8 cm dbh).

Data from Troy, East Lansing, and Adrian, MI, indicate most of the ash trees in cities along the leading edge of the contiguous EAB invasion front will perish within five years of when the first trees are found to die from EAB. This was certainly true for Troy, MI, and much of the Detroit Metropolitan area where the first ash trees began to die in 2004. By 2009 all of the ash trees were dead except ones that were protected with insecticide treatments or where young trees have sprouted from the stumps of dead ones. Sprouting ash trees and the germination of ash seed will guarantee the survival of EAB, but populations will be much smaller after the initial five to eight-year period when unprotected ash trees perish. This means the remaining ash trees will be easier to protect with insecticides.

Acknowledgments. We appreciate the assistance of Terrance Davis for supervising the field research, and the Cities of Troy, East Lansing, and Adrian, for assisting with branch sampling. This research was partially supported by Arborjet, Inc., Syngenta Crop Science, and the Michigan Agricultural Experiment Station.

LITERATURE CITED

Bray, A.M., L.S. Bauer, R.A. Hauck, T. Poland, and J.J. Smith. 2007. Invasion Genetics of Emerald Ash Borer (Agrilus planipennis Fairmaire) in North America. In: Proceedings from the Third Workshop on Genetics of Bark Beetles and Associated Microorganisms, B. Bentz, A. Cognato, and K. Raffa (Eds.).

Cappaert, D., D.G. McCullough, T.M. Poland, and N.W. Siegert. 2005. Emerald ash borer in North America: a research and regulatory challenge. American Entomologist 51:152–165.

Haack, R.A., E. Jendek, H. Liu, K.R. Marchant, T.R. Petrice, T.M. Poland, and H. Ye. 2002. The emerald ash borer: a new exotic pest in North America. Newsletter of the Michigan Entomological Society 47:1–5.

Herms, D.A., D.G. McCullough, D.R. Smitley, C.S. Sadof, R.C. Williamson, and P.L. Nixon. 2009. Insecticide options for protecting ash trees from emerald ash borer. North Central IPM Center Bulletin. 12 pp.

Kreutzwiser, D.R., K.R. Good, D.I. Chartrand, T.A. Scarr, and D.G. Thompson. 2008. Are leaves that fall from imidacloprid-treated maple trees to control Asian longhorned beetles toxic to non-target decomposer organisms? Journal of Environmental Quality 37:639–646.

Marshall, J.M., A.J. Storer, I. Fraser, and V.C. Mastro. 2009. A predictive model for the detection of Agrilus planipennis larvae in ash trees. Entomologia Experimentalis et Applicata 133:1–16.

Poland, T.M., and D.G. McCullough. 2006. Emerald ash borer: invasion of the urban forest and the threat to North America's ash resource. Journal of Forestry 104:118–124.

SAS 2003. SAS 9.1. SAS Institute Inc. Cary, NC.

Smitley, D., T. Davis, and E. Rebek. 2008. Progression of ash canopy thinning and dieback outward from the initial infestation of emerald ash borer (Coleoptera: Buprestidae) in Southeast Michigan. Journal of Economic Entomology 101:1643–1650.

Smitley, D.R., E.J. Rebek, R.N. Royalty, T.W. Davis, and K.F. Newhouse. 2010. Protection of individual ash trees from emerald ash borer (Coleoptera: Buprestidae) with basal soil applications of imidacloprid. Journal of Economic Entomology 103:119–126.

USDA APHIS. 2010. Cooperative Emerald Ash Borer Project. <http://www.emeraldashborer.info/files/MultiState_EABpos.pdf>.

David R. Smitley (corresponding author)
Department of Entomology
Michigan State University
East Lansing, MI 48824, U.S.
smitley@msu.edu

Joseph J. Doccola
Arborjet, Inc.
99 Blueberry Hill Road
Woburn, MA 01801, U.S.
joedoccola@arborjet.com

