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The Black Locust in Alabama

By
L. M. WARE

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M. J. FUNCHESS, *Director*
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By
L. M. WARE, Horticulturist

THE BLACK locust (*Robinia pseudoacacia*) has been quite generally recognized as one of the best adapted of all species of trees for planting on eroded hillsides and gullied lands. It has also been generally recognized as a plant which is able to grow on rather poor sites and one which demands little or no attention. Mattoon (1), referring to the black locust, states: "Its strong spreading root system and rapid development gives it first place among all trees in ability to check erosion in gullies and on steep hillsides." He advises against planting on very sandy, very wet, or very acid soils. Meginnis (2), in describing the black locust, states: "It is not only particularly well adapted for growth on most eroded sites and exposed clay subsoils much too poor for agricultural use, but, like most legumes, it also builds up the soil by contributing nitrogen." Tillotson (5), in discussing this species for forest plantings in the eastern United States, says: "It grows on poor, sandy, gravelly, or clay soils." Rehder (3), describing the characteristics of the black locust and a closely related species, states: "They are not particular as to the soil and they do well even on poor sandy soil and dry locations." Turner (6), describing the behavior of the black locust in Arkansas, reports: "This species grew exceedingly well on strongly acid soil at the Fruit and Truck Branch Experiment Station." It was emphasized in the report that the successful growth of the locust on acid soil was contrary to current belief.

Sargent (4), gives the distribution of the black locust as follows: "The slopes of the Appalachian Mountains, central and southern Pennsylvania to northern Georgia; in southern Illinois; now widely naturalized in the United States east of the Rocky Mountains and perhaps indigenous as a low shrub in northern and western Arkansas and in Oklahoma." Mattoon (1) states that the locust has been generally recommended for planting from the New England States south to Georgia and west to Texas, Missouri, and Illinois.

Since 1927 the Alabama Experiment Station has made 10 different experimental plantings of the locust at various points in the State. These plantings have definitely shown that the locust in Alabama does not behave according to the generally accepted opinions expressed in literature and commonly held by people in other sections. Because the locust has been so highly regarded as a plant for use in erosion control and in reforestation programs and because its behavior in this State has been different from the behavior one might expect, a brief re-

port is made of the results obtained with the locust under different conditions. This is done in the belief that the results reported may be of value in helping to shape various erosion control and reforestation programs. A discussion is given also of its use for different purposes. The results which are presented should not be considered final or conclusive. Portions of the experiment will not be concluded for many years.

EXPERIMENTAL

Six different experimental plantings have been made at the Experiment Station and four on Experiment Fields. Two of the plantings at the Station were made in 1927, two in 1933, and two in 1934. The plantings were made usually in January or February of the year indicated. Two of the plantings on the Experiment Fields were made in 1930 and two in 1934. The two plantings made in 1930 on the Fields were made at Tuskegee and Alexandria; the two made in 1934 were made at Alexandria and LaFayette. The soil at each place was acid.

Behavior in Gullies.—Both of the experimental plantings started in 1927 at the Station were located on narrow areas bordering shallow "shoestring" gullies. The plants were placed in and along the sides of the gullies. The surface soil was in most places eroded to the subsoil which was sandy clay. There was no plowing-in of the gullies and no preparation of the areas for the plants. In Figure 1 is shown a typical plant in one of these plantings eight years after transplanting. This plant is about 3 feet in height as may be seen from the rod which is divided into feet and tenths of a foot. The average height of the plants in this planting after eight seasons growth—nine seasons growth including the year in the nursery—was 3.74 feet and the average diameter .55 inches at the base.

FIGURE 1.—Typical plants 9 years from seed; no preparation of land; no fertilizer; no cultivation; located on sides of shallow gully.

The second planting made in 1927 has had a varied history. At the time of planting the general area surrounding the gullies was covered with small loblolly pine

seedlings one to three years of age. In 1931 the upper half of the area was cleared, and the locust cut to the ground. The plants on the lower area have disappeared with the exception of a few which appear as brush beneath pines that now stand 20 feet in height. On the upper area there is a scattered stand of locust which has been produced from sprouts originating from the old plants; these plants, therefore, have nine-year root systems and four-year tops. Growth is better on the upper area of this planting than in the first planting described, although still unsatisfactory. The average height of the plants on the area which was cleared was 7.3 feet and the average diameter 1.02 inches after four years growth of the sprouts.

