

MORRISTOWN NATIONAL HISTORICAL PARK

ORCHARD MANAGEMENT PLAN

FOR

WICK ORCHARD



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in partial fulfillment of SCA
Internship for John Donahue,
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INTRODUCTION

The Wick Farm Orchard is located in the Jockey Hollow Unit of Morristown National Historical Park, in Morristown, New Jersey. The farm was owned by farmer Henry Wick, and later became the command post for ^{Brigadier General} ~~Conf.~~ Arthur St. Clair, Commander of the Pennsylvania Line. ^{during 1780} Originally the orchard consisted of 300 apple trees at the time of Henry Wick. At this time it is being brought back to its original standing through policies of the National Historical Park. *Is this really the case?*

The Orchard Management Plan will serve as a guide and source material for present and future management of the Wick Orchard. The document will detail the essential information and prevent future repetition of this research. The Orchard Management Plan will also serve as a general guide to the budgetary requirements for Orchard Management.

not really correct! The Apple trees found in the orchard today are representatives of the original trees of the Wick Orchard. Even though they were planted by the National Park Service, they were purchased through nurseries that only raise historical species of fruit and ornamental trees. *← where do they get this info?*

An important aspect of this plan is a limited dependence on chemicals for pest management. We have developed an integrated pest management plan based on organic methods. Emphasis is placed on deterrence, early recognition, and cultural orchard methods.

Another important aspect of the Orchard Management Plan will be the preservation of the historical aspects of the orchard. The methods used will be more relative to nineteenth century orcharding, due to the problems of gaining information of eighteenth century orcharding. These methods may have a more modernized appearance, but only in the forms of application, and not what is being applied.

There is much data available on 18th c. apples/orchards as well. I pointed numerous sources out to John, which he didn't follow up on. A number of nurseries specialize in early apple varieties & can be obtained for the part.

I think this is an excellent first draft & accomplishes many of its stated objectives. More work is needed, however, on the historical accuracy & goals of the plan and an inventory of apple varieties on-hand & proposed for introduction. David & John are to be commended for implementing this document.

J Koch
10-12-89

MANAGEMENT OBJECTIVES

The Orchard Management Plan has been developed to accomplish the following goals for the site.

To provide a scientific and Systematic approach to the management of the Wick Farm Orchard:

- ✓ - establishing general needs that apply to all of the orchards
- ~~✓~~ - establishing specific needs of each species
- ✓ - establishing a daily program along a calendar year outline
- ✓ - provide continuity during periods of personnel fluctuation
- - to establish an orchard that is in close relation to the original Wick Orchard

✓ - The plan in its present form seems to accomplish the stated objectives that are checkmarked.

○ - Objectives with a 'O' in front are not addressed or mentioned in the body of this plan. A major need that should be taken care of ASAP is an inventory or breakdown of apple varieties presently in the orchard -- this is nowhere in the plan.

Soils

The soil structure within the Wick Orchard is mainly Edneyville soils. These are the soils best suited for Agricultural use within the park, as shown by the Morris County Soil Survey.

The Edneyville series of soil consists of deep, gently sloping to steep, well drained, loamy soils. These soils usually contain granitic gneiss gravel, cobbles, and stones. They have irregular shapes and the areas in which they lie are usually 10-40 acres in size.

The surface layer consists of a dark grayish-brown gravelly loam about 10 inches thick. The subsoil usually consists of a brown sandy clay loam (app. 12 inches) on the upper portion, and the lower portion is usually a strong, brown, heavy sandy loam about 15 inches thick. The permanent and available water capacity are moderate. The make up of this soil allows for good compaction, while also allowing for good root penetration throughout the profile. The slopes of the Edneyville soils are usually 3 to 8 percent, which are very well suited for farming.

FERTILIZING

Fertilizing is an essential element in the management of any contrived plant community. Properly fertilization the trees within a community or orchard, you must take into account the soil structure, climatic conditions, and the specific needs of the species of trees.

The structures of the soil and the percolation it affords determines the timing of the fertilizer application. The times of fertilizing vary between areas because of their climatic conditions. This tells orchard managers that they must know their climate, and climate changes for best production.

SOIL REQUIREMENTS

The edneyville soils are by far the best agricultural soils within the park boundaries. Soils tests have indicated the element nitrogen was sparse or none existed within the orchard soils. The application of nitrogen should take place annually.

The soil sampling should be accomplished twice a year in spring and the end of fall. The main use of these samples are nutrient deficiency and ph. Every three years a leaf sample analysis and a comprehensive soil test should be performed by a university or accredited private laboratory.

Constant monitoring and record keeping of tree conditions are essential. The conditions of the leaves, flowers and fruits are an excellent indication of soil requirements. Symptoms of nitrogen deficiency for example are:

- 1) smaller then normal, pale green leaves
- 2) vegetation shoots with small diameters
- 3) profuse bloom, heavy drop and light set
- 4) early leaf fall

EXCESSIVE NUTRITION

Excessive amounts of nutrients can be as harmful as deficiencies. Although this is not a common problem it should be carefully avoided. It is particularly easy with strong commercial fertilizers.

ORCHARD TEST PLOT

If symptoms indicate a need for a particular element, it should be tried on a limited basis. If a test plot shows suitable results then the procedure should be generally implemented.

Usually 10 trees are chosen to be representative. Detailed records must be kept. Observation should be recorded of symptoms, changes, improvements, procedures, and total fruit output. You can consult the local farm advisor for help.

FERTILIZING METHODS

There are two categories of fertilizing; chemical and organic. The organic method requires more time and more machinery, but in the long run the benefits greatly exceed the cost.

The chemical fertilizers are applied in one of three ways:

- 1) apply evenly throughout orchard incorporating into soil
- 2) fertilize each tree at the rate of 1lb.
actual nitrogen applied under the dripline or outer canopy of the tree
- 3) filling drilled holes under the canopy with fertilizer at the rate of 1lb. actual nitrogen.

RATE OF APPLICATION

You must determine the rate of application for the crop in question, usually 1-3 lbs. of nitrogen per tree. Actual nitrogen refers to the percentage of nitrogen in the fertilizer. The numeric formula of a fertilizer is the N-P-K. That is a 20-0-0 base, 20% nitrogen, 0% phosphorus, and 0% potash. In a 12-4-8 formula, there is 6lbs of nitrogen in a 50lb. bag. That amount will feed 6 average fruit trees by dripline method.

After fertilizer is spread, it should be incorporated into the soil. It requires much less material then fertilizing by the acre. Each tree receives individual treatments and rate adjustments according to its needs and size.

pH - A measure of acidity. Most crops do best at a pH of around 6.5. The amount of limestone recommended is the amount suggested to bring the pH up to the desired level, based on the crop to be grown. The amount recommended is usually 1 ton/acre (50 lbs/1000 sq. ft.), 2 tons/acre (100 lbs/1000 sq. ft.), or 3 tons/acre (150 lbs/sq. ft.). Most soils require the equivalent of 1 ton/acre per year in order to maintain a specific pH level. The pH is lowered each year as a result of leaching of calcium and magnesium from normal rainfall, the removal of these elements as a result of crop harvest and fertilizers containing nitrogen, whether they be organic or inorganic sources, reduce pH as a function of the amount applied.

EXTRACTING SOLUTION - Considerable time has been spent on what extracting solution to use. The amount of element extracted is greatly influenced by the type of extracting solution used. For years, the Suburban Experiment Station has used the Morgan Soil Testing System. We decided to stick with this extracting solution because of the many years' experience with its use on soils. It is a 10% solution of sodium acetate in 3% acetic acid with a pH of 4.8. We feel the amount of each element taken out can be related to the amount of element taken up by growing plants.

MACRONUTRIENTS - This group of nutrients include those needed or utilized by plants in larger quantities. These include nitrogen, phosphorus, potassium, calcium, and magnesium.

Nitrogen - This nutrient is measured via the quantity of nitrates and ammonium ions.

Nitrates (HO_3^-) may mean very little when soils are exposed to normal rainfall. Nitrates can accumulate or be high in a soil as a result of recent additions or as a result of normal nitrification, the break-down of organic matter by microorganisms. Nitrates leach out of the soils readily, especially sandy soils. The soil can be very high before a rain but, if tested after a rain, it may be quite low. In confined areas, such as greenhouses, nitrates are much more meaningful. For outdoor crops, the nitrate levels are rarely considered in making recommendations, except in situations where someone may have accidentally applied excessive quantities of fertilizer. Then we consider the nitrate level in attempting to diagnose the possible element occurring in excessive amounts. Low soil levels would be 10 ppm HO_3^- . High soil levels would be 75 ppm HO_3^- or higher.

Ammonium ion (NH_4^+) reflects the quantity of recently applied ammonium from fertilizer or manure or, if considerable quantities of organic matter has been applied, the ammonium ion will usually be high. Unlike nitrates, the ammonium ion can be used in estimating the quantity of nitrogen needed to be applied for outdoor crops. If the ammonium ion is high, less nitrogen need be applied since the ammonium ion will not leach readily from the soil, and it will be gradually converted to the nitrate form, the form most readily used by plants, by microorganisms in the soil. Low soil levels would be 6 ppm ammonium.. High soil levels would be 24 ppm or higher ammonium. Most crops require between 50 to 150 lbs of nitrogen/acre (1.16 to 3.48 lbs/1000 sq. ft.) per year. If 100 lbs of nitrogen/acre is required, for example, this could be met by applying 300 lbs. of ammonium nitrate (33% nitrogen)/acre.

Phosphorus (P) - This element is needed in fairly large quantities early in the life of a plant. Phosphorus will leach little, if any, from a soil. If fairly large quantities have been applied in recent years, the soil test will likely show high levels. Low soil levels would be less than 2 ppm P. High soil levels would be 25 ppm P or higher. Crops usually require 50 to 200 lbs P_2O_5 /acre (1.16 to 4.65 lbs/1000 sq. ft.) per year to grow the crop. Most of the fertilizer phosphorus should be applied 2 inches to the side and 2 inches below the seed for row crops in order to make certain adequate phosphorus is there for the young plant. To convert 1 ppm P to pounds per acre P_2O_5 , multiply by 6.0. This was recently changed to more accurately reflect the amount considered available for plant growth. (Example: If your soil test shows 30 ppm P, this is equivalent to 180 lbs P_2O_5 per acre.)

Potassium (K) - This element does not leach readily but will move in a soil much more than phosphorus. The bulk of this element is usually applied broadcast. Low soil levels would be less than 50 ppm K. High soil levels would be greater than 200 ppm K. Most crops require 50 to 200 lbs K_2O /A/year (1.16 to 4.65 lbs/1000 sq. ft.). To convert 1 ppm K to lbs/acre K_2O , multiply by 0.9. This latter factor is reduced by 63% because sodium acetate-acetic acid buffer solution extracts more than is normally taken up by plants. (Example: If your soil test reports 60 ppm K, this is equivalent to 54 lbs K_2O /acre.). If an additional 80 lbs of K_2O were recommended per acre, one would apply 133 lbs muriate of potash (60% K_2O). Greater than 90% of all potash applied is in the form of muriate of potash.

Calcium (Ca) - Crops seldom show symptoms which are direct effects of calcium deficiency. Many crops show symptoms related to inadequate calcium uptake, but actually this is related to inadequate moisture during a critical stage of growth for a plant. However, some of these problems may be greatly reduced if an abundance of calcium had been in the soil initially. Low soil levels would be less than 300 ppm Ca. High soil levels would be in excess of 1600 ppm Ca. The cheapest source of calcium is regular ground limestone. Ca levels are usually maintained at a desirable level if the soil pH is maintained to the level desirable for the given crop. Occasionally soils need additional Ca, but the pH is at a desirable level. In these instances, $Ca(NO_3)_2$ can be applied, but only if nitrogen is also needed. Other sources of Ca are $CaSO_4$ or $CaCl_2$. Excessive application of Ca can depress uptake of Mg, K, Mn, Fe, and B, especially on sandy soils.

Magnesium (Mg) - Many of our soils in Massachusetts have adequate magnesium. This is because the major limestone used is Lee lime, and this limestone is fairly well supplied with Mg. Low tests are common on acid soils, particularly in sandy soils. Where this occurs, the limestone applied should be dolomitic limestone which typically carries 20% MgO . Low soil levels of Mg would be less than 20 ppm Mg. High soil levels would be greater than 150 ppm Mg.

MICRONUTRIENT ELEMENTS - These are elements needed by plants but are needed in quite small quantities. The elements include zinc, boron, manganese, molybdenum, copper and iron.

Zinc (Zn) - This element has been found effective in treating some physiological diseases, but not much is known about its action in plants. It is generally conceded that zinc is an essential plant-food element. More recently, zinc deficiency has been found in many soils throughout the world, and new cases are brought to light each year. Peach and corn can be good indicators of zinc deficiencies. Zinc deficiency is also likely in field and green beans, onions, sorghum, and tomato plants. The most typical visual symptom is interveinal chlorosis. Zinc deficiency is most likely on soils with a pH about 7.0. Low soil levels would be less than 3 ppm Zn. High soil levels would be greater than 70 ppm Zn. If zinc deficiency is expected, apply a fertilizer with 2% Zn added, or apply a spray with 0.3 percent $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ as a foliar spray when growth stage of the plant is in its initial stage. Also 5-15 lbs of zinc sulfate/acre, broadcast and incorporated, has been effective in controlling zinc deficiency in some cases.

Boron (B) - This is an essential element for plant growth. Early stages of boron deficiency with many crops cannot be easily identified, except by leaf or soil analysis. Crops shown to have boron deficiency are alfalfa, apples, apricots, barley, beans, beets, begonia, blueberry, the cabbage family, muskmelons, carrots, celery, cherry, clover, corn, grapes, larkspur, lettuce, oats, onion, parsnips, peas, peach, pear, peppers, potatoes, radishes, red raspberries, rye, soybeans, spinach, squash, strawberry, tomatoes, turnips, and wheat. Low soil levels of boron would be less than 0.3 ppm B. High soil levels would be greater than 1 ppm B. Boron deficiency occurs mainly on sandy soils which have a relatively high pH (greater than 7.0) and a low level of B in the soil analysis. To correct boron deficiency apply 10-20 lbs/acre of Borax. Be careful what crop follows a fairly heavy application of Borax. Some crops are sensitive to fairly high levels of boron.

Manganese (Mn) - Manganese deficiency symptoms on many plants are well defined and, if not masked by other deficiencies or toxicity symptoms, supplemental tissue analysis to determine Mn status is usually unnecessary. However, it is easy to confuse symptoms of Mn deficiency with Zn and Fe deficiencies. In these cases, especially, leaf analysis will provide differential diagnosis. Mn is usually not readily available to plants when the soil pH is above 6.5. Also, very sandy, mineral soils are usually low in native Mn contents. Plants where Mn deficiency has occurred are: alfalfa, apple, apricots, barley, beans, beets, begonia, the cabbage family, celery, cherry, chrysanthemum, cineraria, clover, corn, cucumber, gardenia, geranium, hydrangea, lettuce, oats, parsnips, peas, peach, pear, poinsettia, potato, primrose, raspberry, rose, rye, snapdragon, spinach, strawberry, tomato, and wheat. Low soil levels of Mn should be less than 3 ppm. High soil levels should be greater than 15 ppm Mn. When soils are low in Mn, 2-4 lbs of manganese sulfate/acre, broadcast and incorporated, will usually give satisfactory correction. Also, 2-4 lbs/ MnSO_4 /100 gal of spray/acre has been foliar applied to correct anticipated deficiencies, provided it is applied in the early stage of plant growth.

Molybdenum (Mo) - This element is one of the most recently recognized plant micronutrients. Often the first and most obvious symptoms of Mo deficiency are similar to those of uncomplicated nitrogen deficiency. If the pH is unfavorable, soil levels as high as 3.5 ppm may not be adequate plant-available molybdenum. Liming, in such cases, may release sufficient molybdenum. Crops in which Mo deficiency has occurred are: alfalfa,

barley, beans, beets, the cabbage family, carrot, celery, chard, clover, cucumber, grasses, lettuce, muskmelon, oats, parsnips, peas, potato, radish, rose, roselle, spianch, tomato, and wheat. Low soil levels would be less than 1 ppm Mo. High levels would be greater than 2.5 ppm Mo. Please note that just because a soil shows little or no Mo does not mean than Mo need necessarily be added. To date, a good extracting solution has not been found to provide reliable measure of Mo analysis. Soil tests, in combination with tissue analysis, appears to be the best approach. Sodium or ammonium molybdate at rates of as small as a few ounces have prevented deficiencies.

