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HEDGEROWS: TURNING FARM WASTE AREAS INTO ACTIVE IPM LIFE CYCLES

Final Progress Report for Contract Number 95-0265
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SUMMARY OF PROGRESS

Five sites and grower-cooperators have been selected for the establishment of insectary hedgerows. Four of these sites were planted with native grasses, shrubs, and perennial forbs this year, although grasses need to be reseeded next fall at two sites. Drip irrigation systems have been set up at two sites and will be set up at a third site shortly. The fourth site is furrow-irrigated. Our grower-cooperators are large-scale rotational field crop producers from Yolo County, including Cliff Fong, Blake Harlan, John Meek, and Fred March. At the fifth site, located on an agricultural/urban border zone in the City of Davis, we have focused on suppressing and controlling weeds this year to prepare for planting this fall. The City of Davis Parks Department is cooperating to demonstrate how hedgerows can be used as buffer zones and alternative landscapes. We believe all of the growers have learned a great deal about designing and planting hedgerows; likewise the field manager has benefited from their expertise.

Many community members, in addition to our grower-cooperators, have been instrumental in advising us and helping us plan, install, maintain, and monitor the hedgerows. Some of these were members of an "innovator group", set up to promote the installation and research of hedgerows, and consisting of growers, University of California Cooperative Extension farm advisors, a pest control advisor, City of Davis Parks Department representatives, and a developer.

A monitoring assistant was hired in January to assist us with developing and implementing monitoring protocols. We have begun monitoring programs for insect, rodent, and bird use of hedgerows, and we have also kept records of hedgerow plant survival. We continue to update our protocols based on field results and advice from advisors. Bat boxes have been set up within two hedgerows and near a third, as well as at other locations, with the help of a representative from Bat Conservation International.

Outreach and education efforts have included a "Working Habitat for Working Farms" workshop held in February 1997, a Hedgerow and Tailwater Pond Workshop held in June 1996, a field tour for UCD entomology students at John Meek's site, presentations about hedgerows and beneficial insect activity at two Biological Prune Systems workshops, creation and distribution of a handout entitled "Establishing Hedgerows for Pest Control and Wildlife", publication of a newspaper article, a Cooperative Extension newsletter article, and the purchase of sturdy metal signs for display at hedgerow sites explaining what they are.

RESULTS AND DISCUSSION

A. Summary of Project Objectives

* Create a set of five replicated, sustainable, multi-species hedgerow systems, in a variety of field crops and locations, to demonstrate reduction of pesticide use, lower costs, and fewer environmental and health impacts.

* Use hedgerows to function as visible evidence and educational sites. Innovator group leaders will use hedgerows to teach their IPM constituents about hedgerow composition and maintenance, how individual plant characteristics foster insect predators, sight recognition of beneficial insects, and on-site pest management analyses that impact

when, if, and how to use chemical spraying.

* Establish hedgerows as a credible IPM component by monitoring pest and predator species use.

* Make hedgerows models for an extended outreach program to additional farm advisors, PCAs, researchers, agency staffs, developers, and the public. The aim is to advance their understanding of the dynamic life cycle between crop, pest, and predator by demonstrating how this type of sustainable IPM system works. Informed city planners and developers are more likely to recommend hedgerows as vegetative buffers along the agricultural/urban interface as standard practice and as mitigation corridor areas recommended under the upcoming county Habitat Conservation Plan.

Implementation of Objectives

1. Creation of Hedgerows

Five sites have been selected for hedgerow installation, and four have been planted with native grasses, shrubs and perennial forbs, although two will require reseeding of grasses in the fall. The fifth site has been controlled for weeds, and will be planted in cooperation with the City of Davis Parks Department in the fall. Photographs of each hedgerow site are included in Attachment A. All five hedgerow sites are located adjacent to fields planted to rotational field crops, such as tomatoes, corn, wheat and beans. This type of replication within variable systems offers excellent opportunities for future research and monitoring. Hedgerows may be particularly important in these systems as stable habitat for beneficial insects and other wildlife during transitions in surrounding fields.

The major criteria for the selection of a particular site were the grower's interest in alternative farming practices and their willingness to participate in planting and maintenance. We particularly favored growers who had little or no previous involvement in other RCD habitat enhancement programs, who have large-scale rotational farming operations, and who are well-respected in the community. These qualities should prove beneficial in the future dissemination of information to people who might not otherwise be impacted by RCD programs.

With the help of Jeff Chandler, of Cornflower Farms in Elk Grove, and John Anderson's expertise, the field manager selected appropriate species of shrubs, perennials, and native grasses for the sites. Attchment B shows a sample hedgerow layout with the species we chose. Shrubs and perennials were ordered from Cornflower Farms; native grass seed was purchased through TS&L Seed Co. in Woodland. The four grower sites were broadcast-seeded with a mix of native grasses, and then planted with one line of mixed shrubs and perennials. The City of Davis site was planted with an annual insectary mix for weed suppression.

We have kept written records of the costs and time required to establish and maintain our hedgerows. From these, we have estimated the costs for the installation and maintenance of a typical hedgerow. We will use these to advise growers who may wish to plant hedgerows of the costs and time requirements they should expect. Attachment C contains cost estimates for each of the four hedgerows we have planted, and Attachment D displays cost estimates for a typical hedgerow.

Site 1: Fong

Cliff Fong's hedgerow is very robust and growing quickly. The combination of the excellent soil (Brentwood silty clay loam) and the conscientiousness of the grower in

preventing any weeds from taking hold has been ideal for hedgerow establishment. Cliff is particularly interested in seeing an increase of beneficial insects, since he uses only pest control methods that fall within CCOF guidelines in this location. Cliff's hedgerow should prove particularly useful for promoting hedgerows to other organic farmers.

The hedgerow is situated along an old, unused fence line on land to the north of Cache Creek and south of Road 20. The fence marks the border between a rotational tomato field and an alfalfa field that is transitioning to organic. The length is approximately 1800 feet, and width about 6 feet on either side. The west side of the fence was broadcast-seeded with native grasses on November 13, 1996, and the east side was planted with shrubs and perennial forbs on November 15. The need to establish this hedgerow without the use of chemical weed controls has required him to flame under the fence and send hoeing crews through twice, but the density and establishment of native grasses is excellent, and offers the hope of good future weed suppression. We have placed tree tubes on selected shrubs to prevent rodent predation, and weed mats around the base of the shrubs for weed suppression. Drip irrigation will be installed next week. The survival rate of the shrubs and forbs was about 93% on March 5.

Site 2: Harlan

This site is located west of Road 89 between Roads 25 and 26, just south of a large canal. The hedgerow has been planted between a dirt road on the southern border of the canal and an old, unused cement ditch. The cement ditch separates the site from a large tomato field to the south. The area is approximately 1300 feet long by 20-25 feet wide and has traditionally been a haven for invasive weeds such as star thistle. Our grower-cooperator, Blake Harlan, hopes to cut down on long-term weed control expenses in this otherwise unproductive strip.

The ground was prepared and seeded with native grasses on November 8, 1996, and the seed was harrowed in a week later. A broadleaf herbicide was sprayed on December 19, 1996 for control of cheeseweed that was emerging. Shrubs and perennial forbs were planted on December 20. Tree tubes and weed mats were installed in January. Shrubs and perennials continue to grow well, with a survival rate of about 95% on March 5. However, the native grass areas were accidentally sprayed with Roundup by Blake's crew in early March. On March 7, Blake reseeded with native grasses at his own expense in expectation of rain that weekend. The rain never materialized, and the grasses did not emerge. At the time of accidental spraying, the native grass stand had quite a bit of competition from non-native grass weeds, so we regard the accidental spraying as an opportunity to exercise one more season of weed control before reseeding.

Site 3: March

Both shrubs and grasses at Fred March's hedgerow are flourishing. This site is located on a plot of land off of Road 14 between Roads 96 and 97. Fred grows tomatoes, wheat, and other rotational field crops. He has an interest in agricultural research and IPM methods, and is a keen observer of insects, diseases, and changing conditions in his fields. The hedgerow is 1000 feet long by 16 feet wide, and is situated between a corn and a tomato field. A few oak trees already inhabited this spot, and we incorporated our insectary plants into this setting.

Fred broadcast-seeded native grasses on December 6, 1996, and sprayed with Roundup for cheeseweed control ten days later. On December 17 we planted shrubs and perennial forbs, and installed tree tubes. Since Fred's native grass stand was so good, we delayed installing weed mats until March, when weed problems developed. Drip irrigation was placed on March 5. Currently, Fred's native grass density is very good, and there appear to be very few non-native grasses present. Knotweed has become quite prevalent in spots, and Fred plans to control it with a broadleaf herbicide. We had a high initial

mortality rate of some shrub species, due to herbicide damage at our supplier's greenhouse and problems with one member of our planting crew, but the shrubs look generally very healthy now. The shrub survival rate on March 6 was approximately 89%, excluding the species damaged at the greenhouse.

Site 4: Meek

John Meek is the grower-cooperator for a hedgerow in a field of largely alkaline soil south of Road 27 and west of Highway 113. Because of the poor quality of the soil, it has not been very productive, and has been left fallow this year and last year. We selected an area 1500 feet long and 16 feet wide along the western edge of the field for the hedgerow. Surrounding fields have better soil, and have been planted to alfalfa and rotated field crops. The site was prepared and seeded with native grasses on November 16, 1996. Emergence and density of the native grasses was very poor. A large quantity of broadleaf weeds took over very quickly. The site was sprayed with a broadleaf herbicide on December 20, and provided good control of mustard and miner's lettuce, but chickweed was not controlled effectively. We have decided to disc the area (excluding the shrubs), improve the soil this summer by adding compost and gypsum, and reseed with native grasses in the fall.

Shrubs and forbs were planted on January 7 and 8. They have suffered from the poor soil, and many are not very robust. The survival rate of the shrubs was 90% on March 6, but we expect that rate to drop as some of the less healthy shrubs succumb to the effects of the soil. From our mortality records, we have been able to draw some conclusions about what types of shrubs to avoid for alkaline conditions, and what types fare better. We continue to research alkaline-tolerant species, and intend to replant areas where shrubs die. By testing these species ourselves, we will be able to make recommendations and minimize losses for growers in our area who have alkaline soil and want to plant hedgerows in these unproductive areas.

Site 5: Davis

One of the goals of our project was to select a hedgerow site along an agricultural/urban interface to exemplify how developers can provide a functional buffer zone to minimize problems associated with farming practices for adjacent cities. Working with Robert Snyder and Ken Nunes of the City of Davis Parks Department, we selected a city-owned strip of land just south of Covell Boulevard (Road 31) and west of Lake Avenue. The land across Road 31 was planted to safflower last year and wheat in the winter.

The site was planted several years ago with a single line of pistache and pine trees, which are not particularly suited to the area, and have grown slowly. Otherwise the area has been allowed to be taken over by all types of invasive weeds, and has required extensive weed control before native grasses can be planted. In order to suppress weed growth, we planted a mix of annual beneficial insectary plants on November 14, 1996. This mix, and associated weeds, grew quickly, and the area was sprayed with Roundup by Parks Department employees to prevent non-native grasses from going to seed. They will continue to keep the area clear of weeds until fall, when we will seed native grasses.

We had considered planting shrubs and perennials this spring, but decided that fall would be the best time to plant to avoid having to disc around shrubs and drip tube. We plan to conduct a workshop with the City of Davis at the time of planting to promote hedgerows to developers and landscape designers, and to demonstrate how to plant native grasses and shrubs. Robert Snyder and William Michaels, of the City of Davis Parks Department, have had some experience with planting and maintaining native vegetation in other areas of the city, and will demonstrate their results.

2. Group Formation and Participation of Community Members

An integral part of our approach to planning, installing, maintaining, and monitoring the hedgerows, as well as to promoting the use of hedgerows as an IPM component, has been to draw out help, support, and advice from community members. We have benefited from the diversity of opinions and suggestions we have received, and continue to incorporate the best of those into our program and adapt our project to fit community needs. At the beginning of our program, an "innovator group", composed of University of California Cooperative Extension farm advisors, a pest control advisor, City of Davis Parks Department representatives, and a developer, was set up to promote the use of hedgerows for IPM programs, research, and agricultural/urban buffer zones. Members of this group, our grower-cooperators, and other trusted advisors have contributed significantly to our project.

