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U. S. DEPARTMENT OF AGRICULTURE

# FOREST TREE PLANTING .....

*here's how in the  
Redwood-Douglas-fir  
Region of California*



MISCELLANEOUS PAPER No. 20

MAY 1957

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION  
GEORGE M. JEMISON, DIRECTOR

U. S. DEPARTMENT OF AGRICULTURE — FOREST SERVICE



## PREFACE

This pamphlet was prepared to fill a request from foresters in northwestern California. It is not offered as original work. To the contrary, it was written from the outline of "Here's how--a guide to tree planting in the California pine region," by C. W. Corson and H. A. Fowells, and, although parts have been rewritten, some passages of "Here's how" have been reproduced verbatim. Audrey E. Kursinski illustrated both "Here's how" and this adaption for the Redwood--Douglas-fir Region of California.

Sincere thanks are proffered to reviewers Eugene A. Hofsted, Forester, County of Humboldt; Alfred H. Merrill, Forester, Hammond-California Redwood Company; Edwin W. Pierson, Assistant Professor of Forestry-Lumbering, Humboldt State College; George J. Rau, formerly Forest Technician, Jackson State Forest, California Division of Forestry; Stanley R. Stevenson and John J. Van Akkeren, U. S. Forest Service; and Lloyd P. Tevis, Jr., formerly Specialist, Experiment Station, Department of Zoology, University of California, Davis.

D. F. Roy, Forester,  
Forest Management Research Division,  
California Forest and Range  
Experiment Station

The Experiment Station is maintained at Berkeley, California in cooperation with the University of California.

griculture--Forest Service, Berkeley, California



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## INTRODUCTION

Thousands of acres of burned or cut-over redwood and Douglas-fir timber land in California need to be reforested. Although some of this area will restock naturally, we cannot always depend upon natural seed-fall to do the job. Sometimes enough seed trees do not survive fire or logging. Even when adequate seed trees are left, weather conditions, insects, or seed-eating rodents may prevent effective restocking.

Natural regeneration, of course, is preferred, but land managers cannot afford to wait many years before starting another tree crop. Furthermore, they sometimes find that the natural seedlings are not the tree species they want to grow, and sometimes brush soon covers the ground so completely that too few trees survive. In these cases they must turn to artificial regeneration, planting either seeds or trees.

You probably have heard that seeding or planting forest trees is a difficult job in California. It is, but it is not impossible. Both practical experience and research have shown that seeding or planting can succeed--if done

in the right place

at the right time

with the right stock

in the right way

In this booklet these points will be summarized to help you plan and do a better job of getting the new forest started.

## THE RIGHT PLACE

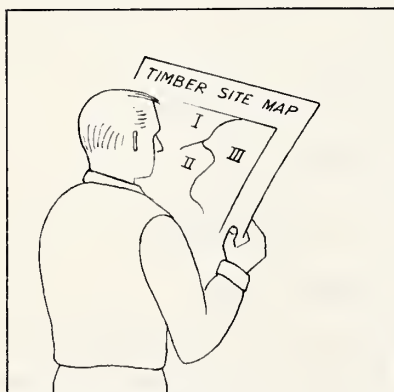
Obviously, you will want to plant trees where the money and time you invest will earn the most-- where timber-producing capacity is high. This is the land foresters rate "site quality I through III," by a scale in which site I is the best and site V is the poorest forest land.

The better sites usually have soil more than 3 feet deep. Also they are not covered with brush, grass, or weeds. Have you ever noticed how trees planted within a year or two after logging grow better than those planted later when brush runs wild? Here is the reason:

Rainfall is seasonal in California. The young trees must get their water from moisture already in the soil when summer begins. Often brush or grass quickly draws out the moisture and the trees die. Even though weedy plants are far apart, their roots often reach through all the soil. Another thing: the leaves falling from brush sometimes smother young trees.

The right place to plant, then, is on the better sites with little or no competing vegetation.

Maps showing soil and vegetation are a big help in choosing where to plant. These have been made for much of northwestern California, and survey crews are mapping still other areas. The maps tell you the kind, density, and sprouting characteristics of brush on your land and the soil series.



<b>GOOD SOILS</b>	<b>POOR SOILS</b>
<ol style="list-style-type: none"> <li>1. Hugo</li> <li>2. Josephine</li> <li>3. Melbourne</li> <li>4. Mendocino</li> <li>5. Empire</li> <li>6. Sites</li> <li>7. Larabee</li> </ol>	<ol style="list-style-type: none"> <li>1. Tyson</li> <li>2. Dubakella (serpentinaceous)</li> <li>3. Hoover (shallow)</li> <li>4. Hugo (shallow)</li> <li>5. Any soil less than 3 feet deep</li> </ol>

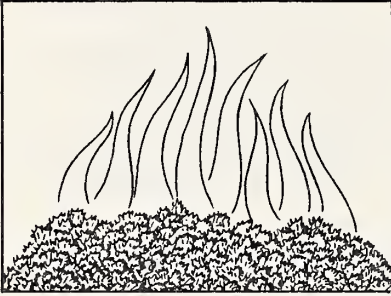
We know that the characteristics which group soils into series affect the timber-growing capacity of an area. The most important factor is the depth of the soil to bedrock, hardpan, or claypan. Other characteristics are the material from which the soil was formed, the texture of the surface soil and subsoils, soil acidity or alkalinity, drainage, and general topography. So the soil map is a rough guide to site quality and will help set priorities for areas to be planted.

If you cannot get maps and no help is available from farm advisors or local foresters, dig a hole and check the soil depth. If the soil is more than 3 feet deep, it's a good bet that the area is a favorable timber site and planting trees will be worthwhile.

To get Soil-Vegetation maps write to:  
 Regional Forester, U. S. Forest Service  
 630 Sansome Street  
 San Francisco, California

## How to Improve the Site

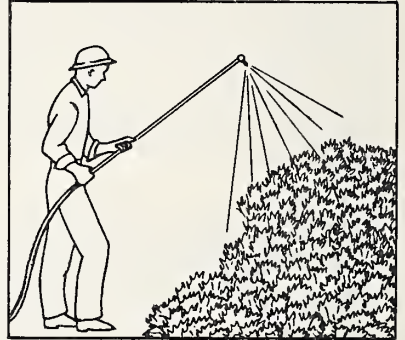
What if you can't pick and choose where to plant? Then your best chance is to improve the site so trees will have the greatest possible opportunity to grow. The most helpful improvement is to clear the ground of competing vegetation. You can do this three ways.