Copper (cu) - There has been a mass of evidence to verify the essentiality of copper for growth of plants. Early stages of copper deficiency produce no definite symptoms beyond those of reduced growth or yield. Crops in which copper deficiency has been observed are : alfalfa, apple, apricot, barley, beet, cabbage, canary grass, carrot, celery, clover, corn, eggplant, lettuce, oats, onion, peas, peach, pear, pepper, potato, tobacco, tomato, and wheat. Copper deficiency is most common in peat and muck soils, soils with a pH above 7.0, or leached sandy soils. Although no basis is available as to what constitutes low or high levels of Cu, I am temporarily choosing less than 1 ppm as low Cu levels, and greater than 5 ppm Cu as high. Where Cu deficiency is suspected on mineral soils, from 5-25 lbs copper sulfate ($\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$)/acre is sufficient and this application need only be made once. In the case of organic soils, 50-200 lbs Cu/acre as a one-time application may be required for normal yield of vegetable and field crops. A foliage spray, using 5-10 lbs copper sulfate/100 gal water, has been effective in preventing deficiencies.

Iron (Fe) - Lack of iron produces, in its more advanced stages, a characteristic and easily recognizable type of leaf clorosis which can be easily confirmed with plant tissue analysis. Fe deficiency is commonly accompanied by a reduced rate of growth. Crops which Fe deficiency has been observed are: apple, apricot, bean, beet, begonia, blueberry, broccoli, cabbage, carrot, celery, cherry, chrysanthemum, cineraria, clover, corn, gardenia, geranium, grape, hydrangea, kale or collards, oak, oats, peach, pear, potato, prim-rose, raspberry, rose, snapdragon, soybean, strawberry, tobacco, tomato, turnip, and wheat. Soils in which Fe deficiency is more likely are those with a pH greater than 7.0, poorly drained soils, and soils which are high in one or more of the following elements: zinc, copper, manganese, or nickel. There is no evidence that there is a reliable relationship between soil-extracted Fe and expected Fe deficiency. This is because there are many other factors that influence whether or not a plant can take up sufficient Fe. However, soil showing high Fe levels are less likely to to show deficiencies. Like copper, there is no basis available as to what constitutes low or high levels of Fe. I am temporarily choosing less than 3 ppm as low, and greater than 20 ppm as high. For correcting Fe deficiencies, major advances have been made during the past few years in the use of compounds of Fe with various chelating agents. Although details cannot be given here, Fe EDTA is effective in correcting Fe deficiency in soils that are slightly acid. In soils above pH 7.0, other Fe chelates are more effective. These include Fe HEEDTA, Fe DTPA, and Fe EDDHA. Most of these have been useful as a foliar spray in that they can be used at a higher concentration with reduced toxicity as has been common with ferrous sulfate. Check with your fertilizer dealer for chelating Fe materials, if needed.

Zinc (Zn) - This element has been found effective in treating some physiological diseases, but not much is known about its action in plants. It is generally conceded that zinc is an essential plant-food element. More recently, zinc deficiency has been found in many soils throughout the world, and new cases are brought to light each year. Peach and corn can be good indicators of zinc deficiencies. Zinc deficiency is also likely in field and green beans, onions, sorghum, and tomato plants. The most typical visual symptom is interveinal chlorosis. Zinc deficiency is most likely on soils with a pH about 7.0. Low soil levels would be less than 3 ppm Zn. High soil levels would be greater than 70 ppm Zn. If zinc deficiency is expected, apply a fertilizer with 2% Zn added, or apply a spray with 0.3 percent $\text{ZnSO}_4 \cdot 7 \text{H}_2\text{O}$ as a foliar spray when growth stage of the plant is in its initial stage. Also 5-15 lbs of zinc sulfate/acre, broadcast and incorporated, has been effective in controlling zinc deficiency in some cases.

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HEAVY METALS OR NON-ESSENTIAL ELEMENTS - At this writing, these include cadmium, lead, arsenic, and aluminum. Major concern with these elements is the possible toxic effects to plants, as well as humans who consume the plant products. Unfortunately, little is known about soil concentration levels at which danger exists. The best uses to be made from data reported on these heavy metals are: (1) identify soils where high levels may exist; (2) until more information is developed, plant non-food crops where high levels exist; and, (3) where levels are high and food crops have been planted, have the edible portion tested in our laboratory in order to make certain the edible portion is safe to eat.

Cadmium (Cd) - Ninety percent of all soils reported thus far have had levels less than 0.2 ppm. Cd levels which are high have not been tested as of this writing. In view of our lack of knowledge about Cd, note the three 'best uses to be made of these data' under Heavy Metals.

Lead (Pb) - By far, the major source of lead results from the use of lead paints chipped or scraped from buildings. Occasionally vegetables are grown adjacent to a painted building, or in a garden where a building once stood, but has since been burned by fire. A garden may be planted where there once was a fruit orchard that had been sprayed with lead arsenate for many years. This once was an approved insecticide. Finally, gardens located adjacent to a well-traveled highway can be exposed to automobile emissions. Lead levels are usually higher here than in soils which are at a greater distance from the highway.

We extract from 7 to 25% of total lead using our extracting solution. As of this writing, there appears to be a good linear fit ($R = 0.92$) between the square root of sodium acetate-acetic acid buffer solution extracted lead and total lead. This equation is in the following form: Predicted Total Lead (ppm) = $-115 + 106.4 \sqrt{\text{Extracted Lead (ppm)}}$. Note, however, when extracted lead reads 0 - 2.25, total lead will be reported as 0 - 45 ppm. An example in the use of the above equation may be helpful. If extracted lead were reported as 36 ppm, predicted total lead would be 523.4 ppm or $523.4 = -115 + 106.4 \sqrt{36}$.

Gardens having less than 500 ppm predicted total lead will be categorized as Low lead; 500-1000 ppm as Medium lead; 1000-3000 ppm as High lead; and greater than 3000 ppm as Very High. Until recommendations are put out by the computer, a special sheet will accompany all soils giving instructions on recommendations and cautions for each of the lead levels above Low. Please note that any lead level less than 33.4 ppm extracted lead will be listed as Low lead level.

Arsenic (As) - In soils, toxic amounts of arsenic arrest the germination of seeds; the viability of seedlings is much reduced, with greatest toxic effect at the seedling stage. At this writing, it is assumed that any soil less than 1 ppm is low. How high arsenic levels can be and still be safe is not known at this writing. Therefore, note the 'three best uses to be made of this data' under Heavy Metals.

Aluminum (Al) - Unlike Cd, Pb and As, no known health hazards exist with high levels of Al. High levels of Al usually reflects low pH. The lower the pH, the higher the Al level in the soil. There are soils in the U.S. in which Al levels are naturally low and these soils would have little or no concern for toxic levels of Al. Soils which are limed properly should contain less than 40 ppm Al. Soils in which the Al content is as high as 200 ppm may produce plants which show Al toxicity which will be reflected

in reduced growth and yield. These soils should be lined according to recommendations. After one cropping season, test soil again, and again lime according to recommendations.

SOLUBLE SALTS (SS) - Soluble salts refers to inorganic constituents which are appreciably soluble in water. It can result from many, many elements including Al and Cl or most any fertilizer element when applied in excess of amounts recommended. Many growers get into problems with soluble salts when they have the philosophy 'if a little bit of fertilizer will help then doubling or tripling the recommended rate will help all the more'. Using our system of measuring soluble salts, field soils usually have low SS values (less than 20). Therefore, unless a special request for SS is made, it will not be run on out-door soils. most problems of SS come from greenhouse operators. For germination of seed, soils should have a SS reading less than 50 (may be greater if a soilless mix is used). Seedlings will withstand slightly higher SS reading. Liming excessively acid soils can reduce the SS levels and soils with slight excesses in SS levels may reduce that level by leaching. The amount of reduction in SS level is a function of the degree of leaching. Certain soilless mixes can have a SS reading between 200-300 without serious problems. Therefore, one must know something as to the type of media before one can be certain as to whether or not SS will be a problem.

**"A SOIL TEST IS ONLY AS GOOD
AS THE SOIL SAMPLE"**

It is important that soil samples taken for analysis be carefully selected as truly representative of the area being studied.

Follow these simple steps to insure representative soil samples:

1. Select proper sampling tool. Garden trowel for lawns, spade for gardens.
2. Areas that constitute different problems and are different in appearance, slope, drainage, soil type, or past treatment should be sampled separately: i.e. front lawn, rear lawn, vegetable garden, flower garden, evergreens, etc.
3. Take a separate composite sample for each soil area. Take soil from at least six places, mix thoroughly, and save a portion (about one half pint) for analysis.
Method and depth of taking soil sample:



Use the same procedure with garden trowel. Lawn areas can be sampled to a depth of about 3 inches. Any surface litter, grass, or rubbish, should be first scraped away before sampling.

4. Place sample in a clean container (ice cream container) and properly mark with your name, crop, and number, to identify it with the particular area from which it was taken. Avoid paper bags as the bags soon disintegrate from soil moisture.

To save time, soil samples can be air dried at home. Don't dry samples on a stove or radiator.

REMEMBER - Soil tests have their limitations. They can only be used as a guide for proper soil management practices. They are not able to provide all the answers to problems arising on the Home Grounds.

"Available to the public without regard to race, color, or national origin."

SOIL TEST LEVELS WHICH ARE CONSIDERED LOW and HIGH AS OF JANUARY 26, 1981

<u>Element</u>		<u>Low</u> ppm		<u>High</u> ppm
NO ₃ ⁻		10		75
NH ₄ ⁺		6		24
P		2		25
K		50		200
Ca		300		1600
Mg		20		150
Zn		3.0		70
B	 Less than	0.3	Greater than	1.0
Mn		3.0		15
Mo*	 Less than	1.0	Greater than	2.5
Cu	 Less than	1.0	Greater than	6.0
Fe		3.0		20
Cd	 Less than	0.2		**
Pb		33		110
As	 Less than	1.0		**
Al		40		200

* Soil tests likely will not reflect available levels of this element.
Use plant tissue analysis.

** High levels not established as of this writing.

FERTILIZER SYNOPSIS

- 1) Soil test
- 2) pH test
- 3) Monitor and record plant conditions
- 4) Apply fertilizer
 - A) 1 - 3 lbs actual nitrogen per tree or
 - B) 40 lbs per acre actual nitrogen
- 5) Incorporate
- 6) Decreased or increased amounts for stressed trees
- 7) Ammonium sulfate 20-0-0
 - 5 lbs per 1 lb actual nitrogen
- 8) Begin incorporating manure, compost, organic matter into soil regularly
- 9) Begin using organic fertilizers

Name	Compound Formula	Per Cent Nitrogen	Advantages	Disadvantages
Anydrous ammonia	NH_3	82	High nitrogen percentage; ease of application; no residue; little danger of leaching	(a) In irrigation water: Uneven distribution if irrigation system not adapted to its use. Cannot be used with sprinklers. (b) Dry injection: Some loss if ground is trashy or cloddy
Ammonia solution	NH_4OH	Usually 20	Easier to handle than anydrous; no residue	Same as for anydrous
Ammonium sulfate	$(\text{NH}_4)_2\text{SO}_4$	21	Acid residue (for alkaline soils); little danger of loss by leaching; ease of handling	Acid residue (for very acid soils) Delayed availability during nitrification
Ammonium nitrate	NH_4N	3	High N percentage; no residue. Half immediately available, half delayed	
Ammonium phosphate-sulfate (16-20) mixture		16	Same as ammonium sulfate. Carries phosphate if needed for covercrop	Same as ammonium sulfate
Ammonium phosphate	$\text{NH}_4\text{H}_2\text{PO}_4$	11	High phosphate content where needed for covercrop	Low N percentage
Calcium nitrate	$\text{Ca}(\text{NO}_3)_2$	15.5	Calcium residue (for acid or high sodium soils). Immediate availability	May be leached
Urea	NH_2CONH_2	42	High N percentage. Is not fixed if irrigated at once, before conversion to ammonium-carbonate. No residue.	May be toxic in high concentration
Sodium nitrate	NaNO_3	16	Alkaline residue (for acid soils); immediate availability	Sodium residue undesirable on high sodium soils. May be leached
Calcium cyanamide	CaCN_2	24	Alkaline residue (for acid soils). Calcium residue	Danger of burning, especially at high rates or in growing season

*There is no serious trouble with the physical properties of any of these materials unless they are stored too long or under poor conditions

WOODY PLANT SYMPTOMS THAT ARE REPORTED TO BE ASSOCIATED WITH DEFICIENCIES OF CERTAIN NUTRIENTS

NUTRIENT	LEAF	SHOOT	FLOWER AND FRUIT
Nitrogen N	General yellowish-green, more severe on older leaves Small, fewer leaflets High fall color, early drop	Short Small diameter May be reddish to reddish brown	Heavy bloom Light fruit set Small fruit, highly colored, mature early
Phosphorus P	Green to dark green, slightly smaller Veins, petioles or lower surface may become reddish-purple, especially when young; dying of lower pine needles	Normal length unless severe Small diameter	Light bloom Few and small fruit
Potassium K	Crinkling and upward rolling of older leaves first Chlorosis followed by scorch — margins to entire leaf	Shoot tips die back late in season Lateral buds grow Zigzag, short, brushy	—
Iron Fe	Yellow with narrow green veins on young leaves first Older basal leaves greener Exposed leaves bleached Severe in spring	Length normal, but when severe can lead to twig dieback Small diameter	—
Boron B	Occasionally red, bronzed or scorched, young leaves first Veins yellowish Some species distorted	Dieback of new growth Zigzag, short, brushy	Deformed fruit, e.g. olive (monkey-faced)
Zinc Zn	Yellow, small ('little-leaf') May be deformed Tuft of leaves at shoot tips May be mottled with necrotic spots	Short internodes near 'rosette' of leaves Twigs may die back Small diameter	Light fruit set Small, pointed, high colored fruit
Sulfur S	Entire leaf pale yellow-green Small on some species	—	—
Magnesium Mg	Intervinal and marginal chlorosis of old leaves Thin and brittle Leaves drop early	Growth not restricted until severe deficiency	—
Manganese Mn	Young leaves yellow with wide green bands along veins followed by necrotic spots	—	—

PLANT SYMPTOMS THAT MAY BE ASSOCIATED WITH EXCESSES OF CERTAIN ELEMENTS

ELEMENT	LEAF	SHOOT
Boron B	Marginal and tip scorch Dark, intervenal necrotic spots Progressively worse from tip to base of shoots	Swelling and cracking below buds
Sodium Na	Marginal and tip scorch	—
Chloride Cl	Marginal and tip scorch	—
Manganese Mn	Yellow margins with necrotic spots on margins and intervenally (freckling) Early leaf drop	Stunting when severe

SUGGESTED CONTROL MEASURES FOR CERTAIN NUTRIENT DEFICIENCIES OF LANDSCAPE TREES AND SHRUBS

NUTRIENT	CHEMICAL FORM ¹	SOIL APPLICATION ²				SPRAY APPLICATION		
		Sandy loam	Clay loam	How applied	Time effective	Amount of nutrient (chemical form)	Other material to be added to the spray solution	Plant stage when applied
Nitrogen	N Urea	3-6 ³	3-6	On surface	1-2	7.5	-	Foliage ⁴
Phosphorus	P	2-4	4-8	Incorporate	3-5	-	-	-
Potassium	K	5-15	15-30	Incorporate ³	5-10	-	-	-
Boron	Borax	0.5-1	1-2	On surface	5-7	1	-	Foliage
Copper	CuSO ₄ •5H ₂ O	5	10	Incorporate	5-7	3-6	4.5 lb hydrated lime	Foliage ⁴
Iron	Chelate ⁴	0.5-1	1-2	On surface	1-3	1-1.5	1 pt detergent	Early foliage
	FeSO ₄ •H ₂ O ⁷	24	36	Incorporate ⁷	3-5	4	1 pt detergent	Early foliage
	Dormant Growing	12	18	Incorporate	-	-	-	-
Magnesium	MgSO ₄ •7H ₂ O ⁸	25-50	50-100	Incorporate	5-7	20	-	Foliage ⁴
Manganese	MnSO ₄ •2H ₂ O	5-20	5-20	Incorporate ⁸	1-5	2.5-8	5 lb lime spreader	Foliage
Sulfur	CaSO ₄ •2H ₂ O ⁹	10-15	15-25	Incorporate	5-7	-	-	-
Zinc	ZnSO ₄ •7H ₂ O	-	-	-	-	10-50 (dormant) 4-6 (foliage)	- 3 lb hydrated lime	Dormant Foliage
	Chelate							
	Soil pH < 6.0	2.5	2.5	On surface	1-3	1-2	1 pt detergent	Early foliage
	Soil pH > 6.0	4	4	On surface	1-3	1-2	1 pt detergent	Early foliage

U.C. Cooperative Extension

1. If only the element is given, there is more than one compound that can be satisfactorily used. Rate is on elemental basis for N, P and K.
2. To convert lb/1000 sq ft to lb/inch diameter of tree trunk:
 - for trees less than 6 inches multiply by 0.05
 - for trees more than 6 inches multiply by 0.1
3. In heavy rainfall areas or where high rates of irrigation are necessary, this annual amount should be split into two applications.
4. Foliage application not commonly recommended, but can be a test to determine if the plant will respond to the nutrient.
5. To apply 10 lb of K per 1000 sq ft as a solution to inject, the following is suggested to mix in 100 gallons of water.

	lb	N	P	K
Potassium nitrate	KNO ₃	6.5	1.8	-
Potassium sulfate	K ₂ SO ₄	5.5	-	2.5
Potassium dihydrogen phosphate	KH ₂ PO ₄	8.8	-	2.5
		1.8	1.0	10.0
6. A number of iron chelates are available; for example (Sequestrene 138 Fe), Chel 138 and 330[®] have given response with a wide range of species. Chel 138 is recommended for alkaline soil conditions (>pH 7.0). Follow manufacturer's directions for effective treatment.
7. Dissolve 1 lb of ferrous sulfate in 1 gallon of water and inject into holes (10-12 inches deep) 30 inches apart around drip line of tree. In dormant season inject 1 gallon in each hole; half that amount during the growing season. For upright growing trees, space the holes 2 feet apart. In a shrub area injections of holes can be made 30 inches apart applying 2 ounces at each site.
8. Use magnesium sulfate (Epsom salts) in neutral or alkaline soils and dolomitic limestone under acid conditions.
9. Preferred method is spray application to foliage.
10. Should not be needed if sulfur-containing materials are used for pest or deficiency control

PRUNING

Pruning is both a science and an art. It is essential element in the production of vigorous orchard trees, vineyards, and horticultural plantings. Pruning stimulates growth by setting in motion the appropriate hormonal reactions. It provides shape not only for aesthetic purposes, but also for strong properly angled branches and scaffolds. It increases sunlight by opening the canopy to the penetration of the sun and allows aeration by eliminating overcrowding. This reduces disease and prevents mechanical injury caused by cross branching which can create entry wounds for fungal infections. Pruning eliminates diseased and dead wood which serves as a site for secondary infections. Beginning at the time of planting and continuing to the demise of the tree, pruning may very well be the single most important cultural practice.