Rachael Long, a Yolo County University of California Cooperative Extension Farm Advisor, was originally named on the project proposal as the "insectary and animal research coordinator" for our innovator group. But her involvement in planning and implementing the goals of this project has been so extensive that she will now be listed as a Principal Investigator. She has helped the field manager plan project activities, and has provided direction for the planning, installation, and maintenance of the hedgerows. She has also worked with our monitoring assistant to develop and update a monitoring protocol.

John Anderson, a Yolo County Resource Conservation District Director and Principal Investigator for our project, has advised the field manager on project planning, information sources, native grass and shrub species selection, planting techniques, weed control methods, and maintenance requirements. He has visited hedgerow sites repeatedly to check on progress and density of native grass and weed species, has talked about hedgerow benefits and native grass establishment techniques with our grower-cooperators, and has helped install bat boxes.

Other innovator group members include:

Jeff Chandler, of Cornflower Farms, donated many hours of his time to help the field manager select shrub and perennial forb species and choose a layout for the hedgerows; he also spoke at the Hedgerow/Tailwater Pond Workshop in June 1996.

Robert Snyder, William Michaels, and Ken Nunes of the City of Davis Parks Department have been an integral part of our program; they are the grower-cooperators for the City of Davis site, and have been active in sharing information regarding planting techniques for native plants. Robert Snyder and William Michaels attended our "Working Habitat for Working Farms" workshop in February 1997.

Kerry Beane, an independent pest control advisor, connected us with one of our grower-cooperators, Fred March. We expect to have more involvement with her in the coming year as a promoter of hedgerows in her programs related to IPM methods in tomatoes.

Tom Lanini has provided advice regarding weed control at our alkaline site. We expect to have more involvement with him this year as we make decisions regarding fall weed control and the need for pre-emergent herbicides in the native grasses.

Bruce Rominger, a Yolo RCD Director, has served as an advisor. Charlie Rominger spoke at our "Working Habitat for Working Farms" workshop. They are growers with experience in hedgerow establishment.

We have not had much contact with John Whitcombe, a developer, but expect to draw on his support this year as we plan outreach activities targeted to developers and landscape designers.

We have also recruited the advice of several community leaders outside the innovator group. Shu Geng, an Agronomist and Statistician with the University of

California at Davis (UCD), has advised us in setting up statistically useful monitoring techniques and keeping appropriate records regarding the hedgerows. He and his graduate student will help us record information about the hedgerows and surrounding fields in a GIS-type database, so that researchers may incorporate that information into future projects. Dr. Geng will serve on our innovator group during the project's second year.

Les Ehler, a UCD Entomologist who specializes in biocontrol, visited all of our hedgerows in order to advise us on insect monitoring techniques. He also met two of our grower-cooperators, and spoke with them regarding insect pest concerns related to the hedgerows and surrounding fields.

Dessley Whisson, a Vertebrate Pest Ecologist with UCD, helped our monitoring assistant research and choose appropriate rodent monitoring techniques.

Michael Perrone, a biologist with the State Water Resources Control Board (and an avid birdwatcher), visited all of our sites to identify bird species in the area, suggest which bird species could be of particular importance in each area, and advise us on bird monitoring techniques.

Jay Rosenheim, an Entomologist at UCD, discussed our monitoring plans with Rachael Long, and suggested changes in our insect monitoring program.

Jeanette Wryzinski, with the Yolo RCD, has collaborated with us in researching monitoring techniques and advised us regarding our protocols. She visited all of our sites during Michael Perrone's tour.

Clyde Clark, a field assistant at the Yolo County UCCE office and a former PCA, has advised us on weed control measures, and has helped us with planting and maintenance of our hedgerows.

Jim Kennedy, a bat house researcher from Bat Conservation International in Austin, Texas, has advised us on proper design and placement of bat house boxes in our area. He toured all of our sites during his February visit.

3. Monitoring

In January, we hired Claudia Funari, a recent graduate of the undergraduate wildlife biology program at UC Davis, as a monitoring assistant. With the help of Rachael Long and others mentioned above, she tackled the task of setting up and implementing the monitoring protocols listed below:

Insect use

In February 1997, we began monitoring for beneficial and pest insect activity within the hedgerows. This monitoring will be conducted for several years to measure changes over time as the hedgerows mature. We conduct our sampling and observations at each site once every two weeks in the morning. We measure insect use of the native grasses at each site via sweep-net sampling with four replications at each site. We measure insect use of shrubs and perennial forbs via visual observations at two individuals of each species at each site. We will particularly watch for cucumber beetles, Lygus bugs, and stinkbugs, because they are major pests in rotated field crops in this area, and we want to know if any hedgerow plant species serve as hosts to these insects. We also tried using sticky cards stapled onto stakes to measure insect use of shrubs and forbs, but decided to abandon their use until the plants become larger. By attaching them to branches within the shrubs' canopies, we will insure that the insects drawn to the card will be from that particular plant.

In order to evaluate the impact over time of the hedgerows on beneficial insect activity and pest control in adjacent crops, we will conduct a study using an insect pest species and its parasites as biological assays. We chose parasitic wasps as target beneficials because many species use floral resources in hedgerows and move into adjacent crops. We

had considered using aphids as our pest species, but opted instead to use armyworm egg masses. These should be better suited for our study because they are easy to acquire, measure, and situate according to our needs. Each summer, for several years, we will order egg masses from a laboratory supplier, place specific numbers in strategic locations in the hedgerows and surrounding fields, collect them a week later, and count the number of parasitic wasps that emerge. As the hedgerows mature, we hope to see a greater increase in parasitic wasp activity and pest control.

Rodent use

We will monitor for changes in abundance of three types of rodents over time, to determine whether hedgerows attract and serve as a reservoir for rodent activity in adjacent crops. Target rodents will be voles, gophers, and squirrels, because three of these rodents can be pests in agricultural situations. The presence of voles in hedgerows will be measured once every three months with the use of snap traps. They will be set every 10 feet in a 150 foot transect within the hedgerow and within a control transect. Squirrel presence will be measured twice a year at the beginning of spring and fall with visual scans.

Gopher activity will be measured every three months; we conducted our first monitoring in early March. New mounds and holes will be counted within a 100 foot transect in the hedgerow and a control transect. After initial counts, mounds will be destroyed and holes filled. Then we will return within a week to measure the number of new mounds and holes.

Bird Use

In order to estimate bird use of hedgerows, we have been conducting observations of bird species and numbers once a month within 400 foot long transects at each site. Birds may be a potential problem in crops adjacent to hedgerows if they feed on developing seedlings. Once a week during the growing season, we will record any damage by birds to adjacent fields by measuring approximate percentages of emerging plants within 100 foot transects in the three rows closest to the hedgerow.

Invasive Weeds

At each of our sites we have been working closely with the growers to make sure that annual grass and broadleaf weeds are kept under good control, because this is the most challenging part of establishing native grass systems. Various strategies are being used and documented so that we can determine which system works best for each area, including flaming, mowing, hoeing, and the use of herbicides.

Bats

In February 1997, Jim Kennedy, from Bat House Conservation International in Austin, Texas, flew here at our invitation and spent two days visiting our sites, determining the best locations for bat houses, and talking to growers. Prior to his arrival, 20 bat boxes of a design he recommended were constructed by students with the Esparto High School Agricultural Mechanics program. Jim helped us properly erect and situate the bat houses at three of our hedgerow sites, as well as on other farms in Yolo County. We will monitor for use of these bat houses, and we plan to use them as educational tools during hedgerow tours. Jim also gave an informal slide show on bat house designs. We have compiled the information acquired during his visit into a handout entitled "Bat Houses for the Central Valley" (Attachment J).

Raptor Perches and Barn Owl Boxes

Our monitoring assistant is working Laura Bailey of HAWK-Americorps to erect

raptor perches at two of our sites. The other sites already have raptor perches in the form of telephone poles. We also have plans to erect barn owl houses within the vicinity of each hedgerow within the next year.

Farmer response to program

Growers have been working directly with the field manager, and relaying their comments and concerns to her, throughout the program. This has helped us determine what types of questions will be most useful to include in a questionnaire, which we have sent out to each grower. See Attachment G for a copy of the questionnaire. We will use the information obtained to help us determine the best methods to educate growers about hedgerows, to assess what types of research need to be conducted in relation to hedgerows, and to develop printed materials on practices and costs associated with hedgerow plantings.

IV. Extended Outreach

Outreach and education efforts have included workshops about hedgerows and other wildlife enhancement techniques, a field tour by entomology students at one site, slide presentations at two Biological Prune Systems meetings, preparation and distribution of written materials, and the purchase of sturdy metal signs for display at hedgerow sites explaining what they are.

On February 7, 1997, the Yolo RCD held its annual Wildlife Workshop. This year's title was "Working Habitat for Working Farms". About 70 people attended this all-day program including four of our grower-cooperators: Blake Harlan, Cliff Fong, Fred March, and Robert Snyder and William Michaels from the City of Davis parks Department. Several of the day's activities related to hedgerows (see Attachment E for an itinerary). The field manager of our project gave a slide show presentation on establishing and maintaining hedgerows. She spoke about the benefits of hedgerows, how to select an appropriate site, how to choose appropriate plant species, and how to grow native grasses, perennial forbs, and insectary shrubs. Robert Bugg, an entomologist with the University of California Sustainable Agriculture Research and Education Program, gave a slide show about the use of hedgerows as an IPM component. He spoke about beneficial insects, choosing plants for year-round blooming, and IPM theories and practices in hedgerow establishment. In the afternoon, participants visited Blake Harlan's hedgerow site during a field tour. Blake spoke to the group about why he had wanted to establish a hedgerow, and answered questions from the audience regarding the hedgerow and his farming practices in general. The tour also visited Russ Lester's and John Anderson's farms, where they were able to see mature hedgerows.

On June 27, 1996, the Yolo RCD and UCCE Yolo County held a Hedgerow/Tailwater Pond Workshop (see Attachment F for an itinerary). This program was tailored to growers who had received funds through the USDA Agricultural Conservation Program for establishment of hedgerows or tailwater ponds, and included information on plant species and establishment techniques. The meeting was attended by numerous growers, including one of our grower-cooperators, Blake Harlan.

On February 27, 1997, Dr. Michael Perella, an entomologist at UC Davis, brought about 30 students from his Economic Entomolgy class to visit John Meek's hedgerow site and hear a talk by Eugene Miyao, a UCCE Yolo County Farm Advisor. Gene talked about general farming practices and common insect pests in Yolo County, and he discussed new IPM approaches with the students. The field manager for our project gave a brief explanation of our reasons for planting hedgerows and our plans for insect monitoring. Students then collected insects from the site. We hope to work more with Dr. Perella and other professors in the future to encourage similar educational uses of the hedgerows.

During two Biological Prune Systems workshops addressing pest management concerns in the prune industry, the field manager presented slide show talks on the visitation and movement of beneficial insects from hedgerows into surrounding fields. The workshops were sponsored by Fred Thomas, a PCA, and were held in Richvale on January 10, 1997, and at the Colusa Farm Show on February 6, 1997. Hedgerows may hold a particular attraction for prune growers who want to attract insect predators of aphids, or who want to establish hedgerows to serve as "traps" for runoff water and pesticides (particularly as concerns grow regarding contamination of groundwater supplies with chemicals contained in dormant sprays used in prunes). In the following year we hope to target more of our outreach efforts towards growers of tomatoes and other field crops in our area, in the same way that Fred Thomas targets his efforts towards progressive prune growers. We plan to work with Kerry Beane, who is active in educational efforts regarding IPM for tomatoes. Hedgerows may particularly benefit field crop growers because they can be used as windbreaks, as well as beneficial insect refuges.