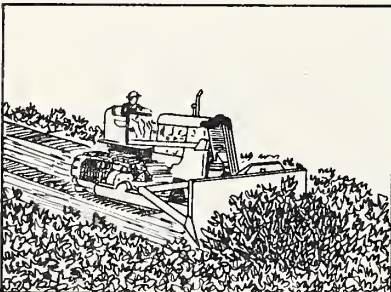
Burning is one way to clear the ground provided the danger of erosion is not excessive. Fire will be most effective if the brush first is smashed by tractor. Each time you want to burn brush the conditions will be different. Therefore, seek advice from California Division of Forestry fire-

control technicians for any control-burn project. And you must obtain a burning permit.

Spraying also can kill unwanted vegetation. Chemicals can be applied from aircraft, from truck-mounted tanks, or from back pumps. Chemists have developed several new sprays and techniques in the last few years. Consult your County Farm Advisor or County Agricultural Commis-



sioner if you want the latest information or help in killing competing vegetation with chemicals.



Bulldozing is another way to get rid of brush. The blade should dig deep enough to remove the root-crowns, but should avoid moving much soil. A rake-type attachment is ideal because it allows the soil to sift through.

Your costs for brush clearing will vary with size of brush, topography, and area treated. Generally, you can smash and burn light and medium size brush for \$6 to \$8 an acre, but getting rid of heavy brush may cost from \$20 to \$50. Costs for chemical control should range between \$5 and \$10. One way to save money, if you do it right, is to clear only part of the area.

### Clear in strips

A good method is to clear strips 10 to 12 feet wide. If erosion is a hazard the strips should follow the contour. Space them 20 feet apart on centers. Later, plant trees 6 feet apart down the centers of the strips. At this spacing you will need about 350 trees per acre. One possible disadvantage of strips is the convenient walkways they provide for deer.

If you windrow the brush it will create a fire hazard for several years. Therefore, burn it. You can eliminate the expense of burning, though, by pushing the brush into piles. If you space the piles far enough apart they will not increase fire hazard significantly. Avoid creating continuous strips of slash which can carry fire, or spacing piles so closely that one burning pile would ignite its neighbor.

### Clear in blocks

Instead of strips you can clear blocks at least 60 to 70 feet square. Plant the trees at 8 x 8 feet spacing, but avoid competition by planting no closer than 5 feet to the uncleared brush. The space between planted stock and brush also will reduce damage by hares. These sometimes serious pests seldom move far from the protective brush cover.

Another way to save money is by avoiding areas where animals may damage planted trees. If you find evidence that harmful rodents or deer are concentrated on an area choose some other place to plant. Of course, you don't want to waste money planting trees where livestock congregate.



Timing is as important to tree planting as to winning Olympic games. Both fall and spring planting have been tested in California. Results have been equally good in the two seasons when freshly lifted stock was used, planting was carefully done, and soil moisture and the weather were favorable.

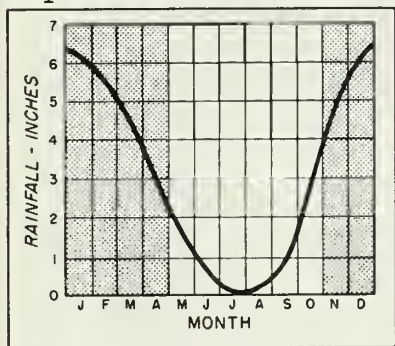
Close to the coast, where precipitation falls as rain and planting areas remain accessible, fall or winter planting is preferred. Frost damage to plantations should be rare, and seedlings will be ready when the next growing season begins. The young trees will have maximum opportunity to develop root systems adequate to carry them through the summer period of little or no rainfall.

JANUARY	FEBRUARY	MARCH	APRIL
✓	✓	✓	✓
MAY	JUNE	JULY	AUGUST
SEPT.	OCTOBER	NOVEMBER	DECEMBER
		✓	✓

When you plant in the fall, however, make sure that the soil is thoroughly wet at least a foot deep. Don't rely on the first fall rain, though. It seldom wets the soil evenly, particularly on recently logged or burned areas, so you should check the soil moisture before starting to plant. The only way to be sure is to dig several holes to see whether the soil is really wet down to a depth of one foot.

Farther inland favorable conditions for planting are less likely to prevail in the fall. Planting areas are generally at higher elevations, they are less accessible during the fall, and a larger proportion of the precipitation is snow. Therefore, planting in the spring is more likely to succeed. But trees should be planted as early as possible to avoid weather which is too warm and too dry for planting. Try to plant trees immediately after the snow melts.

If you plan to sow seed instead of planting trees, fall or winter are best. This way the seed will germinate as early in the spring as possible and new seedlings will have a chance to obtain maximum development before the summer dry period begins. Waiting until after fall rains is not necessary. However, late fall or winter sowing is best because late seeding shortens the period during which seeds are exposed to rodents. Winter seeding should be considered where snowfall is not a problem.



between 36° F. and 41° F. Keep the seed moist but be sure excess water will drain out the bottom of the container.

If sowing in the spring is necessary the seed should be stratified for prompt germination. You can stratify seeds by mixing them with moist peat or sand and storing them for 30 to 60 days at temperatures

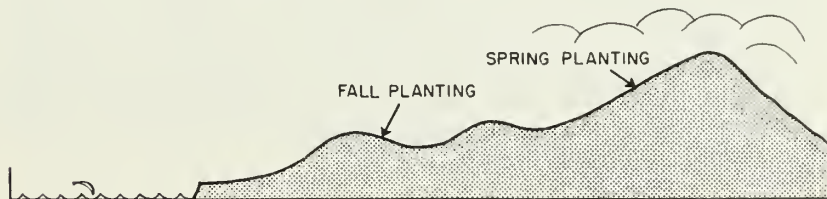
To Sum Up

Near the coast plant anytime after fall rains have thoroughly wetted the soil.

Farther inland plant in the early spring, as early as possible.

Plant south and west slopes first because they will dry out first.

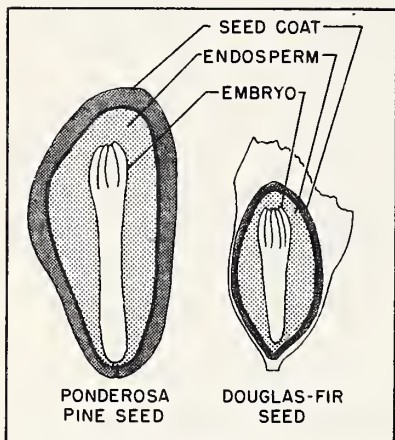
Time seeding so the seed will be exposed to rodents for the shortest time but will germinate early in the spring.



