OCCASIONAL PAPERS* - No. 35 September, 1934.

SOUTHERN FOREST EXPERIMENT STATION

U. S. Forest Service New Orleans, La.

THINNING LOBLOLLY PINE IN EVEN-AGED STANDS

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Thinnings in general

Second-growth or old-field southern pine stands are frequently very dense, with the individual trees so badly crowded that their rate of growth is very slow. This actual stagnation of growth brought about by intense competition, however, can be avoided or corrected by a thinning, which is defined as a cutting made in immature stand for the specific purpose of increasing the remaining trees. The two-fold object of increasing the rate of growth is to hasten the production of merchantable products from selected trees and to increase the total yield of the stand. In practice, a thinning generally includes also the removal of trees of undesirable species or form and trees that would otherwise die before another cutting. Cuttings made for the same purpose as a thinning in immature stands averaging three inches or less in diameter breast high are called "cleanings" rather than "thinnings."

Thinnings are highly desirable from a silvicultural standpoint in all fully stocked or overstocked stands or groups of trees, and in this connection it should be noted that stands understocked on the whole are often fully stocked or overstocked in small groups. It is because of the widespread silvicultural desirability of thinnings that one often hears it said, "Such-and-such stand needs thinning." Such statements are likely to be literally true from a silvicultural standpoint, but good silviculture is not necessarily good economics and to a forest owner the latter requirement necessarily carries the most weight. In the following discussion, the economic aspect of thinnings is fully considered and the conclusions and suggestions offered are believed to be economically as well as silviculturally sound.

A thinning is only a means to an end. This is important to keep in mind because the desired end-product should largely determine the nature of the thinning. If we desire to raise sawtimber we should thin in one way; if we desire to raise pulpwood we should thin in another way. But even with the desired end-product clearly in mind, the best or most appropriate method of thinning can not be determined without consideration of such additional factors as (1) the market or possible local use of material removed in the thinning, (2) the financial status of the forest owner, and (3) the attitude of the owner toward the use of his land for forestry.

It is important that all pertinent factors be carefully weighed before undertaking an actual thinning. Mistakes are difficult to correct after the trees have been cut. Before thinning is begun, the owner should have a definite idea of exactly what is desired, why it is desired and how the stand should appear when the operation is completed.

Thinnings in the South

Since all fully stocked or overstocked stands of trees are potentially in need of thinning, the practice is applicable throughout the South wherever such stands occur. Each commercial species or forest type of commercial value, however, presents special individual problems and is best adapted to special individual methods of treatment. To go beyond the bare definition and theory of thinning, given in the foregoing section, to specific problems and solutions, it is necessary to confine the discussion to a single species or forest type. In this article, the discussion is limited to loblolly pine growing in even-aged stands in what is generally known as the shortleaf-loblolly pine-hardwood forest, in the southern United States. This forest occupies about 55,000,000 acres in Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, and Oklahoma. A very small percentage of this widespread forest consists of even-aged, second-growth loblolly pine, but the total acreage of such stands is very large.

Up to the present time, most commercial thinnings in the South have been made in dense young stands of longleaf and slash pines, with the object of hastening and increasing the yield of naval stores. The value of these thinnings is already rather widely appreciated. Such thinnings are comparatively easy to make and have a single, well-defined purpose.

The values and benefits of thinning loblolly pine, however, are not widely appreciated. There are several reasons for this. Usually no single purpose is involved but, instead, the owner may have several different purposes in mind, often loosely defined and hedged with "if's" and "when's." Whatever the purpose, it is no easy task to make a satisfactory thinning or, let us say, one that will seem as satisfactory five years hence as it does when made. These difficulties, however, are far from insurmountable and it is felt that, by and large, thinnings made in loblolly pine should prove every bit as profitable as those made in longleaf and slash. This article presents recommendations for such thinnings.

Thinning even-aged loblolly pine

The Southern Forest Experiment Station has established and maintained a number of experimental thinnings near Urania, LaSalle Parish, La., and many of these have been under way long enough to indicate what may be expected from different methods of thinning in different-aged stands.