Each species has its own specific set of pruning requirements. In fruit trees these needs should be attended to with particular care. The quantity and quality of the fruit can often be decided by the pruners' judgment and tools in the dead of the winter. This is true because many trees fruit and flower on first and second year wood, while others fruit on spur branches. Some trees need regeneration of fruiting wood every year, while other may fruit on the same branches for ten years. It is essential that the pruning operation occurs during the proper season. Most species are pruned while dormant. Spring flowering shrubs, however, set their buds on the previous years wood. It is therefore not advisable to prune them until after they have flowered.

Recent research, however, has shown that we have held some mistaken beliefs for over a hundred years. Traditionally these steps were followed:

- 1) remove all dead and diseased wood
- 2) remove all cross branching
- 3) when removing a large branch make an undercut
- 4) never top, head back, or pollard unless absolutely necessary and noted as a requirement of that particular species
- 5) always remove at the crotch of the two branches
- 6) always make the cuts as flush as possible

However, research performed by Dr. Alex Shigo of the U.S. Forest Service has shown that a flush cut is not always good cut. This work has revealed the highly compartment structure of trees. Rather than making a flush cut and depending solely on the formation of a layer of callous tissue, this new system works with the natural protection of the plant. On every branch there is an area of branch collar. Following this approach the cut is made just outside of this collar. The collar represents a zone of chemical protection for the tree. This does not mean to leave a stub. It means to locate the area where the tree has formed a collar indicating where the branch should be removed. A collar forms around the wound. A perfect cut has a complete encircling of the wound. A half encirclement represents a half correct cut and so on.

Pruning should be conducted as an annual regime, but if time is a problem can be done on the biennial basis. Pruning of the apple trees should take in account the fruit on terminal spurs which can bear for 15-20 years, but are best for the first 8-10 years. Raise the scaffold for cultivation and machinery. Thin out branches to increase light. Thin shoots, branches and spurs to reduce hard thinning and alternate bearing. Light bearing is satisfactory because of longevity of fruit spurs. Look for 10-20" of growth on young and 6-10" on older trees.

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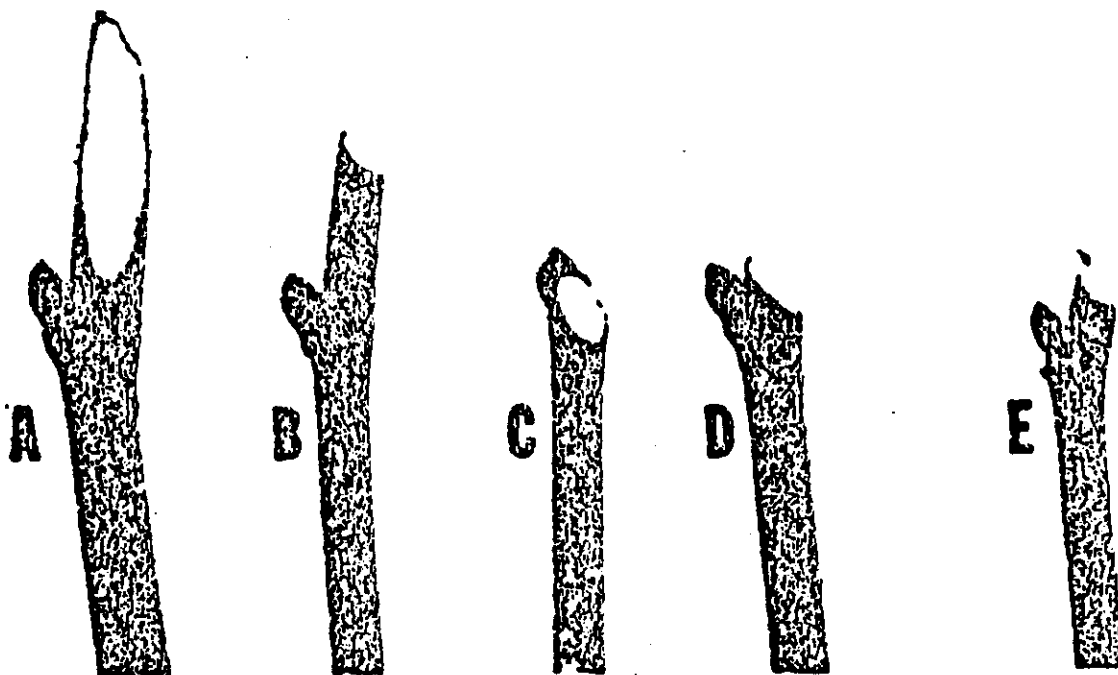
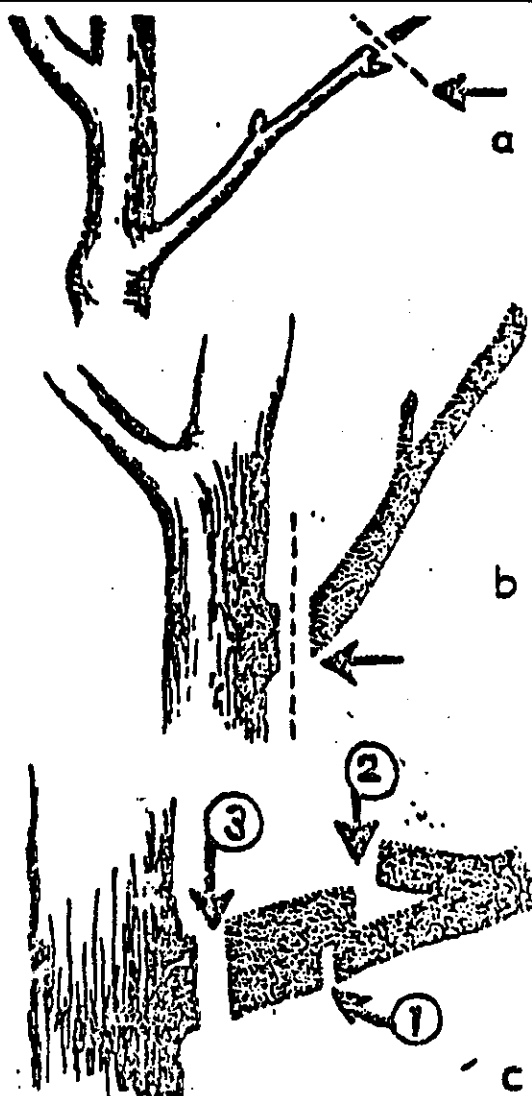
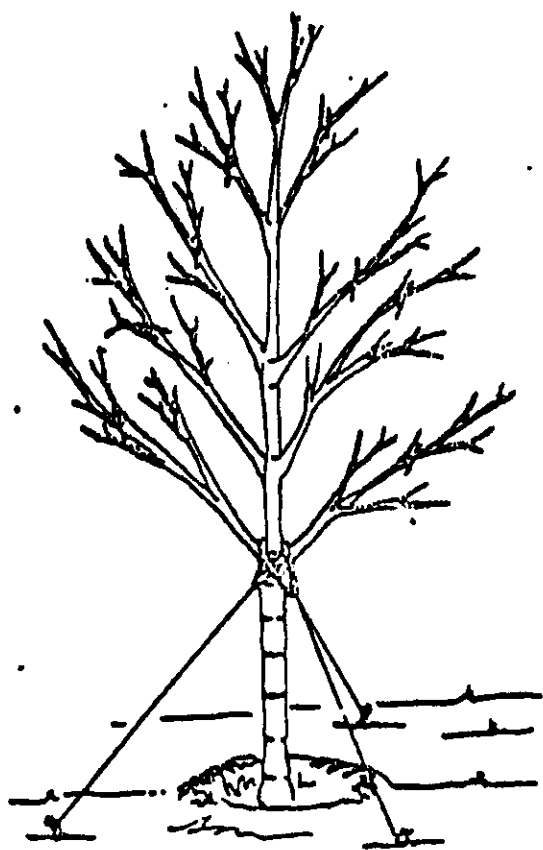
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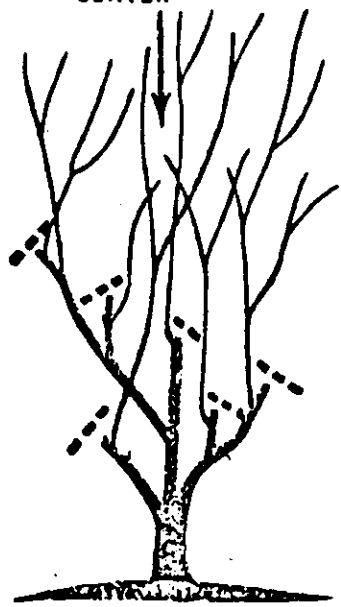


Proper and improper pruning cuts. (A) Too slanting, exposes too much heartwood. (B) Too long, will cause die-back of stub. (C) Too short, will interfere with bud

growth. (D) Ideal cut, starts opposite base of bud and slants up toward top of bud. (E) Slightly longer cut practiced in cold climates to prevent drying out of bud

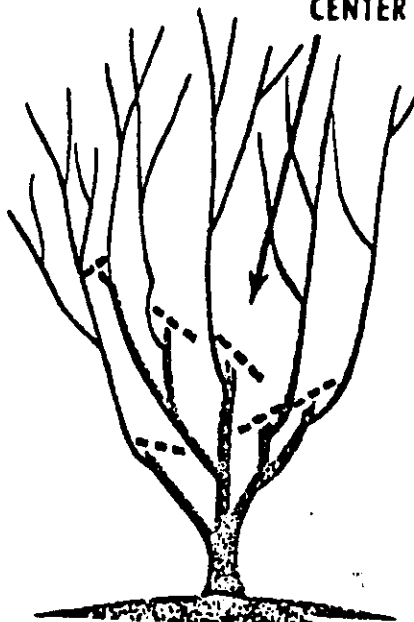
CONTROLLING SHAPE

TIGHT
CENTER

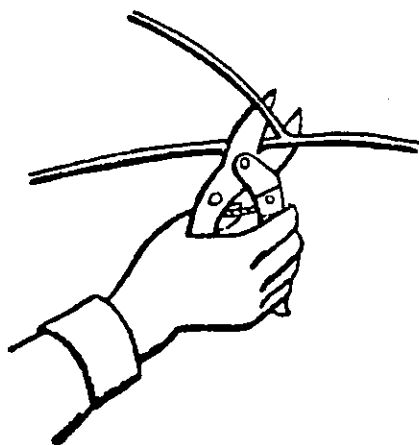


UPRIGHT

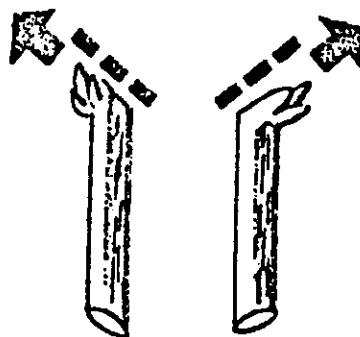
OPEN
CENTER



SPREADING



To change the shape of a plant, cut it back to where a branch or twig grows in the direction you want the plant to grow.



You can control the direction of the new growth by cutting back to a side bud that points in the direction you want the branch to grow. New growth will follow the dotted line.

TRUNK

DO NOT

cut behind the
branch bark ridge.
Cuts behind the BBR
wound the trunk.

BRANCH

chemical protection
zone

BRANCH BARK RIDGE

BRANCH
COLLAR

DO cut from
outside of the
branch bark ridge.

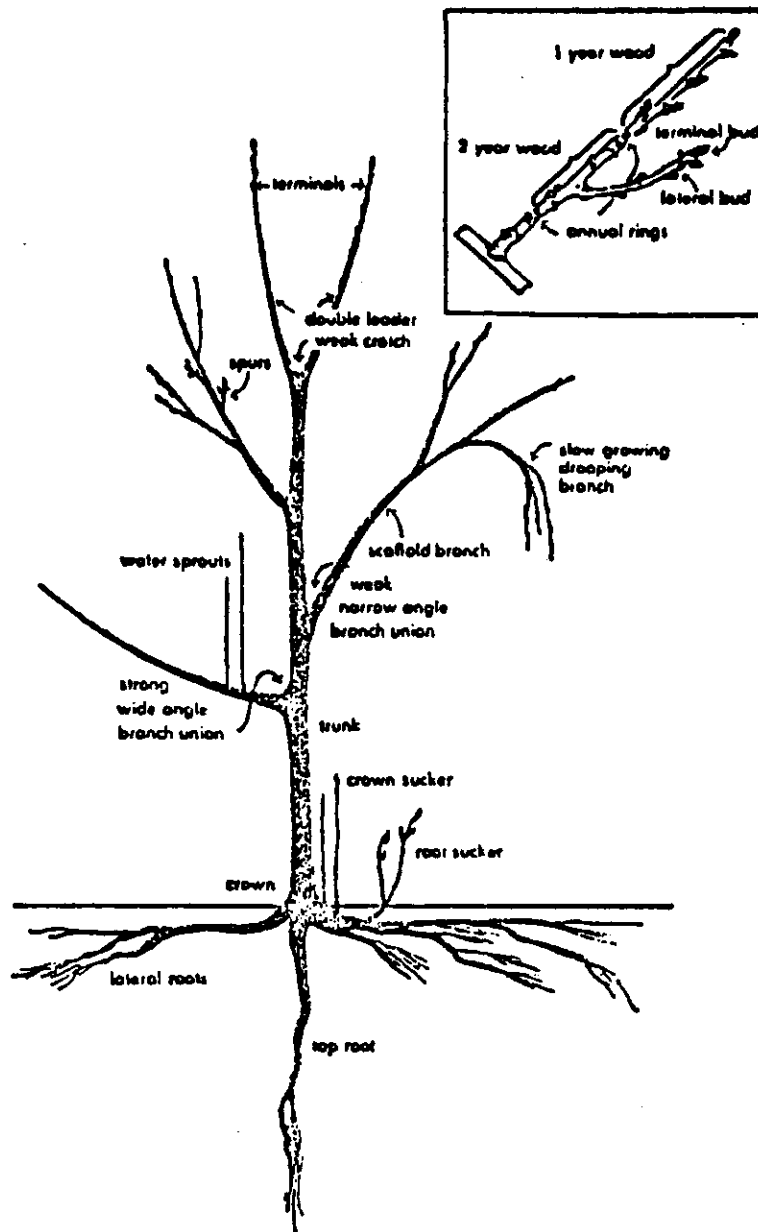
Do not leave a stub.

Do not paint.