Getting the right stock is one of the first things you will need to plan. You'll have to consider seed source, quality and age of stock, and tree species.

Seed source is important to make sure the trees in your plantation will be adapted to local conditions. If you want to sow seed, know which one of California's seed collection zones contains the planting site. Use only seed from that zone. And if you order trees from a nursery, buy those grown from seeds collected in the zone where you will plant the stock.

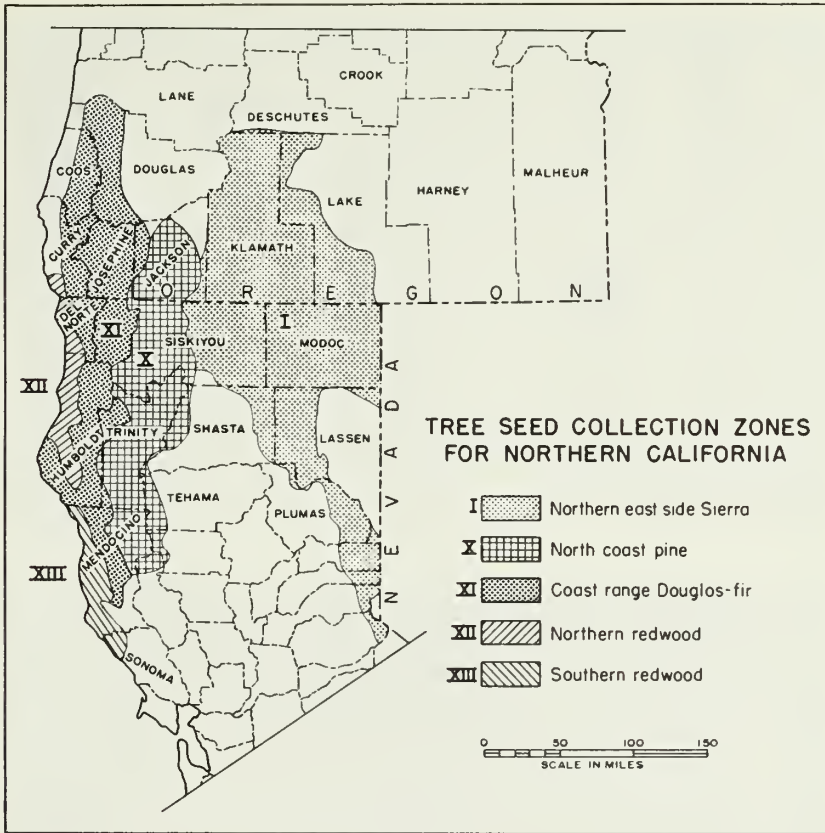
If you collect your own seeds, take some simple precautions. Gather cones from well formed and vigorous trees growing near the planting site or at the same elevation. Also, be sure the cones are not heavily infested with insects and the seeds are ripe.



Seeds mature at different times from year to year. They may be ripe as early as the middle of August. A ripe seed has a hard seed coat and the endosperm, or meat, will be firm and not milky. The embryo, which lies along the long axis of the seed, should be well developed--nearly as long as the endosperm. You must, of course, collect the cones before they open and drop their seeds.

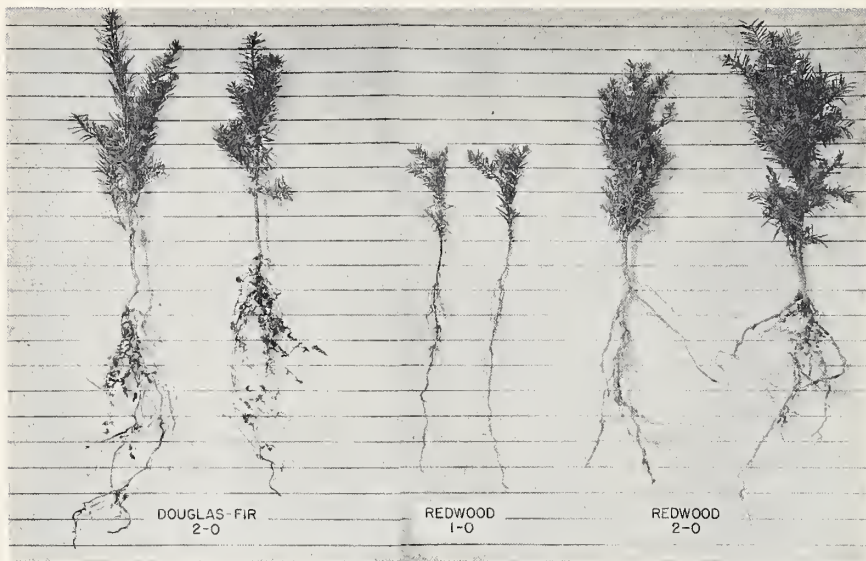
After you gather the cones keep them well ventilated to prevent molding and heating, which can destroy the seed viability. Spread the cones in a single layer as soon as possible in a warm, dry place. The cones will open and some seed will drop out in from 1 to 3 weeks. If the cones don't open they probably were gathered too soon or are insect-infested. Be sure to protect the seeds from rodents and birds during the drying and opening period.





When the seeds begin to fall out, shake the cones to free the rest of the seeds. Special tumblers sometimes are built, but you can extract the seed fairly well by raking or tapping the cones. After extracting the seeds, store them in air-tight cans at about 32° F.

Quality of planting stock is pretty much up to the nurseryman. He should grade the trees for quality at the nursery so only those with good top and root growth are shipped out. A minimum stem diameter of 0.11 inch has been set for grade 1 ponderosa pine and Jeffrey pine stock. Size grades have not yet been established for other species.



Good trees will have a proper balance between top and root growth. A top-heavy tree will lose more water through its leaves than the roots can absorb. The trees with the best chance of coming through are those with plenty of fibrous roots.

Age of stock usually is up to the nursery, too. Most of them produce trees which have grown 2 years in the seedbed and were not transplanted. Such trees are called 2-0 stock. Past experience shows that you will have more consistent success if you can obtain 1-1 transplants (trees grown 1 year in the seedbed and 1 year in a transplant bed). This age class of planting stock has generally survived well.

Species you'll usually want to plant for timber growing purposes are redwood and Douglas-fir. Near the coast Douglas-fir is better suited for the drier, more exposed ridges and southerly exposures. Farther inland ponderosa or Jeffrey pine may be best for the more severe sites. Several other desirable timber trees grow in northwestern California, but they require more exacting site conditions. Besides, planting stock of these species is not available now. When it does become attainable, stick with species native to the planting site.