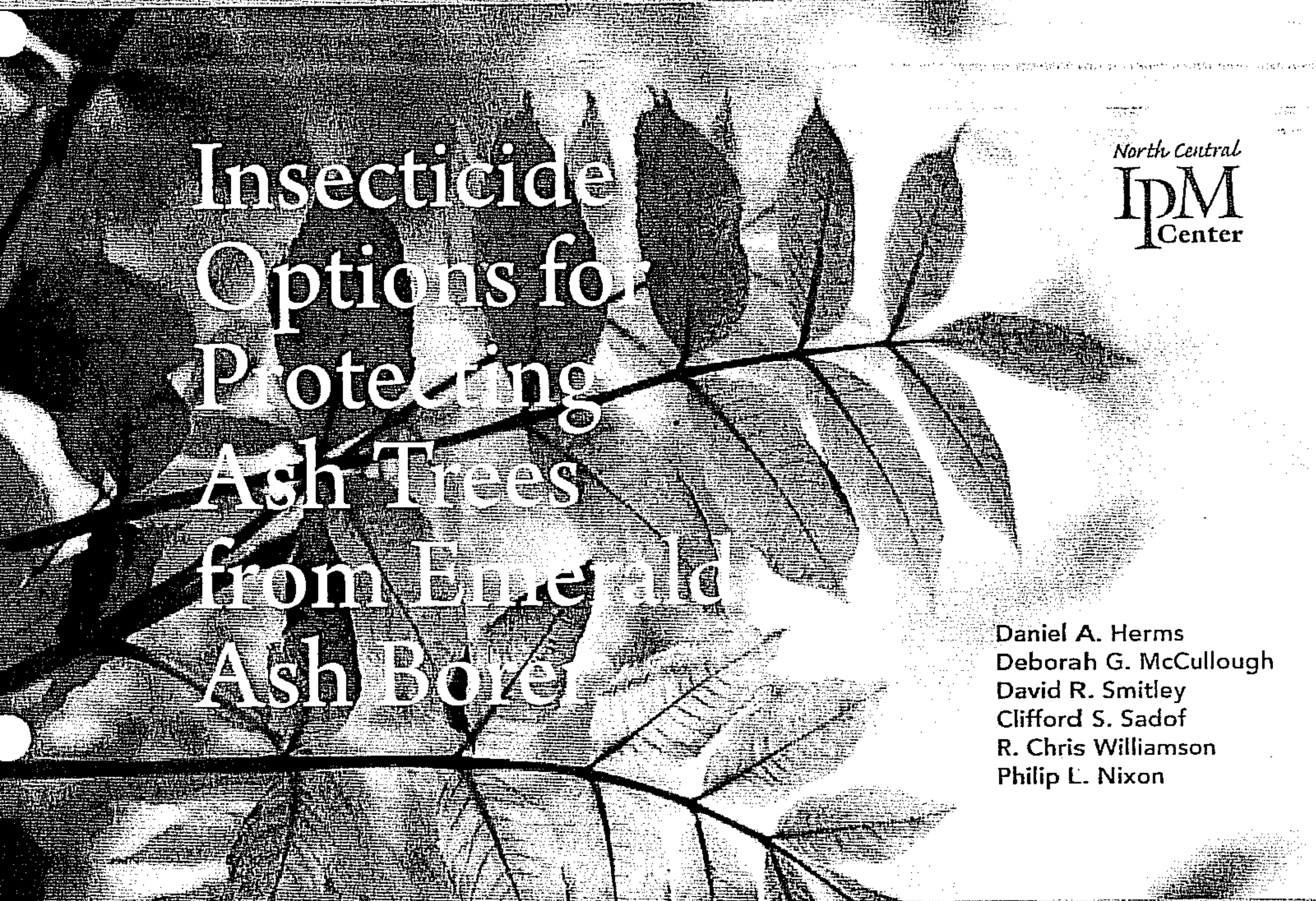
David L. Cox
Syngenta Crop Protection, Inc.
14446 Huntington Rd
Madera, CA 93636, U.S.
david.cox@syngenta.com

Résumé. Des frênes de Pennsylvanie (*Fraxinus pennsylvanica* Marsh.) de rue de 25 à 45 cm de DHP ont été injectés au tronc avec du benzoate d'emamectine à des taux de 0,1 à 0,6 g d'ingrédient actif par 2,54 cm de DHP, et ce au Michigan en 2005 ou 2006. La condition de santé des arbres a été suivie en regard des taux de densité de la cime et de dépérissement jusqu'à quatre ans après un traitement unique. Des échantillons de branches ont été récoltées en automne et l'écorce enlevée pour faire un décompte des larves d'agrile du frêne pour la plupart des traitements durant la même période. Une injection unique dans le tronc de benzoate d'emamectine à des taux de 0,1 ou 0,4 g d'ingrédient actif a produit un contrôle à 100% des larves d'agrile du frêne sur 98 des 99 arbres traités durant une période de 2 à 3 ans. Les cimes sont demeurées similaires chez les arbres traités durant une période de 2 à 4 ans après l'injection dans le tronc tandis que plus de 50% des arbres témoins mouraient au cours de la même période. Les frênes qui ont reçu une combinaison d'imidacloprid par injection dans le tronc et par injection dans le sol ou par injection annuelle dans le sol avaient des cimes similaires, mais plus de larves ont été découvertes dans les branches des arbres qui recevaient des injections annuelles dans le sol.

Zusammenfassung. Grüne Eschen als Straßenbäume in der Größe von 25–45 cm Stammdurchmesser wurden im Stamm mit Emamectin Benzoat in Raten von 0,10–0,60 g ai/2,54 cm Stammdurchmesser an drei verschiedenen Standorten in Michigan, U.S. injiziert. Die Baumgesundheit wurde überwacht durch jährliches Ausdünnen der Krone und Bewertung der Totholzbildung für bis zu 4 Jahren nach einer Behandlung. Im Herbst wurden Astproben gesammelt und bei den meisten Behandlungen auch die Rinde entfernt, um die Larven des Eschenbohrers im gleichen Zeitraum zu zählen. Eine einzelne Stamminjektion mit Emamectin Benzoat mit Raten von 0,1, 0,2 und 0,4 g ai ergab eine 100% Kontrolle der Larven in 98 von 99 behandelten Bäumen in 2–3 Jahren. Die Kronenbewertung bei behandelten Bäumen blieb über für 2–4 Jahre nach der Behandlung gleich, während >50% der kontrollierten Bäume im gleichen Zeitraum abstarben. Eschen, die eine Kombination aus Imidacloprid-Stamm-Injektion und Imidacloprid-Wurzelaufguss oder einen jährlichen Imidacloprid-Wurzelaufguss erhielten, hatten ähnliche Kronenbilder, aber es wurden mehr Larven in Ästen von Bäumen gefunden, die einen jährlichen Imidacloprid-Wurzelaufguss erhielten.