Printed materials were also important in our outreach efforts this year. In preparation for the 1997 Wildlife Worksop, the field manager prepared a short paper on hedgerow establishment (Attachment I). Every project participant received one, and we anticipate distributing them through the offices of the Yolo RCD, UCCE Yolo County, and the City of Davis Parks Department. Other publications this year have included the bat house handout mentioned previously (Attachment J), a press release about the project published in the August 4, 1996 Woodland Daily Democrat (Attachment K), and a Cooperative Extension newsletter article. We also had high quality, durable signs constructed for display at two hedgerow sites to inform the public and the agricultural community about our project.

We are looking forward to expanding our educational efforts this year. We intend to coordinate the planting of the City of Davis site with a workshop demonstrating how to plant native grasses and shrubs. The visibility of this site makes it ideal for outreach programs targeting new audiences: we hope to use it for the promotion of hedgerows as buffers for agricultural/urban interfaces, and intend to contact developers, landscape designers, CalTrans officials, and representatives of Yolo County and the cities of Woodland and Winters.

ATTACHMENT A

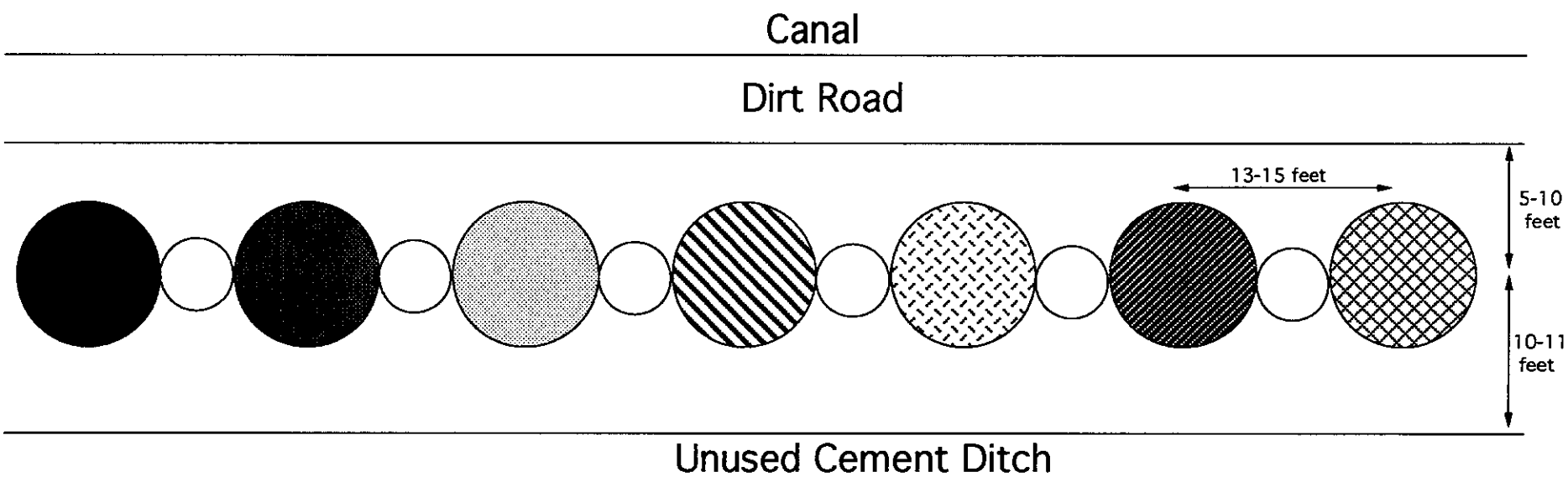
Cliff Fong's Hedgerow Site

Blake Harlan's Hedgerow Site

Fred March’s Hedgerow Site

John Meek’s Hedgerow Site

Attachment B: Sample Hedgerow Layout



- Coffeeberry
- Ceanothus 'Ray Hartman'
- Toyon
- Elderberry
- Coyote Bush
- Ceanothus 'Yankee Point'
- Hollyleaf Cherry/Western Redbud
- Small Shrub, Perennial Forb, or Deer Grass

Perennial Forbs:
Common Yarrow
'Salmon Beauty' Yarrow
'Paprika' Yarrow
Narrowleaf Milkweed

Small Shrubs:
California Buckwheat
St. Catherine's Lace

Large shrubs were planted with 15 feet of space between their centers. The space between the center of the shrubs and the cement ditch was left wide enough for a mower to pass through unimpeded.

Shrubs and perennials were planted over a base of native grasses which were broadcast-seeded over the entire area between the dirt road and cement ditch.

The native grass seed mix contained these species:

Purple Needlegrass	Slender Wheatgrass
California Oniongrass	California Melic
Blue Wildrye	California Brome
Creeping Wildrye	Meadow Barley

COST ESTIMATES FOR HEDGEROW INSTALLATION, LISTED BY SITE

Cost and time estimates related to the preparation, installation and maintenance of each hedgerow site are listed in the following four tables. Labor costs are broken down into contributions of the growers and contributions of the project. For ease of calculation and understanding, cost estimates of skilled labor provided by the growers and their employees, equipment operators, and chemical applicators is set at a standard of $10.00/hour. Unless otherwise stated, material costs were paid by the project, and equipment costs by the grower.

Cliff Fong's Hedgerow Site

Task	Date	Labor: Grower Contribution	Labor: Project Contribution	Labor: Total Time	Materials	Equipment
Planning, hedgerow layout design, species selection, drip irrigation planning	6/96-10/96	6 hr.	20 hr.	26 hr.	Survey flags: 290 @ $.04 = $11.60	
Cultivation, grading, and seedbed preparation	10/96	2 hr.		2 hr.		Tractor + disc, grader: $60.00
Sprinkling twice while irrigating adjacent field	10/96-11/96	6 hr.		6 hr.		
Harrowing for weed control	11/96	1 hr		1 hr		Honda + harrow: $15.00
Flaming along fence line for weed control	11/96	2 hr.		2 hr.	Fuel: $15.00 (paid by grower)	Honda + flamer: $30.00
Broadcast-seeding native grasses with belly-grinder	11/13/96		3 hr.	3 hr.	Seed: $227.70 for 10 lb.	
Harrowing and rolling to cover seed	11/13/96	1 hr		1 hr.		Honda + harrow: $15.00
Planting shrubs and forbs	11/15/96	4 people for 2 hr.	4 people for 2 hr.	16 hr.	Plants: $501.15 for 290 shrubs and forbs Fertilizer tablets: 144 @ $.29 = $41.76	
Installing 2' tall tree tubes	1/9/97		6 hr.	6 hr.	Tree tubes: 115 @ $1.15 = $132.25	
Hoeing (twice)	1/97-3/97	2 people for 2 hr.		4 hr.		
Installing 3' x 3' weed mats	1/97-3/97		24 hr.	24 hr.	Weed mats: 144 @ $.69 = $99.36 Stakes: 864 @ $.12 = $103.68	
TOTAL		30 hr.	61 hr.	91 hr.	$1132.50	$120.00

Fred March's Hedgerow Site

Task	Date	Labor: Grower Contribution	Labor: Project Contribution	Labor: Total Time	Materials	Equipment
Planning, hedgerow layout design, species selection, drip irrigation planning	11/96-3/97	6 hr.	20 hr.	26 hr.	Survey flags: 130 @ $.04 = $5.20	
Discing area	11/96	1/2 hr.		1/2 hr.		Tractor + disc: $15.00
Harrowing for weed control after first rain	11/96	1/2 hr.		1/2 hr		Honda + harrow: $7.50
Broadcast-seeding native grasses with belly-grinder	12/6/96	3 hr.		3 hr.	Seed: $227.70 for 10 lb.	
Harrowing to cover seed	12/6/96	1/2 hr.		1/2 hr		Honda + harrow: $7.50
Rolling to break soil crust	12/16/96	1/2 hr.		1/2 hr.		Honda + roller: $7.50
Spraying Roundup for weed control before native grass emergence	12/16/96	1/2 hr.		1/2 hr.	Roundup: $30 for 1/2 gallon (paid by grower)	Honda + sprayer: $7.50
Planting shrubs and forbs, replanting poorly planted shrubs & forbs, and installing 2' tall tree tubes	12/17/96	5 hr.	10 hr.	15 hr.	Plants: $270.00 for 155 plants Fertilizer tablets: 60 @ $.29 = $17.40 Tree tubes: 60 @ $1.15 = $69.00	
Installing 3' by 3' weed mats and hoeing around plants	2/97 - 3/97		14 hr.	14 hr.	Weed mats: 60 @ $.69 = $41.40 Stakes: 360 @ $.12 = $43.20	
Installing drip irrigation for shrubs and forbs	3/5/97	5 hr.	8 hr.	13 hr.	Drip system components: $393.19	
TOTAL		21.5 hr.	52 hr.	73.5 hr.	$1097.09	$45

Attachment D

Cost Estimates for Installation of a Typical Hedgerow

The following installation costs are estimated for a hedgerow 1/4 mile long by sixteen feet wide (about 1/2 acre area), planted according to the Attachment B layout. Labor costs are set at $10.00/hour. It is assumed that grower already owns all necessary equipment, and costs of equipment use are set as follows: Tractor + attachment, $30.00/hour; Honda + attachment, $15.00/hour. In order to calculated costs of drip irrigation installation, it has been assumed that grower owns a pump and is plumbing from a garden hose-type fixture.

Task	Labor	Material	Equipment	Total
Planning	20 hr. = $200.00			$200.00
Cultivating area in early fall	1 hr. = $10.00		Tractor + disc = $30.00	$40.00
Bed preparation for shrubs	1 hr. = $10.00		Tractor + bed-shaper = $30.00	$40.00
Spraying with Roundup for weed control, if necessary	1 hr. = $10.00	Roundup: $30.00 for 1/2 gallon	Tractor + sprayer = $30.00	$70.00
Harrowing lightly to break for weed control after first rain, if necessary	1 hr. = $10.00		Tractor + harrow = $30.00	$40.00
Broadcast-spreading grass seed with belly-grinder, seeding rate 25 lb./acre	4 hr. = $20.00	Seed: 12.5 lb. @ $22/lb. = $275.00		$295.00
Harrowing and rolling to incorporate grass seed	2 hr. = $20.00		Honda + harrow: $30.00	$80.00
Spraying with Roundup for weed control before native grass emergence, if necessary	2 hr. = $20.00	Roundup: $30.00 for 1/2 gallon	Honda + sprayer = $30.00	$80.00
Rolling to break soil crust before native grass emergence, if necessary	1 hr. = $10.00		Honda + roller = $15.00	$25.00
Spot-spraying with broadleaf herbicide, if necessary	1 hr. = $10.00	Broadleaf herbicide: 1 quart, $20.00	Honda + sprayer = $15.00	$45.00

Planting shrubs and perennial forbs	10 hr. = $100.00	Plants: 182 @ $2.50 = $455.00 Fertilizer tablets: 140 @ $.29 = $40.60	$595.60
Installing tree tubes around shrubs	7 hr. = $70.00	Tree tubes: 140 @ $1.15 = $161.00	$231.00
Installing weed mats around shrubs	24 hr. = $240.00	Weed mats: 140 @ $.69 = $96.60 Ground stakes: 840 @ $.12 = $100.80	$437.40
Installing drip irrigation system	10 hr. = $100.00	Drip irrigation components: $250.00	$350.00
TOTAL ESTIMATED COST			$2529.00