You can start your plantation of forest trees in two different ways. One way is to sow seed directly in the field where you want the trees to grow. The other is to plant nursery-grown trees.

Whichever you do, starting the plantation the right way is most important. The first few months are critical because healthy, vigorous trees are the only ones that can hold their own against weeds and brush.

Yet there is no secret to successful plantations. The key is care with all details. Careful attention to even a seemingly petty detail may be the difference between success or failure. So give the trees the best send-off possible and then protect them from destructive pests and fire.



A 5-year old Douglas-fir plantation,  
Slate Creek, Trinity National Forest.

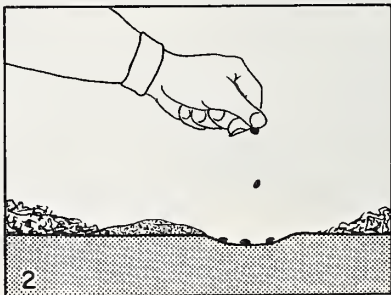
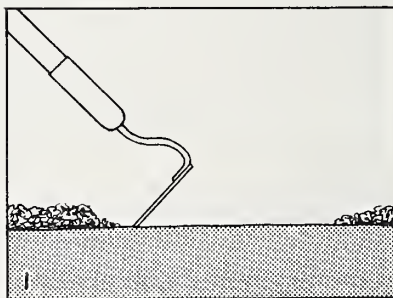


Sowing forest tree seeds the right way means that you take three essential steps. The first of these is to provide the proper seedbed. The second is to free tender seedlings from competition by brush and other vegetation. The third, and perhaps most important, is to protect the seed from rodents.

Seedbeds best suited for California conifers are composed of loose mineral soil. Seeds buried in this kind of place get enough moisture and oxygen for germination. Later, the loose soil allows the new roots to penetrate easily and the young seedlings can develop the vigorous root systems they need to survive the summer drought.

Competing vegetation withdraws moisture from the upper soil layer where young seedlings must get their water. Therefore, you must remove other vegetation to conserve moisture and prevent "surface drought" which kills more seedlings in California than any other agent.

Rodents, by stealing seeds, have caused most of the seeding failures in California. When rodents were controlled, the numbers of seedlings established from spot seeding have compared favorably with survival of transplanted stock. Covering the seed spots with screens is the most effective method now known to prevent rodent damage. You can make screens from quarter-inch-mesh hardware cloth, giving them a domed or conical shape so the small seedlings will have room to grow. The screens will cost about 17 cents apiece.



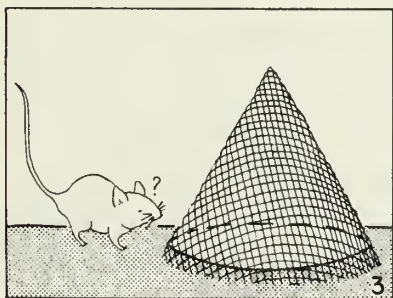
How much seed do you need? Since seeds are sold by weight, you'll need to know redwood averages 122,000 and Douglas-fir 32,000 seeds per pound. Plan for 680 spots per acre, that is, an average spacing of 8 x 8 feet. The number of seeds you'll need for each spot will depend upon their viability, which varies by seed lot and species. Average germination for Douglas-fir is about 75 percent; for redwood, less than 30 percent. If seed viability is 50 percent or better, plan to sow 5 per spot because some seedlings won't survive the first season. If viability is lower and you want to be certain at least 1 seed will germinate, plant this many per spot:

Seed viability	40%	30%	20%	10%
Number required	6	9	13	29

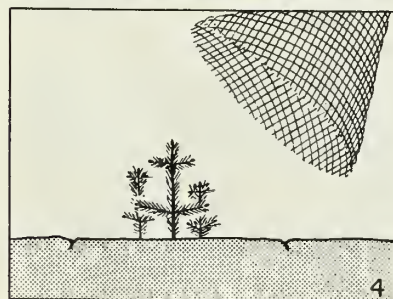
Do the job this way:

1. Choose a spot at least 4 or 5 feet away from any brush, even though this means you cannot stick to a regular 8 x 8 foot spacing.

2. Scrape away vegetation, litter and trash so you expose mineral soil in a foot-square area.



3. Put the seeds on the seedbed and cover them with soil. Plant them twice as deep as their width.

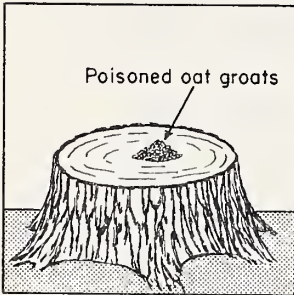


4. Center a screen over the spot. Twist it into the ground at least an inch deep so it won't be easily dislodged.

5. Remove the screens at the end of the first or second year so the seedlings will not be injured trying to grow through them--and so you can use them again.

Protecting seeds from rodents is so vital that many research workers are seeking something better than wire screens. One possibility is to use poison baits to kill rodents. Another is to find non-lethal substances that will repel them.

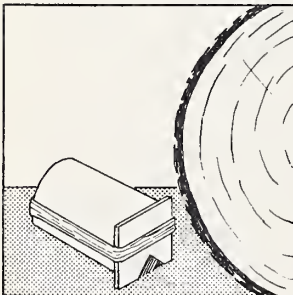
Poison baits have proved fairly effective. You can kill rodents with "1080" or thallium-treated oat groats a few weeks before seeding. Include a buffer strip one-fourth mile wide around the area. Distribute about one-half pound of bait for each acre. When the seeds start to germinate a second poisoning may be necessary to protect the young seedlings.



You can determine the need for retreatment by planting a few seed spots at several places on the seeded area. Examine them two days later. If the seed spots have been robbed, distribute more poison.

Repellents are being tested. Recent experiments indicate that Endrin, a relatively inexpensive chemical, may effectively protect coniferous seeds.

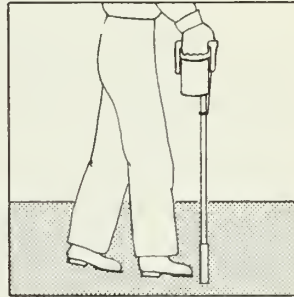
Zoologists have developed a tricky way to protect seed. Enough poisoned seeds to last all winter are placed in containers on the area a week before sowing. The containers, four to the acre, are designed to protect the bait from rain and snow. Some mice eat the treated conifer seed and die. Others are only sickened, and, thereafter, will not eat more seed, poisoned or not. Before long a population of mice which will not destroy seed spots develops.