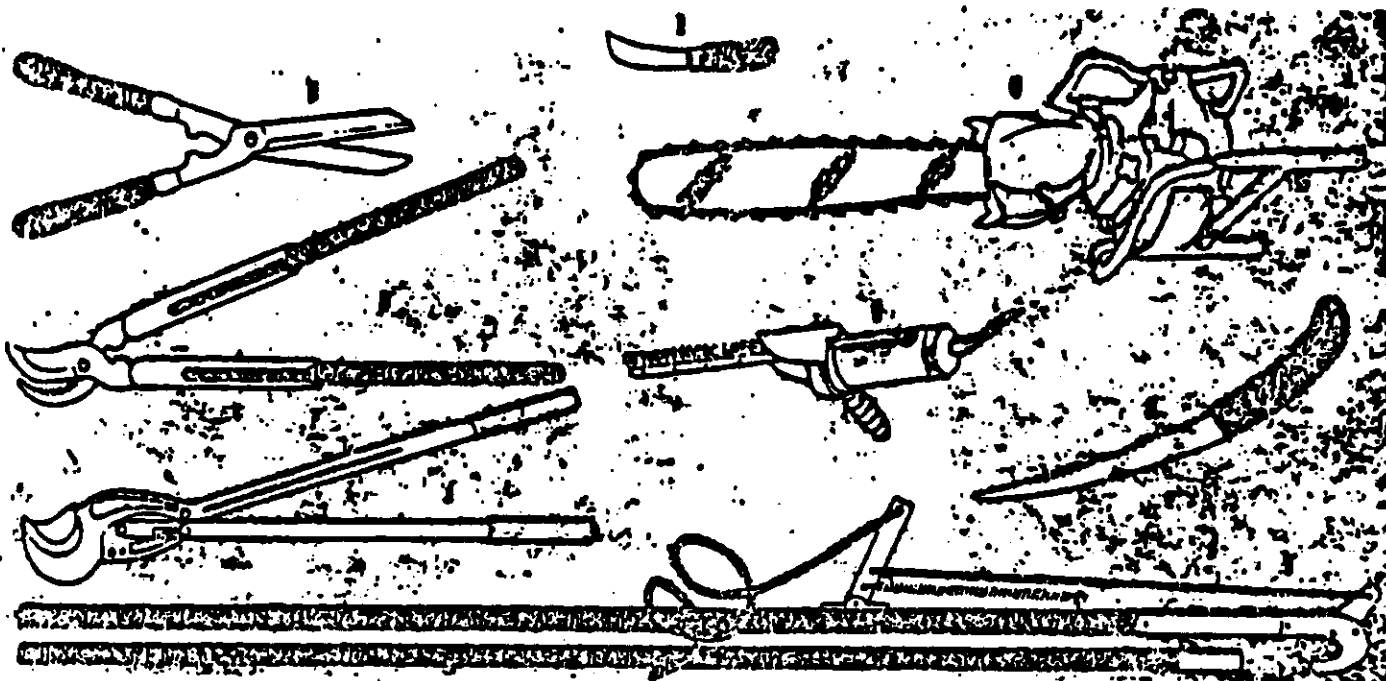
Do not injure or remove the
branch collar.

The tree's chemical protective
zone forms in the branch collar.

For more information contact Dr. A.L. SHIGO, Box 640, Durham, NH 03824

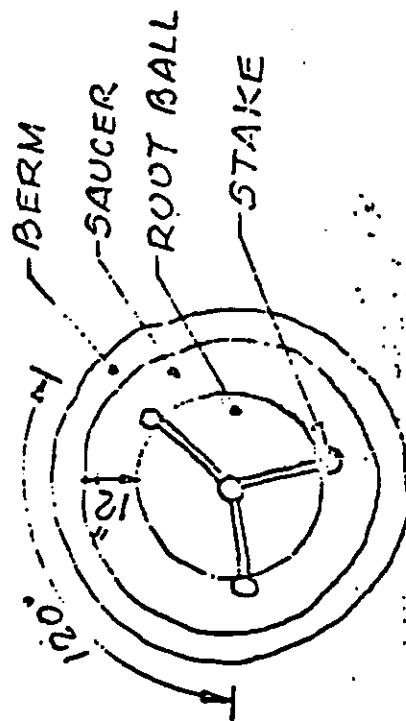
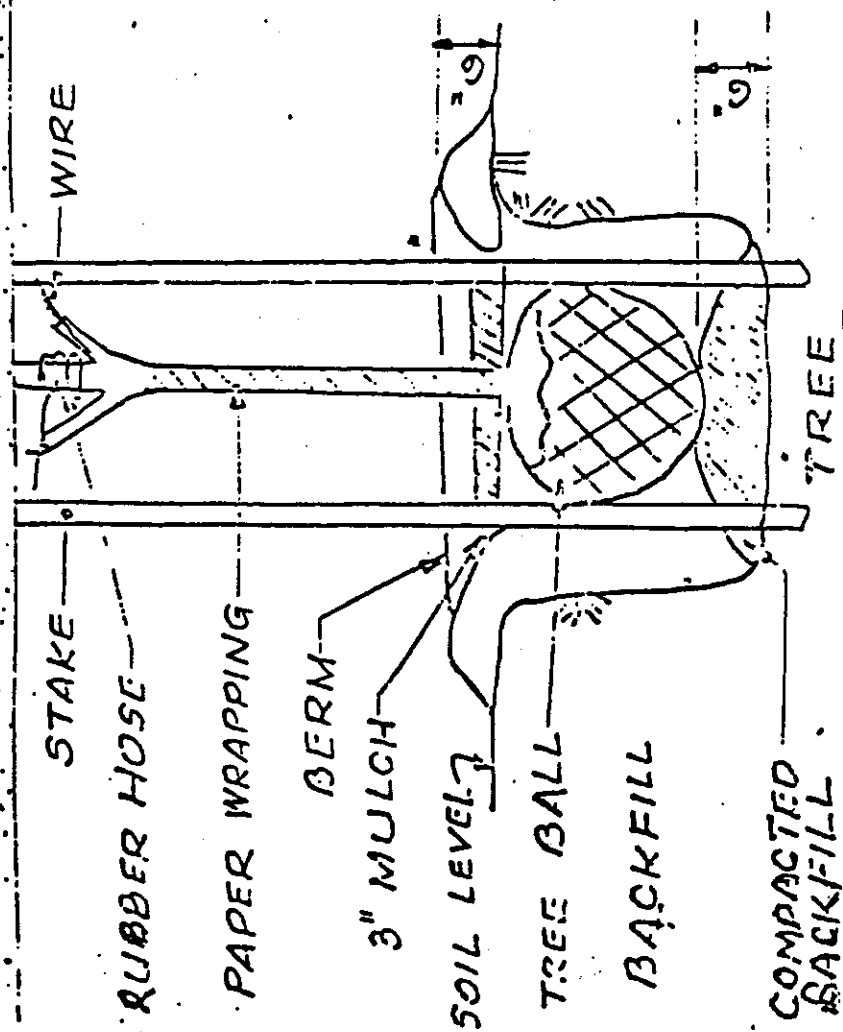


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PLANTING

Planting is an important part of any orchard project. Replacing fruit trees in small blocks, as they approach senegal, is standard operating procedure. This prevents expensive and labor intensive replacement of the entire orchards. A plan is necessary for efficient replanting & continuation of the historic scene.



PLAN

MONITORING

Monitoring is the foundation of an integrated pest management strategy. The accuracy of the data controls the validity of the program. Monitoring provides evidence of the prevalent problems. Damage is easily observable in the summer, but it is often preventable in the spring if it is detected by early monitoring.

Proper monitoring techniques provide identification of problems at an early level of development. After the population level or disease stage is evaluated, action levels can be set. This level will be the point at which maximum advantage can be gained. Certain insects are susceptible at only one stage of their life cycle regardless of the substance used. Monitoring will provide the information to both evaluate the situation and plan the action necessary. If pheromone traps indicate the level of adults is at a dangerously high level, then life cycle knowledge will allow you to predict the next peak in the population.

After researching through techniques of monitoring, the following program will fulfill most needs.

- 1) yellow sticky traps will be placed in the orchard at the rate of 16/acre
- 2) Pheromone traps 2/orchard
- 3) Check and scrape traps at least twice a week; species must be counted and identified and the trap cleaned.
- 4) Once every growing season have a vacuum collection of insects.
- 5) Tanglefoot, should be spread as a mechanical barrier on the trunk of trees, for monitoring crawling insects as well.
- 6) All information should be recorded and graphed on the park computer for interpretation.
- 7) 2 to 3 times a season trees should be examined everyday for a week to see any changes.

Another form of monitoring would be the use of a hygrothermograph to monitor the changes in humidity and temperature within the orchard. This information will help us find out when the insects will be attacking the orchard, by the changes of temperature and humidity.

- 1) set hygrothermograph in protected area from weather changes such as a weather box. Protection from bugs may also be necessary, so that traps may need to be put inside of the weather box.
- 2) check read out weekly or monthly depending on your instrument
- 3) translate information from read outs to record sheets and then to database programs for graphing and charting.

IPM

The principles that this pest management program is based upon is to incorporate the most modern techniques while following the policy (of the National Park Service). The use of organic pesticides such as (copper and sulfur) will be regularly employed to eliminate rampant bacterial and fungal problems.

The practices outlined in the Orchard Management Plan will encourage healthy plants which will be resistant to disease and pest problems. There is mounting evidence that insects and disease are drawn to stressed trees and are not necessarily the primary cause of stress. Our primary concern in any problem situation is to relieve stress that is diagnostic and not simply symptomatic. We will attack the problem and not the symptoms. In addition to the orchard program ecosystem. Our goal will not be the elimination of the harmful species, but achieve a balance between the two which is self perpetuating.

SPRAYING PROGRAM

The expense involved in purchasing equipment and the complications in the use and storage of pesticides make contracting this service a viable alternative. Contractors will be selected through competitive bidding each year. The program includes the application of a dormant oil and copper mixture to all of the orchard trees. The applications will be timed to coincide with leaf fall, dry periods, and bud breaks. This will eliminate many fungal and bacterial problems. These problems are rampant, at present, and this program will be an annual event for the foreseeable future.

This compound (COCS) is fairly innocuous, but it will be applied as early in the morning as possible to avoid public exposure to drift. Environmental factors to be considered are 1) drift- windy day is unacceptable; 2) dry weather- a period of forty-eight hours without rain after the spraying would insure efficacy, but a minimum of six to twenty-four hours is required for any possibility of effectiveness. If it rains before that time, the treatment should be repeated. The dormant oil will mechanically smother insect eggs and the copper will combat a host of problems.

SPRAY SCHEDULE

PLEASE NOTE: Label rates and other application considerations vary from state to state and so are not included here. In all cases, the label is the law, even for general use pesticides. Read the label and observe all requirements and cautions.

Appendix I. Minimum input preventative spray program to protect apple trees from certain arthropod pests, and from apple scab and black rot pathogens, based on tree development .

Devel. Stage	Recommendation
Green tip	No action
1/2 inch green	No action
Tight Cluster	Oil Spray with contact fungicide *
Pink	Full rate contact fungicide
Bloom	Half rate contact fungicide if rain has been often or prolonged
Petal fall	Full rate contact fungicide
10-14 days post PF	Half rate contact fungicide if rainy
End of primary scab season through harvest	No additional fungicides

Appendix II. Low input pest Management program to protect apple trees from additional key arthropod pests(Leafrollers, plum curculio, European apple sawfly, codling moth, apple maggot fly), and from apple scab and black rot, based on tree development .

DEVEL. Stage	Recommendation
Green tip	No action **
1/2 inch	No action **
Light cluster	Oil Spray with contact fungicide *
Pink	Full rate of contact fungicide
Bloom	Half rate of contact fungicide if rain has been often or prolonged
Petal fall	Full rate of contact fungicide plus full rate of phosmet insecticide
10-14 days post PF	Half rate of contact fungicide if rainy plus full rate of phosmet insecticide.
Rest of season through harvest	Deploy adequate numbers of odor-baited red sphere traps against AMF in each tree No additional fungicides

Appendix III. Low input spray program using a combination of eradicant *** and contact fungicides, combined with weather monitoring and use of a Mill's chart to protect trees against apple scab and black rot and against certain arthropod pests.

Devel. Stage	Recommendation
Green Tip	No action **
1/2 inch	No action **
Tight cluster	Oil Spray. At any time hence when weather
Pink	monitoring indicates a Mill's infection has
Bloom	occurred, apply a SI fungicide in combination
Petal Fall	with a 1/2 rate contact if no fungicide applied
End primary scab season	within 7 days through end of scab season.
Rest of growing season through harvest	No additional fungicides

Appendix IV. Low input pest management spray program using eradicant *** and contact fungicides, weather monitoring and a Mill's chart, and low toxicity insecticides against key pathogens and arthropod pests.

Devel. Stage	Recommendation
Green tip	No action **
1/2 inch green	No action **
Tight cluster	Oil Spray. Fungicides as in App. III
Pink	Fungicides as in App. III
Bloom	Fungicides as in App. III
Petal Fall	Full rate Phosmet
10-14 days post PF	Full rate Phosmet
Rest of season	Deploy odor bait red spheres No additional fungicides unless rainy

* Suggested materials include Polyram, Thiram, and Captan. If sulfur is used against scab, spray thoroughly before each rain from 1/2 inch green through end of primary of scab season.

** At any time foliar or other injury is noted from leafrollers, fruit worms, eyespotted budmoth, apply full rate of Bacillus thuringiensis insecticide.

*** Suggested materials include sterol-inhibiting fungicides such as triforine (Funginex tm) and fenarimol (Rubigan tm).

TONS TO TEASPOONS

How To Convert Fertilizer Applications in Pounds per Acre into Amounts for Small Areas

The author is N. C. Welch, Farm Advisor, Santa Cruz County.

Home gardeners, nurserymen, landscape managers, and greenhouse growers often have difficulty figuring how much fertilizer to use, since the recommended amounts usually are given in tons or pounds per acre. For small areas, single rows, or single potted plants, the convenient measuring tools are pints, cups, tablespoons, and teaspoons.

The chart at the bottom of the sheet gives amounts of fertilizers for flowerpots and boxes.

The chart on the back will help the "little lander" convert pounds to teaspoons. The conversions in the charts are not exact, but are accurate enough to guide you in determining the proper amount of fertilizer.

Listed are the weights of fertilizers to be applied to areas of 100 and 1000 square feet. Also listed are the equivalent volumes for various fertilizer materials for 10 square feet, 100 square feet, and for 10 lineal feet of rows spaced 1, 2, and 3 feet apart. The volume of fertilizer to be applied varies with different materials, even though the weight is the same. For example, 1 pint of ground limestone weighs 23 ounces, while 1 pint of ammonium nitrate weighs approximately 13 ounces.

To use the chart on the back: Follow the 3 steps given:

- 1 Find your material.
- 2 Find the recommended rate per acre.
- 3 Determine the amount of fertilizer needed for the area to be fertilized.

For example: if your material is ammonium sulfate and the recommended rate is 500 pounds per acre; for a 100-foot area, use 1.2 pounds or 1 pint of fertilizer; for 10 feet of row spaced 1 foot apart, use 3 tablespoons; for 10 feet of row spaced 3 feet apart, use .6 cup.

To figure the volume of fertilizers not listed, scoop the material loosely into a 1-pint container and weigh carefully. If the material weighs 16 ounces, for example, you would use the third block in the chart.

Equivalents

1 acre is equal to 43,560 square feet (this is a plot about 209 by 209 feet).

1 pint of water weighs about 1 pound.

1 pint is equal to 2 cups, or 32 tablespoons, or 96 teaspoons.

The rates given in this leaflet are not intended as recommended rates. Recommendations as to rates of application maybe listed on the package or maybe found in agricultural or gardening bulletins, (also see "Soil and Water Management for Home Gardeners" Leaflet 2258).

CONVERSIONS FOR FLOWERPOTS OR FLOWER BOXES

At These Rates Per Acre	Use These Volumes of Average Fertilizer				
	Flowerpots			Flower Boxes	
	4-Inch	6-Inch	8-Inch	1 Sq Ft	2 Sq Ft
	Tsps	Tsps	Tsps	Tsps	Tsps
500	.05*	.10*	.3*	1	2
1000	.10*	.20*	.6*	2	4

Since it is difficult to measure this small amount, you can dissolve 1 teaspoon of fertilizer in a pint of water and add appropriate proportion to the flowerpot.

Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

LEAFLET

2285

FOLLOW THESE STEPS TO DETERMINE HOW MUCH FERTILIZER YOU NEED



Find Your Material in the List Below		Find the Recommended Rate per Acre	Determine the Amount of Fertilizer Needed for Your Specific Area						
Material Grouped According to Approximate Weight per Pnt		Amounts per Acre	Use These Weights per Specified Area		Use These Volumes per Specified Area				
			100 Sq Ft	1000 Sq Ft	10 Sq Ft	100 Sq Ft	1 Ft	2 Ft	3 Ft
Activated Sewage Sludge } Dried Blood } Sulfur } (10 oz per pint)		Lbs 100 500 1000	Lbs .2 1.2 2.3	Lbs 2.3 11.5 23.0	Tbsps 1.2 6 12	Pints .4 1.9 3.7	Tbsps 1.2 6	Tbsps 2.4 12	Cups .2 1.1
Ammonium Chloride } Ammonium Nitrate } Urea } (13 oz per pint)		100 500 1000	.2 1.2 2.3	2.3 11.5 23.0	.9 4.5 9	.3 1.4 2.8	.9 4.5	1.8 9	.2 .8
Ammonium Phosphate } Gypsum } Mixed Fertilizers } Potassium Chloride } (16 oz per pint)		100 500 1000	.2 1.2 2.3	2.3 11.5 23.0	.7 3.5 7	.2 1.2 2.3	.7 3.5	1.4 7	.1 .7
Ammonium Sulfate } Calcium Nitrate } Mixed Fertilizers } Superphosphate } (19 oz per pint)		100 500 1000	.2 1.2 2.3	2.3 11.5 23.0	.6 3 6	.2 1 2	.6 3	1.2 6	.1 .6
Ground Limestone } Potassium Sulfate } (23 oz per pint)		100 500 1000 2000	.2 1.2 2.3 4.6	2.3 11.5 23.0 46.0	.5 2.5 5 10	.2 .8 1.6 3.2	.5 2.5	1 5	.1 .5

*Since high rates are not desirable in row fertilization, they are omitted in this table.