Resumen. Árboles de fresno (*Fraxinus pennsylvanica* Marsh.) de tamaños de 25 a 45 cm de DAP fueron inyectados al tronco con benzoato de emamectin a tasas de 0.10 – 0.60 g/2.54 cm de DAP en tres localidades de Michigan en 2005 y 2006. Fue monitoreada la salud de los árboles por muerte descendente y aclareos de copa anuales por cuatro años después del tratamiento. Se colectaron muestras de ramas en el otoño y la corteza removida para contar las larvas del barrenador esmeralda del fresno para los tratamientos en el mismo período. Un solo tratamiento de inyección al tronco de benzoato de emamectin a una tasa de 0.1, 0.2 o 0.4 g dio 100% de control de larvas del barrenador esmeralda del fresno en 98 de 99 árboles tratados para 2-3 años. Los estados de las copas para los árboles tratados permanecieron similares para 2-4 años después de la inyección, mientras que >50% de los árboles tratados murió durante el mismo período de tiempo. Los fresnos que recibieron una combinación de una inyección al tronco de imidacloprid y una zanja basal de imidacloprid o un tratamiento anual de zanja con imidacloprid tuvo estados de copa similares, pero se encontraron más larvas en ramas de árboles que recibieron zanjas anuales.

Attachment E



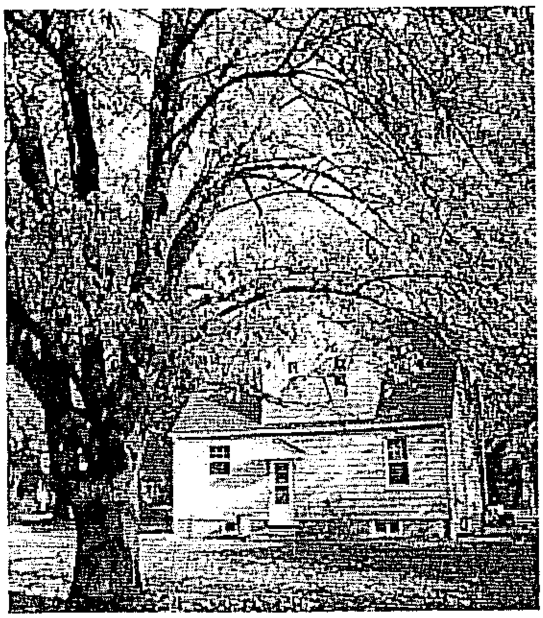
Insecticide Options for Protecting Ash Trees from Emerald Ash Borer

North Central IPM Center

Daniel A. Herms
Deborah G. McCullough
David R. Smitley
Clifford S. Sadof
R. Chris Williamson
Philip L. Nixon

The Ohio State University Extension OARDC
Michigan State University
Purdue University
UW Extension Cooperative Extension
Illinois

Insecticide Options for Protecting Ash Trees from Emerald Ash Borer



Daniel A. Herms[1], Deborah G. McCullough[2], David R. Smitley[3], Clifford S. Sadof[4], R. Chris Williamson[5], and Philip L. Nixon[6]

[1]Professor, Department of Entomology, Ohio Agricultural Research and Development Center, The Ohio State University, Wooster, OH 44691

[2]Professor, Department of Entomology and Department of Forestry, Michigan State University, East Lansing, MI 48824

[3]Professor, Department of Entomology, Michigan State University, East Lansing, MI 48824

[4]Professor, Department of Entomology, Purdue University, West Lafayette, IN 47907

[5]Associate Professor, University of Wisconsin-Madison and University of Wisconsin Cooperative Extension, Madison, WI 53706

[6]Extension Entomologist, Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign, Urbana, IL 61801

Contents

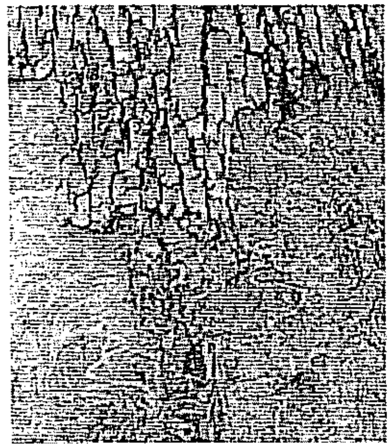
Insecticide Options for Protecting Ash Trees from Emerald Ash Borer

Emerald ash borer (*Agrilus planipennis* Fairmaire), an invasive insect native to Asia, has killed tens of millions of ash trees in urban, rural and forested settings. This beetle was first discovered in 2002 in southeast Michigan and Windsor, Ontario. As of June 2009, emerald ash borer (EAB) infestations were known to be present in 12 states and two Canadian provinces. Many homeowners, arborists and tree care professionals want to protect valuable ash trees from EAB. Scientists have learned much about this insect and methods to protect ash trees since 2002. This bulletin is designed to answer frequently asked questions and provide the most current information on insecticide options for controlling EAB.

Answers to Frequently Asked Questions

What options do I have for treating my ash trees?

If you elect to treat your ash trees, there are several insecticide options available and research has shown that treatments can be effective. Keep in mind, however, that controlling insects that feed under the bark with insecticides has always been difficult. This is especially true with EAB because our native North American ash trees have little natural resistance to this pest. In university trials, some insecticide treatments were effective in some sites, but the same treatments failed in other sites. Furthermore, in some studies conducted over multiple years, EAB densities continued to increase in individual trees despite annual treatment. Some arborists have combined treatments to increase the odds of success (e.g., combining a cover spray with a systemic treatment).



Our understanding of how EAB can be managed successfully with insecticides has increased substantially in recent years. The current state of this understanding is detailed in the bulletin. It is important to note that research on management of EAB remains a work in progress. Scientists from universities, government agencies and companies continue to conduct intensive studies to understand how and when insecticide treatments will be most effective.

I know my tree is already infested with EAB. Will insecticides still be effective?