The experimental thinnings from which tentative conclusions can be drawn, however, are confined to even-aged, old-field stands. The following discussion applies directly to such stands and in a general way to all even-aged stands, whether old-field or not. The problems involved in thinning old-field stands of loblolly pine (pure or mixed with shortleaf pine and hardwoods) can be appreciated and evaluated only with a knowledge of the character and typical development of these stands, and a brief description is therefore given.

Old-field stands usually start as dense stands of small seedlings with densities ranging up to several thousand per acre. There is a very great variation in the number of seedlings that become established, but the stands most in need of thinning usually started out with well over 2,000 seedlings per acre. Usually such stands are not strictly even-aged, but seed in over a period of at least 2 or 3 years and the oldest seedlings usually maintain their superior size and become outstanding dominant trees when the stand closes. The average development of old-field loblolly in unthinned, well-stocked to overstocked stands is illustrated in Table 1.

Table 1. - Typical development of an old-field stand of loblolly pine

Age	Approximate range in number of trees per acre	Average number of trees per acre	Approximate range in diameter breast high	Average diameter breast high	Average mortality in number of trees in 5 years after given age
Years			Inches	Inches	Percent
10	1,500-4,000	2,200	0- 6	2	45
20	550-1,200	800	2-11	6	28
30	250- 700	420	3-16	8	19
40	150- 450	280	3-20	10	14
50	120- 300	205	4-23	12	12
60	100- 250	160	4-25	13	8

This table shows a tremendous mortality between 10 and 60 years, but the rate of mortality is not sufficiently rapid to prevent a serious stagnation of growth. This indicates that natural thinning should be supplemented by artificial or man-made thinning. The thousands of small

original seedlings grow rapidly until their crown and root systems meet and begin to interlock and interfere with one another, at which time the stand is said to have closed. After the stand has closed there is very intense competition for both light and soil moisture. The competition is the more intense and injurious to individual trees because it takes place between trees of approximately the same size, with similar crowns and root systems. This results in the sudden slowing down of the fast early growth typical of old-field stands. The sharply decreased growth rate continues unless or until the proper kind of thinning is made. It should be clearly understood in this connection that not just any kind of thinning will improve the growth rate. It has been found that several types of light and medium thinnings have no appreciable effect on the growth rate, in fact are thinnings only in form and not in accomplishment.

Suppose that saw timber is the desired end product. Given a sufficient time, old-field stands will produce timber of saw log size, although, unfortunately, not often of high quality because of the abundant large knots. If the forest owner can afford or desires to wait for the trees to reach good saw log size in the course of their natural development, no thinning is necessary. If, however, he wants to shorten appreciably the time during which he must wait before the trees reach good saw log size, thinning is essential. When pulpwood rather than saw timber is to be the main crop, the same considerations apply and the only real difference is that the wait will not be so long.

The emphasis so far has been placed on the fact that thinnings do or should increase the growth rate of the remaining trees. This seems justified on the grounds that the average forest owner would not otherwise be interested in thinning. However, something should be said in behalf of the light thinnings which might, but usually do not, increase the growth rate, although they do remove trees of poor form, quality or species, diseased and unhealthy trees, and trees that would otherwise die through suppression and crowding before the next cutting. If the material thus removed can be utilized to advantage locally, or sold at no loss, such thinnings are entirely desirable. It is only when the cut material can not be utilized that these thinnings become merely a waste of time and money, since they improve the growth of residual trees only slightly, if at all.

The principal silvicultural problem involved in thinning is to increase the growth rate of the remaining trees by an appreciable amount without cutting too many potentially merchantable trees. On the one hand it is difficult to increase the growth with a light thinning, and on the other hand it is difficult to make a heavy thinning that will increase the growth rate of individual trees, yet not result in a decreased final yield of the whole stand. For example, consider two good 7-inch trees, growing about 6 feet apart and with practically no other competition. Shall we cut one out, or shall we leave both? By cutting one, we

can certainly increase the growth of the other, but how much? Will it grow sufficiently faster to make up for the fact that in the future only one crop tree can be harvested instead of two? Two 17-inch trees, for example, will usually contain about 25 percent more lumber than one 20-inch tree, but about 5 percent less lumber than one 23-inch tree. The decision depends on the expected increase in growth, the size of timber desired and the attitude of the owner as to the time he can wait for the final cutting. The main silvicultural problem, then, is to find the happy medium between too light thinnings that do no good and too heavy thinnings that defeat their own purpose. Additional silvicultural problems have to do with the production of the highest quality of material and the gradual development of conditions suitable for reproducing the stand naturally.