Remember that under California law only duly authorized persons may distribute certain poison baits, so you had better check regulations with your County Agricultural Commissioner.

Sowing in spots is better than broadcast sowing when rodents are controlled by poisoning. By spot seeding you can make sure all the seeds are in mineral soil, free of competition from brush and other plants. The seed can be sown by hand. Or you can use one of the so-called walking stick planters designed to place and cover the seed by means of a spring mechanism, but check carefully to make sure it is planting the seed at the proper depth.

When using a planter, you should sow more seed spots than when planting by hand. You can calculate roughly the number of seed spots per acre from the number of seedlings you want, the seed viability, and your estimate of seedling survival. Suppose the planter you are going to use drops only 1 seed at a time and you want 680 seedlings per acre at the end of the first growing season. The seed viability tested 80 percent and you estimate that 80 percent of the seed spot seedlings will survive the first season. The number of seed spots to plant will be:



$$\frac{680}{.80 \times .80} = 1,062 \text{ per acre}$$

No matter how you sow, certain precautions should be followed in handling the seed. Store the seed in a dry cool place. Excessive heat and moisture reduce seed viability. Before you start to sow, stir the seed within the container. Stir frequently during the seeding operation to prevent segregation of good and bad seed. In this way you will be sure that at least one good seed is sown in each seed spot. If seed are not stirred, bad seed will "float" to the top of the container.



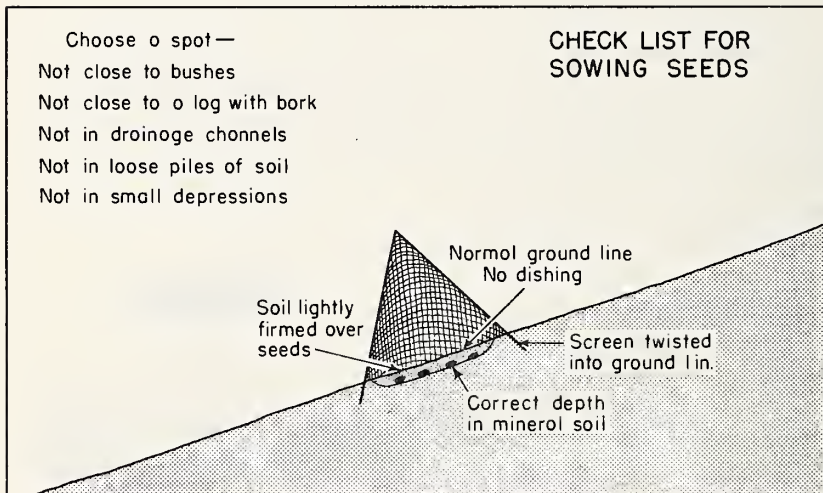


## DIRECT SEEDING

Choose a good spot for each sowing instead of trying to maintain uniform spacing. If possible, plant spots which will be shaded part of the day, but do not plant close to logs still holding bark. In a few years the bark will probably slough off and may smother the seedlings. Avoid windrows of soil thrown up during logging. These small ridges remain dry longer in the fall and dry out sooner in the spring than other spots. Also avoid small depressions and drainage channels. Excess water rots seed or washes them away.

When sowing seed on steep ground, maintain the original ground line. If seeds are placed in dished spots, moving soil particles will fill the depressions and cover the seed too deeply. Hardwood leaves also collect in depressions and will smother conifer seedlings. And when placing the seed don't firm the soil covering too tightly, especially in clayey soils. Otherwise, soil will be compacted so seedlings will be unable to emerge from the ground after germination.

All this may seem a lot of trouble just to get some seed in the ground, but the results will justify the work. Direct seeding can be successful when you make sure there is a mineral seedbed, rodent control that will last until seeds germinate, and no competing vegetation.







Planting nursery-grown trees has been more dependable, and over the years more successful than direct seeding. Care is the watchword here--care in handling, planting, and protecting the young trees. They are living plants, even though they are dormant when they are shipped and set in the ground. It's your job to keep them alive.

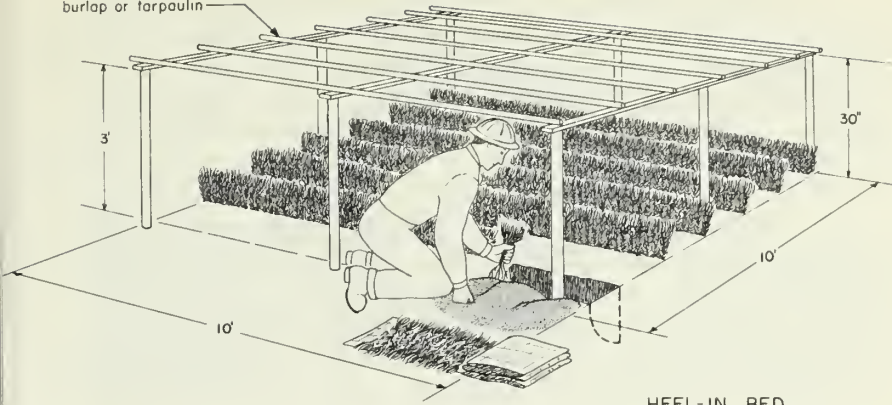
This job of planting trees is like a chain because it is made up of many parts. And, like the chain with a weak link, your planting job may fail because you were inattentive to a single detail which seemed unimportant. You must do each part of the job the right way to plant successfully.

Careful planting jobs in California have paid off in the past. Even on some of the drier sites of the Sierra we've had 95 percent of our transplants survive the first year. At the end of 9 years survival has been as high as 90 percent.

