

RISK MANAGEMENT IN CHRISTMAS TREE ESTABLISHMENT IN THE SOUTHWEST

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(While the following article deals primarily with growing Christmas trees in the Southwest, it does contain important facts about establishing a plantation in other parts of the country as well - Editor)

INTRODUCTION

Much of New Mexico and the Southwest is considered too arid for Christmas tree production. In fact, New Mexico was not targeted for federally sponsored windbreak tree planting projects following the dust bowl era (1930s). Essentially, climate and soils of the southwestern Great Plains region were considered too adverse to expect successful tree establishment. Innovations in dryland farming, seedling stock types and selective herbicides now permit successful plantings in most areas of the Southwest. For southern New Mexico's coarse-textured, droughty soils, introduction of drip irrigation technology and heat tolerant eldarica pine were major advances. These advances have reduced, but have not eliminated, the risk of crop failure.

The purpose of this paper is to categorize often ill-defined acts-of-nature into understandable risk factors that can be greatly minimized. The key is to address each factor with an appropriate level of management. "Appropriate" deserves emphasis because too much or too little attention can adversely affect profitability. Our approach will be to address six topics, and to emphasize some key concepts associated with each. Concepts and examples drawn from New Mexico's problems are applicable to neighboring states with similar topography and climate. Additionally, detailed discussions of specific treatments are available elsewhere (see literature cited), and will be avoided to maintain concept emphasis.

Factor Interactions

There are six issues that greatly influence establishment success (Figure 1). Each

factor potentially interacts with all others, and can have both direct and indirect influences on crop success. For example, a mountain-valley site that has previously grown alfalfa-brome pasture on a clay-loam soil underlain with river-deposited cobble, needs (1) ripping to reduce soil compaction zones, (2) plowing to remove old alfalfa roots, (3) herbicide applications to kill re-sprouted vegetation, and (4) modification of the land surface to permit uniform and efficient irrigation. Species selection must consider cold hardiness, water availability and growth rate needed to return financial investments in the time allowed. Additionally, crop protection methods and cost will be greatly affected by all the above factors.

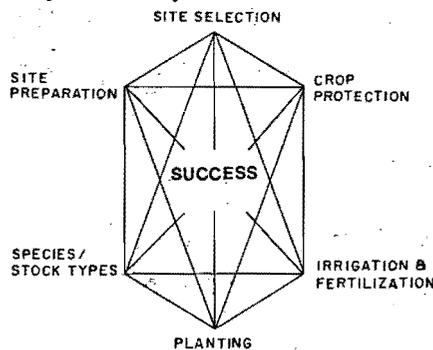


Figure 1. Interactions Important in Christmas tree plantation establishment. 1. Site Selection

Site quality is defined as capacity to grow crops. It determines land cost, which is a major consideration if capital investment is required. Figure 2 underscores a simple relationship in terms of economic risk. Land can be so physically poor that risk of failure is high, or in such demand for other high-value crops that economic risk is high. Land that is good for tree growth but below optimum for more site-demanding conventional crops would be most desirable.

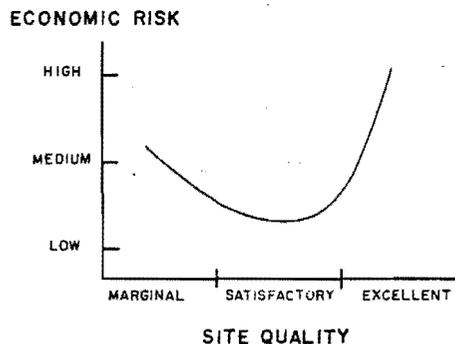


Figure 2. Economic risk of Christmas tree establishment as a function of site quality.

In addition to the economic risk, site quality influences time required to produce a merchantable tree. Trees with superior growth potential can require more years to

reach marketable size on sites with problems posed by soil physical condition or environmental stress (Figure 3). Practices that improve soil physical condition can greatly improve tree growth rate. However, to some extent, the economic risk is shifted from land to equipment used to correct soil compaction or poor drainage. By contrast, low soil fertility can be corrected easily at comparatively low cost.

A further site consideration is product diversity. Within limits, production of several species, as opposed to one, can reduce risks associated with commodity supply and demand imbalances. Therefore, the number of tree species that can be grown on a site influences the risk.