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MECHANICAL AND CULTURAL OPERATIONS

MOWING: mowing of grass and weeds within orchards help to control populations of insects by keeping grass low which will decrease insect breeding.

BANDING: banding trees with burlap will be employed to trap codling moths - all of the orchard trees will be banded with tanglefoot to prevent crawling insects, particularly ants from entering the trees. This has proven very effective to date.

PRUNING: Elimination of diseased and infected limbs by pruning is very effective with fire blight, aphids, webworm, tent caterpillar, and tussock moth to name a few.

SANITATION: Removal of all infected leaves, fruit, and branches prevents the spread of the disease, eliminating the pathogens for the following year. It is essential that all clippings be removed or chipped up for the elimination of disease. Also burning has been a major form of sanitation removal.

TRAPS: Although the purpose of the sticky traps and Pheremone traps is monitoring, they are also removing insects from the population and the gene pool.

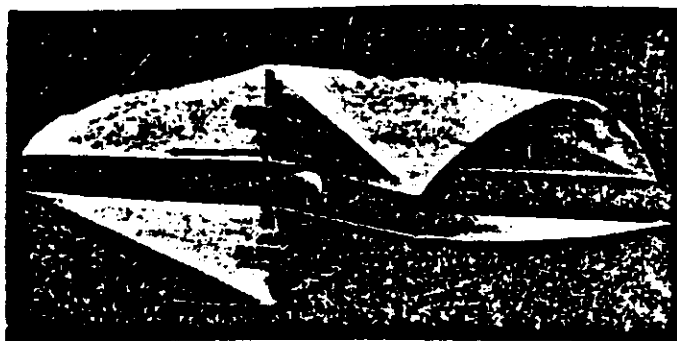
FENCING: Keep out deer and other animals.

WICK ORCHARD MANAGEMENT CALENDAR

TASK	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PRUNING	X	X	X	X								X
FERTILIZE				X	X	X	X	X				
DORMANT SPRAY			X	X	X	X	X	X	X			
WEED CONTROL					X	X	X	X				
THIN FRUIT						X	X	X				
HARVEST								X	X	X		
PRUNE FIR BLI			X	X	X	X	X	X	X			
MONITOR INS,DIS			X	X	X	X	X	X	X	X		

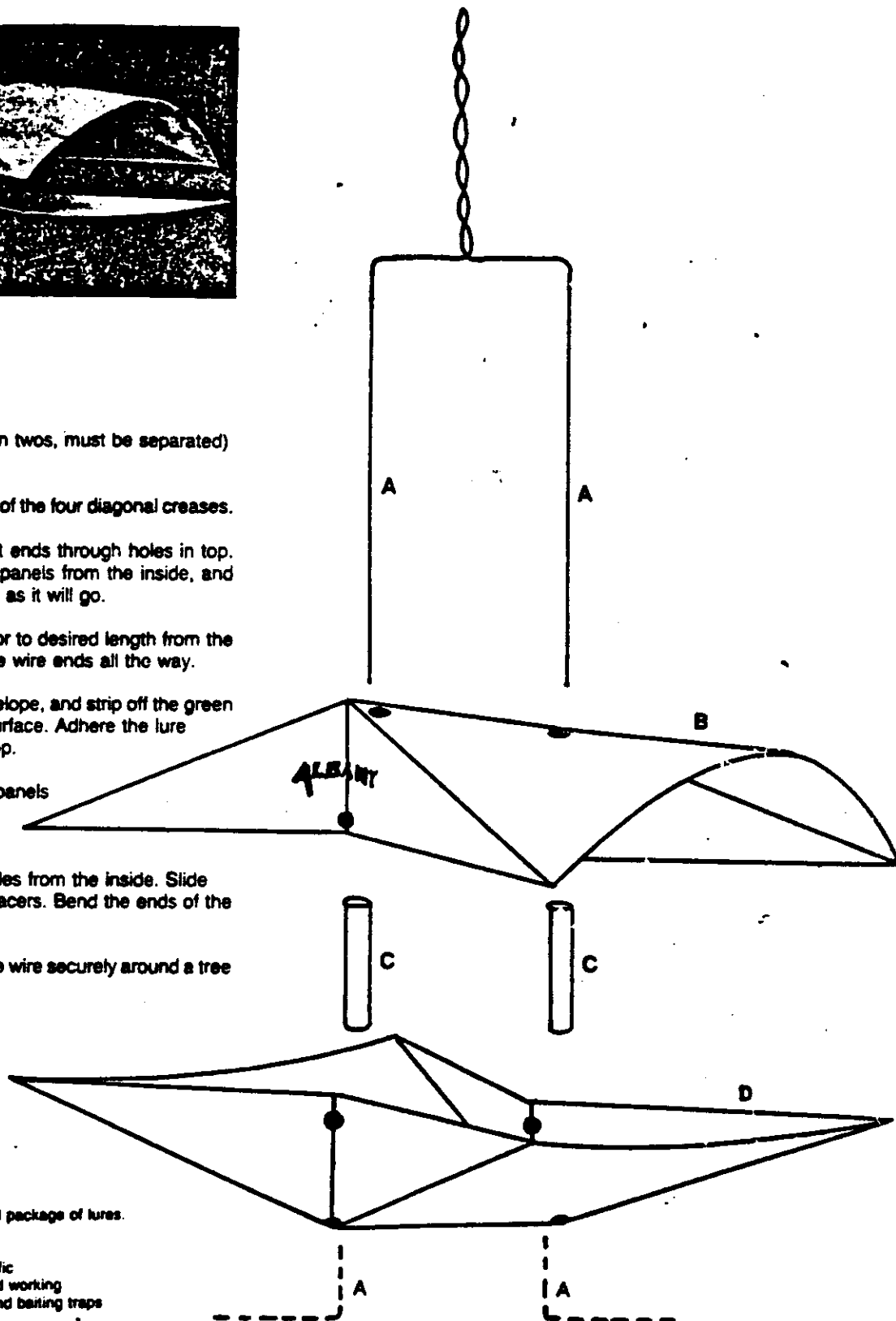
Scentry Wing Trap assembly instructions

ALBANY
INTERNATIONAL



Remove from package
1 wire hanger, folded (A)
1 plastic trap top (B)
1 plastic tube for spacers (C)
1 paper trap bottom (D) (packed in twos, must be separated)
1 foil envelope of 4 lures

1. Fold plastic top inward along each of the four diagonal creases.
2. Straighten wire hanger, and insert ends through holes in top. Bring ends through holes in side panels from the inside, and push the wire hanger down as far as it will go.
3. Cut two spacers two inches long or to desired length from the plastic tube, and slide each up the wire ends all the way.
4. Remove one lure from the foil envelope, and strip off the green backing paper to expose sticky surface. Adhere the lure to the inside surface of the trap top.
5. With sticky side up, fold the side panels of one of the trap bottoms inward, and insert wire ends through the holes in side panel from the outside, and through the lower holes from the inside. Slide the trap bottom up snug to the spacers. Bend the ends of the wire upward.
6. To hang, wrap the twisted part of the wire securely around a tree limb or other support.



7. Upon receipt, refrigerate or freeze the foil package of lures.

8. To avoid cross-contamination,
only handle traps and lures for one specific
pest species at a time. Wash hands and working
surfaces thoroughly before assembling and baiting traps
for other species.

9. To inspect trap and remove insects, and to re-bait the trap, straighten one wire
and lower the trap bottom on that side. For further use, return bottom, spacer
and wire to their original positions.

INSECT PROBLEMS AND SOLUTIONS

Apple Maggot: Rhagoletis pomonella

Description- there are four stages in their cycle:

- 1) the eggs are tiny and white under the apples skin
- 2) larvae are white tapered maggots slightly smaller than those of the house fly.
- 3) pupae are usually in soil during winter time
- 4) adult is a fly slightly more than 6mm in length, dark brown, with light bands on the abdomen, both light and dark markings on wings.

LIFE CYCLE:

After winter has past pupae in soil begin emerging from soil, and in late june adult flies emerge. At the same time some pupae may remain inactive in the soil until the second summer. The flies will emerge for a month or more, then within a week after emergence eggs will begin to be deposited under the skin of the apple. Each female will deposit approximately 300 eggs on a 30 day period. Hatching occurs within a few days and the larvae will mine the fruit, leaving irregular winding tunnels, which often cause premature dropping of the fruits. Larvae development requires from 2 weeks to 3 or more months depending on variety of fruit. When fully developed they will leave the fruit and crawl into the soil to pupate.

One generation per year is typical, usually late in season around September.

CONTROL

- 1) Parasites *Biosteres mellus*, which attacks larvae and *Patasson conotracheli*, which attacks eggs.
- 2) No true predators are known.
- 3) Systematic destruction of infested dropped apples.
- 4) Elimination of hawthorns in area is advisable.
- 5) Cold storage of fruits at 32 degrees fahrenheit for a period of 40 days will kill maggots.

Graphtholitha moths - Graphtolitha molesta

Description- four stages of life cycle

- 1) eggs are laid on twigs and foilage and later on fruit
- 2) larvae are white with a pink tinge, nearly 12mm long when fully grown last abdominal segment bearing a dorsal, black, 5 toothed, comblike structure, which is a means of distinguishing it from coddling moth larvae.
- 3) pupation occurs in in early spring from coccooned larvae in soil and trees
- 4) the adults are similar to the coddling moth adults in shape but somewhat smaller in size, 6mm in length, and of a dark gray color.

LIFE CYCLE:

Larvae hibernate in silken cocoons on the ground, in the tree, or on other nearby objects. Pupation takes place in the spring and moths begin emerging near peach blossom time. Eggs are laid on twigs and foilage, and later fruit. Early larvae tunnel into tips of tender green twigs, where they cause the characteristic wilting that indicates their presence. Full growth

requires almost 2 weeks, after which they leave the twigs, spin silken cocoons on nearby objects, and transform to pupae. In 10 days adult emergence occurs. During the summer approximately 1 month is required to complete the life cycle. There are 4 or 5 generations each season in the latitude of New Jersey.

CONTROL:

- 1) parasites: Trichogramma minutum, parasite of eggs
Macrocentrus ancyllivorus
M. delicatus
M. instabilis
Brachymeria ovata
Eurytoma tylodermatis
Pristomerus euryptychiae
Itoplectis conquisitor
Temelucha forbesi
T. epagoges
T. minor
Glypta rufiscutellaris
- 2) chemicals
chemicals used have had outstanding effects on controlling this
only that chemicals also effect the parasites.

Coddling Moth Laspey pomonella

Description - there are four stages:

- 1) the eggs are about the size of a pinhead.
- 2) pupae are yellow to brown 1/2 inch long.
- 3) larvae are whitish with dark heads 3/4 inches long.
- 4) adults have brownish front wings, wavy cross lines, and a characteristic copper spot near the tip of each wing, wing span 3/4".

LIFE CYCLE:

Pupae emerge in the spring when fruit trees are in bloom. Most activity is during sunset. A moth can lay fifty to seventy-five eggs on fruit, twigs, and leaves. Eggs hatch into larvae which enter the fruit, feed for several weeks and emerge to pupate leaving behind a characteristic brown frass. After pupating in hidden places (crotches, wounds, bark) they emerge as adults. There are several generations and depending on temperatures, eggs hatch in 5-12 days. Larvae feed for 25-35 days and pupate for 8-20 days. Moths do not lay eggs below 65 degrees F and will not fly below 55 degrees F.

CONTROL:

- 1) Trichogramma wasps should be released when the monitoring indicates the first generation has begun to mature.
- 2) Place a sheet around the tree and eliminate all loose bark which can serve as egg laying sites during dormant season, remove all loose objects under trees (firewood, etc.) seal all pruning wounds.
- 3) Band all trees by late April. Wrap the tree with a 6" wide strip of burlap or corrugated cardboard several times. The flutes of the cardboard must be at least 3/16" side. Remove the band 1/week in warm weather and 1/ every 2 weeks in cool weather. Drop larvae in gasoline.
- 4) Remove infested fruit in a plastic bag and place in the sun for two weeks.
- 5) Thin the fruit when they are ping pong ball size.

OPTIONAL:

- A. Place one Pheremone trap in every apple tree.
- B. Spread B.T. when the larval stage is detected.

Aphids: Members of Homoptera. We are concerned with the Woolly Apple Aphid, Green Apple Aphids, and Rosy Apple Aphids.

Life Cycle: Winter is passed in the egg stage, but many generations and rapid reproduction occur beginning in the spring. They are herded by ants for their honeydew excrement. The ants must be controlled simultaneously.

Control:

- 1. diatomaceous earth sprinkled on the infestation
- 2. insecticidal soap in spot treatments
- 3. tanglefoot the trees to prevent repopulation by the ants

Mites- non-insect class Arachnida

description- reddish brown or pale and resemble miniature spiders

Life cycle: They hide in debris producing many generations a year.

Control:

- 1) ladybugs, lacewings, predatory mites
- 2) cold water

Caterpillars: (Lepidoptera)

Beside borers and codling moth, there are a great many lepidoptera of less significance. These insects are not especially significant on the site, but they can cause damage if left unchecked. They are controlled by the following methods:

- 1) mechanical removal (pruning, and burning)
- 2) B.T.
- 3) Trichogramma Wasps (if the other methods are not successful)

DISEASE PROBLEMS OF WICK ORCHARD OF MORRISTOWN NATIONAL HISTORICAL PARK

Brown rot: the pathogen is a fungi *Monilinia fructicola* or *Monilinia laxa*. The symptoms are twig blight, bud blight, dieback, cankers, fruit decay and mummies.

Control includes:

1. Removal of all infected wood and mummies
2. The application of 3 sprays of dormant oil and COCS

Threshold - none, any brown rot is too much.

Action level - preventive and remedial measures are called for at this time.

Cystosporina - *Eutypa armeniaca*

The pathogen is the assexual stage which is cystosporina.

The symptoms are cankers, dieback, and oozing.

Control: Prune 2-3' below the infected area, but only in dry weather since the pathogen is spread by rain. Practice sanitation and remove all mummies and clippings from the site.

Threshold: none

Action level - As soon as diagnosed; we are presently enacting remedial measures. There is no chemical control.

Crown Gall: Pathogen is the bacterium *Agrobacterium tumefaciens*.

Symptoms: Galls or tumors begin as small white overgrowths and become convoluted and blackened as they age. Severely diseased plants produce small chlorotic leaves.

Control:

1. Since the bacterium can only enter through a wound, careful cultivation is required. All pruning tools must be sterilized in bleach after being exposed to crown gall.
2. Heat can control the organisms and soil solarization can be helpful in this effort.
3. A competing bacterium can control disease and it is marketed as Galltrol.

Powdery Mildew: pathogen is a fungus *Sphaerotheca pannosa*

Symptoms: Leaves powdery white and some spots on the fruit.

Control: Three sprays with copper; one at petal fall, one two weeks later at pit hardening, and a third during dormancy.

Fireblight: Bacterium - *Erwinia amylovora*

This disease is spread by pollinating insects, wind, and rain, and by holdover cankers. Appearance of fireblight is a temperature--related phenomena and can be monitored in terms of degree days. We are presently assembling more data on this process.

Control:

Remove limbs 6-12" below the infected area and burn or remove the clippings from the site. It is not true that the disease is spread on pruning tools despite traditional claims. Spray streptomycin at 100ppm beginning at 60 degrees in May and spray every 4-5 days until the bloom is over. Another alternative which we will try first is to hang small bottles of mycin and let the pollinators spread the mycin as they spread the pathogens. Fertilize

minimally or not at all since the young growth is especially susceptible to the fireblight infection. The copper spray will also help, but would not be effective by itself.

Entomosporin Leaf Spot: Cause- fungus *Entomosporium maculatum*

Symptoms: brown lesions on leaves, sunken black spots on fruit and twig cankers.