Behavior on Old Fields.—The two plantings made at the Experiment Station in 1933 were located on old cultivated fields. One planting was made on an old field of low fertility and slightly eroded; the other planting was made on a low area of fair fertility. The soil on both areas was sandy loam, and both plantings were handled alike. The land was not prepared and no cultivation was given the plants. Grass was removed from the base of each plant once during the first year with a hoe. In Figure 2 is shown the size of one of the largest plants found in the first of these two plantings two years after transplanting; the plant is, therefore, three years old from seed. It may be seen from the rod that this plant is about 1.3 feet tall. In this planting the average height of the plants, after three seasons' growth, was 9 inches and the average diameter at the base was .19 inches; only 6 per cent of the plants were alive at the time the measurements were made. In the second planting, located on the better soil, the plants two years after transplanting averaged 2.69 feet in height and .37 inches in diameter at the base.

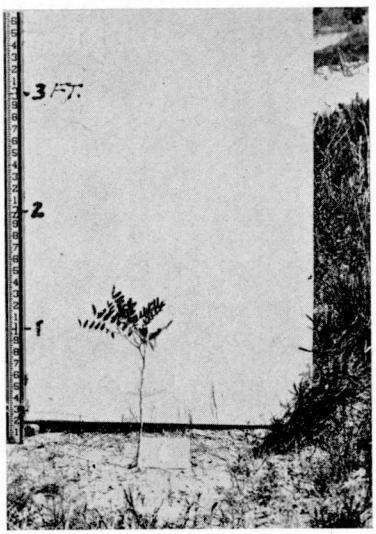

FIGURE 2.—Typical plant 3 years from seed; no preparation; no fertilizer; no cultivation; located on old field.

On the Experimental Fields, both of the plantings made in 1930, the one at Tuskegee, the other at Alexandria, failed. They were established on old fields without preparation of land or cultivation of plants. Within three years practically all plants were dead and the few which were alive were still unable to make their way above the grass.

In all of these experiments where the locust has been planted on soils of low or fair fertility and on sites generally suggested for locust plantings, they have failed. In no instance has special preparation been given the land or special attention given the plants. It is doubtful if the locust in general plantings on similar soils and sites and similarly handled will behave any different.

Behavior as a Crop.—Failure of the locust in all of the earlier experiments led to a different type of experiment in 1934. This experiment was designed to determine just how the locust must be handled for satisfactory growth. The soil selected for the experiment was a loamy sand of low fertility. The whole area was prepared by breaking broadcast. Eight different treatments were given. These treatments are indicated in Table 1. In Treatment No. 1, no cultivation was given and no fertilizer was added. In Treatment No. 2, three shallow cultivations were given but no fertilizer was added. In Treatments Nos. 3, 4, 5, 6, 7, and 8, cultivation was given and fertilizers added as follows: to Treatment No. 3, only phosphorus; to Treatment No. 4, phosphorus and nitrogen; to Treatments Nos. 5, 6, 7, and 8, phosphorus, nitrogen, and potash. In Treatment No. 6, the amount of fertilizer applied was one-half the standard. The standard fertilizer for each plant was .32 pounds of superphosphate, .22 pounds of nitrate of soda, and .06 pounds of muriate of potash. In Treatment No. 7, small plants were used and in No. 8, summer pruning was given. Plants, except in No. 7, were 18 to 30 inches in height when planted. No pruning was given in any treatment except No. 8. The seeds were planted on June 18 in order to produce plants not too large for transplanting by winter. Plants were transplanted in January. Measurements and photographs were made in late July. The distance from camera to plant was the same for all photographs except in Figure 1.

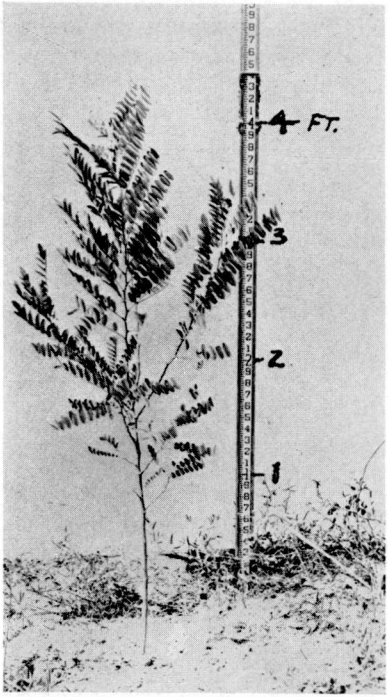

FIGURE 3.—Plant 13 months from seed; land prepared; no cultivation; no fertilizer.