Yolo County Resource Conservation District
7th Annual Wildlife Workshop

Working Habitat for Working Farms

February 7, 1997
Lillard Hall, Yolo County

7:30	**Registration**	
8:00	**Welcome & "Working Habitat for Working Farms" Slide Show**	Paul Robins *Yolo County RCD*
	Hedgerows to Host Wildlife & Beneficial Insects:	
	Installation & maintenance	Celia Lamb & Jeanette Wrysinski *Yolo County RCD*
	Integrated Pest Management Benefits	Bob Bugg *UC Sustainable Agriculture Research & Education Program*
	Roadside Prairie Establishment for Water Quality & Wildlife	Brian Young & Roger Jones *Bufferlands*
9:45	BREAK	
10:00	**Establishing Ponds on Your Property:** Stock & Wildlife Ponds Tailwater Ponds	Charlie Rominger *AH Rominger & Sons*
	Slough & Stream Revegetation and Management	Erik Gantenbein *Sierra View Landscape, Inc.*
	Canal vegetation for Bank Stabilization & Weed Control	Chris Rose *Yolo Co. RCD*
	Break for lunch	
12:00	**Luncheon Resource Agency Panel**	
	Cost Sharing (NRCS)	Phil Hogan *Natural Resources Conservation Service*
	Stream permits (CDFG)	Steve Jimenez *California Department of Fish & Game*
	Water Rights/Quality (SWRCB)	Stefan Lorenzato *State Water Resources Control Board*
	Question & Answers	
1pm	**Load bus and depart on tour**	

Yolo County Resource Conservation District

7th Annual Wildlife Workshop

Working Habitat for Working Farms

Tour Itinerary
February 7, 1997

1:00	Leave Lillard Hall
STOP #1	Wetland creation and slough restoration site (Rds. 93 & 26)
STOP #2	Organic Walnut Orchard with Insectary Hedgerow and Cover Crops - Dixon Ridge Farms (Rd. 89 north of Rd. 27)
STOP #3	Tailwater Return Pond & Wildlife Area - Harlan & Dumars, Inc. (off Rd. 89 on Cottonwood Slough)
	Roadside Prairie Establishment on Road 89 (south of Madison)
STOP #4	Newly Planted Insectary Hedgerow - Harlan & Dumars, Inc. (off Rd. 89)
STOP #5	Established Hedgerows, Vegetated Roadsides & Canals, and Tailwater Ponds - Hedgerow Farms (Rds. 88 & 27)
4:45	Back at Lillard Hall

ATTACHMENT F

Yolo County Resource Conservation District
221 W. Court St., Ste. 8 Woodland, CA. 95695
(916) 662-2037 (916) 662-4876 FAX

Hedgerow and Tailwater Pond Workshop

Norton Hall, Woodland, CA
Thursday, June 27, 1996
7 - 9 pm

7:00pm Welcome, Introductions

7:15pm Hedgerow/Planting Panel

- Jeff Chandler, Cornflower Farms: Hedgerow design & layout
- Robert Bugg, University of California Sustainable Research and Education Program: How to plant for maximum insectary benefit
- Jeanette Wrysinski, Yolo County Resource Conservation District: Hedgerow cultural requirements, planting tips, first year maintenance
- Chris Rose, Yolo County RCD: Establishing native perennial grasses.
- Question & Answer Period

8:15pm Tailwater Pond & Wildlife Panel

- John Reyes, John Reyes Landleveling, Dunnigan
- Carlos Velasquez, USDA Natural Resources and Conservation Service
- Question & Answer Period

9:00pm Close

Speaker Contact Information

Jeff Chandler, Cornflower Farms, P.O. Box 896, Elk Grove, CA 95759. (916)689-1015.

Robert Bugg, UC SAREP, University of California, Davis, CA 95616. (916)754-8549.

Jeanette Wrysinski & Chris Rose, Yolo County RCD, 221 W. Court St., Suite 8, Woodland, CA 95695. (916) 662-2037.

John Reyes, P.O. Box 168, Dunnigan, CA 95937. (916) 724-3510.

Carlos Velasquez, USDA NRCS, 221 W. Court St., Suite 5, Woodland, CA 95695. (916) 662-2037.

Charlie Rominger, A.H. Rominger & Sons, 662-5787.

Grower-Cooperator Questionnaire
Part 1: Program Comments

1. How did you first hear about hedgerows?

A. Through another grower.
B. At a workshop sponsored by the Yolo RCD or UC Cooperative Extension.
C. Through a Yolo RCD or UC Cooperative Extension employee.
D. Other _____

2. Why did you want to establish a hedgerow on your farm?

A. To attract wildlife.
B. To attract beneficial insects.
C. To make use of an unfarmed area.
D. To suppress weed growth.
E. As a trap for runoff water, sediments, and/or chemicals.
F. For aesthetic value.
G. Other _____

3. If you had not participated in this program, would you have planted a hedgerow on your own?

A. Yes. If yes, please answer questions 1 and 2 below:

1. What types of plants would you have used?
   a. native grasses
   b. insectary plants
   c. trees
   d. other _____

2. How would you have laid out the hedgerow?
   a. As it is currently laid out (linearly).
   b. In patches.
   c. Other.

B. No. If no, what incentives prompted you to participate in this program? Please number each incentive in order of importance to you.

____Sharing the costs of native grass seed.
____Sharing the costs of shrubs and forbs.
____Sharing the costs of drip irrigation supplies.
____Sharing the task of choosing species and layout of plants.
____Sharing the task of planting native grasses.
____Sharing the task of planting shrubs and forbs.
____Sharing the task of installing drip irrigation (if relevant).
____Sharing information with, and receiving advice from, Yolo RCD and UC Cooperative Extension personnel.
____Other _____

4. How did the amount of time and resources required for these activities compare to what you had expected? Please circle appropriate answer.

A. Weed control prior to planting

More than expected Less than expected

B. Preparing seedbed before planting

More than expected Less than expected

C. Seeding native grasses

More than expected Less than expected

D. Planting shrubs

More than expected Less than expected

E. Installing drip irrigation (if relevant to your site)

More than expected Less than expected

5. Would you consider planting another hedgerow?

A. Yes. If yes, where would you put it?

1. Along another field edge.
2. Along the edge of a riparian area.
3. In an area that occasionally floods.
4. Other _____

B. No.

6. Have you noticed changes in populations of any of the following on your farm since the hedgerow was planted? Please circle appropriate answer, and list relevant species.

1. Birds: More Less No Change
   What kind? _____
2. Beneficial insects: More Less No Change
   What kind? _____
3. Pest insects: More Less No Change
   What kind? _____
4. Rodents: More Less No Change
   What kind? _____
5. Weeds: More Less No Change
   What kind? _____

7. Have other growers seen your hedgerow?

A. Yes. If yes, how many? _____

B. No.

8. Would you advise other growers to plant an insectary hedgerow?

A. Yes.

B. No. If no, what concerns would you express to them about hedgerows?

1. Costs of installation.
2. Costs of maintenance.
3. Amount of time required for installation.
4. Amount of time required for maintenance.
5. Weed problems associated with hedgerow.
6. Rodent problems associated with hedgerow.
7. Bird problems associated with hedgerow.
8. Pest insect problems associated with hedgerow.
9. Other._____

9. What information do you feel would encourage more growers to plant hedgerows?

A. Farm visits by Yolo RCD or Cooperative Extension personnel.

B. Pamphlets describing planting options and installation techniques.

C. Workshops

D. Other _____

_____

Grower-Cooperator Questionnaire
Part 2: Field Histories

1. What crops did you have planted in fields near your hedgerow location in 1996?

2. What were the average yields from those crops in 1996?

3. What crops will you plant in those fields in 1997?

4. Name and address of your pest control advisor:

Name_____

Company_____

Address_____

_____

Phone No._____

5. If you do your own pest monitoring, how is that monitoring conducted? Do you keep monitoring records?

Attachment H

BUDGET TO 3/19/97

Original Grant Allotment: $30,000.00
Total Remaining Funds after 3/19/97: $8,450.19

	DATE INVOICED	AMOUNT INVOICED	BALANCE REMAINING
Field Manager	**Beginning**		**12,480.00**
Field Manager	6/25/96	564.00	11,916.00
Field Manager	8/6/96	684.00	11,232.00
Field Manager	9/1/96	84.00	11,148.00
Field Manager	9/26/96	408.00	10,740.00
Field Manager	10/31/96	402.00	10,338.00
Field Manager	11/25/96	1,344.00	8,994.00
Field Manager	12/20/96	576.00	8,418.00
Field Manager	1/22/97	1,014.00	7,404.00
Monitoring Assistant	1/22/97	630.00	6,774.00
Field Manager	2/25/97	1,272.00	5,502.00
Monitoring Assistant	2/25/97	1,053.00	4,449.00
Field Manager	3/19/37	1,050.00	3,399.00
Monitoring Assistant	3/19/97	675.00	**2,724.00**
Project Coordinator	**Beginning**		**2,760.00**
	9/26/96	1,552.73	1,207.27
	10/31/96	253.00	954.27
	11/25/96	207.00	747.27
	12/20/96	184.00	563.27
	1/22/97	207.00	356.27
	2/25/97	80.50	275.77
	3/19/97	.	**275.77**
Fringe Benefits	**Beginning**		**386.00**
	9/26/96	252.77	133.23
	10/31/96	35.42	97.81
	11/25/96	28.98	68.83
	12/20/96	25.76	43.07
	1/22/97	28.98	14.09
	2/25/97	11.27	2.82
	3/19/97	.	**2.82**

Outreach	**Beginning**		**2,000.00**
Services by Robert Becker	10/31/96	80.00	1,920.00
Sign Language: Metal signs for display at hedgerov	12/20/96	137.19	1,782.81
Econolodge: Lodging for Jim Kennedy	2/25/97	158.40	1,624.41
Safeway: Food for Wildlife Workshop	2/25/97	48.16	1,576.25
Cookie Co.: Food for Workshop	2/25/97	39.60	1,536.65
Action Bus- Transportation for Field Tours	3/19/97	195.00	1,341.65
Long's Drugs: slide processing	3/19/97	8.45	1,333.20
Photoquick: slide processing	3/19/97	14.97	**1,318.23**
Mileage	**Beginning**		**1,800.00**
	6/25/96	45.32	1,754.68
	8/6/96	46.20	1,708.48
	9/26/96	11.44	1,697.04
	10/31/96	24.64	1,672.40
	11/25/96	86.02	1,586.38
	12/20/96	52.14	1,534.24
	1/22/97	118.58	1,415.66
	2/25/97	275.88	1,139.78
	3/19/97	122.76	**1,017.02**
Plant Materials	**Beginning**		**5,000.00**
Cornflower:Deposit for plant orders	10/31/96	1,025.73	3,974.27
TS&L: Native grass seed	12/20/96	1,194.75	2,779.52
TS&L: Annual beneficial insectary mix seed	12/20/96	11.55	2,767.97
Cornflower: Tree tubes and weed mats	12/20/96	652.51	2,115.46
Agriform: Fertilizer tablets	12/20/96	108.00	2,007.46
Cornflower: Plants	1/22/97	1,232.67	**774.79**
Equip. rental	**Beginning**		**700.00**
RCD Overhead	**Beginning**		**2,400.00**
June & July, 1996	8/6/96	400.00	2,000.00
August, 1996	9/1/96	200.00	1,800.00
September, 1996	9/26/96	200.00	1,600.00
October, 1996	10/31/96	200.00	1,400.00
November, 1996	11/25/96	200.00	1,200.00
December, 1996	12/20/96	200.00	1,000.00
January, 1996	1/22/97	200.00	800.00
February, 1996	2/25/97	200.00	600.00
March, 1996	3/19/97	200.00	**400.00**

Supplies & Expenses	**Beginning**		**2,474.00**
Blackburn: Survey flags	12/20/96	39.25	2,434.75
Irrigation Supply Co.: Ground stakes for weed mats	1/22/97	12.87	2,421.88
True Value: Lumber and supplies for bat boxes	2/25/97	229.62	2,192.26
Ace Hardware: Post-hole digger	2/25/97	23.54	2,168.72
True Value: Staples for staplegun	3/19/97	3.64	2,165.08
Ace Hardware: Potting soil	3/19/97	6.41	2,158.67
Irrigation Supply Co.: Ground stakes for weed mats	3/19/97	58.34	2,100.33
Irrigation Supply Co.: Ground stakes for weed mats	3/19/97	117.98	1,982.35
Irrigation Supply Co.: Ground stakes for weed mats	3/19/97	43.76	1,938.59
Esparto High School: Bat box construction	3/19/97	200.00	1,738.59
InterNet: Netting for bat boxes	3/19/97	219.80	1,518.79
Fisco: Roundup, 2-1/2 gallons	3/19/97	171.59	1,347.20
Long's Drugs: Slide film, notebook supplies	3/19/97	18.63	1,328.57
Long's Drugs: Notebook supplies	3/19/97	10.65	1,317.92
Payless: Posterboard for sticky card traps	3/19/97	26.28	1,291.64
Payless: Clipboard, plastic wrap for sticky cards	3/19/97	8.02	1,283.62
True Value: Staplegun and staples	3/19/97	19.82	1,263.80
True Value: Staplegun staples	3/19/97	2.67	1,261.13
True Value: Shovel and hoe	3/19/97	23.57	**1,237.56**

Yolo County Resource Conservation District

Establishing Hedgerows for Pest Control and Wildlife

Growers in Yolo County have found a solution to the problem of maintaining field borders and other noncrop farm areas. By planting hedgerows of non-invasive native plants, they create wildlife habitat areas that attract beneficial insects and provide competition against invasive weeds. With careful establishment and management techniques, hedgerows can provide a useful and attractive alternative to continuously scraping, spraying, and cultivating field edges and other "unfarmed" areas that would otherwise become sources of weed seeds.