The principal economic problem is to make the thinning pay. This does not necessarily mean obtaining an immediate cash profit, for a present expense may often be converted into a future profit. The economic justification of thinning depends on a number of factors, many of which can not be accurately estimated or predicted. Among these are the financial status of the owner, the market value (if any) of the removed material, the probable future market for the products to be grown, and the location and accessibility of the stand.

It is not intended to recount in this paper all the technical findings resulting from the experimental thinnings conducted by the Southern Forest Experiment Station. This paper, however, does present a set of specific recommendations and suggestions based on analysis of the available data. The recommendations may be changed somewhat with further experimentation. For convenience and conciseness they have been arranged in tabular form and are presented in Table 2. The suggestions following the tabular material are designed to aid in carrying out the recommenations. A summary of tentative conclusions derived from the experimental work in northern Louisiana to date is also given.

RECOMMENDATIONS FOR THINNING EVEN-AGED LOBLOLLY PINE, EITHER PURE OR IN MIXTURE WITH SHORTLEAF PINE AND HARDWOODS

The nature of the thinning recommended to be made in any specific stand is considered to be largely dependent on three factors: (1) The market conditions and the market or utilization value of the thinned material; (2) the wishes and plans of the owner with reference to the end-products desired and the length of time he is willing or can afford to wait; and (3) the extent to which the dominant trees are clear of live branches (a convenient single factor that reflects the combined influence of age, size, site and stocking). Dominant trees are those with crowns extending above the general level of the forest and which

receive full light from above and partly from the side.

The recommended thinning practices summarized in Table 2 represent a compromise between two radically different practices each of which has special advantages and disadvantages. The first consists of very early and very heavy thinnings which require an immediate cash outlay since there are usually no merchantable products in the small trees that are cut, but which are likely to result in the greatest ultimate yield in the shortest time. The second practice consists of late or delayed thinnings which produce the highest immediate profit but generally have little or no beneficial effect on the rate of growth of residual trees. The compromise is made in the belief that the combination of some immediate profit and some increased growth is usually most desirable to the average timber owner.

The recommendations are for first thinnings and presuppose the possibility of additional later thinnings. No recommendations are made for stands in which the dominant trees have dead branches or are clear for less than 17 feet (one log length), due to the lack of sufficient experimental data.

Table 2. - Is divided into three parts according to the existing or potential markets for the trees cut in thinning:

Part A. - There is a market for pulpwood or other small material, or the trees can be used to advantage for firewood, etc.

Part B. - There is no market or use at all for the thinned material. There is, however, reasonable hope for a future market for small material within about 10 years.

Part C. - There is no market or use at all for the thinned material. There is, likewise, no hope for a market within about 10 years.

TABLE 2. - Recommended thinning practice for first thinnings

Part A. - Assuming there is a market for pulpwood or other small material, or the trees can be used to advantage for firewood, etc.

Wishes and plans of owner	Stands in which dominant trees are clear or have only dead branches for an average length of 34 ft. or more (i.e. at least two logs).[1]	Stands in which dominant trees are clear or have dead branches only for an average length of about 17 ft. (i.e. one log).[1]
Saw timber alone is desired and as soon as possible.	Leave best 30-80 trees per acre (average spacing 23-38 ft.); cut practically everything else, except small trees in openings. In general, leave all trees 5 inches d.b.h. or less when they are not directly interfering with the crown development of the best crop trees.	Leave best 100-140 trees per acre (average spacing 18-21 ft.); cut practically everything else, except small trees in openings. In general, leave all trees 5 inches d.b.h. or less when they are not directly interfering with the crown development of the best or crop trees.
Saw timber alone is desired, but maximum volume and highest quality are preferred to an early return.	Leave best 80-120 trees per acre (average spacing 19-23 ft.); cut practically everything else, except small trees in openings. In general, leave all trees 5 inches d.b.h. or less when not directly interfering with the crown development of the best or crop trees.	Leave best 160-200 trees per acre (average spacing 15-17 ft.); cut practically everything else, except small trees in openings. In general, leave all trees 5 inches d.b.h. or less when they are not directly interfering with the crown development of the best or crop trees.