Site elevation is a major factor in determining potential species diversity because air temperature drops as elevation increases, and species differ in cold tolerance. The number of conifer species that can be grown commercially in New Mexico increases as elevation increases from 4000 feet (1200 m) to 7500 feet (2250 m), then decreases up to timberline (Figure 4). This relationship changes somewhat as latitudinal distance from the equator increases. Species represented in Figure 4 are considered among the best for developing plantations in New Mexico. As the Christmas tree

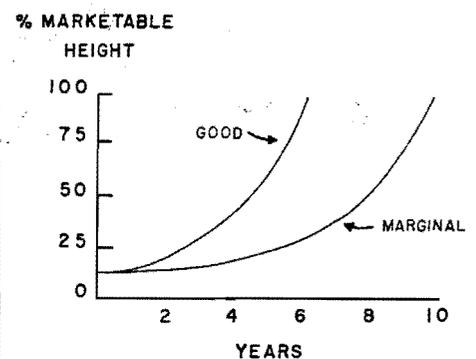


Figure 3. Effect of site quality as years to marketable height of Christmas trees

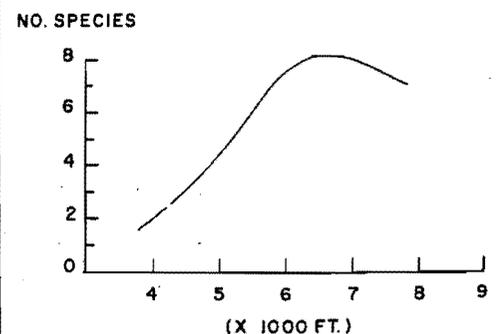


Figure 4. The number of Christmas tree species that can be grown at different elevations in New Mexico.

industry grows, additional species will prove worthy of culture (Fisher and Fancher, 1986). Figure 4 indicates that land from 6000 to 7000 feet (1800 to 2100 m) maximizes opportunity for producing diverse tree crops in New Mexico.

2. Site Preparation

Christmas tree farmers have to be as attentive as corn farmers to site preparation. Too often, site preparation receives inadequate planning and attention, resulting in unnecessary cost, poor growth and poor survival. Effective site preparation positively alters the site for planting. Depending on conditions it can (1) remove competing vegetation and debris, (2) level land to improve irrigation efficiency, (3) fracture plow pans and (4) prepare the soil for planting by breaking soil aggregates (a benefit especially needed for machine planting).

Fundamentally, site preparation interacts synergistically with efforts made to improve other factors shown in Figure 1. For example, one dollar invested in site preparation combined with one dollar spent for fertilizer can result in an overall positive effect with three dollars or more. This synergism has been shown repeatedly in establishment trials, and results in improved sur-

vival and growth. For example, when site preparation, fertilization and irrigation treatments are applied in all possible combinations, plantation test plots receiving all three treatments generally show best survival and growth. In fact, fertilization in the absence of good site preparation or adequate water can reduce growth (Fisher and Mexal, 1984).

One site preparation technique establishes a cover crop and kills strips with herbicides before planting. Tree farms established in a carefully selected cover crop will have fewer weed problems and will require less maintenance than wild areas. Planting strips are easy to establish in cover crops because they are more sensitive than weed species to herbicides. Cover crops offer obvious advantages on erodible soils. They also retard loss of pesticides and fertilizers to streams, ponds and groundwater. Several criteria are used to select cover crop species (Table 1).

Table 1. Desirable attributes of cover crops

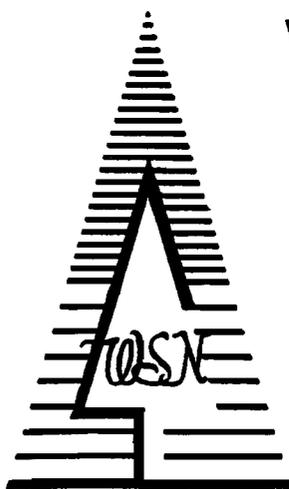
1. Establishes readily
2. Outcompetes noxious weeds
3. Slow lateral growth
4. Maintains low growth habit

5. Tolerant of drought and poor soils
6. Requires infrequent fertilization
7. Withstands traffic
8. Unpalatable to rodents
9. Will not limit tree growth