What is a hedgerow?

Hedgerows are lines or groups of trees, shrubs, perennial forbs, and grasses that are planted along field edges or other unused areas. For agricultural areas in California, we recommend using a variety of native grasses, perennial forbs, shrubs, and trees that attract different types of beneficial insects, mammals, reptiles, and birds (including raptors). Native plants work extremely well in hedgerows because they require very little care after an establishment period of about three years. Many native plants have deep roots that hold soil and increase water permeability. Hedgerow areas suppress weeds by providing competition, and are less susceptible to wind and water erosion than bare soil. They can also filter surface runoff water, preventing silt, nutrients, and pesticides from entering waterways.

Selecting a Site

Any unused farm area with good soil and access to water may make a good hedgerow site. Make sure the area is out of the way of equipment. This may mean planning spaces in the hedgerow for equipment to drive through. If you will be planting native grasses and shrubs in the same hedgerow, be sure to allow enough room for a mower to pass through without damaging shrubs.

Choosing Plants

Plants should be selected according to the purpose you want the hedgerow to serve, but local species are likely to be best adapted to conditions on your farm. It is important to look at the water needs of each plant. Some natives, such as Toyon and California buckwheat, are extremely drought-tolerant and will die if their root crowns get wet for too long. These are best planted in well-drained soils. Others, such as willows and cottonwoods, prefer wetter areas.

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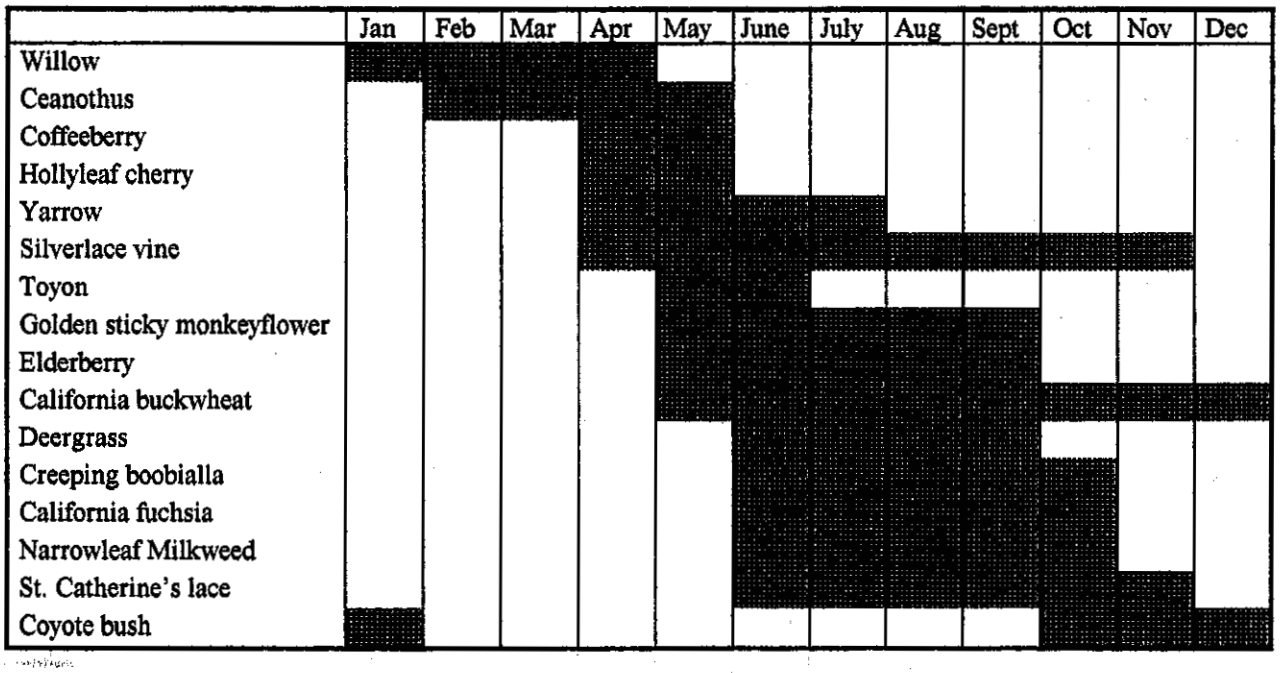
(916) 662-2037 (916) 662-4876 FAX

If you would like your hedgerow to serve as a windbreak, then you should design a hedgerow with many tall-growing shrubs and trees. Recommended species include cottonwoods, willows, native oaks, redbuds, and elderberry. For lists of possible species for different settings in the Yolo County area, please see the attached list.

If you would like to attract beneficial insects (i.e. insects that prey on or parasitize crop pests), you should plant species with plentiful nectar and pollen. If you are unsure whether a plant will attract beneficial insects, observe one during its flowering stage to see if bees and other insects are using it. For example, flowering Ceanothus and coyote bushes tend to have large quantities of hoverflies and bees feeding on their pollen and nectar, whereas flowering oleander bushes attract very few insects. Consider at what time of year each species flowers, and plan your hedgerow for year-round flowering. The diagram below contains information you may use to plan a hedgerow with staggered flowering periods.

Flowering Periods of California Native Insectary Plants



Site Preparation and Planting

Unless the future hedgerow site has been kept free of weeds, it is best to begin regular discing, burning, and/or spraying at least one year before you intend to plant. Reducing the weed seed bank in this way will be especially important if you intend to plant grasses. Depending on the layout of your hedgerow and your irrigation method, you may need to prepare one or more planting beds. Consider whether you want mixed or grouped plantings, how wide your hedgerows should be, and whether you will drip- or furrow- irrigate.

The best time to plant native grass seed is during the fall. You may want to wait for a rainstorm to bring up the first flush of weeds, and then spray, burn, and/or harrow before planting. You can also control weeds in the first 1-2 weeks after planting by spraying glyphosphate before the native grasses emerge. Please refer to the article "Strategies for Establishing California Native Grasses

by Direct Seeding in the Sacramento Valley and Adjacent Foothills," available through the Yolo County Resource Conservation District.

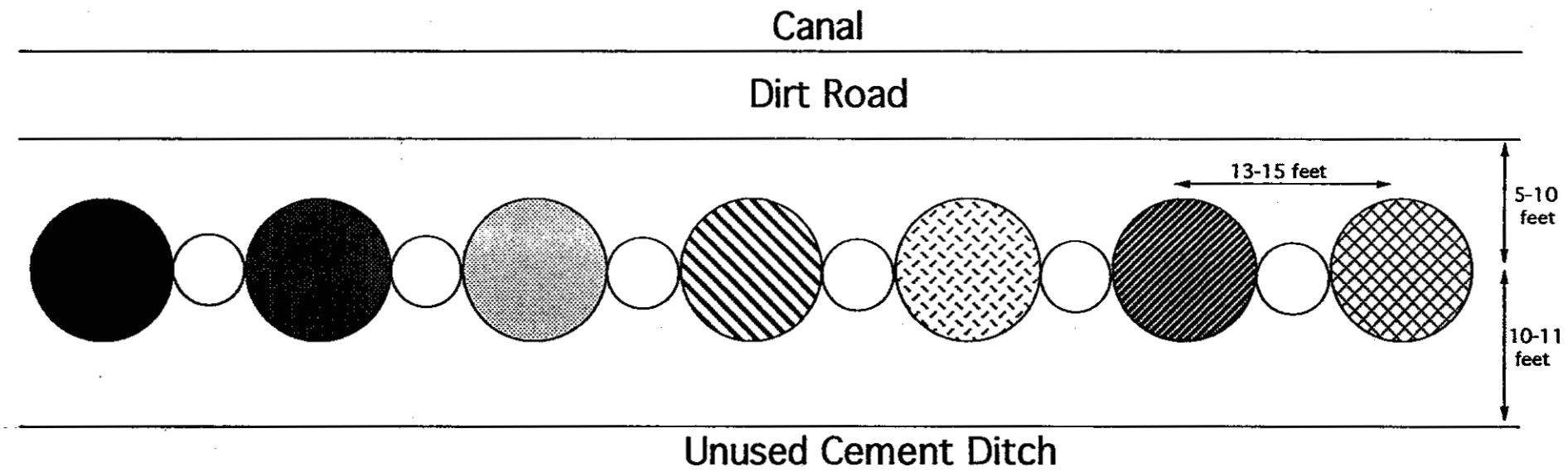
Most native forbs, shrubs, and trees should be planted in the fall, although some become dormant at that time. Consult with your plant supplier for the best transplanting time. When planting, be sure to allow the shrubs and trees enough room to spread. A good rule of thumb is to plant them at centers 10-15 feet apart from each other.

Before transplanting shrubs and trees, you may need to pre-soak the area to be planted to make hole-digging easier. Pre-soaking holes before transplanting is also a good way to reduce the likelihood of transplant shock. You may want to consider using fertilizer tablets for woody shrubs and trees. Dig a hole about twice the width and 1 1/2 times the depth of the original root ball, drop the fertilizer tablet in, and cover with a small amount of soil so that the tablet is not in direct contact with the roots. Mound soil in the base of the hole so that the top of the root ball is roughly at the surrounding ground level. Remove the plant gently from its container and place it in the hole. If you need to loosen the root ball from the sides of the container, roll the container around in your hands, but never pull the plant out by its stem. Pack soil gently around rootball to ensure good soil contact and minimize settling. Cover the top of the rootball with 1/4" - 1/2" of soil to prevent it from drying out. Be sure not to cover the top of the root ball too much, especially if the plant is a drought-tolerant shrub; the soil can hold water against the root crown, killing the shrub. Soak the new plantings well to minimize transplant shock and settle any air pockets around the rootball.

Hedgerow Maintenance

Hedgerows need to be "farmed" during the first 2-3 years. This entails controlling invasive weeds and irrigating during dry periods. Find out the water needs of your plants from your supplier. Native grasses do not need summer watering because they become dormant at that time. Most shrubs and trees will need watering about every 2-4 weeks during drought months. After the 2-3 year establishment period, irrigation should no longer be necessary (depending on the plant species), and weed control measures can be considerably reduced. You may wish to keep notes on insect and wildlife visitation, weed problems and control methods you use in the hedgerow, weather conditions, and plant species that seem especially suited to your area, so you can share your results with others. The Yolo RCD has planted several hedgerows, and we would be very interested in hearing your questions and comments regarding your own hedgerow as we continue to monitor our hedgerows and work on improving our establishment methods.

SAMPLE HEDGEROW LAYOUT



- Coffeeberry
- Ceanothus 'Ray Hartman'
- Toyon
- Elderberry
- Coyote Bush
- Ceanothus 'Yankee Point'
- Hollyleaf Cherry/Western Redbud
- Small Shrub, Perennial Forb, or Deer Grass

Perennial Forbs:
Common Yarrow
'Salmon Beauty' Yarrow
'Paprika' Yarrow
Narrowleaf Milkweed

Small Shrubs:
California Buckwheat
St. Catherine's Lace

Large shrubs were planted with 15 feet of space between their centers. The space between the center of the shrubs and the cement ditch was left wide enough for a mower to pass through unimpeded.