Control:

1. Fungicide treatment as described in the spray program.
2. Sanitation.

CLIMATE

The climate of the Morristown National Historical Park, is very humid and temperate, with no influence from the ocean. Summer temperatures never usually exceed 100F, but stabilize around the mid 90F. Winter temperatures do not often fall below 10F, but are cold enough to force drainage tile to be placed at a depth below 30" for protection.

The average precipitation rate for the area is 46-49", that is equally distributed throughout the year. With the evenly distributed rainfall, and having heaviest rainfalls in July and August, some lands are still irrigated for high valued crops.

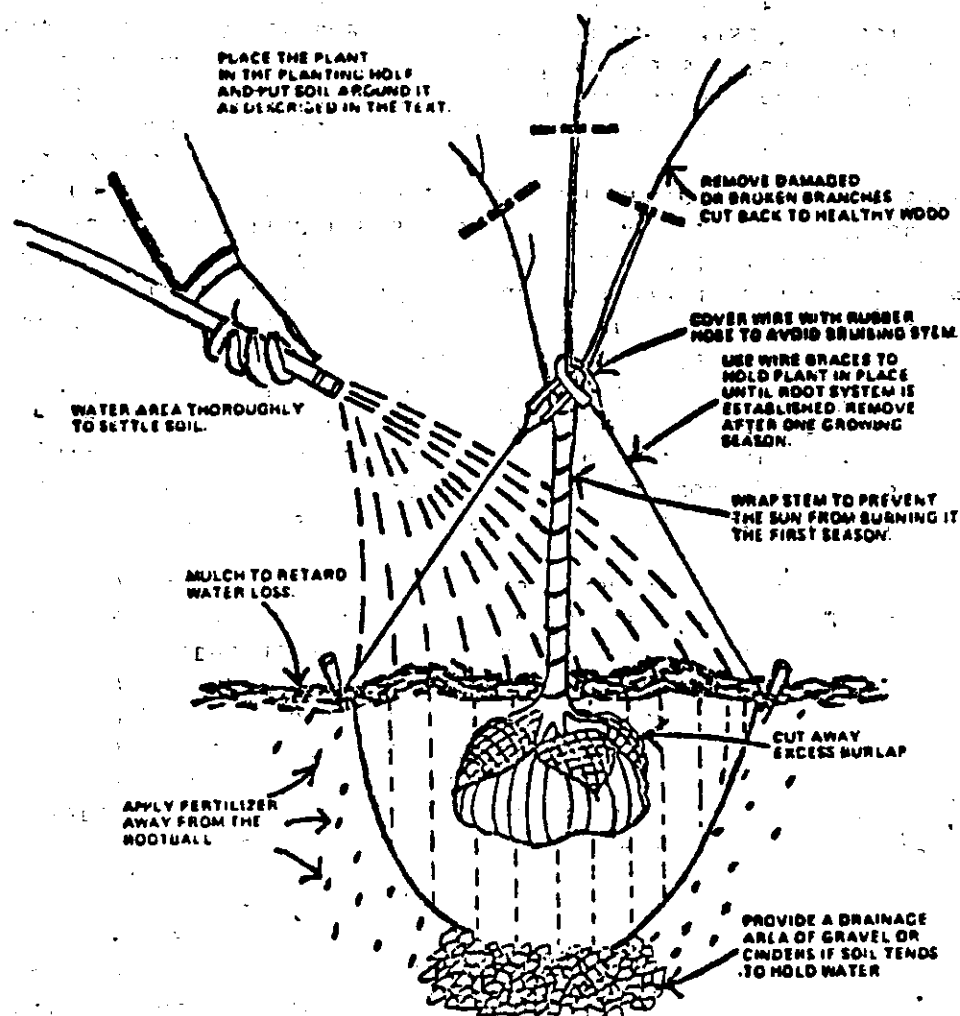
The growing season for Morris County is in average length, approximately 159 days. The average date for the last killing frost in spring is May 2, with the first killing frost of the fall being approximately October 8.

During the winter months the temperatures are not cold enough to keep ground frozen due to infrequent rain falls. This allows soils to thaw a 2-3", and to be highly erodible.

APPENDIX I

PLANTING AND TRANSPLANTING

PLANTING LARGE BALLED AND BURLAPPED TREES IN THE GROUND



- Fill the funnel with water. When it empties, fill it again.

- When water no longer drains from the funnel, stick your finger in the neck so the water will not run out, and remove the funnel.

The most efficient way to water your plants is with an automatic waterer. This allows you to leave your plants unattended for longer periods of time than is possible when you water by hand.

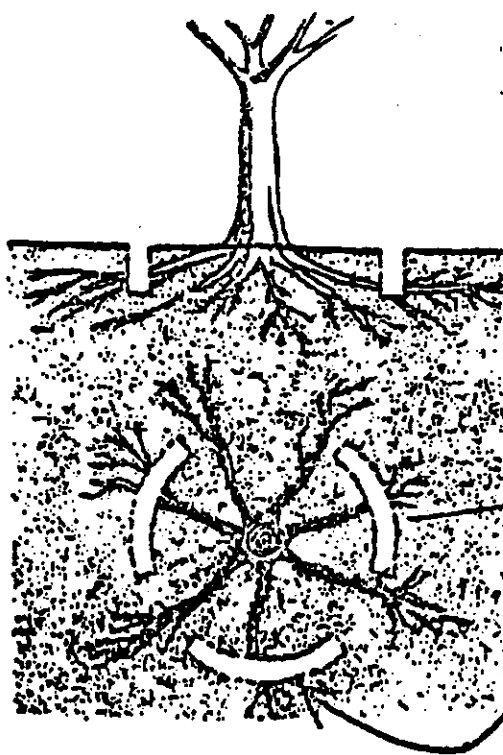
An automatic waterer includes:

- (1) A proportioner to mix the water with liquid fertilizer. It is attached to the water faucet. All moving parts should be stainless steel or plastic.

- (2) A solenoid valve to automatically control the flow of water. It operates electrically.

- (3) A line strainer to clean the water. It protects nozzles, solenoids, and pumps from damaging particles.

U.C. Cooperative Extension



spring root pruning
1/3 effect
fall 2/3

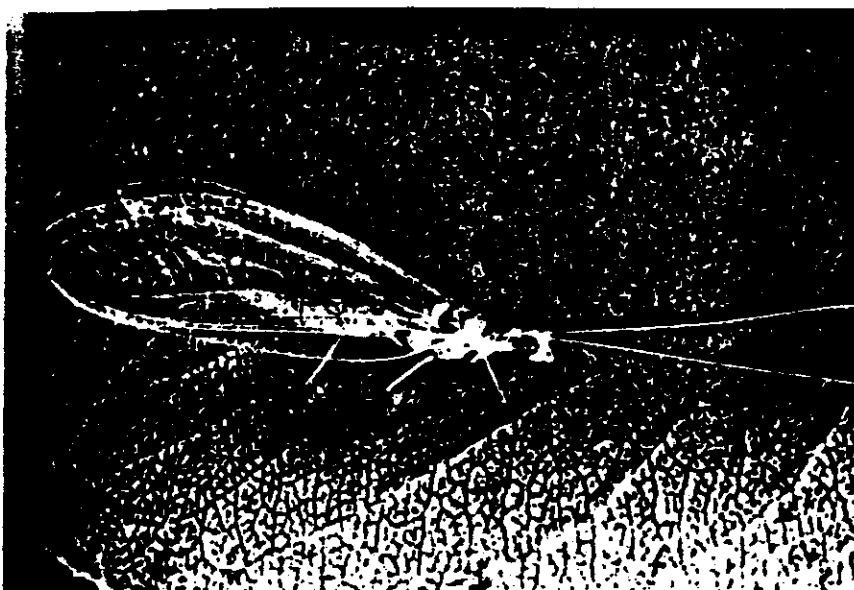
APENDIX II

SOURCES OF BIO SUPPLIES

Some Commercial Sources of **BIOLOGICAL CONTROL AGENTS** in California



Right: Praying mantis: actual size 35mm.
Below left: Green lacewing: actual size 12mm.
Below right: Parasitic wasp laying egg in aphid:
actual size 0.3mm.



Biological control is the use of parasites, predators, and disease-causing organisms to help keep insect pests in check. Naturally occurring agents are continually at work in the environment. In some cases man has assisted in this process by releasing additional numbers of these agents in an attempt to improve the biological control of pests. However, limitations do exist in this type of program. For example, some biological control agents, such as the praying mantis, are general

feeders, and are just as likely to capture and consume a beneficial insect as a crop-destroying pest. Others, such as the convergent lady beetle, cannot be expected to remain confined to the locale where they are released. Despite the limitations of some biological control agents, positive results have been obtained and interest in them continues. The purpose of this leaflet is to provide information on some commercial sources of parasites, predators, and pathogens available in California.

University Extension

Department of Agricultural Sciences

UNIVERSITY OF CALIFORNIA

LEAFLET 21105



seeds of this plant can produce severe allergic reactions in some people. Seeds are available from:

1. HIGH-YIELD GARDENING
401 Market Ave. N.
Canton, OH 44750
2. JOSEPH HARRIS CO., INC.
Moreton Farm
Rochester, NY 14624
3. THE NATURALISTS
P.O. Box 435
Yorktown Heights, NY 10598
4. MELLINGER'S, INC.
2310 W. South Range Rd.
North Lima, OH 44452
5. THE NECESSARY TRADING
COMPANY
New Castle, VA 24127

The plants alone are repellent to moles. You can also make a mixture with castor oil, which is nonpoisonous:

1/4 cup castor oil
2 tablespoons liquid detergent
6 tablespoons water

In a blender, whip together castor oil and liquid detergent until the resultant mixture is like shaving cream. Add the water and whip again. Take a regular garden sprinkling can, fill it with warm water, and add 2 tablespoons of the oil mixture. Stir and sprinkle the liquid immediately over the areas of the greatest damage. For best results, apply after a rain or a thorough watering.

■. *Euphorbia lathyris* (mole plant, caper spurge, gopher spurge) is also said to drive moles and gophers from the neighborhood. CAUTION: THIS IS A POISONOUS PLANT. Although not as toxic as the castor bean above, the stems contain a milky sap that can irritate the skin, and the fruit has been mistaken for the true caper and has been eaten by children, producing severe digestive symptoms. Seeds are available from:

1. HIGH-YIELD GARDENING
401 Market Ave. N.
Canton, OH 44750
2. LAKELAND NURSERIES SALES
340 Poplar St.
Hanover, PA 92083
3. TAYLOR'S HERB GARDENS, INC.
1535 Lone Oak Rd.
Vista, CA 92083

1. **CASA YERBA**
Star Rt. 2, Box 21
Days Creek, OR 97429
2. **PLANTS OF THE SOUTHWEST**
1570 Pacheco St.
Santa Fe, NM 87501
3. **REDWOOD CITY SEED CO.**
P.O. Box 361
Redwood City, CA 94064
4. **OTTO RICHTER & SONS, LTD.**
Goodwood, Ontario
Canada L0C 1A0
5. **TAYLOR'S HERB GARDENS, INC.**
1535 Lone Oak Rd.
Vista, CA 92083
6. **YANKEE PEDDLER HERB FARM**
Route 1, Box 251A
Burton, TX 77835

To make pyrethrum dust, just grind up the dried flower heads.

To make a spray, soak the flower heads overnight in methyl alcohol (the pyrethrin toxin is water insoluble), then dilute this solution with approximately 100 times as much water before spraying.

Because commercial preparations of pyrethrum usually contain a chemical synergist like piperonyl butoxide, which can increase the potency of pyrethrum fourfold, they will work more effectively than the pyrethrum you make at home.

Homemade preparations will knock down insects very well but may not kill them.

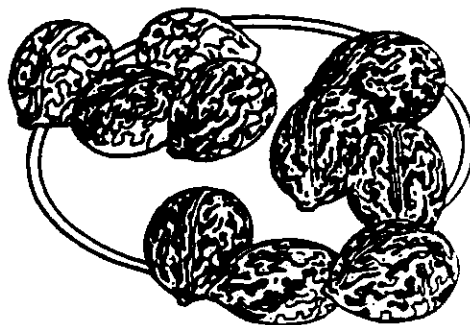
Both the dust and the spray described above break down quickly when exposed to light and air. They should be stored in dark, airtight containers.



Marigolds

Only the French marigolds (*Tagetes patula*) have been shown to be an effective control for nematodes if the entire infested area is planted with them for a full season or if they are heavily interplanted. They are also said to repel many other types of garden pests. Seed for French marigolds is available from:

1. **GEORGE PARK SEED CO., INC.**
Hwy. 254N
Greenwood, SC 29647
2. **OTTO RICHTER & SONS, LTD.**
Goodwood, Ontario
Canada L0C 1A0
3. **NICHOLS GARDEN NURSERY**
1190 North Pacific Hwy.
Albany, OR 97321



Mole Repellents

- A. Castor beans (*Ricinus communis*)** are reputed to be good mole repellents. **CAUTION: THIS IS A POISONOUS PLANT.** It should never be planted where small children play. The entire plant is toxic, especially the seeds. One to three of the mottled black, brown and white glossy seeds can be fatal to a child. In addition, handling the leaves and

DOS AND DON'TS OF SPRAYING

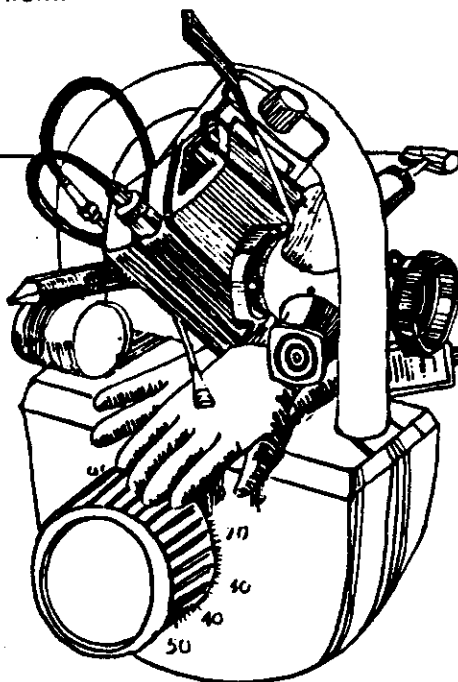
—Read label instructions completely before using a dust or spray.

Although they are often incomplete and sometimes misleading, manufacturer's directions mention many essential cautions and procedures.

—Store all sprays in a locked cabinet out of the reach of children and away from pets. All dusts should be kept in a cool, dry, dark place. All liquid concentrates should be stored away from heat and open flame.

—Because many organic dusts and sprays can irritate skin, nasal passages and lungs, wear gloves and a protective face mask when you handle or spray them.

—Check a duster or sprayer out only before you buy it. Most dusters are not



precision-made, go through the motions of loading and pumping the applicator before you step up to the counter to pay for it. Make sure the lid fits tightly and that the duster can be completely emptied of all powders. A special cup on the duster nozzle will give better control of the direction

of the powder. Check to see how hard it will be to disassemble a sprayer in case it clogs.

—Change clothes and wash hands as soon as spraying is completed. Bathe as soon as possible.

—Contact your local poison control center immediately if a pesticide poisoning is suspected.

—**Don't** spray on a windy day. Confine applications to those plants you want to treat.

—**Don't** mix wettable powders in the sprayer itself. Instead, use a separate jar or bucket to make the solution before adding it to the sprayer.

—**Don't** reuse organic insecticide containers. Dispose of them in a safe place.

—**Don't** add a new pesticide to the sprayer or duster before making sure that the applicator is empty, clean and dry.

—Tony DeCrosta

(Continued from page 3)

V. Botanical Poisons

Please note that even though these pesticides are plant-derived and nonpersistent in the environment, they are still poisons and deserve very careful handling. Pay particular attention to our DOS AND DONTS OF SPRAYING immediately following this section.

Rotenone is an extremely poisonous substance. It will kill bees and other beneficials and is deadly to swine and fish. Although it is biodegradable, its acute toxicity is in the same range as paraquat. Ingestion of derris root (a source of rotenone) was a common means of suicide by natives of New

Guinea. Powders and sprays may cause irritation to the skin. Pyrethrum is less toxic than rotenone, but it is still a nonselective pesticide and will kill earthworms, adult ladybugs and most any other insect with which it comes in contact, not to mention fish. Find out more about these products before you use them and never apply them indiscriminately. If your library can't help, send a Self-Addressed Stamped Envelope to Organic Gardening Reader Service, 33 E. Minor St., Emmaus, PA 18049, and ask for the reprint called "Organic Sprays and How to Use Them."