The growth made under the different treatments is summarized in Table 1. Data for three of the earlier plantings are included. Typical plants grown under several selected treatments are shown in Figures 3, 4, 5, and 6. The contrast between plants grown under the different treatments is striking. The plants grown one year on prepared soil even though not cultivated or fertilized were almost as tall as the eight-year-old plants grown in the first planting. They were considerably larger than those grown 3 years on unprepared soil. It should be noted how marked was the response in growth of the locust to each better treatment. The differences in growth are probably more strikingly shown by the photographs than by the table since no measurement given indicates accurately the volume of growth. The basal area, or the cross section area of the plant

FIGURE 4.—Plant 13 months from seed; land prepared; cultivation given; no fertilizer.

at the base, probably represents more nearly the relative size of plant than any other of the measurements given in the table. The plants set on prepared land but uncultivated and unfertilized had an average height of 3.38 feet and an average diameter at the base of .39 inches 13 months from the date of seeding. Plants which were cultivated in addition to being planted on prepared land but which received no fertilizer were, as indicated by relative basal areas, 2.27 times as large as those similarly handled but not cultivated; cultivation thus more than doubled the size of plants. Continuing the use of the basal area as an index of size, the plants receiving phosphorus in addition to cultivation were 3 times as large, those receiving phosphorus

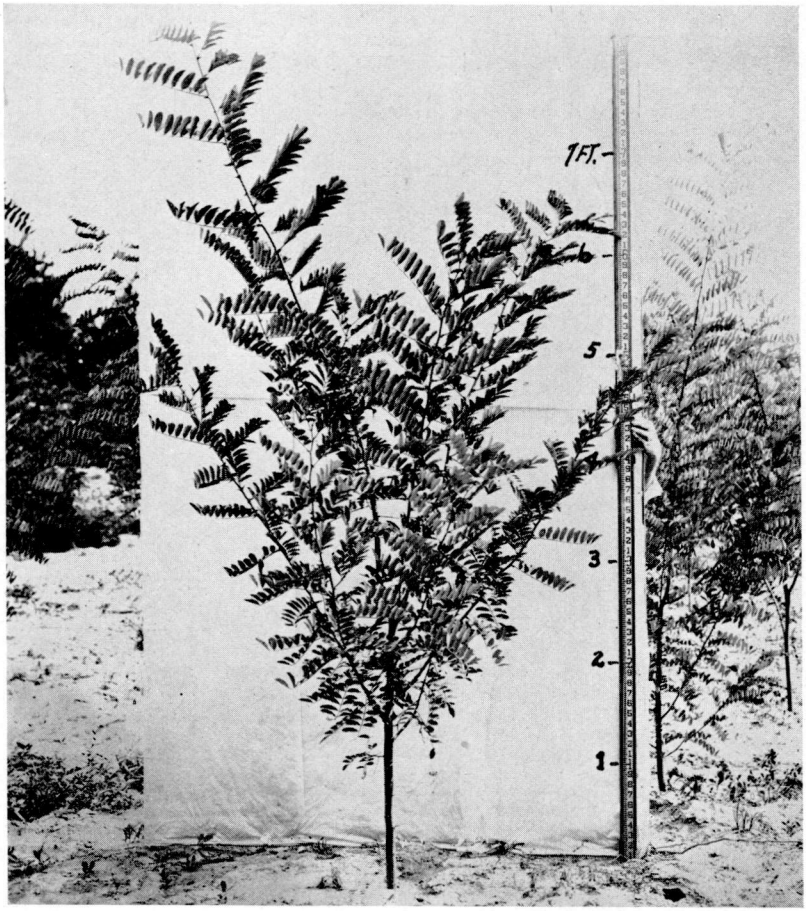

FIGURE 5.—Plant 13 months from seed; land prepared; cultivation given; phosphorus added.