Shrubs and perennials were planted over a base of native grasses which were broadcast-seeded over the entire area between the dirt road and cement ditch.

The native grass seed mix contained these species:

Purple Needlegrass	Slender Wheatgrass
California Oniongrass	California Melic
Blue Wildrye	California Brome
Creeping Wildrye	Meadow Barley

Plant List for
VALLEY OAK WOODLAND AND SAVANNAH SITUATIONS

(adapted for insectary plantings in small areas)

The following is a list of possible plants for hedgerow designs in valley oak woodland/savannah situations. The notes provide information to help determine planting combinations that allow indvidual species appropriate sunlight & water and adequate space. General growth habits may also be included. Hedgerows comprised of a mix of trees and shrubs are generally long lived. Trees are typically longer lived than shrubs. However, many shrubs can have life spans of more than 15 - 20 years. The *Ceanothus* sp. have one of the shortest life spans - five to ten years is typical. **All of these plants do require summer irrigation during their establishment period.**

SMALL TREES (Deciduous)

Common Name	Scientific Name	Notes
Western redbud	*Cercis occidentalis*	Many branched shrub to multiple trunk tree, 6'-20' tall, 10'-15' wide, tolerates partial shade to full sun. Occasional summer water.
Blue elderberry	*Sambucus mexicana*	Shrub 4'-10' tall or tall tree to 40', commonly found in moist places but can tolerate some drought. Flowers April - Nov. Occasional summer water.

SMALL TREES (Evergreen)

Common Name	Scientific Name	Notes
Treasure Island blueblossom	*Ceanothus* 'Ray Hartman'	Mounding shrub with 1"-2" leaves; 8'-15' tall, 10'-15' wide, train to small tree, needs full sun. Infrequent summer water. Flowers Feb.-April.
Blue blossom	*Ceanothus thyrsiflorus*	Hardy, 6'-20', full sun. Flowers March-May. Infrequent summer water.
Toyon	*Heteromeles arbutifolia*	Dense shrub 6'-10' or multitrunked small tree, 15'-25', grows in full sun or partial shade. Flowers May-June. Looks better with occasional summer water.
Hollyleaf cherry	*Prunus ilicifolia*	Moderate growth rate, 20'-40' tall (large and old specimens resemble Califonia live oak), best in full sun, can take light shade. Flowers April-May. Looks better with infrequent deep summer water.
Coffeeberry	*Rhamnus californica*	Mounding shrub,reaches 12'-15', variety 'Eve Case' is more compact, 3'-8' tall and wide, grows in full sun to half shade. Flowers April-May. Looks better with occasional summer water.

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SHRUBS (Deciduous)

Common Name	Scientific Name	Notes
Quail bush	*Atriplex lentiformis*	Densely branched,sometimes spiny; 3'-10' tall, 6'-12' wide, needs full sun. Flowers July - October. **Plant in areas isolated from sugarbeet prodution.**
Brewer saltbush	*Atriplex lentiformis ssp. breweri*	Almost evergreen, not spiny; 5'-7' high, 6'-8' wide. **Plant in areas isolated from sugarbeet production.**
Mule fat	*Baccharis viminea*	6'-10' tall. Flowers March - May. Drought tolerant but looks better with occasional water.

SHRUBS (Evergreen)

Common Name	Scientific Name	Notes
Coyote brush	*Baccharis pilularis*	Tough, 4'-8' wide and high. Looks better with occasional summer water. Males flower Oct.-Nov., females Oct.-Jan.
Wild lilac	*Ceanothus* 'Concha'	Densely clad, small leaves, 6'-8' tall and wide. Flowers March-April. Infrequent summer water.
Buckbrush	*Ceanothus cuneatus*	8' tall. Flowers Feb.-April. Very drought tolerant.

SMALL SHRUBS/GROUND COVER

Common Name	Scientific Name	Notes
Common yarrow	*Achillea millefolium*	Spreading perennial with fernlike foliage and flowers' stems up to 3', needs full sun, care-free. Flowers April-July. Tolerates dry conditions well.
Narrowleaf milkweed	*Asclepias fascicularis*	Upright perennial, 2'-3' tall with long narrow leaves, needs full sun. Flowers July-Oct. Tolerates dry conditions.
Coyote brush	*Baccharis pilularis,* compact form	Dense, 12"-18" tall with 5'- 6' spread, needs full sun. Can flower Oct.-Jan. Looks better with occaional summer water.
Yankee Point Carmel creeper	*Ceanothus g.* var. *h. 'Yankee Point'*	Fast-growing, 3'-5' tall, 6'-8' wide, good ground cover, needs full sun. Flowers March-May. Looks better with occasional summer water.
California buckwheat	*Eriogonum fasciculatum* var. *foliolosum*	Forms 2'-5' tall, 4' wide clump, with wide, woolly leaves, needs full sun. Flowers May-Dec. Best on drier sites.
St. Catherine's lace	*Eriogonum giganteum*	Large open form, 4'-5' tall. Flowers June-Nov. Best on drier sites.

GRASS (available in both seed and plug form; seed combinations, totaling 15 lbs. drilled or 25 lbs. broadcast*, should be mixed according to site conditions)

Common Name	Scientific Name	Notes
Three-awn	*Aristida hamulosa*	Warm season clumping, 10" tall. Very drought tolerant.
California brome	*Bromus carinatus*	Cool season, annual/biennial, 1.5'-3' tall. Deep soils.
Blue wildrye	*Elymus glaucus*	Cool season perennial bunchgrass, 2'-3' tall. Etablishes rapidly, deep good soils.
Yolo slender wheatgrass	*Elymus trachycaulus majus*	Cool season perennial bunchgrass, 18"-4' tall, tolerates full sun to light shade. Deep good soil.
Idaho fescue	*Festuca idahoensis*	Cool season tufted perennial, 1'-2', tall. Tolerates dry conditions.
Meadow barley	*Hordeum brachyantherum*	Tufted, perennial bunchgrass, 1' tall, 8" wide. Adapted to wet conditions.
California barley	*Hordeum californicum*	Adapted to upland dry meadows, 2'-4' tall. Tolerant of winter and spring flooding.
Creeping wildrye	*Leymus triticoides* 'Rio'	Cool season, perennial, spreads by rhizomes, 2'-3' tall. Suited to wetter conditions.
Onion grass	*Melica californica*	Cool season grass growing 1'-2' tall with flower spikes, tolerates full sun to partial shaded. Well drained soils, deep or shallow.
Nodding needlegrass	*Nassella cernua*	Cool season spreading bunchgrass, 1'-2' tall. Well drained soils, deep or shallow.
Purple needlegrass	*Nassella pulchra*	Cool season bunchgrass, 1'-2' tall, flower stocks to 30" in spring. Widely adapted.
Foothill needlgrass	*Nassella lepida*	Cool season perennial bunchgrass, 1'- 2' tall. Adapted to dry conditions.
Pine bluegrass	*Poa secunda*	Cool season tufted perennial bunchgrass, 2.5' tall summer dormant. Adapted to shallow soils.
Squirrel tail	*Sitanion jubatum*	Cool season, clumping, 1.5'-5' tall, tolerates full sun . Dry soils.

* On challenging sites (e.g. low fertility soil, steep slopes, disturbed areas), use up to 20 lbs. drilled and 30 lbs. broadcast.

Plant List for "RIPARIAN" HEDGEROWS

The following is a list of possible plants for hedgerow designs in riparian-type situations. Abundant water is one prerequisite for establishment and normal growth. Plant's proximity to standing water should vary from species to species (e.g. locate most trees higher on slope than shrubs). Consult planner for appropriate planting schemes. The notes provide information to help determine planting combinations that allow indvidual species appropriate sunlight and adequate space. General growth habits may also be included. Hedgerows comprised of a mix of trees and shrubs are generally long lived. Trees are typically longer lived than shrubs. However, many shrubs can have life spans of more than 15 - 20 years. ***All of these plants do require summer irrigation during their establishment period.***

TREES (Deciduous)

common name	scientific name	notes
Box elder	*Acer negundo*	fast growing 40'-60'; tolerates full sun or partial shade.
Black walnut	*Juglans californica* var. *hindsii*	single trunk, broad crown; 45'-75'; needs full sun.
California sycamore	*Platanus racemosa*	multiple trunk; fast growing 50'-100'; needs full sun.
Fremont cottonwood	*Populus fremontii*	fast growing 40'-60'; needs full sun.
Valley oak	*Quercus lobata*	60'-80' tall and wide; grows up to 3' a year; needs full sun.
Red willow	*Salix laevigata*	20'-40' tall; needs full sun.
Gooding's black willow	*Salix gooddingii*	20'-30'; needs full sun.

TREES (Evergreen)

common name	scientific name	notes
Coast live oak	*Quercus agrifolia*	dense foliage 30'-60' tall and wide; grows up to 25' in 10 years; needs full sun.

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SMALL TREES/TALL SHRUBS (Deciduous)

common name	scientific name	notes
Quail bush	*Atriplex lentiformis*	densely branched, sometimes spiny; 3'-10' tall, 6'-12' wide; needs full sun. Plant in areas isolated from sugarbeet production.
Brewer saltbush	*Atriplex lentiformis ssp. breweri*	almost evergreen; denser form than quail bush; 5'-7 tall, 6'-12' wide; needs full sun. Plant in areas isolated from sugarbeet production.
Button willow	*Cephalanthus occidentalis*	grows 3'-12'; found along streambanks; tolerates full sun to partial shade.
California blackberry	*Rubus vitifolius*	mounding vine or shrub to 20'; tolerates full sun to light shade.
Blue elderberry	*Sambucus caerulea*	mounding shrub or spreading tree growing 15'-20' tall and wide; tolerates full sun or light shade.

SMALL TREES/TALL SHRUBS (Evergreen)

common name	scientific name	notes
Toyon	*Heteromeles arbutifolia*	dense shrub or multi-trunk dome tree, 15'-25' tall and wide; grows in full sun or partial shade. Plant high on slope or drier sites; an uncommon plant in riparian forest.
Coyote brush	*Baccharis pilularis*	dense, many branched; grows 4'-8' tall, spreads to 6'+; needs full sun. Plant high on slope or drier sites.
Mule fat	*Baccharis viminea*	erect willow-like shrub, 6'-12' high, 4'-6' wide.

SMALL SHRUBS/GROUND COVER

common name	scientific name	notes
Coyote brush	*Baccharis pilularis,* compact form	dense evergreen; grows 12"- 18" with 5'-6' spread; needs full sun. Plant high on slopes or drier sites.
California wild rose	*Rosa californica*	deciduous; grows to 6'; tolerates sun or shade.
Mule fat	*Baccharis viminea*	erect willow-like shrub, 6'-12' tall, 4'-6' wide.

GRASS / SEDGE (Plugs)

common name	scientific name	notes
Santa Barbara sedge	*Carex barbarae*	grows to 3'; tolerates full sun to partial shade
Creeping wild rye	*Leymus triticoides*	cool season grass with blades 2' high and stems reaching 3' in summer; spreads by rhizomes; tolerates full sun to light shade.
Deer grass	*Muhlenbergia rigens*	warm season perennial forming dense clumps from the base; grows 24"-30" tall; tolerates full sun to light shade.

GRASS (seed mixes should total 15 - 20 lbs if drilled or 25-30 lbs broadcast)

common name	scientific name	notes
Purple needle grass	*Nasella pulchra*	cool season bunchgrass, 1'-2'; flower stocks to 30" in Spring.
Blue wild rye	*Elymus glaucus*	cool season perennial bunchgrass, 2'-3'; establishes rapidly.
Meadow barley	*Hordeum brachyantherum*	tufted, perennial bunchgrass, 1' tall, 8" wide.
California brome	*Bromus carinatus*	cool season, perennial bunchgrass.
Yolo slender wheatgrass	*Elymus trachycaulus*	cool season perennial bunchgrass, 18"-4'; tolerates full sun to light shade.