A. Rotenone

Sources: 10, 12, 17, 22, 24, 25,

26, 35, 40, 43, 46

B. Pyrethrum

Sources: 25, 40, 46

(See Section 3 for instructions on making your own pyrethrum)

C. Pyrethrum-Rotenone Blend

Sources: 24, 25, 35

D. Pyrethrum-DE Blend

Sources: 5, 12, 19, 21, 25, 35

E. Rotenone-DE Blend

Sources: 12, 19

F. Pyrethrum-Rotenone-Ryania Blend (Botanic; Tri-Excel DS) when available

Source: 25, 28

G. Sabadilla

Sources: 9, 46, 48

H. Ryania (when available)

Sources: 25, 43, 46

SECTION III

PEST CONTROL MATERIALS YOU CAN GROW YOURSELF OR MAKE AT HOME

General All-Purpose Insect Spray

This spray makes use of the repellent qualities of garlic, onion and hot peppers. The soap makes it cling to plant leaves.

garlic bulb

small onion

tablespoon cayenne pepper

quart water

tablespoon liquid soap detergent

Chop or grind garlic and onion, add cayenne, and mix with water. Let steep four hours, then add liquid soap detergent. Store in a tightly-covered jar in the refrigerator up to 1 week.

From: THE NATURAL FORMULA BOOK FOR HOME AND GARDEN. RODALE PRESS, 1982.)



HOW TO MAKE BUG JUICE

Step to making bug juice is to identify which pest is causing you

trouble, or about to cause you trouble. Collect about half a cup of the bugs, keeping a lookout for sick ones, which can be especially effective. Place the bugs in a blender with two cups of water and liquefy them. Strain the result through cheesecloth or a fine sieve to prevent your sprayer from becoming clogged. To use the juice, dilute about 1/4 cup with one or two cups of water in a small hand sprayer (if you have any left over, it can be frozen for a year or more). Spray both sides of your vegetables' leaves, along with stems and runners. If it rains soon afterward, spray again.

We first reported on this method of grinding up pests in a blender and spraying them on your crops back in 1976. We were tipped off by a Florida pest-control expert who had seen bug juice work wonders on soybean and peanut crops. We still don't know why it works for some gardeners, but there are several theories. Grinding up the insects may cause them to release an "alarm pheromone" that frightens away their friends. Or a few sick or disease-carrying bugs are whizzed up and sprayed on crops, and the disease quickly spreads to others. It may also be that the smell of chopped-up insects attracts the pest's natural enemies.

Helga Olkowski of the John Muir Institute in Berkeley, California, wrote to

warn us that lab technicians sometimes develop allergies when working with insect parts. She advises wearing a filter mask and protective clothing (a long-sleeved shirt, rubber gloves and long pants should do) when spraying insect extracts.

We'd also like to caution gardeners against using the bug juice method against fleas, ticks, mosquitoes and other insects that attack man and may harbor human diseases. And just to be on the safe side, don't use your household blender to make bug juice. If you haven't got an old one around to use exclusively for this purpose, just mash the insects up with a mortar and pestle.

—Michael Lafavore



Pyrethrum

Chrysanthemum cinerariifolium is the flower from which this poison is made. Be forewarned, some people are highly allergic to pyrethrum flowers and crude extracts. Seeds are available from:

GREEN LACE-WINGS	LADY-BUGS	PRAYING MANTIDS	BGG WASPS	* OTHER ORGANISMS	SUPPLIER	MAIL ORDER	PHONE ORDER	RETAIL	WHOLE SALE	NOTES
			X		Gothard Inc. P.O. Box 370 Conoverville, TX 79835 (505) 874-3125	X	X	X	X	Free brochure
	X	X	X	GHP	Gurney Seed & Nursery Co Yankton, SD 57079	X		X		Catalog available
X	X		X	BSP,DS,FPM, FPS,GHP,GWP, MD,PMC,PMO, PMP,RSM	Integrated Pest Management 305 Agostino Rd San Gabriel, CA 91776 (213) 287-1101	X	X	X	X	Some literature
X	X	X	X	BP,FP,MD	King's Natural Pest Control 224 Yost Ave. Spring City, PA 19475	X		X	X	Post pd Free literature
	X	X			Lakeland Nurseries Sales Inc. 340 Poplar Street Hanover, PA 17331 (717) 637-5555	X	X	X		Catalog available
	X	X	X	BP,GHP	Melinger's Nursery 2310 W. South Range Rd North Lima, OH 44452 (216) 549-9861	X	X	X		Free catalog
		X			Mincemoyer's Nursery R.D. 7, Box 379 Jackson, N.J. 08527	X		X		
		X			Nationwide Seed & Supply Box 91073 Louisville, KY 40291	X		X		Postage paid
X	X	X	X	BSP,FPM,FPP, FPS,GWP,MD, PBP,PMC,PMO, PMP,RSM	Natural Pest Controls 9397 Premier Way Sacramento, CA 95826 (916) 362-2660	X		X	X	Whole-sale postage paid
				PMC,PMO,PMP	Nature's Control 2518 Stewart Ave. Medford, OR 97501 (503) 773-5927	X	X	X		Prepaid only Free brochure
	X	X			Organic Control, Inc. 5132 Venice Blvd Los Angeles, CA 90019	X		X	X	Free catalog Post pd
				DS	Pacific Agricultural Labs Inc P.O. Box 439 San Luis Rey, CA 92068 (714) 439-6921	X	X	X	X	
X	X	X	X	BP,BSP,DS, FPM,FPS,GHP, GWP,MD,MF, NOW,NPV,PMC, PMH,PML,PMO, PMP,PN,PNC, RSB,RSM	Peaceful Valley Farm Supply 11173 Peaceful Valley Rd Nevada City, CA 95959 CA 95959 (916) 265-3339	X	X	X	X	Free catalog
X	X		X	BSP,DS,FP, GWP,MD,NOW, PMC,PMO,PMP, RSM	Rincon-Vitova Insectaries, Inc. P.O. Box 95 Oak View, CA 93022	X		X	X	
X			X	FPG,FPM,FPR, FPS,GWP,MD	Spalding Laboratories 760 Primiz Rd. Arroyo Grande, CA 93420 (805) 489-5946	X	X	X	X	
X	X	X	X	FP,GWP	Unique Insect Control P.O. Box 15376 Sacramento, CA 95852 (916) 961-7945	X	X	X	X	Free literature available
				GWP	Whitefly Control Company P.O. Box 986 Milpitas, CA 95035 (408) 295-1444 EXT 520	X	X	X	X	Free literature

GREEN LACEWINGS-*Chrysopa carnea*

LADY BUGS-*Hyperaspis convergens*

PRAYING MANTIDS-*Tenodera aridifolia sinensis*

BGG WASPS-*Trichogramma pretiosum*

Trichogramma plumbeum

Trichogramma pretiosum

BP-Belly spots-*Bombus populis*

BSP-Bark scale parasite-*Microplitis dictyosphaeriae*

DS-Crown gall preventive-*Agrobacterium radiobacter*

MF-Meadow gull preventive-*Rumex crispus*

PN-Predatory nematodes, various species

FPG-Fly parasite-*Sphaerogaster* sp.

FPM-Fly parasite-*Muscidifurax rapax*

FPP-Fly parasite-*Nematus variegatus*

FPR-Fly parasite-*Phaenocarpa ruficornis*

FPS-Fly predator-*Cryptus* sp.

FPS-Fly parasite-*Spalangia oleris*

FPZ-Fly parasite-*Muscidifurax zappari*

GHP-Graham hopper parasite-*Nematus leucostictus*

GWP-Greenhouse whitefly parasite-*Encarsia formosa*

LT-Greenbug parasite-*Lysiphilus abnormis*

MD-Meadow gull preventive-*Rumex crispus*

MF-Meadow gull preventive-*Rumex crispus*

NOW-Navel orangeworm parasite-*Gnomonia ligulosa*

NPV-Nuclear polyhedrosis virus

PBP-Pink bollworm parasite-*Meteorus blackburni*

PMC-Predatory mite-*Anisotoma californica*

PMH-Predatory mite-*Anisotoma hibiscus*

PML-Predatory mite-*Phytoseius longipalpus*

PMO-Predatory mite-*Mesochorus ornatus*

PMP-Predatory mite-*Phytoseius persimilis*

PN-Predatory nematodes, various species

PNC-Predatory nematode-*Nemalectus carolinensis*

RSB-Red scale parasite-*Campoplex bispinosus*

RSM-Red scale parasite-*Aphidius matricariae*

Biological Control Services Program
3288 Meadowview Road Sacramento, California 95832
(916) 445-6214

SECTION II

1982 SUPPLIERS OF BENEFICIAL ORGANISMS IN NORTH AMERICA

State of California
Department of Food and Agriculture

Larry G. Bezark
Eric J. Rey

Biological Control Services Program
Division of Pest Management, Environmental Protection and Worker Safety

GREEN LACE- WINGS	LADY- BUGS	PRAYING MANTIDS	EGG WASPS	* OTHER ORGANISMS	SUPPLIER	MAIL ORDER	PHONE ORDER	RETAIL	WHOLE SALE	NOTES
				CGP	Ag Bio Chem Inc. 3 Fleetwood Ct. Orinda, CA 94563 (415) 254-0789	X	X		X	Free literature
				DS,MD	Associates Insectary P.O. Box 969 Santa Paula, CA 93060 (805) 933-1301	X	X	X	X	
				FPG,FPS,FPZ	Beneficial Biosystems 1803-F 63rd St. Emeryville, CA 94608 (415) 655-3928	X	X	X		Whole- sale for PCA's
				FPM,FPM,FPS	Beneficial Insectary 245 Oak Run Rd. Oak Run, CA 96069 (916) 472-3715	X	X	X	X	Postage paid
	X				Beneficial Insects Company P.O. Box 323 Brownsville, CA 95919 (916) 675-2251	X	X	X	X	Free brochure
X			X	FP	Beneficial Insects Ltd. P.O. Box 154 Banu, CA 95304	X		X		Lace- wings Apr-July
				GWP,PMP	Better Yield Insects 13310 Riverside Dr., E. Tecumseh, Ontario, Canada	X		X		Need permits for US import
X	X	X	X	FP	Bio-Control Company 13451 Highway 174,P.O.B. 247 Cedar Ridge, CA 95924 (916) 272-1997	X	X	X	X	Free literature
			X		Biogenesis, Inc. Box 36 Mathis, TX 78368 (512) 547-3259	X	X	X	X	
X	X		X	BSP,FPM,FPS, GHP,GWP,LT,MD, NPV,PMC,PMO, PMP,RSM	Bio Insect Control 1710 S. Broadway Plainview, TX 79072 (806) 293-5861	X	X	X	X	
				PMC,PMO,PMP	Biotactics, Inc., Sales 7765 Lakeside Drive Riverside, CA 92509 (714) 685-7681 after 6pm	X	X	X		
				PN,PNC	B.R. Supply Company P.O. Box 845 Exeter, CA 93221 (209) 732-2738	X	X	X	X	
	X	X			Burpee Seed Co. 300 Park Ave. Warminster, PA 18974	X		X		
			X	FP	California Green Lacewings P.O. Box 2495 Merced, CA 95340 (209) 722-4985	X	X	X	X	Catalog available
	X		X	BSP,DS, FPM,FPS, MD,RSM	Foothill Ag. Research Inc. 510 W. Chase Drive Corona, CA 91720 (714) 371-0120	X	X	X		Will not ship
	X				Fountain's Sierra Bug Co. P.O. Box 114 Rough & Ready, CA 95975 (916) 273-0513	X	X	X	X	Free brochure

This pamphlet does not imply an endorsement of the suppliers or their products by the California Department of Food and Agriculture, nor does it imply that the suppliers or products are not listed. This pamphlet may be freely reproduced. One copy per request is available from:

(41) WOOD STREAM CORP.

Front & Locust Sts.
Littiz, PA 17543
(717) 626-2125
(Manufacturer of Havahart traps and others. Contact Customer Service Department for list of distributors.)

(42) ZOECON CORPORATION

975 California Ave.
Palo Alto, CA 94304
(Contact for a list of distributors for their insect monitoring systems and Pherocon® attractants and traps.)

Late Additions

(43) BAUSER'S ORGANIC SALES

Trailer Rd., Box 127, RD #1
Mohrsville, PA 19541
(Diatomaceous earth; DE + pyrethrum; rotenone; ryania when available)

(44) BIOCHEM PRODUCTS

A Div. of Salisbury Labs, Inc.
Box 264
Montchanin, DE 19701
(Manufacturers of *Bacillus thuringiensis*—trade name Bactospeine—and B.t.i.—trade name Bactimos—in flowable concentrate or wettable powder. Contact for distributors in your area.)

(45) D & R SALES & MFG. CORP.

A Div. of Boma Enterprises, Inc.
600 Railway St.
Williamsport, PA 17701
(Dead-End Roach Killer, Diatomaceous earth + inert ingredients. Contact for more information.)

(46) GROWING CRAZY

2460 S. Beyer Rd.
Baginaw, MI 48601
(Catalog \$1.25. 1% rotenone; 5% rotenone; pyrethrum; 50% ryania—limited supply; 20% sabadilla—limited supply; insecticidal soap; Thuricide; Dipel; Milky Spore; insect traps; pheromone traps; Tanglefoot; Fossil Shell Flour [DE].)

THE NEMATODE FARM

1717 San Pablo Ave.
Berkeley, CA 94702
(*Steinernema carpocapsae*, a predatory nematode effective against a wide range of pests. Contact for more information.)

(48) BARGYLA RATEAVER

3049 Covina St.
San Diego, CA 92126
(Sabadilla dust, 1 lb. bags; BXN, containing 6 fungi predaceous upon nematodes, and BX, a bacterial culture; Grasshopper Spore for 3,000 sq. ft. and 10,000 sq. ft.; Milky Spore, 1 lb.)



SPECIFIC PRODUCTS

I. Disease Organisms/Microbial Insecticides

A. *Bacillus thuringiensis* (B.t., Dipel, Thuricide, etc.)

Sources: 9, 10, 17, 20, 21, 22, 23, 24, 25, 26, 28, 36, 40

B. B.t.i. (Teknar, Bactimos, Vectobak)

Sources: 1, 8, 22, 36, 44

C. *Bacillus popilliae* (Milky Spore, Milky Disease, Doom, Japademic)

Sources: 16, 23, 24, 25, 34, 46, 48

(See also "Beneficial Organisms" list)

D. *Nosema locustae* (Grasshopper Spore)

Sources: 17, 21, 22, 23, 24, 25, 30, 34, 48

(See also "Beneficial Organisms" list)

E. *Anabrus simplex* (Mormon Cricket Spore)

Sources: 24, 25, 34

F. Nuclear Polyhedrous Virus (NPV, Eicar, etc.)

Source: 36

(See also "Beneficial Organisms" list)

II. Traps

A. Insect Traps

Sources: 2, 3, 4, 7, 10, 15, 17, 21, 22, 24, 25, 33, 34, 42, 46

B. Pheromone Sex Lures

Sources: 2, 3, 22, 25, 42, 46

C. Animal Traps

Sources: 9, 10, 17, 21, 24, 25, 41

D. Tanglefoot

Sources: 10, 12, 17, 21, 22, 23, 25, 35, 39, 46

III. Assorted Products

A. Dormant Oil

Sources: 9, 21, 23, 35

B. Netting/Mesh

Sources: 4, 6, 9, 10; 12, 17, 21, 23, 24, 30

C. Insecticidal Soap

Sources: 12, 19, 22, 24, 25, 30, 35, 38, 46

D. Boric Acid (Roach Free, Anti-Roach, Roach Prufe)

Sources: 11, 25, 28, 29

(Use with care around children.)