and nitrogen in addition to cultivation were 5.54 times as large, and those receiving nitrogen, phosphorus, and potash were 7.07 times as large as plants which had received no cultivation or fertilizer. Each more intensive treatment, therefore, resulted in better growth. An even more striking contrast may be made by a comparison of the three-year-old plants set on unprepared land and those planted on prepared land, cultivated and given a complete fertilizer. The better handled plants at 13 months of age were 10 times as tall, had an average diameter 5.5 times as great, and according to relative basal areas, were 30 times as large as the three-year old plants set on unprepared land. Ninety-seven per cent of the plants were living on the cultivated and fertilized plots; on the unprepared plot, only 6 per cent were living.

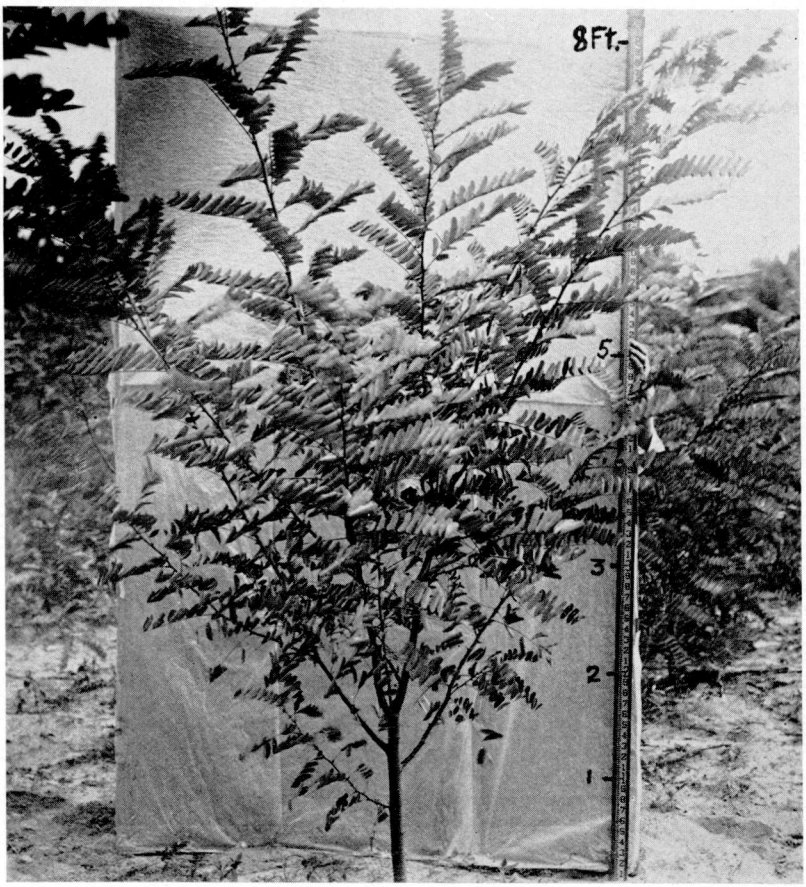

FIGURE 6.—Plant 13 months from seed; land prepared; cultivation given; phosphorus and nitrogen added.

TABLE 1.—Growth of the Black Locust under Different Treatments.

Treatment No.	Age of plants	Character of land	Treatments given			Height	Diam.	Basal area	Rel. basal area
			Land preparation	Cultivation	Fertilizer[1]				
						(feet)	(inches)	(sq. in.)	
1	13 mo.	old field	prepared	none	none	3.38	.391	.120	1.00
2	13 mo.	old field	prepared	cultivated	none	4.97	.590	.273	2.27
3	13 mo.	old field	prepared	cultivated	P	5.62	.687	.371	3.09
4	13 mo.	old field	prepared	cultivated	P+N	6.94	.920	.665	5.54
5	13 mo.	old field	prepared	cultivated	P+N+K	8.14	1.04	.849	7.07
6	13 mo.	old field	prepared	cultivated	½ (P+N+K)	7.31	.947	.704	5.86
7[2]	13 mo.	old field	prepared	cultivated	P+N+K	5.92	.778	.475	3.96
8[3]	13 mo.	old field	prepared	cultivated	P+N+K	8.08	1.01	.801	6.67
9	9 yrs.	gully	none	none	none	3.74	.55	.238	1.98
10	3 yrs.	old field	none	hoed once	none	2.69	.368	.106	.88
11	3 yrs.	old field	none	hoed once	none	.75	.19	.028	.23

[1]P = .32 pounds per plant of superphosphate; N = .22 pounds of nitrate of soda per plant; K = .06 pounds per plant of muriate of potash.
[2]Small plants 6 to 10 inches—all other plants 18 to 30 inches.
[3]Given one summer pruning.