Plant List for
VALLEY OAK WOODLANDS AND SAVANNAHS

The following is a list of possible plants for hedgerow designs in valley oak woodland/savannah situations. The notes provide information to help determine planting combinations that allow indvidual species appropriate sunlight, adequate space, and appropriate watering. General growth habits may also be included. Hedgerows comprised of a mix of trees and shrubs are generally long lived. Trees are typically longer lived than shrubs. However, many shrubs can have life spans of more than 15 - 20 years. The *Ceanothus* sp. have one of the shortest life spans - five to ten years is typical. **All of these plants do require summer irrigation during their establishment period.**

TREES (Deciduous)

Common Name	Scientific Name	Notes
California black walnut	*Juglans hindsii var. hindsii*	45'-75' tall ;single trunk, broad crown, needs full sun. Needs no summer water after establishment.
Valley oak	*Quercus lobata*	60'-80' tall and wide; grows up to 3' a year; needs full sun. Do NOT summer water indigenous specimens. Infrequent summer water OK for planted ones.

TREES (Evergreen and Conifers)

Common Name	Scientific Name	Notes
Foothill or gray pine	*Pinus sabiniana*	fast growing conifer, up to 50' tall, 25'-50' wide; forked trunk with lacy, open crown; needs full sun. Water to establish.
Coast live oak	*Quercus agrifolia*	dense foliage, 30'-60' tall and wide; grows up to 25' in 10 years; needs full sun. Do NOT summer water indigenous specimens. Infrequent summer water OK for planted ones.
Interior live oak	*Quercus wislizenii*	30'-75' tall and wide; needs full sun. Do NOT water indigenous specimens. Infrequent summer water OK for planted ones.
California bay	*Umbellularia californica*	30'-60' tall; tolerates full sun to partial shade. Tolerates wide range of conditions. Does not require water after established.

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SMALL TREES/TALL SHRUBS (Deciduous)

Common Name	Scientific Name	Notes
Quail bush	*Atriplex lentiformis*	densely branched,sometimes spiny; 3'-10' tall, 6'-12' wide; needs full sun; **plant in areas isolated from sugarbeet prodution.**
Brewer saltbush	*Atriplex lentiformis ssp. breweri*	almost evergreen; not spiny; 5'-7' high, 6'-8' wide, **plant in areas isolated from sugarbeet production.**
Western redbud	*Cercis occidentalis*	many branched shrub to multiple trunk tree, 6'-20' tall, 10'-15' wide; tolerates partial shade to full sun. Occasional summer water.
Blue elderberry	*Sambucus mexicana*	4'-10', commonly found in moist places but can tolerate some drought. Occasional summer water.

SMALL TREES/TALL SHRUBS (Evergreen)

Common Name	Scientific Name	Notes
Coyote brush	*Baccharis pilularis*	tough, 4'-8' wide and high. Looks better with occasional summer water.
Treasure Island blueblossom	*Ceanothus* 'Ray Hartman'	mounding shrub with 1"-2" leaves; 8'-15' tall, 10'-15' wide; needs full sun. Infrequent summer water.
Wild lilac	*Ceanothus* 'Concha'	densely clad, small leaves; 6'-8' tall and wide. Infrequent summer water.
Toyon	*Heteromeles arbutafolia*	dense shrub 6'-10' or multitrunked small tree, 15'-25'; grows in full sun or partial shade. Looks better with occasional summer water.
Hollyleaf cherry	*Prunus ilicifolia*	20'-40'; oldest and largest resemble California live oak; grows best in full sun, can take light shade. Looks better with infrequent deep summer water.
Coffeeberry	*Rhamnus californica*	mounding shrub,reaches 12'-15'; variety 'Eve Case' is more compact, 3'-8' tall and wide; grows in full sun to half shade. Looks better with occasional summer water.

SMALL SHRUBS/GROUND COVER

Common Name	Scientific Name	Notes
Common yarrow	*Achillea millefolium*	spreading perennial with fernlike foliage and flowers whose stems reach up to 3'; needs full sun; care-free. Tolerates dry conditions well.
Narrowleaf milkweed	*Asclepias fascicularis*	upright perennial; 2'-3' tall with long narrow leaves; needs full sun. Tolerates dry conditions.
Quail bush	*Atriplex lentiformis*	densely branched,sometimes spiny; 3'-10' tall, 6'-12' wide; needs full sun; **plant in areas isolated from sugarbeet production.**
Brewer saltbush	*Atriplex lentiformis* ssp. *breweri*	almost evergreen; not spiny; 5'-7' high, 6'-8' wide, **plant in areas isolated from sugarbeet production.**
Coyote brush	*Baccharis pilularis,* compact form	dense evergreen; grows 12"-18" tall with 5'- 6' spread; needs full sun. Looks better with occaional summer water.
Yankee Point Carmel creeper	*Ceanothus g.* var. *h. 'Yankee Point'*	fast-growing evergreen, 3'-5' tall, 6'-8' wide; good ground cover; needs full sun. Looks better with occasional summer water.
California buckwheat	*Eriogonum fasciculatum* var. *foliolosum*	evergreen; forms 2'-5' tall, 4' wide clump, with wide, woolly leaves; needs full sun; best on dry sites.

GRASS (available in both seed and plug form; seed combinations, totaling 15 lbs. drilled or 25 lbs. broadcast, should be mixed according to site conditions)

Common Name	Scientific Name	Notes
Three-awn	*Aristida hamulosa*	warm season clumping, 10" tall, very drought tolerant.
California brome	*Bromus carinatus*	cool season, perennial bunchgrass, deep soils.
Blue wildrye	*Elymus glaucus*	cool season perennial bunchgrass, 2'-3' tall, establishes rapidly, deep good soils.
Yolo slender wheatgrass	*Elymus trachycaulus*	cool season perennial bunchgrass, 18"-4' tall, tolerates full sun to light shade, deep good soil.
Idaho fescue	*Festuca idahoensis*	cool season tufted perennial, 1'-2', tall, tolerates dry conditions.
Meadow barley	*Hordeum brachyantherum*	tufted, perennial bunchgrass, 1' tall, 8" wide, adapted to wet conditions.
California barley	*Hordeum californicum*	adapted to upland dry meadows, tolerant of winterand spring flooding
Creeping wildrye	*Leymus triticoides* 'Rio'	cool season, perennial, spreads by rhizomes, 2'-3' tall, suited to wetter conditions.
Onion grass	*Melica californica*	cool season grass growing 1'-2' tall with flower spikes, tolerates full sun to partial shaded, well drained soils, deep or shallow.
Nodding needlegrass	*Nassella cernua*	cool season spreading bunchgrass, well drained soils, deep or shallow.
Purple needlegrass	*Nassella pulchra*	1'-2', cool season bunchgrass; flower stocks to 30" in Spring, widely adapted.
Foothill needlgrass	*Nassella lepida*	cool season perennial bunchgrass, 1'- 2' tall, adapted to dry conditions.
Pine bluegrass	*Poa secunda*	cool season tufted perennial bunchgrass,summer dormant, adapted to shallow soils.
Squirrel tail	*Sitanion jubatum*	cool season, clumping, tolerates full sun and dry soils

ATTACHMENT J

Yolo County Resource Conservation District,
221 W. Court St. Suite 1, Woodland, CA 95695 (916) 662-2037
Rachael Freeman Long - Farm Advisor, Yolo/Solano County,
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Bat Houses for the Central Valley

Bats are the most important predator of night-flying insects and consume vast numbers of pests. A single little brown bat can catch 600 mosqitos in an hour, and a typical colony of 150 big brown bats in the midwest easily eats 38,000 cucumber beetles, 16,000 June bugs, 19,000 stink bugs and 50,000 leafhoppers as well as thousands of moths in a season. The twenty million Mexican free-tails from Bracken Cave, Texas, eat 250 tons of insects nightly.

Bats are mammals that belong to the group Chiroptera, which means "hand-wing", as their wings resemble extended arms with fingers and thumbs. They're not rodents, and they are more related to us than they are to mice. They mate in the fall and generally have one 'pup' the following spring. If food is scarce bats may re-absorb the embryo and fail to reproduce until the following year. Many bats live for thirty years or more.

Most of the bats in our area of the Sacramento Valley migrate south or to the coast for the winter, where food is more abundant. Others may hibernate in caves where they remain dormant during the winter months. Bats often return to their original roosting sites in the spring when weather beings to warm and insects become more abundant.

Bats are frequently associated with people and are often found in man-made structures. They prefer places that are warm, dry, and protected from disturbance, such as in old water towers and in expansion joints under bridges. They have even been found roosting behind burlap sacks on one area farm.

Bat numbers have declined dramatically in recent years due to habitat loss and human disturbance of roosts. This is why, in many instances, bats are choosing roosting areas that only marginally serve their needs. However, while bat standards for roosting areas may have dropped, the bats are still pretty fickle about where they choose to live. So when you're deciding to put up a bat house, there are some important aspects that should be considered. Here are some of the most important things to worry about when putting up a bat house.

Bat House Criteria

1) Construction and Design: Exterior plywood is best. Staples and bolts used must be galvanized or exterior grade. Bat houses need to be at least 32 inches tall, 14 inches wide, and have a 3-6 inche landing pad extended below the opening. Houses should have 1-4 roosting chambers, spaced at 3/4 of an inch. The landing pad and the inside of the

roosting chambers should be roughened or have some sort of durable plastic screening for the bats to grab hold. Try and make sure there are no sharp points within the house due to nails or plastic screening, because bats may tear their wings on them. Vents should be placed on houses to avoid overheating and stuffiness. Front and side vents should be used. Side vents are six inches tall by 1/2 inch wide. Front vents are as long as the box is wide.

In the Central Valley, houses should be painted a dark brown for optimum heat transference. All seams must be caulked. Bats don't like leaky houses. Remember this house is going to be up for years, so make it last!

Note: Some people like to treat the houses with bat guano diluted with water. This is not necessary. It only makes the house smell and feel a little more weathered. You can produce this same effect by putting the house out during winter, before the bats return for the spring.

2) **Solar Radiation:** Will the houses get too hot?

Here in California the summers are HOT (sometimes a little too hot for us). Fortunately, bats like it that way. Temperature extremes either way will likely deter bats from your house. Houses should receive at LEAST 8 hours of sun and should be tall enough (at least 2 ft tall) to allow for temperature variation within the house. Bats can move around to cooler or warmer places in the house to adjust to the changing daily temperatures.

In the Central Valley, it may be best to put the houses facing southeast. This way houses receive the morning sun and avoid becoming too hot in the afternoon.

3)Habitat: Where should you put your bat house?

-Any place that has already had bats is best. Bats can't be introduced into areas where they do not already live. If there are bats in your area, you have a good chance of attracting them to your house.

-Any place near water is best. They need to drink every night, usually right after they emerge at dusk. The suggested distance from water is a quarter of a mile.

-Bats prefer agricultural over urban areas, mainly because of the diversity of habitat and insects. Habitat diversity is related to prey diversity. In a largely agricultural area, bats depend on the insects from crops. When insect populations cycle, bats need to have alternative prey bases to depend on for food. Therefore, an area with fruit orchards and tomato fields would be more likely to have bats then an area with only fruit orchards.

- Houses should be placed near areas with any sort of protected cover, such as near a grove a trees. The most dangerous times for bats are at dusk and at dawn when both nighttime and daytime predators are hunting. A place of cover to duck into immediately after they emerge gives the bats the protection from predators which they require. Houses should be placed 20-25ft from the nearest tree-this gives them flying space when they emerge, and protects them from any tree climbing or perching predators.

Finally, **do not** place bat boxes near barn owl boxes! This is a common mistake. While barn owls do help by eating rodents, they also eat bats. Place your house a fair distance from your barn owl box , and don't face them towards each other.

4) Placement of Houses: Where is the best place to put my house?