E. Pent-A-Vate

Sources: 25, 31

F. Miscellaneous Items (Scarecrows, etc.)

Sources: 4, 10, 17, 21, 23, 24, 25

G. Predatory Nematodes

Source: 47

(See also "Beneficial Organisms" list)

H. BXN (fungi predaceous upon nematodes) and BX (a bacterial culture)

Source: 48

IV. Diatomaceous Earth (DE, Perma Guard, Earth Guard, Fossil Shell Flour, Diatomite, etc.)

A. Plain DE

Sources: 5, 13, 14, 18, 19, 22, 25, 27, 37, 40, 43, 46

B. DE + Pyrethrin

Sources: 5, 12, 19, 21, 25, 35, 43

C. DE + Rotenone

Sources: 12, 19

D. DE + Boric Acid

Source: 22

E. DE + Inert Ingredients

Source: 45

(Continued on page 6)

- (15) **ELLISCO, INC.**
American & Luzerne Streets
Philadelphia, PA 19140
(Contact for a list of distributors
for their Japanese beetle traps.)
- (16) **FAIRFAX BIOLOGICAL
LABORATORIES**
Clinton Corners, NY 12514
(Manufacturer of Doom Milky
Disease. Can buy directly from
them or through their
distributors.)
- (17) **FARMER SEED & NURSERY
CO.**
818 N.W. 4th St.
Faribault, MN 55021
(Thuricide, Grasshopper Spore,
1% rotenone, traps, netting,
Tanglefoot)
- (18) **FRANK FOSBENNER**
371 New St.
Quakertown, PA 18951
(Perma Guard, Fossil Shell Flour,
DE)
- (19) **FOSSIL FLOWER NATURAL
BUG CONTROLS**
463 Woodbine Ave.
Toronto, Ontario
Canada M4E 2H5
(FOR CANADA ONLY:
Manufacturers of Fossil Flower
products, including plain
diatomaceous earth, DE +
pyrethrins, DE + rotenone, and
insecticidal soap. Can buy
directly from them or through
distributors.)
- (20) **GALT RESEARCH, INC.**
P.O. Box 319
Nashville, IN 47448
(Dipel)
- (21) **BURNEY SEED & NURSERY
CO.**
1016 Page St.
Brandon, SD 57079
(Dipel, Thuricide, Grasshopper
Spore, DE-pyrethrin blend,
dormant oil, netting, traps,
Tanglefoot. Also see "Beneficial
Organisms" listing.)
- (22) **ARMONY FARM SERVICE &
SUPPLY**
1000 Sonoma Ave.
San Francisco, CA 95444
(Dipel, Thuricide, Grasshopper
Spore, 1% rotenone powder, DE,
insecticidal soap, dormant and
active pheromone traps,
Tree Tanglefoot, IPM
monitoring tools, plus a good
selection of beneficial insects)
- (23) **HERBST BROTHERS
SEEDSMEN, INC.**
1000 N. Main St.
Brewster, NY 10509
(Dipel, Milky Spore, Grasshopper
Spore, B.t., 1% rotenone dust,
pyrethrum-rotenone concentrate,
dormant oil, yellow sticky strips,
netting, Tanglefoot)
- (24) **MELLINGER'S**
2310 W. South Range Rd.
North Lima, OH 44452
(Dipel, Thuricide, Mormon
Cricket Spore, Grasshopper
Spore, Milky Spore, 1%
rotenone, pyrethrum-rotenone
blend, dormant oil, insecticidal
soap, mesh, netting, traps,
Tanglefoot, Sticky Stakes,
repellent plants. Also see
"Beneficial Organisms" listing.)
- (25) **THE NECESSARY TRADING
COMPANY**
New Castle, VA 24127
(Dipel, Grasshopper Spore,
Mormon Cricket Spore, Milky
Spore, DE, ryania when avail.,
DE-pyrethrin blend, rotenone,
rotenone-pyrethrum blend, 1%
liquid pyrethrin concentrate,
dormant oil, insecticidal soap,
Tanglefoot, traps, pheromone
monitoring traps, Pent-A-Vate for
nematodes, herbs and herbal
oils, plus a good selection of
beneficial insects.)
- (26) **NICHOLS GARDEN NURSERY**
1190 North Pacific Hwy.
Albany, OR 97321
(Thuricide, rotenone, netting)
- (27) **OFF-LAND**
Rt. 3, Box 345 AC
Lafayette, LA 70501
(("Earth Guard" diatomaceous
earth)
- (28) **ORGANIC CONTROL, INC.**
5132 Venice Blvd.
Los Angeles, CA 90019
(B.t.; Anti-Roach boric acid;
Botanic, a pyrethrum-rotenone-
ryanian blend, available when they
can get it.)
- (29) **ORGANIC DISTRIBUTORS**
P.O. Box 1367
Conroe, TX 77305
(Roach Free boric acid)
- (30) **GEORGE PARK SEED CO.,
INC.**
Hwy. 254 N.
Greenwood, SC 29647
Grasshopper Spore, insecticidal
soap, netting)
- (31) **PENT-A-VATE**
966 W. Palm St.
Lindsay, CA 93247
(Fish emulsion and yucca extract
for nematodes)
- (32) **J. L. PRICE PRODUCTS, INC.**
P.O. Box 9
South Milwaukee, WI 53172
(Big Stinky and Wee Stinky fly
traps)
- (33) **W. A. RAPP & SON
MANUFACTURING CO., INC.**
2031 S. Eastwood St.
Santa Ana, CA 92705
(Slug and bug trap)
- (34) **REUTER LABORATORIES**
2405 James Madison Hwy.
Haymarket, VA 22069
(Manufacturer of Milky Spore,
Grasshopper Spore, Mormon
Cricket Spore, Japanese beetle
trap. Can buy directly from them
or through their distributors.)
- (35) **OTTO RICHTER & SONS, LTD.**
Goodwood, Ontario
Canada L0C 1A0
(FOR CANADA ONLY: Thuricide,
pyrethrin-rotenone blend,
rotenone dust and spray,
pyrethrin-DE blend, dormant oil
spray, insecticidal soap, Tree
Tanglefoot, repellent plants, plus
some beneficial insects)
- (36) **SANDOZ, INC.**
480 Camino del Rio South
San Diego, CA 92108
(Manufacturer of Thuricide B.t.,
Teknar B.t.i., Ekar NPV. Contact
for a list of distributors.)
- (37) **SOL-LIF OF MICHIGAN, INC.**
213 Railroad St.
Wayland, MI 49348
(Diatomaceous earth)
- (38) **SAFER AGRO-CHEM, INC.**
13910 Lyons Valley Rd.
Jamul, CA 92035
(Manufacturer of Safer Agro-
Chem's Insecticidal soap. Can
buy directly from them or through
their distributors.)
- (39) **THE TANGLEFOOT COMPANY**
314 Straight Ave., SW
Grand Rapids, MI 49504
(Contact for a list of distributors
for Tree Tanglefoot, Tanglefoot for
Insects, Bird Tanglefoot, Rat &
Mouse Tanglefoot.)
- (40) **WALNUT ACRES**
Penns Creek, PA 17862
(Dipel, pyrethrum spray,
rotenone dust, DE)

RESOURCES FOR ORGANIC PEST CONTROL

INTRODUCTION

Organic pest control is multifaceted. The organic gardener attempts to understand and augment the natural forces that work to keep potential pests in check and avoids trying to eliminate insects by resorting to pesticides—both natural and chemical. Not only are pesticides dangerous to people, but in the long run they don't work. In extreme cases it may be necessary to save a crop by using a plant-derived poisonous spray, but only as a last resort. The primary tools of the organic gardener are knowledge of life cycles, handpicking, companion planting, insect diseases, traps and predators.

At one time it was difficult to find sources for organic pest-control materials. That is not so today. Garden centers across the country carry many more organic materials than they used to, and a quick check of the Yellow Pages will often give you a source in your area. If that doesn't work, one of these mail-order firms may be able to help you. While this listing is by no means complete, it is fairly extensive. There are three sections:

- I. In the MANUFACTURERS AND SUPPLIERS KEY LIST, you'll find sources for diatomaceous earth, traps and lures, B.t.i., insecticidal soap, and the like.
- II. For insect predators and parasites, we have reprinted by permission *1982 SUPPLIERS OF BENEFICIAL ORGANISMS IN NORTH AMERICA* by Larry G. Bezark and Eric J. Rey of Biological Control Services Program, 3288 Meadowview Rd., Sacramento, CA 95832. This excellent pamphlet is also available from the California Department of Food and Agriculture at the above address.
- III. In PEST CONTROL MATERIALS YOU CAN GROW YOURSELF OR MAKE AT HOME, we describe how to make bug juice, tell where to find seeds for pyrethrum, and supply other frequently requested information.

SECTION I

MANUFACTURERS AND SUPPLIERS KEY LIST

- | | | |
|---|--|--|
| <p>(1) ABBOTT LABORATORIES
Dept. 95-M
1400 Sheridan Rd.
N. Chicago, IL 60064
(Manufacturers of B.t.i.—trade name Vectobak—a strain of <i>Bacillus thuringiensis</i> specifically for mosquitoes.) Contact for local distributors.)</p> <p>(2) AEROXON PRODUCTS, INC.
P.O. Box 249
10 Cottage Place
New Rochelle, NY 10802
(Aerixon Giant Fly Catcher, pheromone sex lures)</p> <p>(3) ALBANY INTERNATIONAL
Controlled Release Division
100 Albany
Framingham Heights, MA 02194
(Different pheromone sex lures, different types of traps)</p> <p>(4) ALUMINUM PLASTICS OF
ALABAMA, INC.
10000 Highway 1
Prichard, AL 36067
(Reflective mulch, bird control)</p> | <p>(5) AMORI, INC.
904 W. 23rd St.
Yankton, SD 57078
(DE, Pyrethrin-DE blend)</p> <p>(6) ANIMAL REPELLENTS, INC.
Lawn & Garden Division
P.O. Box 999
Griffin, GA 30224
(Antibird mesh)</p> <p>(7) J. T. BAKER CHEMICAL CO.
Horticultural Products
Phillipsburg, NJ 08865
(Contact for list of distributors for their Japanese beetle traps, barrier tapes.)</p> <p>(8) BIOCHEM PRODUCTS
P.O. Box 264
Montchanin, DE 19710
(Manufacturer of B.t.i.—trade name Bactimos—a strain of <i>Bacillus thuringiensis</i> for mosquito and blackfly larvae. Contact for local distributors.)</p> <p>(9) BURGESS SEED & PLANT CO.
905 Four Seasons Rd.
Bloomington, IL 61701
(Dipel, traps, netting, dormant oil, 20% sabadilla dust in limited supply when available.) 55</p> | <p>(10) W. ATLEE BURPEE
300 Park Ave.
Warminster, PA 18974
(Dipel, 1% rotenone, traps, netting, Tanglefoot)</p> <p>(11) COPPER BRIE, INC.
5147 W. Jefferson Blvd.
Los Angeles, CA 90016
(Roach Prufe boric acid, available in True Value and ACE Hardware stores, or contact for distributors.)</p> <p>(12) WILLIAM DAM SEEDS, LTD.
P.O. Box 8400, Dundas
Ontario, Canada L9H 6M1
(FOR CANADA ONLY: Thuricide, rotenone, DE, DE + pyrethrin or rotenone, insecticidal soap, Tree Tanglefoot, netting, mesh)</p> <p>(13) DOWN TO EARTH ENVIRONMENTAL PRODUCTS
141 E. 26th St.
Holland, MI 49423
(Diatomaceous earth)</p> <p>(14) DYNA-PREP, INC.
2215 Broadway
Yankton, SD 57078
(Fossil Flour diatomaceous earth)</p> |
|---|--|--|

Agents

- BT = Caterpillar disease—*Bacillus thuringiensis*—(Biotrol, Dipel, Thuricide)
 CC = Crown Gall preventive—*Agrobacterium radiobacter*—(Galltrol)
 DM = Predatory mites—*Phytoseiulus persimilis*, *Metaseiulus occidentalis*, *Amblyseius californicus*, *A. hibisci*
 FN = Parasitic nematodes
 GD = Grasshopper disease—*Nosema locustae*—(Grasshopper spore, Hopper stopper)
 GL = Green Lacewing—*Chrysopa carnea*
 HD = Decollate Snail—*Ruminia decollata*
 LB = Ladybugs (lady beetle)—*Hippodamia convergens*
 MH = Black scale parasite—*Metaphycus helvolus*
 MP = Mealybug destroyer—*Cryptolaemus montrouzieri*
 MR = Fly parasite—*Muscidifurax zaptator*
 NC = Navel orangeworm parasite—*Goniozus legneri*
 NV = Fly parasite—*Nasonia vitripennis*
 PM = Chinese praying mantis—Egg cases—*Tenodera aridifolia sinensis*
 PV = Fly parasite—*Pachycrepoideus vindemiae*
 RS = Red scale parasite—*Aphytis melinus*
 SE = Fly parasite—*Spalangia endius*
 SP = Fly parasite—*Sphegigaster* sp.
 TP = Tomato pinworm parasite—*Apanteles scutellaris*
 TW = Parasitic wasp—*Trichogramma* spp.
 TZ = Fly parasite—*Tachinaephagus zealandicus*
 WP = Whitefly parasite—*Encarsia formosa*

Below: Lady beetle devouring aphid: actual size 7mm.



by Gary W. Hickman, Farm Advisor, Cooperative Extension, San Joaquin County.

Illustration by Jack Kelly Clark.

No names of products have been used. No endorsement of named products or brands is intended or implied of similar products which are not mentioned.

Cooperative Extension in compliance with the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and the Rehabilitation Act of 1973 does not discriminate on the basis of race, sex, or physical handicap in any of its programs or activities. For more information, contact the Affirmative Action Officer, Cooperative Extension, 2120 University of California, Berkeley, California 94720, (415) 644-4270.

Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, James H. Sargent, Director, Cooperative Extension, University of California.

REVISED MAY 1983

Agents

CC-	Ag Bio Chem, Inc. 3 Fleetwood Court Orinda, CA 94563 (415) 254-0789
HD, MP, RS	Associates Insectary P.O. Box 969 Santa Paula, CA 93060 (805) 933-1301
MR, SE, SP	Beneficial Biosystems 1603-F 63rd Street Emeryville, CA 94608 (415) 655-3928
GL, SE, TW	Beneficial Insects, Ltd. P.O. Box 154 Banta, CA 95304 (209) 835-6158
MR, NV, SE	Beneficial Insectary 245 Oak Run Road Oak Run, CA 96069 (916) 472-3715
DM	Biotactics 7765 Lakeside Drive Riverside, CA 92509 (714) 685-7681 (call after 6 p.m.)
FN	BR Supply Company P.O. Box 845 Exeter, CA 93221 (209) 732-2738
HD, LB, MH, MP, NV, RS, SE, TW	Foothill Agricultural Research, Inc. 510 W. Chase Drive Corona, CA 91720 (714) 371-0120
BT, GD, DM, GL, HD, LB, MH, MP, MR, SE, RS, TW, WP	Integrated Pest Management 305 Agostino Road San Gabriel, CA 91776 (213) 287-1101
DM, GL, LB, MH, MP, NV, PM, PV, RS, SE, TW, WP	Natural Pest Control 9397 Premier Way Sacramento, CA 95826 (916) 362-2660
FN	The Nematode Farm, Inc. 2617 San Pablo Avenue Berkeley, CA 94702
HD (for release in 8 southern California counties only)	Pacific Agricultural Laboratories, Inc. 3205 Production Avenue Oceanside, CA 92054 (619) 439-6921
BT, CC, DM, FN, GD, GL, HD, LB, MH, MP, MR, PM, PV, RS, SE, TW, WP	Peaceful Valley Farm Supply 11173 Peaceful Valley Road Nevada City, CA 95959 (916) 265-3339
DM, HD, GL, LB, MH, MP, MR, NC, PV, RS, SE, TW, TZ, WP	Rincon Viteva Insectaries, Inc. P.O. Box 95 Oak View, CA 93022 (805) 643-5407
MR, SE, SP, TW, TZ	Spalding Laboratories 760 Printz Road Arroyo Grande, CA 93420 (805) 489-5946
WP	White Fly Control Company P.O. Box 986 Milpitas, CA 95035 (408) 295-1444 (Ext. 520)
BT, GD, LB, PM	Many nurseries and discount stores.

BIBLIOGRAPHY

US Dept. of Agriculture Publications

- Pruning Shade Trees & Repairing Their Injuries (Home & Garden Bulletin #83)
- Report and Recommendations on Organic Farming 1980
- Bridge Grafting & Inarching Damaged Fruit Trees (Leaflet #508)
- Insects on Deciduous Fruit & Nut Trees in the Home Orchard (Bulletin #910)

U.S. Dept. of Interior

- Soils & the Art of Collecting a Soil Sample (Dennis Fenn)

California Department of Agriculture I.P.M. Information Sheets

- | | |
|-----------------|---|
| - Coddling Moth | - Application Equipment for Home Pest Control |
| - Mites | - Fireblight |
| - Aphids | - Biological Control Services Program |

US Ecological Service

- Tree Repair (Bulletin #3)

National Park Service

- Spraying & Other Controls for Diseases and Insects That Attack Trees & Shrubs
- Orchard Management Plan and Integrated Pest Management Plan for John Muir NHS (John Donahue)

University of California Publications Bulletins

- How to Control Insects and Disease in your Home and Orchard

OSA (One Sheet Answer) Publications U.C.

- Planting Landscape Trees
- Plant Your Orchard Tight
- Providing Drainage for Ornamental Trees in Layered Soils

PRIVATE SOURCES

- Sunset Western Garden Book
(Lane Magazine and Book Co.)
- Guide to Organic Gardening
(ED. Sunset Magazine, Lane Publishing)
- Weather Patterns and Apple Yields
(Great Lakes Fruitgrowers News 4/84 - Dr. Alan)
- Organic Plant Protection
(Rodale Press 1966 - Editor- R.B. Yepsen)
- Color Handbook of Garden Insects
(Rodale Press - Anna Carr - 1979)
- Organic Orcharding
(Rodale Press 1981 - Gene Logsdon)
- Guide to Vegetables and Fruits
(Rodale Press 1982 - Editors of Rodale Press)
- Tree Maintenance
(P.P. Pirone)
- Insects That feed on Trees and Shrubs
(Cornell University Press, Warren T. Johnson, Howard H. Lyon)
- Disease and Pests of Ornamental Plants 5th Edition
(Pascal P. Pirone)
- Insects of Farm, Garden and Orchard
(Davidson, and Lyon)

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