3. Species and Planting Stock Types

Christmas tree species suitable for New Mexico have been discussed extensively, including site requirements, growth rates and attributes (Fisher and Fancher, 1986). A primary concept is that all species are not equal in their ability to capture benefits of intensive culture and long growing season. Similarly, species differ in their abilities to tolerate specific stresses. Of notable importance to New Mexico are several species native to the state: white fir (*Abies concolor*), Douglas-fir (*Pseudotsuga menziesii*), blue spruce (*Picea pungens*), southwestern white pine (*Pinus strobus*) and pinyon (*P. edulis*). Exotics include eldarica pine (*P. eldarica* Medw.), actually a variety of *P. brutia* and Scots pine (*P. sylvestris*). In total, at least 12 species can be considered for New Mexico plantings (Fisher and Fancher, 1986).

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WILLOW SPRINGS NURSERY

RD 3, Box 134-B Shelocta, PA 15774
Phone 412-726-1112

SPRING 1990 SEEDLINGS and TRANSPLANTS

	Per 100	Per 1000		Per 100	Per 1000
SCOTCH PINE - <i>Pinus sylvestris</i> Spanish, French			AMERICAN RED PINE - <i>Pinus resinosa</i>		
2 yr. Seedlings 2-0 4-6"	\$19.00	\$95.00	2 yr. Seedlings 2-0 3-6"	\$20.00	\$100.00
3 yr. Seedlings 3-0 10-16"	35.00	175.00	3 yr. Seedlings 3-0 6-10"	31.00	155.00
WHITE PINE - <i>Pinus strobus</i>			DOUGLAS FIR - <i>Pseudotsuga menziesii</i> (Lincoln)		
2 yr. Seedlings 2-0 2-4"	24.00	120.00	2 yr. Seedlings 2-0 8-12"	30.00	150.00
3 yr. Seedlings 3-0 6-10"	37.00	185.00	4 yr. Transplants 2-2 12-20"	105.00	525.00
AUSTRIAN PINE - <i>Pinus nigra</i>			COLORADO BLUE SPRUCE - <i>Picea pungens glauca</i>		
2 yr. Seedlings 2-0 3-5"	19.00	95.00	3 yr. Seedlings 3-0 4-7"	24.00	120.00
3 yr. Seedlings 3-0 8-12"	34.00	170.00	NORWAY SPRUCE - <i>Picea abies</i>		
			3 yr. Seedlings 3-0 6-10"	24.00	120.00
			5 yr. Transplants 3-2 12-20"	100.00	500.00

In New Mexico, selection of seedling stock types is rather simple because of the limited number of types produced in the state. Especially for the beginner, container seedlings have many advantages. Container stock (1) can be planted during many months of the year in mountain valleys, enabling the grower to take advantage of seasonal rains, (2) do not require cool storage before planting and (3) are generally more uniform in size than bare root stock.

This is not to discourage future consideration of bare root stock types. As high-quality stock becomes available, their reduced costs will surely be attractive for the better sites. Good quality bare root types have performed as well as container stock on well-prepared sites with adequate moisture. On marginal sites, containers have a clear advantage.

A variety of large bare root types can be purchased from nurseries in states like Michigan. Most promising, perhaps, are heavy transplants of species that are otherwise slow to become established. True firs (*Abies* sp.) for example are typically slow to enter the rapid, juvenile growth phase and their growth can be severely checked by competing vegetation. Use of heavy balsam fir transplants has greatly reduced time needed to grow Christmas trees in the Northeast. The actual age of a transplant will be indicated by its hyphenated numbers. For example, a 2-3 balsam fir seedling has spent 2 years in the seedling bed and 3 years in a transplant bed. Because seedlings are undercut before being lifted from the seedling bed, new root initiation is encouraged and heavy transplants can arrive with a massive root system. In a semi-arid environment, additional roots are beneficial. Seedlings with too much shoot should be avoided.

Bare root seedling size clearly influences transplant survival and growth. A general rule here is that the size of choice is the biggest seedling that can be successfully established. Large seedlings have an advantage under optimal conditions because the juvenile growth phase can be entered more quickly. However, the same seedling can survive poorly when exposed to moisture stress because it lacks enough roots to keep shoots hydrated. Under optimal and suboptimal conditions, seedlings must be large enough to compete with invasive weeds, but this problem will be more acute on better sites.