-To protect the houses from predators, houses should be at least 15 feet off the ground and 20-25 feet away from any tree. Bat houses on poles or mounted on the side of houses have had the greatest rate of occupancy. DO NOT mount onto a metal building. The houses will get far too hot for bats. Also, houses should not be lit by bright lights.

-Do not tilt bat houses. Some people believe that tilting houses helps bat pups hang on. But in lean years, mothers actually need to kick their babies out of the houses because they don't have the resources to feed their pups. So please let nature take its course and don't slant your houses.

-If you put your bat house up in the winter, before bats return from their annual spring migrations, it will have time to weather. Bats are more likely to roost in slightly weathered houses because they do not like the smells of new paint or wood.

-There are numerous ways to mount your bat houses. Here's a few:

On Buildings: Mount preconstructed bat house on the southeast or east facing side of the house, directly under the eaves. Screw or nail the top and bottom of the house for best results (see diagram for details).

On Panels: One of the easiest and cheapest ways to install bat houses on buildings is simply to attach sheets of plywood to the barn or house with 3/4" spacers between the sheet and the wall. Taller, rather than longer pieces of plywood allow for greater temperature variation. Don't forget a landing pad and some mesh for the bats to hang on to.

On Poles: A great way to put a house up is on poles.

Materials are: 2 - fourteen foot 2x4s
2 - eight foot 4x4's
4- 3/8 x 8" bolts, in addition to washers and nuts for the bolts
6- 2 1/2" screws (Use no more then 2 1/2 " screws! If points extend into box, the bats might catch their wings.)

Use a posthole digger to dig out 3-4 ft holes at the location you wish to place your bat box. The best way to put up your house is to first screw the 2x4s to the house. With that done, bolt the 2x4s to the 4x4s with the poles lying on the ground, but only bolt the top two bolts (see diagram). With only the top two bolts in place, you can then put the 4x4s in the ground (make sure to compact the dirt into the holes once you are finished). The two bolts will allow the 2x4s to rotate. So when you are putting the 4x4s into the ground, you bat box will still be resting on the ground.

Finally, raise the box up to its proper position and put in the bottom bolts. It is best to drill all the bolt holes before you erect the house.

Warning: The Central Valley has a powerful north wind. If your area gets extremely windy, you might want to forgo putting houses on poles. Bats will be too disturbed by boxes that sway too much in the wind.

Maintenance

Bat houses don't require much maintenance. After a couple years you might need to re-caulk or putt on another coat of paint. This insures that the houses are sealed and protected from the weather while the bats are living in them.

Look out for wasp nests. Wasps and bats can live together in bat houses, but if the wasp nests take up too much space, the bats will probably look elsewhere for housing. To avoid this, try cleaning the nest out of your bat box in the winter months when both bats and wasps are absent.

You might want to look into your house every so often and see who's there. If you want to find out how many bats are in your house, just wait outside one evening, watch them emerge and count how many bats come out.

If you are serious about experimenting with bat house design. or would just like be involved in a nation wide research project devoted to collecting information on bat houses, contact Bat Conservation International, PO Box 162603, Austin. TX 78716, 512-327-9721.

If you would like more information on how to construct bat houses call BCI or call Farm Advisor, Rachael Freeman Long at the UC Cooperative Extension at (916) 666-8143.

Health Concerns

Contrary to popular belief, bats are not blind, do not become entangled in human hair, and seldom transmit diseases of other animals and humans. Less than 1/2 of the one percent of our colonial bats contract rabies, and when they do, they develop a type of paralysis, fall to the ground and quickly die. There has never been an epidemic outbreak of rabies in bats. If you do see a bat on the ground, treat it with the respect that you would give any wild animal, and leave it alone. By leaving it alone, you avoid the risk of contracting any diseases.

Bat droppings do not pose any more of a health threat than bird or cat droppings. Inhalation of dust associated with animal feces of any kind should be avoided.

Who Might I Find In My Bat House?

Taken from Bat House Builders Handbook, Merlin Tuttle and Donna L. Hensley

Bats of California that will roost in bat houses

Pallid Bat, *Antrozous pallidus*

This is one of the more interesting looking bat species. Their ears are about 1/2 as long as their head and body combined! You can bet these bats have a marvelous sense of hearing! They are ground feeders and tend to eat larger prey such as grasshoppers, beetles, and even scorpions. This species doesn't migrate, but actually just hibernates in the same area deep within rock crevices. They are attracted to buildings, bat boxes, rock crevices, and under bridges. They are one of the few bats that like the aridity of the central valley.

Big Brown Bat, *Eptesicus fuscus*

These bats are attracted to caves, abandoned mines, and buidings. They are less likely to tolerate high temperatures, but they do tolerate very LOW temperatures. It has been found that their body temperature can reach sub-freezing degrees. Therefore, they do not migrate and can be found overwintering in bat houses. They prefer beetles and tend to hunt around areas with trees.

Little Brown Bat, *Myotis lucifugus*

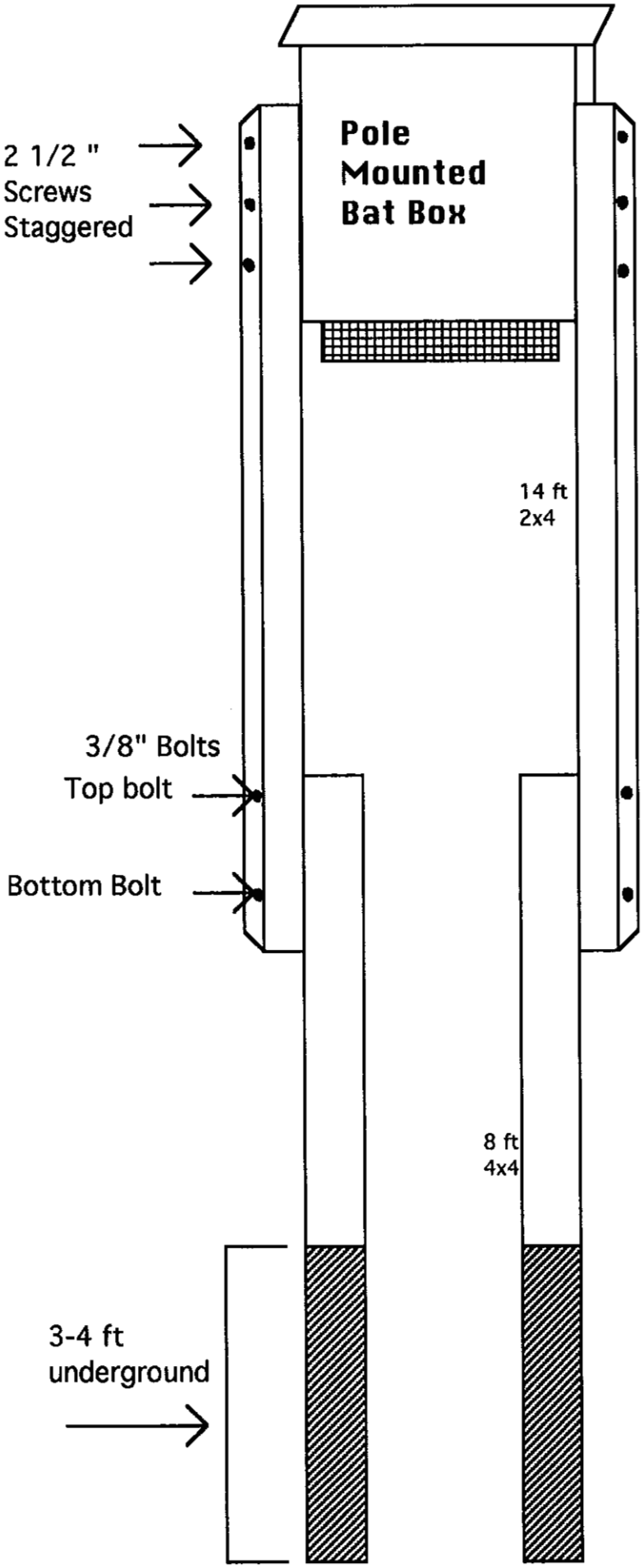
This is the most common bat species in Canada and the northern 2/3 of the US. It is one of the species most likely to occupy bat houses. They can be found almost everywhere in the central valley. They are extremely heat tolerant with body temperatures recorded up to 129F(54C). They roost in woody areas, builings, rock crevices, tree hollows and bat houses and will roost with Big Brown bats. They tend to eat mosquitos, moths and other night flying and aquatic insects.

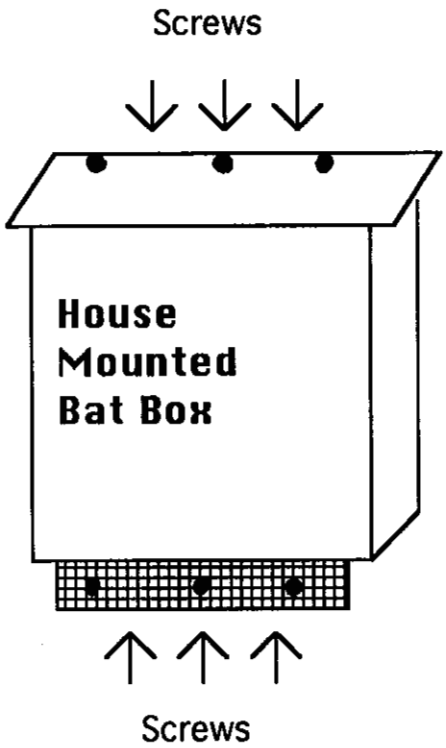
Mexican free-tailed Bat, *Tadarida brasiliensis*

These bats are named "free-tail: because of the projection of the tail past the membrane that connects the legs and tail . Thus the tail is "free" of the membrane.

This is another species most likely to occupy bat houses. It is the most colonial of all species. Mexican free-tails overwinter in Mexican and Central American caves and migrate back to the central valley in the spring. They eat an enormous amount of moths and mosquitos.

Bat Box Mounting





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Davis woman to head beneficial insect program

A project manager has been named to coordinate creation of five model hedgerows to attract beneficial insects.

Davis resident Celia Lamb will handle the project, according to Katy Pye, executive director of the Yolo County Rural Conservation District. The program will be coordinated for the district and UC Cooperative Extension.

According to Rachel Freeman Long, a UC Cooperative Extension agent working on pest management research, Lamb is "one of the very few people who can hit the ground running. Her experience and knowledge about hedgerow design, insectary research, native plants, and county farming greatly facilitates working with our enthusiastic cooperators. Because hedgerows are such a new idea, Lamp is perfect, an ideal choice. We're really pleased to have her."

Lamb has worked on an organic farming operation and studied hedgerows in 1995 in Yolo County and Fresno, learning how "good bugs" can control pest insects. As a field and lab assistant in pest control and integrated pest management, Lamb worked with Long, who investigates how selected native plants attract and use beneficial insects to reduce pesticide use.

Research tracks the life of beneficial insects year-round, showing that they use native plants for feeding and will travel up to a mile away to control pests. Aside from improving the aesthetics of farm sites, native plant hedgerows offer many benefits, Pye stated, such as controlling weeds, reducing tillage and equipment mishaps, and protecting residences from noise, chemicals and dust.

Lamb will be targeting four area sites next to rotated field crops under the grand provided by the conservation district and extension service. The sites will be used to create hedgerows for research and demonstration, aiming to resolve both real and perceived pest management issues, Pye explained. Funding also covers formal and informal workshops, newsletters, media coverage, and group presentations which build on five years of district "Farming with Wildlife" workshops.

"This grant brings together farmers, pest control advisers and agency specialists to demonstrate five hedgerows as reduced-risk, sustainable integrated pest management systems," Pye explained.

Funding from the California Department of Pesticide Regulation is hoped to extend three years, though only the first year is guaranteed.

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Lamb said hedgerows take time to be established and need little maintenance after that. Through careful selection, Lamb hopes to create hedgerows out of plants that will attract predatory insects, easing the stress of applying pesticides on crops.

ATTACHMENT K