If a tree has lost more than 50 percent of its canopy, it is probably too late to save the tree. Studies have shown that it is best to begin using insecticides while ash trees are still relatively healthy. This is because most of the insecticides used for EAB control act systemically — the insecticide must be transported within the tree. In other words, a tree must be healthy enough to carry a systemic

Herms, McCullough, Smitley, Sadof, Williamson, Nixon

insecticide up the trunk and into the branches and canopy. When EAB larvae feed, their galleries injure the phloem and xylem that make up the plant's circulatory system. This interferes with the ability of the tree to transport nutrients and water, as well as insecticides. As a tree becomes more and more infested, the injury becomes more severe. Large branches or even the trunk can be girdled by the larval galleries.

Studies have also shown that if the canopy of a tree is already declining when insecticide treatments are initiated, the condition of the tree may continue to deteriorate during the first year of treatment. In many cases, the tree canopy will begin to improve in the second year of treatment. This lag in the reversal of canopy decline probably reflects the time needed for the tree to repair its vascular system after the EAB infestation has been reduced.

My ash tree looks fine but my county is quarantined for EAB. Should I start treating my tree?

Scientists have learned that ash trees with low densities of EAB often have few or no external symptoms of infestation. Therefore, if your property is within a county that has been quarantined for EAB, your ash trees are probably at risk. Similarly, if your trees are outside a quarantined county but are still within 10-15 miles of a known EAB infestation, they may be at risk. If your ash trees are more than 15 miles beyond this range, it is probably too early to begin insecticide treatments. Treatment programs that begin too early are a waste of money. Remember, however, that new EAB infestations have been discovered every year since 2002 and existing EAB populations will build and spread over time. Stay up to date with current EAB quarantine maps and related information at www.emeraldashborer.info. You can use the links in this Web site to access specific information for individual states. When an EAB infestation is detected in a state or county for the first time, it will be added to these maps. Note, however, that once an area has been quarantined, EAB surveys generally stop, and further spread of EAB in that area will not be reflected on future maps.

I realize that I will have to protect my ash trees from EAB for several years. Is it worth it?

The economics of treating ash trees with insecticides for EAB protection are complicated. Factors that can be considered include the cost of the insecticide and expense of application, the size of the trees, the likelihood of success, and potential costs of removing and replacing the trees. Until recently, insecticide products had to be applied every year. A new product that is effective for two years or even longer (emamectin benzoate) has altered the economics of treating ash trees. As research progresses, costs and methods of treating trees will continue to change and it will be important to stay up to date on treatment options.

Benefits of treating trees can be more difficult to quantify than costs. Landscape trees typically increase property values, provide shade and cooling, and contribute to the quality of life in a neighborhood. Many people are sentimental about their trees. These intangible qualities are important and should be part of any decision to invest in an EAB management program.

It is also worth noting that the size of EAB populations in a specific area will change over time. Populations initially build very slowly, but later increase rapidly as more trees become infested. As EAB populations reach their peak, many trees will decline and die within one or two years. As untreated ash trees in the area succumb, however, the local EAB population will decrease substantially. Scientists do not yet have enough experience with EAB to know what will happen over time to trees that survive the initial wave of EAB. Ash seedlings and saplings are common in forests, woodlots, and right-of-ways, however, and it is unlikely that EAB will ever completely disappear from an area. That means that ash trees may always be at some risk of being attacked by EAB, but it seems reasonable to expect that treatment costs could eventually decrease as pest pressure declines after the EAB wave has passed.

Insecticide Options for Controlling EAB

Insecticides that can effectively control EAB fall into four categories: (1) systemic insecticides that are applied as soil injections or drenches; (2) systemic insecticides applied as trunk injections; (3) systemic insecticides applied as lower trunk sprays; and (4) protective cover sprays that are applied to the trunk, main branches, and (depending on the label) foliage.

Insecticide formulations and application methods that have been evaluated for control of EAB are listed in Table 1. Some are marketed for use by homeowners while others are intended for use only by professional applicators. The "active ingredient" refers to the compound in the product that is actually toxic to the insect.

Formulations included in Table 1 have been evaluated in multiple field trials conducted by the authors. Inclusion of a product in Table 1 does not imply that it is endorsed by the

Table 1. Insecticide options for professionals and homeowners for controlling EAB that have been tested in multiple university trials. Some products may not be labeled for use in all states. Some of the listed products failed to protect ash trees when they were applied at labeled rates. Inclusion of a product in this table does not imply that it is endorsed by the authors or has been consistently effective for EAB control. See text for details regarding effectiveness.

Insecticide Formulation	Active Ingredient	Application Method	Recommended Timing
	Professional Use Products		
Merit® (75WP, 75WSP, 2F)	Imidacloprid	Soil injection or drench	Mid-fall and/or mid- to late spring
Xytect™ (2F, 75WSP)	Imidacloprid	Soil injection or drench	Mid-fall and/or mid- to late spring
IMA-jet®	Imidacloprid	Trunk injection	Early May to mid-June
Imicide®	Imidacloprid	Trunk injection	Early May to mid-June
TREE-äge™	Emamectin benzoate	Trunk injection	Early May to mid-June
Inject-A-Cide B®	Bidrin®	Trunk injection	Early May to mid-June
Safari™ (20 SG)	Dinotefuran	Systemic bark spray	Early May to mid-June
Astro®	Permethrin	Preventive bark and foliage cover sprays	2 applications at 4-week intervals; first spray should occur when black locust is blooming (early May in southern Ohio to early June in mid-Michigan)
Onyx™	Bifenthrin	Preventive bark and foliage cover sprays	2 applications at 4-week intervals; first spray should occur when black locust is blooming (early May in southern Ohio to early June in mid-Michigan)
Tempo®	Cyfluthrin	Preventive bark and foliage cover sprays	2 applications at 4-week intervals; first spray should occur when black locust is blooming (early May in southern Ohio to early June in mid-Michigan)
Sevin® SL	Carbaryl	Preventive bark and foliage cover sprays	2 applications at 4-week intervals; first spray should occur when black locust is blooming (early May in southern Ohio to early June in mid-Michigan)
	Homeowner Formulation		
Bayer Advanced™ Tree & Shrub Insect Control	Imidacloprid	Soil drench	Mid-fall or mid- to late spring

authors or has been consistently effective for EAB control. Please see the following sections for specific information about results from these trials. Results of some tests have also been posted on www.emeraldashborer.info.

