RODENT CONTROL ACTIVITIES WHEN DIRECT SEEDING FOREST LANDS IN NORTHERN CALIFORNIA

PETER C. PASSOF, Forest Advisor, Cooperative Extension, University of California, Ukiah, California

ABSTRACT: The author reviews the changing use of rodenticides for deer mouse control over the past decade. He summarizes the operational procedures associated with direct seeding of forest lands by helicopter and the related practices of forest rodent control as they exist in the north coastal region of California. A description of the various field studies on Peromyscus baits and seed repellents presented to indicate the extent of local research activity in this increasingly important area of forest regeneration.

INTRODUCTION

The north coastal region of California extends from the southern Mendocino County line northward to Oregon. It contains most of the commercial redwood and Douglas-fir forest land of California and is considered to be the most important wood-producing area in the State (Oswald, 1970). The three coastal counties of Mendocino, Humboldt, and Del Norte contributed to more than a third of California's 1972 log production (Dotta, 1973).

Ownership of this prime forest land is in the hands of the forest products industry as well as other private landowners both large and small. Almost 2.4 million acres, or 73 percent of the total commercial forest acreage, is held by private interests. As one might expect, management policies are quite diverse among the various types of owners. Methods of logging can also vary and may depend on such factors as timber species and age, slope, aspect, climate, and soil characteristics. Generally speaking the choice of harvesting system dictates the method of reforestation. Where the natural seed source is unreliable for regeneration, the forester must turn to artificial means to establish his future crop of trees. This then boils down to making the important decision as to whether to plant nursery-grown seedlings or to sow conifer seed directly on the bare and disturbed ground.

Over the past ten years the trend within the north coastal region has favored the procedure of direct seeding with the aid of a helicopter. A recent Forest Service report indicates that on all privately owned forest land in California, a total of 18,585 acres were direct seeded in 1972. In the same year only 3,000 acres were planted by the forest industry (USDA, 1972).

What are some of the factors that have favored seeding to planting? Direct out-of-pocket costs have been a prime consideration. Seeding with Douglas-fir will cost about one-third the expense associated with hand planting. A pound of Douglas-fir seed will cost about $16.00. Seeding rates will vary with circumstances but a three quarter (.75) pound per acre rate and allowing $3.00 for costs of seed protection and application, direct seeding will be about $15.00 per acre. Hand planting will cost approximately $.10/planted seedling and about 450 trees are planted per acre (10' x 10' spacing) for a total $45.00 per acre expense. A basic requirement is that at least 50 percent of the ground must be classified as bare mineral soil for optimum seeding conditions. Accessibility to the site is another reason favoring aerial seeding. Planting of nursery-grown seedlings is usually the selected method if seed supplies are scarce or the likelihood of direct seeding failure due to various environmental (both physical and biological) conditions is high.

What are some of the adverse environmental effects? Excessive summer heat and dry soil conditions favor planting. In 1970, interior California had 96 percent of its artificial regeneration handled by planting while for the same year, 94 percent of all the reforestation on the north coast was from direct seeding (Conkle, 1972).

RODENT CONTROL ACTIVITIES

While climate conditions are out of the control of the forester, he can take action against certain biological factors which diminishes the potential success of direct seeding. Seed-eating forest rodents are a major hazard to seeding efforts. The role of deer mice (Peromyscus spp.) to direct seeding has been well documented in the literature (Radwan, 1963).

As an aid to seed protection from deer mice, the normal procedure followed by forest industry has been to coat the tree seed with a protectant such as endrin and some type of coloring agent such as aluminum powder.

In the early years of direct seeding in California, the use of endrin as a seed protectant was the basic chemical approach to successfully limiting seed loss although both strychnine and sodium monofluoroacetate (1080) baits were registered for deer mouse control (Schubert and Adams, 1971). Beginning about 1964, plans were developed in the redwood region to start relogging operations. This meant the removal of the residual trees that had been left to grow and reseed the land. There was good evidence of increased deer mouse activity in these areas due in part to more favorable ground cover and available food supply.

Trapping studies conducted in Humboldt County in 1965 revealed high counts of deer mice in numbers which warranted direct control procedures prior to seeding. A product coded DRC-714 (trade name, Gophacide) was found to be very successful in early research attempts at deer mouse control with chemicals other than the more popular 1080 rodenticide (Hoffer, Passof, and Krohn, 1969). A more complete description of the use of 1080 in relation to deer mouse control has been reported by Cone (1968).