TABLE 2.—Growth of Locust and the Yield and Value of Corn and Cotton Grown as Intercrop.

Treatment				Height	Diameter	Production[1]	Total value[1]	Net value[1]	Cost of labor and materials[1]	Cost of materials only[1]	Cost of materials above value of intercrop[1]
Treatment No.	Fertilizer	Number of cultivations	Intercrop								
				(feet)	(inches)		$	$	$	$	$
1	none	none	none	3.03	.32	———	———	———	4.75	2.00	2.00
2	NPK[2]	3	corn	6.76	.86	8.8 bu.	8.80	6.10	13.25	9.02	2.92
3	NPK[2]	3	cotton	7.89	1.05	413 lbs.	16.52	12.12	13.25	9.02	3.10[3]
4	NPK[2]	3	none	7.10	.91	———	———	———	13.25	9.02	9.02

[1]On acre basis.
[2]Four tenths pound per plant of a 2-8-5 fertilizer applied in March and one-tenth pound of nitrate of soda applied in April.
[3]Less than materials.

Behavior and Cost Considerations when Intercropped.—If it is necessary to handle the locust as a cultivated crop, which requires preparation of land and cultivation and fertilization of the plant, then it is logical to inquire if cotton or corn may not be grown as an intercrop for the first year to bear the cost of materials and operations. It is also of interest to know what effect these two crops might have on the growth of the locust. A study of these points has been made. In this experiment the land was prepared for all treatments. In Treatment No. 1, there was no cultivation, no fertilization, and no intercrop. In Treatment No. 2, the plants were fertilized and corn was grown as an intercrop; in Treatment No. 3, the plants were fertilized and cotton was grown; in Treatment No. 4, the plants were fertilized but no intercrop was grown. Each fertilized plant received approximately .4 pound of a 2-8-5 fertilizer in March and .1 pound of nitrate of soda about 6 weeks later. The cotton received 200 pounds of superphosphate, 100 pounds of nitrate of soda, and 25 pounds of muriate of potash; the corn received 150 pounds of nitrate of soda. Cultivation was given all treatments except No. 1. Each treatment was duplicated and 63 trees were planted in each plot. The results are presented in Table 2. It may be seen that the locust plants were largest in plots where cotton was used as an intercrop and that the cotton produced a crop having a value $3.10 greater than the cost of the locust plants and the fertilizers for the cotton and the locust. This extra value of cotton over the cost of materials was sufficient to allow a reasonable labor charge for preparation of land and cultivation of both crops. This experiment indicates that the labor and materials for starting a crop of locust posts may be taken care of by planting cotton one year as an intercrop.

DISCUSSION OF USES

These experiments indicate rather conclusively that the commonly accepted ideas that the black locust grows well on poor soils or on eroded hillsides, requires no attention, makes an excellent plant for erosion control, and produces, under unfavorable conditions, valuable posts in a short time, are incorrect under Alabama conditions. The results show, rather, that the locust will fail when planted under unfavorable conditions and given no attention; they will make very rapid growth when planted on prepared land and given some cultivation and fertilizer.

Use in Erosion Control.—These results raise certain questions as to the suitability of the locust for some of the purposes to which it has been so commonly thought adapted and to the

methods of handling locust planted for these purposes. It is obviously useless to plant the locust on poor, eroded hillsides for the purpose of stopping erosion and producing posts, unless the land is properly prepared and cultivation given until the plants have become established. These operations necessarily increase erosion during the first year or probably the first two years after which time the locust should be of material value in reducing erosion. Where the locust is planted to stop "washes" or gullies already formed, it is equally obvious that some preparation and attention are necessary at least during the first year. It seems likely that mechanical traps which cause accumulation of soil around the plants will produce conditions similar to preparation of the soil. In gullies or on hillsides one-half pound of a complete fertilizer analyzing 6-8-4 (N-P-K) added to each plant should stimulate rapid growth and hasten the establishment of the plants. Given the favorable conditions necessary for good growth, the locust will make extremely rapid growth. This is illustrated by the plant in Figure 6 which is only 13 months old from seed and has only made 5 months growth since transplanting. In established gullies where the cost of preparing these gullies and properly handling the locust is of secondary consideration and where a plant is wanted which will make a quick strong growth, the locust will well meet the requirements.