Strategies for the most effective use of these insecticide products are described below. It is important to note that pesticide labels and registrations change constantly and vary from state to state. It is the legal responsibility of the pesticide applicator to read, understand and follow all current label directions for the specific pesticide product being used.

Using Insecticides to Control EAB

Soil-Applied Systemic Insecticides

Systemic insecticides applied to the soil are taken up by the roots and translocated throughout the tree. The most widely tested soil-applied systemic insecticide for control of EAB is imidacloprid, which is available under several brand names for use by professional applicators and homeowners (see Table 1). All imidacloprid formulations can be applied as a drench by mixing the product with water, then pouring the solution directly on the soil around the base of the trunk. Dinotefuran was recently labeled for use against EAB as a soil treatment (in addition to its use as a basal trunk spray discussed below). Studies to test its effectiveness as a soil treatment are currently underway in Michigan and Ohio.

Imidacloprid soil applications should be made when the soil is moist but not saturated. Application to water-logged soil can result in poor uptake if the insecticide becomes excessively diluted and can also result in puddles of insecticide that could wash away, potentially contaminating surface waters and storm sewers. Insecticide uptake will also be limited when soil is excessively dry. Irrigating the soil surrounding the base of the tree before the insecticide application can improve uptake.

The application rates for the homeowner product (Bayer Advanced™ Tree & Shrub Insect Control) and professional formulations of imidacloprid are very similar. Homeowners apply the same amount of active ingredient that professionals apply. However, there are certain restrictions on the use of homeowner formulations that do not apply to professional formulations. Homeowner formulations of imidacloprid can be applied only as a drench. It is not legal to inject these products into the soil, although some companies have marketed devices to homeowners specifically for this purpose. Homeowners are also restricted to making only one application per year. Several generic products containing imidacloprid are available to homeowners, but the formulations vary and the effectiveness of these products has not yet been evaluated in university tests.

Soil drenches offer the advantage of requiring no special equipment for application other than a bucket or watering can. However, imidacloprid can bind to surface layers of organic matter, such as mulch or leaf litter, which can reduce uptake by the tree. Before applying soil drenches, it is important to remove, rake or pull away any mulch or dead leaves so the insecticide solution is poured directly on the mineral soil.

Imidacloprid formulations labeled for use by professionals can be applied as a soil drench or as soil injections. Soil injections require specialized equipment, but offer the advantage of placing the insecticide under mulch or turf and directly into the root zone. This also can help to prevent runoff on sloped surfaces. Injections should be made just deep enough to place the insecticide beneath the soil surface (2-4 inches). Soil injections should be made within 18 inches of the trunk where the density of fine roots is highest. As you move away from the tree, large radial roots diverge like spokes on a wheel and studies have shown that uptake is higher when the product is applied at the base of the trunk. There are no studies that show that applying fertilizer with imidacloprid enhances uptake or effectiveness of the insecticide.

Optimal timing for imidacloprid soil injections and drenches is mid-April to mid-May, depending on your region. Allow four to six weeks for uptake and distribution of the insecticide within the tree. In southern Ohio, for example, you would apply the product by mid-April; in southern Michigan, you should apply the product by early to mid-May. When treating larger trees (e.g., with trunks larger than 12 inches in diameter), treat on the earlier side of the recommended timing. Large trees will require more time for uptake and transportation of the insecticide than will small trees. Recent tests show that imidacloprid soil treatments can also be successful when applied in the fall.

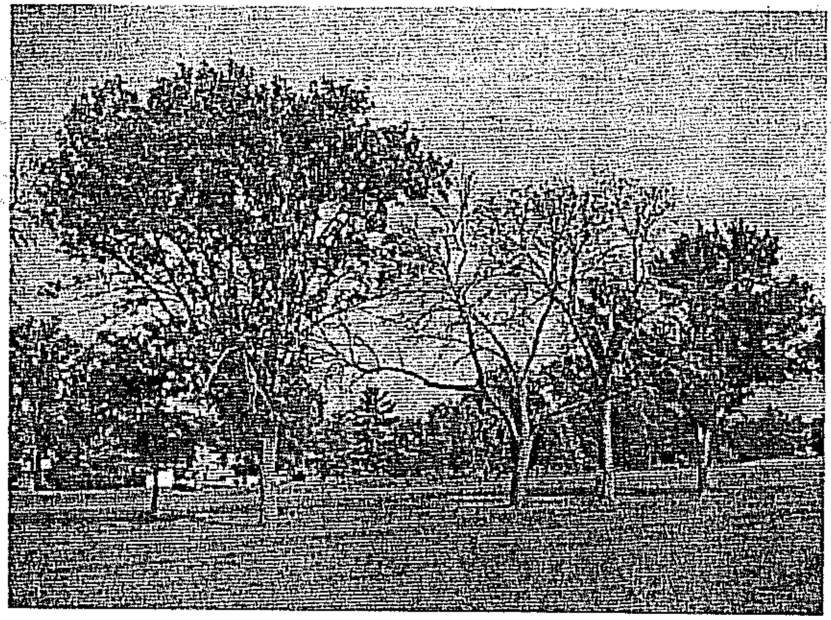
Trunk-Injected Systemic Insecticides

Several systemic insecticide products can be injected directly into the trunk of the tree including formulations of imidacloprid and emamectin benzoate (see Table 1). An advantage of trunk injections is that they can be used on sites where soil treatments may not be practical or effective, including trees growing on excessively wet, compacted or restricted soil environments. However, trunk injections do wound the trunk, which may cause long-term damage, especially if treatments are applied annually.