The early successes of controlling excessive populations of deer mice in Humboldt County prior to seeding Douglas-fir was viewed with interest in Mendocino County. In the winter of 1966-67, two projects using direct seeding were initiated. Hand placement of 0.11 percent 1080 bait was laboriously carried out on 160 acres and then followed by hand seeding. All of this initial effort was under the supervision of the Bureau of Sport Fisheries and Wildlife. By the next year, it soon became apparent that more efficient techniques would be necessary. An agreement was developed between the Agricultural Commissioners of Humboldt and Mendocino County in terms of bait preparation and supervision of field operations. A total of 615 acres were treated in the winter of 1967-68 and all of the 1080 baiting was done by helicopter, with some Douglas-fir seeding accomplished with Cyclone seeders.

It should be pointed out that the great majority of land seeded up to then had seed trees that were purposely left to fascilitate regeneration, but the foresters wanted an extra margin of safety to insure adequate regeneration following logging. The concept worked except there was the ever-present concern that an increasing usage of 1080 might create difficult public relations problems. Although there was little evidence that 1080 was adversely effecting any non-target species in its use in the forest, safer rodenticides were known.

In the spring of 1967, an initial field study was set up in Mendocino County to determine if an anticoagulant bait, diphacinone (trade name, Diphacin), applied by broadcast method would control deer mice. This work was carried out by researchers from the Department of Animal Physiology at University of California, Davis working with funds from the California Division of Forestry (Howard, Marsh, and Cole, 1970). Based on the satisfactory results achieved in this study an operational test was conducted in Mendocino in 1968 on 372 acres to determine the efficacy of two pounds of diphacinone per acre at a concentration of 0.01 percent. Information from this study in addition to laboratory results led to a State registration of 0.01 percent diphacinone bait for Peromyscus control in January, 1969. In that year, following its initial registration, approximately 40 percent of the 3,000 acres baited in Mendocino County utilized the rodenticide diphacinone.

An independent test by the author was conducted in late 1969 to confirm the previous year's results. A total of 150 live traps were placed for three consecutive nights two weeks prior to baiting with diphacinone. Each trapped mouse was ear tagged and released on location. A total of 21 deer mice and four recaptures were tallied for the 450 trap nights. The same procedure was repeated two weeks following baiting. A total of four new deer mice and no recaptures were noted.

The industry became convinced that diphacinone was an acceptable alternative to 1080 and in 1970 they used it in the majority of the areas. Acreage baited that year amounted to over 4,800 acres with diphacinone being employed on over 3,000 acres. Just about the time when it looked like diphacinone was going to replace 1080, Rex E. Marsh and his colleagues conducted laboratory tests comparing diphacinone with another anticoagulant, chlorophacinone. In December of 1970, a field test involving a two pound per acre rate of 0.01 percent chlorophacinone was employed in Mendocino County. Favorable results from this

effort were received. In July, 1971, the Agricultural Commissioner, Ted Eriksen, Jr., sought and received a California registration for ready-to-use chlorophacinone deer mouse bait (Marsh, Passof, and Howard, 1974).

In the fall of 1971 the forest industry was preparing to bait and seed almost 6,000 acres. In anticipation of mixing six tons of oat bait, the question was raised as to whether the application rate could be reduced from two to one pound per acre.

Two areas were established for the test, one having only the one-pound rate of 0.01 percent chlorophacinone and the second having the same rate except that the Douglas-fir seed was treated with endrin. Results of this test with two additional post-baiting censuses is offered in Table 1.

Table 1. Census information on deer mouse populations in two areas treated with a one pound rate of 0.01 percent chlorophacinone. The total mice captured is based on 100 snap traps set for three consecutive nights. Bait and Douglas-fir seed were applied approximately two-weeks following the first census.

Population Census	Number of Deer Mice Captured	
	Area A	Area B*
Pre-baiting Census (November, 1971)	30	14
Post-baiting Census (December, 1971)	0	0
Second Post-baiting Census (March, 1972)	21	3
Third Post-baiting Census (June, 1972)	22	18

* The Douglas-fir seed was treated with 0.5 percent endrin.