[1]For intermediate conditions, assume intermediate or compromised recommendations.

TABLE 2. - Recommended thinning practice for first thinnings

Part A. - Continued.

Pulpwood alone is desired, and a more or less continuous sustained yield is to be achieved.	In stands averaging 11 inches or more in diameter breast high leave all sound trees below 9 inches in diameter breast high, and also leave one 10-inch or better tree per quarter-acre as a seed tree (average spacing 105 ft.). In stands averaging about 8 inches in diameter breast high, leave about 200 sound 6 to 9-inch trees per acre (average spacing 15 ft.) and all sound trees 5 inches in diameter breast high or less that are likely to remain alive until the next cutting. In stands averaging 5 inches or less in diameter breast high no thinning is recommended. Wait until pulpwood can be removed. If, however, there are a number of trees 6 inches and more in diameter breast high, these should be thinned out.	
Wishes and plans of owner	Stands in which dominant trees are clear or have only dead branches for an average length of 34 ft. or more (e.i. at least two logs).[1]	Stands in which dominant trees are clear or have only dead branches for an average length of about 17 ft. (e.i. one log).[1]
Both saw timber and pulpwood are desired, and even relatively small quantities of each are salable.	Leave best 30-80 trees per acre (average spacing 23-38 ft.) for saw timber. These trees should be clean, straight, sound, and give promise of producing at least one No. 1 saw log. Leave all sound trees less than 6 inches in diameter breast high that are likely to remain alive until the next cutting. Cut all trees 6 inches d.b.h. and larger that will never produce at least one No. 1 saw log.	Confine thinning to removing trees directly interfering with the best 150-200 trees per acre (average spacing 15-17 ft.) or do not thin.

[1]For intermediate conditions, assume intermediate or compromised recommendations.

TABLE 2. - Recommended thinning practice for first thinnings

Part B. - Assuming there is no market or use at all for the thinned material, but reasonable hope for a future market for small material within about 10 years.

Under this condition, no immediate thinnings are recommended. Wait for a market or use for the cut material to develop, and then thin according to Part A, above.

Part C. - Assuming there is no market or use for the thinned material and no hope for a market within about 10 years.

Wishes and plans of owner	Stands in which dominant trees are clear or have only dead branches for an average length of 34 ft. or more (e.i. at least two logs).[1]	Stands in which dominant trees are clear or have only dead branches for an average length of about 17 ft. (e.i. one log).[1]
Saw timber alone is desired and as soon as possible.	Leave only best 30-80 trees per acre (average spacing 23-38 ft.) or make no thinning at all.	Leave only best 100-140 trees per acre (average spacing 18-21 ft.) or make no thinning at all.
Saw timber alone is desired, but maximum volume and highest quality are preferred to an early return.	Leave only best 80-120 trees per acre (average spacing 19-23 ft.), or make no thinning at all.	Leave only best 160-200 trees per acre (average spacing 15-17 ft.) or make no thinning at all.
Pulpwood alone is desired, and a more or less continuous sustained yield is to be achieved.	No thinning recommended. Wait for market to develop.	No thinning recommended. Wait for market to develop.

[1]For intermediate conditions, assume intermediate or compromised recommendations.