Products applied as trunk injections are typically absorbed and transported within the tree more quickly than soil applications. Allow three to four weeks for most trunk-injected products to move through the tree. Optimal timing of trunk injections occurs after trees have leafed out in spring but before EAB eggs have hatched, or generally between mid-May and mid-June. Uptake of trunk-injected insecticides will be most efficient when trees are actively transpiring. Best results are usually obtained by injecting trees in the morning when soil is moist but not saturated. Uptake will be slowed by hot afternoon temperatures and dry soil conditions.

Noninvasive, Systemic Basal Trunk Sprays

Dinotefuran is labeled for application as a noninvasive, systemic bark spray for EAB control. It belongs to the same chemical class as imidacloprid (neonicotinoids) but is much more soluble. The formulated insecticide is sprayed on the lower five to six feet of the trunk using a common garden sprayer and low pressure. Research has shown that the insecticide penetrates the bark and moves systemically throughout the rest of the tree.



Healthy ash trees that have been protected with insecticides growing next to untreated ash trees killed by EAB.

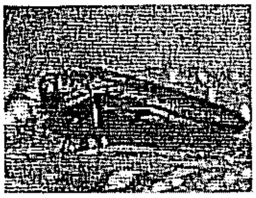
Dinotefuran can be mixed with surfactants that may facilitate its movement into the tree, particularly on large trees with thick bark. However, in field trials, adding a surfactant did not consistently increase the amount of insecticide recovered from the leaves of treated trees.

The basal trunk spray offers the advantage of being quick and easy to apply and requires no special equipment other than a garden sprayer. This application technique does not wound the tree, and when applied correctly, the insecticide does not enter the soil.

Protective Cover Sprays

Insecticides can be sprayed on the trunk, branches and (depending on the label) foliage to kill adult EAB beetles as they feed on ash leaves, and newly hatched larvae as they chew through the bark. Thorough coverage is essential for best results. Products that have been evaluated as cover sprays for control of EAB include some specific formulations of permethrin, bifenthrin, cyfluthrin and carbaryl (see Table 1).

Protective cover sprays are designed to prevent EAB from entering the tree and will have no effect on larvae feeding under the bark. Cover sprays should be timed to occur when most adult beetles are feeding and beginning to lay eggs. Adult activity can be difficult to monitor because there are no effective pheromone traps for EAB. However, first emergence of EAB adults generally occurs between 450-550 degree days (starting date of January 1, base temperature of 50°F), which corresponds closely with full bloom of black locust (*Robinia pseudoacacia*). For best results, consider two applications, one at 500 DD_{50} (as black locust approaches full bloom) and a second spray four weeks later.



EAB adults must feed on foliage before they become reproductively mature.

How Effective Are Insecticides for Control of EAB?

Extensive testing of insecticides for control of EAB has been conducted by researchers at Michigan State University (MSU) and The Ohio State University (OSU). Results of some of the MSU trials are available at www.emeraldashborer.info.

Soil-Applied Systemic Insecticides

Efficacy of imidacloprid soil injections for controlling EAB has been inconsistent; in some trials EAB control was excellent, while others yielded poor results. Differences in application protocols and conditions of the trials have varied considerably, making it difficult to reach firm conclusions about sources of variation in efficacy. For example, an MSU study found that low-volume soil injections of imidacloprid applied to small trees averaging 4 inches in DBH (diameter of the trunk at breast height) using the Kioritz applicator (a hand-held device for making low-volume injections) provided good control at one site. However, control was poor at another site where the same application protocols were used to treat larger trees (13-inch DBH). Imidacloprid levels may have been too low in the larger trees to provide adequate control. Higher pest pressure at the second site also may have contributed to poor control in the large trees.

In the same trials, high-pressure soil injections of imidacloprid (applied in two concentric rings, with one at the base of the tree and the other halfway to the drip line of the canopy) provided excellent control at one site. At another site, however, soil injections applied using the same rate, timing and application method were completely ineffective, even though tree size and infestation pressure were very similar. It should be noted that recent studies have shown that imidacloprid soil injections made at the base of the trunk result in more effective uptake than applications made on grid or circular patterns under the canopy.

Imidacloprid soil drenches have also generated mixed results. In some studies conducted by MSU and OSU researchers, imidacloprid soil drenches have provided excellent control of EAB. However, in other studies, control has been inconsistent. Experience and research indicate that imidacloprid soil drenches are most effective on smaller trees and control of EAB on trees with a DBH that exceeds 15 inches is less consistent.

This inconsistency may be due to the fact that application rates for systemic insecticides are based on amount of product per inch of trunk diameter or circumference. As the DBH of a tree increases, the amount of vascular tissue, leaf area and biomass that must be protected by the insecticide increases exponentially. Consequently, for a particular application rate, the amount of insecticide applied as a function of tree size is proportionally decreased as trunk diameter increases. Hence, the DBH-based application rates that effectively protect relatively small trees can be too low to effectively protect large trees. Some systemic insecticide products address this issue by increasing the application rate for large trees.