4. Planting

Tree planting procedures have been adequately discussed in a previous publica-

tion (Fancher et al., 1987). To that, we would add that proper site preparation makes any planting job less difficult and generally must precede machine planting. The good news is that planting is a chore that machines actually do better than humans. Of course, some fundamental guidelines must be followed. Machine planting also reduces planting cost per seedling, if the job is large enough.

Time of planting is an important consideration and should simultaneously optimize seedling hardiness, soil temperature and moisture. In mountain valleys, trees should be planted when soil temperature is at least 40 degrees F (5 degrees C). Some root growth is necessary to anchor seedlings to avoid displacement caused by soil freezing and thawing. In southern lowlands, seedlings can be planted throughout the year, but the windows of least risk offer moderate temperatures and opportunities for root growth to precede shoot growth, before heat becomes a serious factor. For example, *eldarica* pine is commonly planted in October to exploit conditions that favor root growth and avoid warm-season weeds. One additional suggestion is to irrigate trees soon after planting, even if moisture seems adequate. Irrigation eliminates air pockets in the root zone.

5. Irrigation and Fertilization

Irrigation and fertilization practices should be designed to capture synergistic effects derived from crop treatments. It has been shown repeatedly that fertilization in the absence of sufficient moisture can add stress that kills plants. A more positive approach is to manage these factors jointly to gain maximum benefits. In this vein, several southern New Mexico growers use irrigation systems that deliver fertilizers precisely and routinely. This approach assures nutrient levels do not fall too low, and directs water and dissolved nutrients to crop plants rather than weeds. Another step toward improving farm irrigation efficiency is to laser level land. This improves distribution of both water and nutrients. When performing a cost-and-benefit analysis, one should carefully consider the labor and land quality conserved by these treatments.

The role of nutrition in tree establishment has been examined in recent years (Fisher and Mexal, 1984). As a rule, one should optimize nutrient levels to avoid antagonisms, waste and unnecessary costs. Also it is important to recognize that tree response to nutrient or moisture stress varies in a seasonal manner and is species dependent.

Growers often are frustrated when they cannot find specific fertilization recommendations. They should begin by consulting local orchard growers. Treatments routinely applied to broadleaf fruit or nut crops are tailored to perennial plants whose roots explore large volumes of soil over time, and for reallocating them to tree parts where they are most needed. In contrast, fertilization treatments applied to most agronomic crops reflect the need to provide nutrients in large amounts to rapidly growing plants that are closely spaced.

Another relationship of potential value is that nitrogen (N) fertilization generally produces much greater benefits than other elements. Generally, there is no need to apply elements adequately available in the soil. Plants are highly responsive to N for two rather simple reasons. N is a primary constituent of plant cells and principal metabolic compounds, and N is highly soluble in soil, and leached rapidly after fertilization. Generally, other macro-nutrients such as phosphorous (P) and potassium (K) elicit comparatively smaller positive growth responses. However, there are exceptions to any generality. For example, amounts of total soil P can be adequate according to some soil tests, but be mostly unavailable for plant uptake. This problem is common in southwestern alkaline soils where P forms insoluble precipitates with calcium and other elements. In such cases, fertilization is needed to restore a more favorable N:P balance. Without available P, additional N can further depress growth.

Beyond these statements on fertilization, growers should seek assistance from government agencies and university personnel trained to assist with development of long-range fertilization programs. Many New Mexico growers have markedly improved tree quality by combining this approach with their good judgment. The first step is to have soil tested annually. Records of soil tests and fertilizer applications should be kept, along with information on tree growth and yield. The grower should use the same testing laboratory year after year so changes in soil and tissue levels will be more easily detected. Differences in methodology among testing labs can lead to considerable variation in results, and this can obscure trends otherwise easily seen.

6. Crop Protection

Weed competition is probably the most common cause of planting failure when seedling quality is not an issue. Com-

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petition reduces growth a Christmas tree can attain in the absence of weeds. To understand weed competition, one must recognize two principles, (1) plants are resource limited; therefore, (2) the capacity of a unit of land to produce crops is determined by its inherent resources. With sufficient moisture, nutrients and sunlight, plants can maintain foliage needed to trap carbon dioxide (CO₂) through photosynthesis, and to produce adequate amounts of plant sugars to survive and grow.

Conifer transplants are most commonly injured by moisture stress. Water transpired by competing vegetation leaves less soil moisture for tree survival and growth. Because water is scarce, impact of competition is noticeably more severe in the Southwest than in the Northeast, for example.