Suggestions concerning technique

Stands to be thinned should be marked in advance of cutting. When the number of trees to be cut is about the same as, or greater than, the number to be left, mark those to be left. Dry paint or chalk in a bag or sack, whitewash, or liquid paint, or a light axe or hatchet can be used. Where the trees to be cut are relatively few, mark them instead of those to remain. Even in the latter case, concentrate attention on selecting the trees to be left. Trees to be cut are then merely those not desirable to leave. They can be thought of as trees to be cut not for the sake of cutting but rather because they are interfering with the development of the selected trees or because they are not needed in the stand. Experienced cutters, once they are thoroughly accustomed to the marking and understand the general principles by which it is determined, can thin without preliminary marking.

Make frequent checks of the number of trees being left, in order to keep the thinning along the lines of the method decided upon. Experience and judgment, however, should have full play and the marking should be governed by these factors rather than by average figures as given here. Local conditions require local treatment.

Mark and thin by relatively small units, such as quarter-acres or small groups of trees, in order to keep the spacing as regular as possible. Thus 200 trees per acre should be thought of as, say, 50 trees per quarter-acre or as trees spaced about 15 feet apart. Spacing should be sacrificed, however, to secure good, sound, straight and vigorous trees.

Tentative conclusions and observations derived from experimental thinnings in northern Louisiana

1. - Good sites offer far greater possibilities of beneficial effects from thinning than do poor sites. Thinning should be concentrated on good sites.

2. - Light and medium thinnings that remove only the smaller, more suppressed, slower growing, more poorly situated or dying trees, do not appreciably increase the growth rate of the remaining trees beyond that usually obtained in unthinned stands. Heavy thinnings that remove the same classes of trees increase the growth rate of the remaining trees only slightly. Thinnings that remove only the poorest, smallest trees seem unlikely to be of practical benefit except to the extent that they remove usable or salable material that would otherwise be lost through death and decay.

3. - Thinnings that remove trees competing directly with selected "crop trees", regardless of the size or

vigor of the competing trees, increase the growth of the selected crop trees if made heavy enough and early enough. It is difficult to secure a degree of thinning around selected crop trees that is both silviculturally and economically sound, and from the experimental work to date it is impossible to draw very specific conclusions. It is probable, however, that moderate to heavy crop tree thinnings are generally beneficial and practical, especially when the crop trees are badly crowded and there is a good market for the material to be removed, or when there are many very poor trees of the larger sizes in the stand.

4. - Thinnings have the most marked beneficial effect on the growth rate of the remaining trees when made very early in the life of a stand. Too early thinnings, however, remove trees that in a short time would be of pulpwood or post size; so if there is a market for pulpwood, posts or similar small products, thinnings should be deferred a few years beyond the time when they are likely to have the greatest silvicultural effect.

With no market for small products, and no other use, thinnings should be begun when the dominant trees are about 3 to 6 inches in diameter breast high (about 10 to 15 years old). With a market for small products, the first thinnings should be made when the dominant trees are about 6 to 9 inches in diameter breast high (about 15 to 25 years old). Even where there is no use or market for the trees to be cut, stands destined to produce saw timber should either not be thinned until the dominant trees have pruned themselves at least for one log length (17 feet), or selected crop trees should be pruned at the time of thinning. Although very little is known of the costs, results, or practicability of pruning loblolly pine, it is likely to be very profitable in many instances. Very early and very heavy thinnings in loblolly pine, with pruning of relatively few selected crop trees, have not been investigated to date, but they offer considerable promise and experiments along this line will soon be initiated. Despite their initial expense they may well prove to yield the highest ultimate net return.

5. - Thinnings do not need to remove large volumes of wood per acre in order to pay an immediate profit. A recent study showed that with readily accessible stands and a good market for pulpwood, removal of but one-fourth of a cord per acre actually returned a net profit over all costs. It is usually neither practicable nor desirable to remove such small volumes as this, but it serves as an example of what can be done.

Unthinned old-field stand of loblolly and shortleaf pines 22 years old. There are 924 trees per acre, the growth is exceedingly slow and the stand is badly in need of thinning.

Thinned old-field stand of loblolly pine 21 years old. The thinning reduced the number of trees per acre from 628 to 264. Approximately 18 cords per acre of pulpwood were removed. Two later thinnings reduced the number of trees per acre to 140.