In an OSU study with larger trees (15- to 22-inch DBH), Xytect™ (imidacloprid) soil drenches provided consistent control of EAB when applied experimentally at twice the rate that was allowed at that time. Recently, the Xytect™ label was modified to allow the use of this higher rate, which we now recommend when treating trees larger than 15-inch DBH. Merit® imidacloprid formulations, however, are not labeled for application at this high rate. Therefore, when treating trees greater than 15-inch DBH with Merit® soil treatments, two applications are recommended, either in the fall and again in the spring, or twice in the spring, about four weeks apart (for example in late April and again in late May). This is not an option for Bayer Advanced™ Tree and Shrub Insect Control and other homeowner formulations of imidacloprid, which are limited by the label to one application per year. Homeowners wishing to protect trees larger than 15-inch DBH should consider having their trees professionally treated.

Treatment programs must comply with any limits specified on the label regarding the maximum amount of insecticide that can be applied per acre during a given year.

Trunk-Injected Systemic Insecticides

Emamectin benzoate • In several intensive studies conducted by MSU and OSU researchers, a single injection of emamectin benzoate in mid-May or early June provided excellent control of EAB for at least two years, even under high pest pressure. For example, in a highly-replicated study conducted on trees ranging in size from 5- to 20-inch DBH at three sites in Michigan, untreated trees had an average of 68 to 132 EAB larvae per m^2 of bark surface, which represents high pest pressure. In contrast, trees treated with emamectin benzoate had, on average, only 0.2 larvae per m^2, a reduction of > 99 percent. When additional trees were felled and debarked two years after the emamectin benzoate injection, there were still virtually no larvae in the treated trees, while adjacent, untreated trees at the same sites had hundreds of larvae.

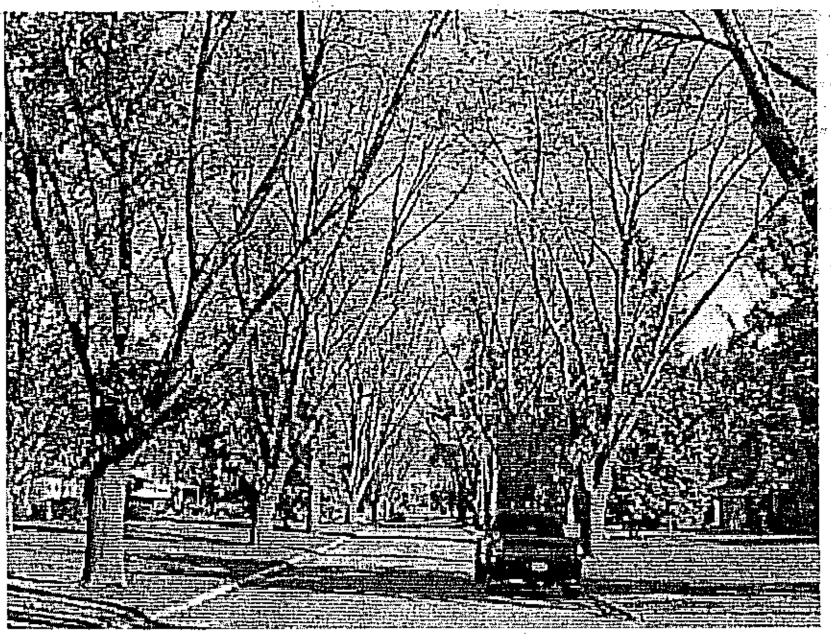
In two OSU studies conducted in Toledo with street trees ranging in size from 15- to 25-inch DBH, a single application of emamectin benzoate also provided excellent control for two years. There was no sign of canopy decline in treated trees and very few emergence holes, while the canopies of adjacent, untreated trees exhibited severe decline and extremely high numbers of emergence holes.

One study suggests that a single injection of emamectin benzoate may even control EAB for three years. Additional studies to further evaluate the long-term effectiveness of emamectin benzoate are underway. To date, this is the only product that controls EAB for more than one year with a single application. In addition, in side-by-side comparisons with other systemic products (neonicotinoids), emamectin benzoate was more effective.

Imidacloprid • Trunk injections with imidacloprid products have provided varying degrees of EAB control in trials conducted at different sites in Ohio and Michigan. In an MSU study, larval density in trees treated with Imicide® injections were reduced by 60 percent to 96 percent, compared to untreated controls. There was no apparent relationship between efficacy and trunk diameter or infestation pressure. In another MSU trial, imidacloprid trunk injections made in late May were more effective than those made in mid-July, and IMA-jet® injections provided higher levels of control than did Imicide®, perhaps because the IMA-jet® label calls for a greater amount of active ingredient to be applied on large trees. In an OSU study in Toledo, IMA-jet® provided excellent control of EAB on 15- to 25-inch trees under high pest pressure when trees were injected annually. However, trees that were injected every other year were not consistently protected.