Start the planting job correctly at the very beginning, that is, in transporting the trees from the nursery to the man who will plant them. Here's the right way:

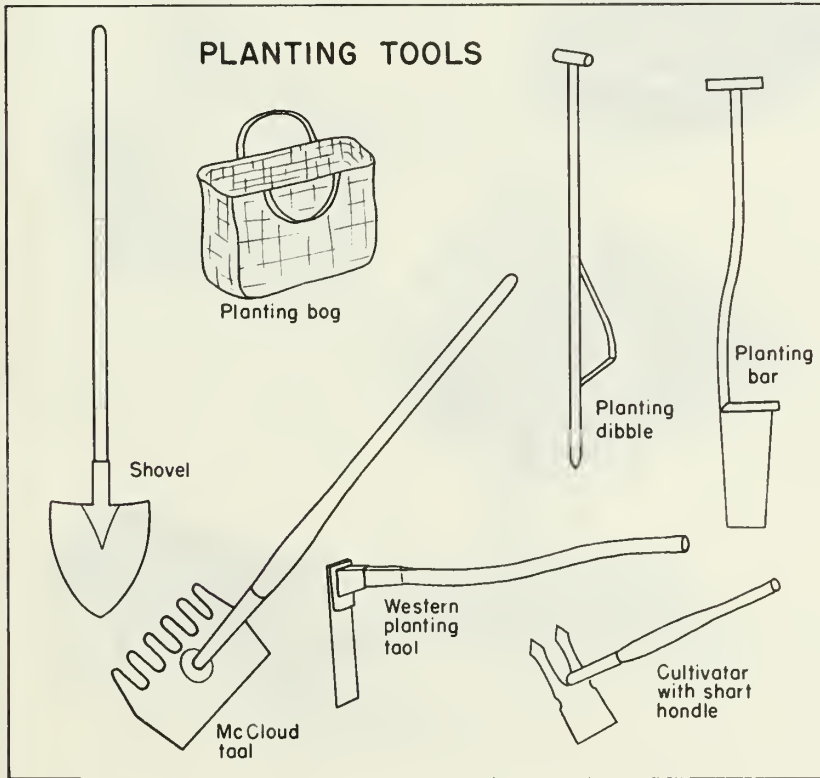
1. Keep the period in transit as short as possible. If more than 24 hours will be required, arrange for refrigerated transport. Shipments made by open truck should be covered with a canvas. Water the trees before starting the trip and water enroute if necessary.
2. Unload the trees immediately on arrival. If they can be planted within 2 weeks, take them out of their containers and heel them in at the planting site. Be sure the soil is moist and water the trees if necessary.
3. If the trees must be held longer than 2 weeks, put the crates or bales in cold storage, keeping the temperature in a narrow range from a little above 32° F. to 36° F. and the relative humidity 90 percent or higher. Be sure to stack the crates or bales to permit circulation of air. Sometimes handling of seedlings can be simplified on large planting jobs by ordering seedlings on a schedule so that seedlings arrive as they are needed for planting.
4. If the trees are kept in storage, take only enough to the planting area for a day's work. If they are heeled in at the site, remove them only as needed. The less the trees are handled, the better.
5. Distribute the trees to the planters in lots of 100. Pack them well in wet moss in the plant carrier (bag, tray, or pail). Be sure that the roots of the trees are protected with wet moss in the carrier at all times.

Cover with branches,  
burlap or tarpaulin



HEEL-IN BED

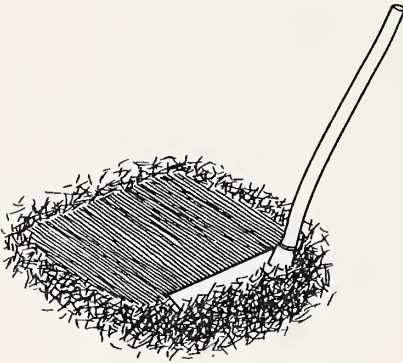
The right tool will do a lot to speed the planter's job. Here are some good ones to use. Some, such as the planting bar and dibble, are easier to use in some kinds of soil, but the western planting tool is the best all-purpose implement because you can use it in any type of soil.



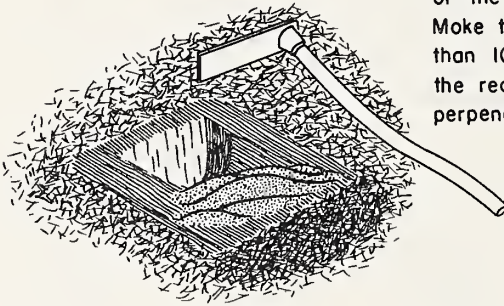
## PLANTING

In setting the trees in the ground, you must take care to do these three things: Dig the planting hole at least as deep as the roots are long, keep the roots moist, and pack moist soil firmly around the roots. Complete planting one tree before moving on to the next planting spot.

Of course there are several ways of planting trees by hand and by machine. In California you'll probably have to rely on hand planting. The right way to do it is outlined by the next few sketches. They show, step-by-step, the method of planting that is recommended for California.

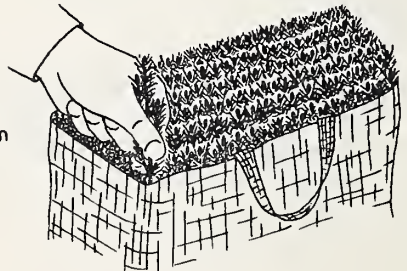


- ① **PREPARE SPOT**  
Clear away litter and dry soil from a spot 12- to 15-inches square.

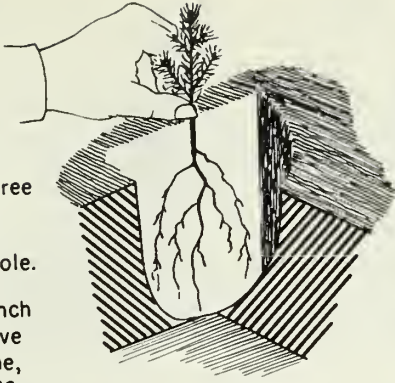


- ② **DIG HOLE**  
Dig a hole at the upper edge of the cleared space. Make the hole not less than 10-inches deep and the rear wall of the hole perpendicular.

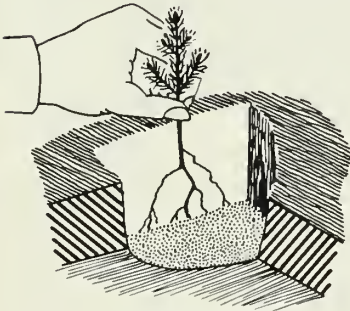
- ③ **Remove ONE tree from the planting bag.**



- ④ SET TREE  
Suspend the tree against the perpendicular wall of the hole. Hold the first needles one inch or more—above the ground line, and spread the roots out fanwise



- ⑤ FILL HOLE  
Holding the tree in position with one hand, fill half the hole with moist soil and tamp with the other hand.



Complete filling the hole with moist soil and tamp this firmly in place.



- ⑥ MULCH  
Push loose soil and litter around the base of the tree.