The preceding study then led to the operational use of chlorophacinone (trade name, Rozol) in December of 1972, where for the exception of a few test locations, the product was exclusively used at the one-pound rate on almost 7,500 acres in the county. Additional experimental applications of chlorophacinone were also initiated in Humboldt and Shasta Counties at the same time. Compound 1080 for deer mouse control had been replaced with these safer compounds for two consecutive years.

The standard procedure followed by landowners in Mendocino County who wish to bait and direct seed their land is to prepare a "Seeding Plan" which outlines their intentions for the Agricultural Commissioner. The plan describes the various areas to be treated and indicates the extent of deer mouse activity by a 100 trap-night census report for each block. An arbitrary three mice per 100 trap nights has been used to justify the use of toxicant baits. A review of the seeding plans for the last six years indicates that freshly logged land in the mixed redwood-Douglas-fir forests will yield an average of 8.5 mice per 100 trap nights. Traps employed in the censusing are the common snap type, baited with peanut butter, spaced 35 to 50 feet apart and placed near appropriate ground cover.

Now that chlorophacinone has a temporary Environmental Protection Agency permit, the door is open for continued research even on federal lands. While direct seeding on public lands in California has not been popular to date, the procedure has been used with success on Bureau of Land Management and U.S. Forest Service areas in Washington and Oregon. Over five million dollars was spent by the two agencies in 1970 for reforestation efforts in those two states alone (Buongiorno and Teeguarden, 1973).

SEED PROTECTION

Another problem facing land mangers wishing to seed their lands, and this is particularly true for the Bureau of Land Management, is the future of endrin as a seed protectant. All of the seed employed in reforestation efforts in California on private lands is treated with endrin at the prescribed 0.5 percent concentration.

Back in 1970, a full-fledged attempt at finding an environmentally acceptable substitute for endrin was launched by the Department of Animal Physiology (now Division of Wildlife and Fisheries Biology) at the University of California at Davis under a contract awarded by the Bureau of Land Management, Portland Center. This author spent a six-month sabbatical leave conducting field research aimed at evaluating a promising candidate compound known as alpha-naphthylthiourea. Four study areas in northern California and two locations near Eugene, Oregon were chosen for the large scale aerial application field work. In the spring of 1973, seedling germination counts were made to determine the relative degree of protection provided by the treatments of alpha-naphthylthiourea and endrin as compared with untreated seed.

The results of these tests will be published. Alpha-naphthylthiourea showed promise as a protectant when compared to untreated seed, but the much higher seedling counts provided by the endrin treatment indicate the continued superiority of that commonly-used compound (Marsh, et al., 1974).

FUTURE PRACTICES

What does the future hold for direct seeding in California? This past winter the acreage seeded in Mendocino County dropped from the previous year's high of 7,800 acres to just over 2,000 acres. The reduced difference in acreage was compensated by a vigorous planting program. The forest industry throughout California is confronting a new Forest Practices Act which mandates adequate regeneration following logging. The industry is concerned with the problem of erratic stocking patterns that sometimes develop from direct seeding. Too many seedlings in one location will eventually have to be thinned at extra expense and too few seedlings in other places is always disappointing.

Modern technology has recently developed a containerized seedling that has the advantages of good survival and can be planted with less labor costs. The difficulty of collecting large amounts of seed to adequately regenerate the logged parcels, plus the real uncertainty concerning the future use of toxicants and repellents, have provided some strong incentives toward planting. Even though hand planting is more expensive initially than seeding, it is a further notch up on the scale of intensive forest management practices. However, seeding will be employed in the future where hand planting is simply prohibitive due to access alone. Therefore, it is an important method of regeneration that must always be made available as a viable option to the land manager where the terrain, if nothing else, makes planting impractical.

CONCLUSION

In conclusion, we are embarking on a relatively new reforestation procedure in California as we phase from direct seeding to containerized or plug seedlings. Until we in the field have had the opportunity to fully evaluate these new planting techniques, it will be highly advisable to continue to maintain a strong position with respect to direct seeding research. We must not let our efforts diminish in seeking acceptable methods of protecting tree seed from losses caused by wildlife.

It only took six years to evolve from hand applications of 1080 bait to aerial applications of the safer anticoagulant baits. These research efforts have promoted a much wider interest in reforestation and in a sense have paved the way to the more sophisticated techniques now being tried for the first time.

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