In a discouraging study conducted in Michigan, ash trees continued to decline from one year to the next despite being injected in both years with either Bidrin (Inject-A-Cide B®) or imidacloprid. The imidacloprid treatments consisted of two consecutive years of Imicide® (10% imidacloprid) applied using Mauget® micro-injection capsules, or an experimental 12% formulation of imidacloprid in the first year followed by Pointer™ (5% imidacloprid) in the second year with both applied using the Wedgle™ Direct-Inject™ System. All three treatment regimes suppressed EAB infestation levels in both years, with Imicide® generally providing best control under high pest pressure in both small (six-inch DBH) and larger (16-inch DBH) caliper trees. However, larval density increased in treated and untreated trees from one year to the next. Furthermore, canopy dieback increased by at least 67 percent in all treated trees (although this was substantially less than the amount of dieback observed in untreated trees). Even consecutive years of these treatments only slowed ash decline under severe pest pressure. In another MSU study, ACECAP® trunk implants (active ingredient is acephate) did not adequately protect large trees (greater than 15-inch DBH) under high pest pressure.

EAB larvae damage the vascular system of the tree as they feed, which interferes with movement of systemic insecticides in the tree.



Noninvasive Basal Trunk Sprays with Dinotefuran

Studies to date indicate that systemic basal trunk sprays with dinotefuran are about as effective as imidacloprid treatments. MSU and OSU studies have evaluated residues in leaves from trees treated with the basal trunk spray. Results show that the dinotefuran effectively moved into the trees and was translocated to the canopy at rates similar to those of other trunk-injected insecticides, and faster than other soil-applied neonicotinoid products.

As with imidacloprid treatments, control of EAB with dinotefuran has been variable in research trials. In an MSU study conducted in 2007 and 2008, dinotefuran trunk sprays reduced EAB larval density by approximately 30 percent to 60 percent compared to the heavily infested untreated trees. The treatment was effective for only one year and would have to be applied annually. In general, control is better and more consistent in smaller trees than in large trees, but more research is needed with larger trees. Studies to address the long-term effectiveness of annual dinotefuran applications for control of EAB are underway.

Protective Cover Sprays

MSU studies have shown that applications of Onyx™, Tempo® and Sevin® SL provided good control of EAB, especially when the insecticides were applied in late May and again in early July. Acephate sprays were less effective. BotaniGard® (*Beauvaria bassiana*) was also ineffective under high pest pressure. Astro® (permethrin) was not evaluated against EAB in these tests, but has been effective for controlling other species of wood borers and bark beetles.

In another MSU study, spraying Tempo® just on the foliage and upper branches or spraying the entire tree were more effective than simply spraying just the trunk and large branches. This suggests that some cover sprays may be especially effective for controlling EAB adults as they feed on leaves in the canopy. A single, well-timed spray was also found to provide good control of EAB, although two sprays may provide extra assurance given the long period of adult EAB activity.

It should be noted that spraying large trees is likely to result in a considerable amount of insecticide drift, even when conditions are ideal. Drift and potential effects of insecticides on non-target organisms should be considered when selecting options for EAB control.

Acknowledgements

Production and distribution of this bulletin were supported in part by cooperative agreements from the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) and the U.S. Forest Service, Northeastern Area, Forest Health Protection. This bulletin may not necessarily express the views of the USDA.

Key Points and Summary Recommendations

- Insecticides can effectively protect ash trees from EAB.
- Unnecessary insecticide applications waste money. If EAB has not been detected within 10-15 miles, your trees are at low risk. Be aware of the status of EAB in your location. Current maps of known EAB populations can be found at www.emeraldashborer.info. Remember, however, that once a county is quarantined, maps for that county are no longer updated.
- Trees that are already infested and showing signs of canopy decline when treatments are initiated may continue to decline in the first year after treatment, and then begin to show improvement in the second year due to time lag associated with vascular healing. Trees exhibiting more than 50 percent canopy decline are unlikely to recover even if treated.
- Emamectin benzoate is the only product tested to date that controls EAB for more than one year with a single application. It also provided a higher level of control than other products in side-by-side studies.
- Soil drenches and injections are most effective when made at the base of the trunk. Imidacloprid applications made in the spring or the fall have been shown to be equally effective.
- Soil injections should be no more than 2-4 inches deep, to avoid placing the insecticide beneath feeder roots.
- To facilitate uptake, systemic trunk and soil insecticides should be applied when the soil is moist but not saturated or excessively dry.
- Research and experience suggest that effectiveness of insecticides has been less consistent on larger trees. Research has not been conducted on trees larger than 25-inch DBH. When treating very large trees under high pest pressure, it may be necessary to consider combining two treatment strategies.
- Xytect™ soil treatments are labeled for application at a higher maximum rate than other imidacloprid formulations, and we recommend that trees larger than 15-inch DBH be treated using the highest labeled rate. Merit® imidacloprid formulations are not labeled for use at this higher rate. When treating larger trees with Merit® soil treatments, best results will be obtained with two applications per year. Imidacloprid formulations for homeowners (Bayer Advanced™ Tree & Shrub Insect Control and other generic formulations) can be applied only once per year.
- Homeowners wishing to protect trees larger than 15-inch DBH should consider having their trees professionally treated.
- Treatment programs must comply with any label restrictions on the amount of insecticide that can be applied per acre in a given year.

The Cooperative Emerald Ash Borer Program

For more information and to order
additional copies of this bulletin:

www.emeraldashborer.info/

The Ohio State University EAB Outreach Team

www.ashalert.osu.edu

Purdue Extension

www.entm.purdue.edu/eab/

University of Wisconsin

www.entomology.wisc.edu/emeraldashborer/

University of Illinois

ipm.illinois.edu/landturf/insects/

University of Minnesota

www.extension.umn.edu/issues/eab/

June 2009

Bibliographic Citation: Herms DA, McCullough DG, Smitley DR, Sadof C, Williamson RC, and Nixon PL. 2009. Insecticide options for protecting ash trees from emerald ash borer. North Central IPM Center Bulletin. 12 pp.