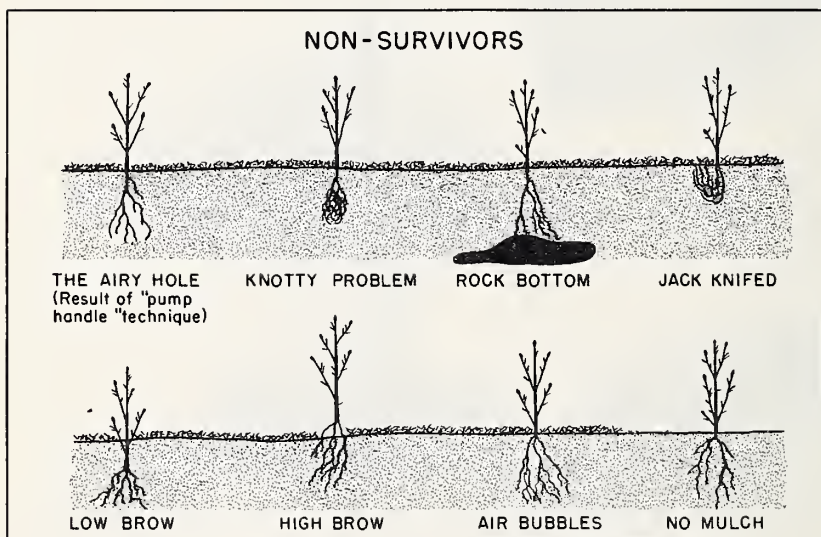
## PLANTING

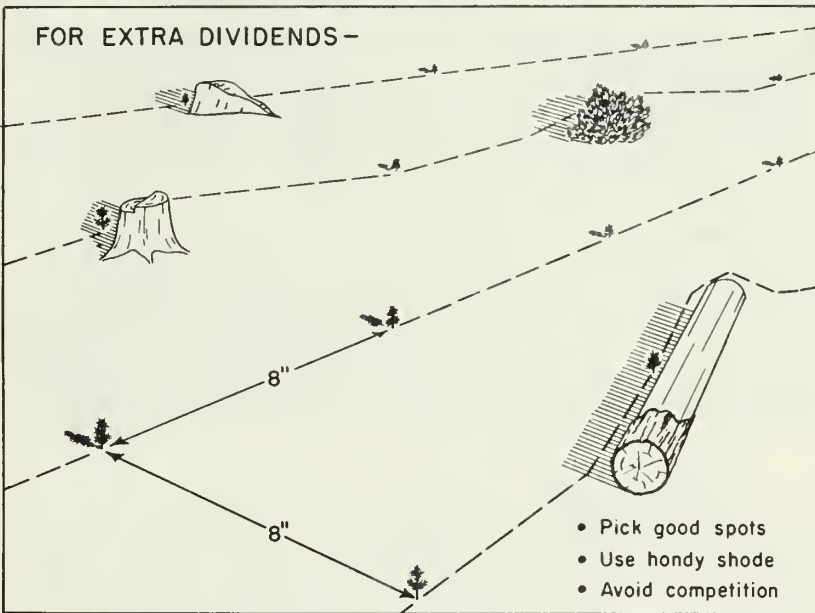
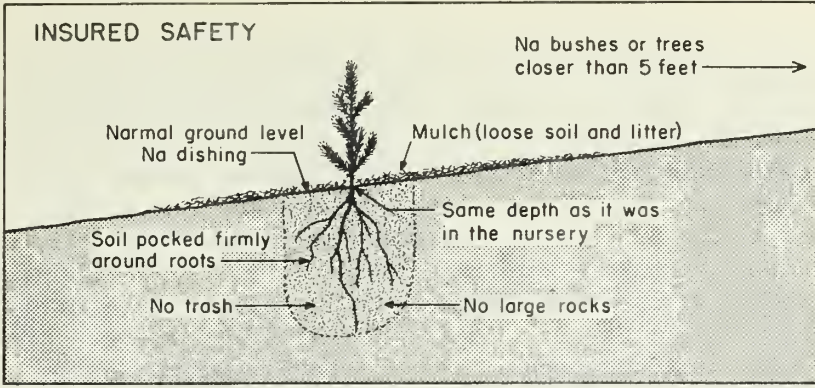
Trees are usually planted 8 feet apart in rows 8 feet apart (680 trees to an acre), but it is far more important to plant each tree in the best spot you can find than to stick to a geometrical pattern. Planting the tree in the right spot often means the difference between failure and success.

The more favorable spots are on the shady side of rocks, stumps, and logs, provided that the logs are not covered with bark which will later slough off in large sheets and smother the seedlings.

Avoid these unfavorable spots: mounds or ridges of loose earth, rocky places with little soil, depressions where water stands, accumulations of bark, chips, rotten wood, or other trash, severely burned soil, and any place within 5 feet of dense vegetation or a growing tree.

You can see by now that quality of workmanship should be stressed more than speed of planting. Careful, frequent inspection of the planters' work is necessary to make sure they are doing a good job. Here are some of the more common mistakes that you should avoid:





What will all this care cost? Each situation will be somewhat different from the next one, but the average costs per acre for planting in California in 1955 may serve as a guide. They were:

Site preparation	\$ 2.85
Stock	11.93
Planting	41.65
Total	<u>\$56.43</u>

This will give you a pretty good guide for estimating costs if you are planning a sizeable project.

Your job is not done when the last tree is planted. Much of the failure in past plantings has been the result of damage that could have been prevented if noticed in time. You ought to check the plantations occasionally to see whether damage is occurring. Fit these checks into scheduled trips that take you near the plantation if you can, but if necessary, make a special trip. If you find that the plantation is being damaged, take action immediately. Delay may be fatal. These are the chief sources of damage, and the protective measures you can take:

Grazing animals. Cattle, sheep, and deer often damage planted trees by browsing and trampling. For best results, cattle should be kept out of planted areas for at least three years, and sheep should be excluded until the terminal buds, or growing tips of the planted trees, are out of their reach. If you direct-seed and use screens, it's still best to keep cattle out because they kick over or trample the screens. Deer are more difficult; it is next to impossible to exclude them, and the use of repellents is not yet practicable. About the best you can do is avoid planting where you know that deer are numerous or likely to congregate.

Other animals. Wood rats were one of the most harmful agents that destroyed trees planted in Mendocino County during the decade 1922-1932. Greatest injury occurred when seedlings were planted on relatively old cut-overs. The contrasting light rodent damage to trees on recently logged land stressed the importance of planting within 2 or 3 years of logging. Rabbits and porcupines are major factors affecting the success of plantations elsewhere but are not known to be serious in northwestern California. And so far, bears have confined their depredations to pole-size timber.

Insects. The tender seedlings growing from seed spots are vulnerable to destruction by wireworms and cutworms during the first growing season.