Plants need growing space to receive adequate sunlight. Therefore, the total amount of vegetation that can be supported per unit of land is limited by amount of growing space available. Of course, other factors also can become limiting before all space is occupied, and this is the situation one finds in the arid Southwest. In irrigated plantations, space and nutrients can be limiting factors. Also, competition among trees grown too close together can result in poor tree quality.

A key issue, is how much bare ground does a young pine seedling need to maintain maximum growth? The answer to this question should affect our efforts to eradicate weeds, as well as the manner in which we manage cover crops. A simple rule is to provide as much bare ground as possible within a 4 foot (1.2 m) radius of the tree (McDonald, 1986). without inviting soil erosion. This can be a difficult decision that may require consultation with soil conservationists. In any case, the site should be thoroughly prepared before planting to give young trees a fighting chance. Competition can slow growth of established trees, but this risk factor becomes less important after trees are established.

Removal of competition provides each plant more water and growing area while reducing other risks. The area becomes less inviting to animals, and reduces exposure to toxic chemical substances produced by weeds (i.e. allelopathy). However, weed control often is begun after growth has been reduced. Consequently, profitability suffers as the cost of prophylactic controls accumulates. Weed control

should be planned before the first seedling is planted.

A weed prevention program reduces need for so-called fire-fighting approaches.

Weed control actually begins, of course, with site preparation and can include cover crop establishment, as discussed. Herbicides should be combined with mechanical weed clearing treatments to thoroughly remove rank vegetation. Herbicides can be used to brown up weeds before plowing and disking, and again to remove resprouts. This is an expensive process and can require months to complete. However, our view is that it generally is better to postpone planting than to attempt weed control shortcuts. As the adage goes, "plan the work and work the plan."

Animal browsing is a more acute problem in semi-arid and arid zones than in wetter regions with plentiful vegetation. Animals can decimate a new plantation of seedlings within a week, or be a source of continued loss by killing 20 to 30 percent of the seedlings each year. Risks posed by animal groups vary over time (Figure 5). A simple relationship is that trees either out-grow risk of predation as their growing points (stem apices) escape vertically, or become increasingly able to tolerate predation as more biomass accumulates.

Risk posed by rabbits is initially high, but diminishes sharply as stem apices escape their reach. Large animals and rabbits pose risks at first, but cattle and deer can and will frequently damage trees less than four feet (1.2 m) tall. Larger trees are damaged less often, but snow can force livestock and deer to feed on exposed branches. Pocket gophers can kill most trees in a plantation over a period of years, and will remain a low to modest threat until harvest. Various insects can attack Christmas trees and risk varies

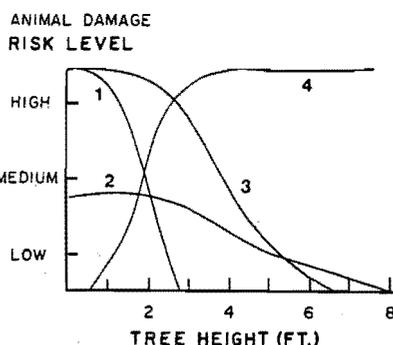


Figure 5. The effect of Christmas tree height on the relative susceptibility to damage from rabbits (1), pocket gophers (2), large mammals (3), and foliage insects (4).

among groups. Tip moth risk is initially low because small trees are less visible, but risk rises precipitously as trees reach a critical target size.

Obviously, control of all plantation-threatening animals should not be practiced throughout life of the plantation. The goal is to effectively control only those pests posing a threat at the time of immediate risk.

SUMMARY

Christmas trees can be successfully established in New Mexico and other southwestern states if steps are planned and taken to eliminate or minimize avoidable risks. Adoption of some rather simple crop management principles greatly improves odds in favor of the grower, as many growers have demonstrated.

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TIE-NET INTERNATIONAL MOVES

Tie-Net International, Inc., marketer of Christmas tree netting, has moved to a new address, 390 Wegner Drive (or P.O. Box 520), West Chicago, Illinois 60185-0520.

Their new phone numbers will be 1-800-736-0990 and/or 708-293-3737, and their FAX number is 293-5303.

Tie-Net markets two kinds of Christmas tree netting, one type especially for trees that will be shipped, and one type for trees at choose and cut operations or retail outlets. Jerry Marchese heads the company.