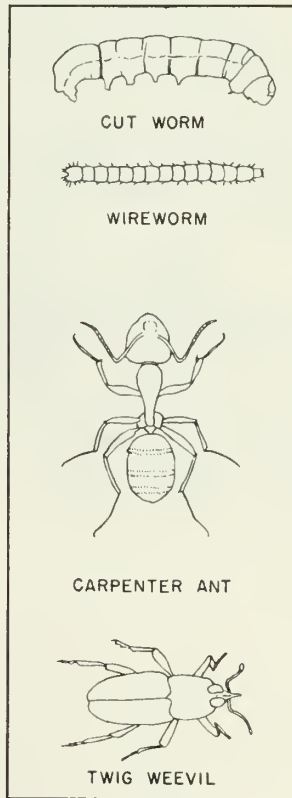


Wireworms, the larvae of click beetles, are long, slim, cylindrical, hard shelled "worms" with feebly developed legs. They prefer to live in heavy, moist soils where they feed on undecayed plant material and small roots, and often enter germinating seeds.

Cutworms also feed underground on roots of various plants, but, probably cause more damage above ground when they emerge at night to feed on foliage or cut the stems of seedlings. They pull the severed tops of young conifers into the soil to be devoured at leisure. Cutworms are thickset, dull-colored, and have few or no hairs on the body. They seem to prefer shaded slopes where soil texture is relatively light and can be found resting on the interface between the dry surface soil and the underlying moist soil.

These pests can be killed by dusting or spraying the soil surface with toxaphene or D.D.T. when you sow the seeds or when you discover insect damage in your plantation. Use a 10 percent dust at a rate of half a pound per 1,000 square feet, or a spray containing 6 ounces of 40 percent wettable powder in 2-1/2 gallons of water per 1,000 square feet. Dieldrin is a relatively new chemical which also merits trial.

After the first year, redwood trees are seldom killed by insects. Young Douglas-fir also are comparatively safe from insects. Some damage does occur, however, and may sometimes become severe. For example, the large carpenter ants have destroyed planted stock by gnawing the outer bark and cambium of



## PROTECTING THE PLANTATION

roots to provide feeding areas for their aphid herds. The Cooley spruce gall aphids, which work within small cottony tufts attached to the underside of Douglas-fir needles, puncture the leaves and cause spots to turn yellow. In severe cases, leaves turn brown prematurely and are shed, but seedling mortality has not been recorded.

Douglas-fir plantations may be vulnerable to the Douglas-fir twig weevil. It is closely related to the pine reproduction weevil which has wiped out several pine plantations in California. Twig weevil attacks on Douglas-fir generally are limited to scattered small branches on open-grown trees. Attacks sometimes deform trees and retard growth, and some trees less than 5 feet tall may be killed. Trees are seldom damaged after they reach 15 to 20 feet in height. Yellowing foliage is the most noticeable sign of weevil attacks. With a little whittling, you may find the tunnelled galleries of weevil larvae in twigs and stems of yellowed trees. Plantations infested with weevils can be saved by early application of the proper insecticide. If you suspect that weevils are attacking your trees, ask the California Forest and Range Experiment Station, P. O. Box 245, Berkeley 1, for instructions.

Fire is a constant threat. Young forests are particularly susceptible to damage by fire because the trees are thin-barked and have their foliage close to the ground. Therefore, adequate fire protection measures are essential for plantation success. As a minimum you should surround your plantation with a fire break, clear the area of snags, and maintain a small cache of fire fighting tools.

Finally, what is the measure of a good planting job? Have you succeeded if most of the trees live through the first year? Well, not quite. Your goal is to have not less than 300 vigorous undamaged trees per acre at the end of 5 years.

Count the trees periodically by running sample lines through the plantation to see if this goal is being met. Set up the lines right after planting. Orient them obliquely to the contours and planting lines so that planting-site differences (which generally vary most with elevational changes) and differences between planters (who generally plant at right angles to the contours) are adequately sampled. Drive stakes close to the trees within 3.3 feet of the lines to provide the basis for future survival counts. Redwood stakes 1 x 2 x 18 inches and painted red or orange are best because they will last and are easy to find again. Run enough lines to sample trees at the rate of 10 to 15 times the number of acres planted. For example, if you plant 15 acres stake 150 to 225 trees.

When a count shows that your goal is not being met and if brush has not taken over, replant the empty spaces with screened seed spots or nursery-grown trees.

Success is possible. Some excellent plantations attest to what can be done in the right place, at the right time, with the right stock, in the right way.

# WHERE TO GET INFORMATION

1. California Division of Forestry
  - a. 135 Ridgeway Avenue  
Santa Rosa, California  
Mail: P. O. Box 477  
Telephone: Santa Rosa 3910
  - b. 1000 Cypress Street  
Redding, California  
Mail: P. O. Box 959  
Telephone: Redding 1800
  
2. U. S. Forest Service  
California Forest and Range  
Experiment Station  
347 Walter Mulford Hall  
University of California  
Berkeley, California  
Mail: P. O. Box 245  
Berkeley 1, California  
Telephone: ASHberry 3-8310
  
3. Extension Forester  
25 Walter Mulford Hall  
University of California  
Berkeley, California  
Telephone: ASHberry 3-6000  
Ext. 8145
  - a. Humboldt County Farm Advisor  
Post Office Building  
P. O. Box 1009  
Eureka, California  
Hillside 3-0896
  - b. Lake County Farm Advisor  
Kelseyville, California  
CRestview 9-4761
  - c. Marin County Farm Advisor  
Post Office Building  
San Rafael, California  
Glenwood 3-2515
  - d. Mendocino County Farm Advisor  
North on Highway 101  
P. O. Box 356  
Ukiah, California  
HOMestead 2-4756
  - e. Napa County Farm Advisor  
1930 Clay Street  
Napa, California  
BALdwin 6-3794
  - f. Shasta County Farm Advisor  
County Office Building  
P. O. Box 560  
Redding, California  
Redding 2043
  - g. Siskiyou County Farm Advisor  
Courthouse  
Yreka, California  
Yreka 540
  - h. Sonoma County Farm Advisor  
912 Santa Rosa Avenue  
Santa Rosa, California  
Santa Rosa 4210 or 4211
  - i. Tehama County Farm Advisor  
Federal Building  
P. O. Box 391  
Red Bluff, California  
Red Bluff 224
  - j. Trinity County Farm Advisor  
Courthouse  
P. O. Box 397  
Weaverville, California  
MAin 3-2361
  
4. Humboldt County  
Department of Forestry  
802 Fifth Street  
Eureka, California  
Telephone: HILLside 3-0936

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