The failure of the locust in Alabama to make satisfactory growth, except where given certain treatments which are costly and require considerable time, raises the serious question of the suitability of the locust for large-scale forest planting in erosion control work in this State. If the proper conditions for successful growth of the locust are supplied, it will require for labor and materials approximately $12 to $14 to establish an acre. This is entirely too costly for general programs involving large areas, and the locust is almost certain to fail unless it is given rather careful attention at least for the first year. Unpublished data at this Station on pines have shown that when planted on eroded hillsides, in washes, and on poor sites, and given no further attention, except fire protection, they have grown rapidly, have been effective in erosion control, and by the eighth year are well on the way toward furnishing a valuable crop of timber. The cost of establishing pines is only a fraction of the cost of establishing black locust because no preparation, no cultivation, and no fertilizer are required for pines. The locust, therefore, does not seem to be as well suited to large-scale plantings as the pine. The locust is furthermore not as valuable for timber purposes as the pine; its uses are more limited and while better adapted to certain purposes than the pine, a limited volume of locust will easily supply the requirements for this species. There is thus little reason for extensive planting of the locust.

Production of Fence Posts.—Although the locust does not appear adapted to general forest plantings it makes an excellent and durable fence post and, when properly handled, offers opportunity to farmers of producing the posts needed on the farm. Where the locust is planted primarily for fence posts and where erosion is of little importance, the planting should be located on land of fair fertility and handled as a cultivated crop for one or two years. After this time it may be left quite largely to take care of itself. In starting the planting, the land should be prepared by turning and the plants set 6 x 6 feet apart, fertilized at the rate of ½ pound per plant with a 2-8-4 (N-P-K) fertilizer, and given clean cultivations the first year. Approximately one-tenth of a pound of nitrate of soda should be added about one month after growth has started. Neither the complete fertilizer nor the nitrate should be placed near the plant. Both should be placed about 6 inches from the plant and distributed in a 6 to 8 inch band around each plant. Isolated areas not easily reached when working other fields may be selected as a site for the planting because little attention is required after the first year, and plantings well established need little care.

The area on which the locust plants are set should preferably be given over to post production indefinitely for two reasons: first, after the first crop of posts has been cut other crops are quickly produced by sprouts from the stumps; second, the locust is completely removed from an area only with great difficulty because of the strong tendency of the locust to send up new plants from wounded or severed roots.

Preliminary studies indicate that some pruning is desirable. About one month after growth starts the first year, the plants should be trained or pruned. Where two or more branches are competing for the central or primary position, each branch should be cut back to one-half its length except the one which is left to assume the central position. The branches which are cut back at this period stop growth until a new mechanism for growth is produced by the formation of lateral buds. During this delay the unpruned branch straightens, and takes the central position; the pruned branches when growth does start have become so reduced in size relative to the unpruned branch that they take secondary positions and become branches of the unpruned branch. During the first winter, another pruning should be given following the principles of the summer pruning. Further experimental work is being done to determine how much pruning should be given to develop a single straight trunk.

One acre of locust planted 6 feet x 6 feet will produce 1,210 stems. Approximately 500 pounds of a complete fertilizer in addition to 125 pounds of nitrate of soda will represent approximately $7 per acre invested in fertilizers. If the cost of the

plants is added then there has been an outlay of about $9 for 1,200 posts or a cost for material of less than one cent per post. The farmer supplies all other requirements in land and labor. A crop of cotton may be grown the first year between the locust to pay for the fertilizer and plants required to establish the planting.

SUMMARY

Results based on 10 experimental plantings established at various points in the State have been presented showing the behavior of the black locust on different sites and under different conditions. The results, while not final, seem to establish rather definitely the following points:

(1) That the locust planted in gullies, on eroded hillsides, or on old fields will fail where the land has not been prepared and where the plants have received no attention.

(2) That the locust planted on old fields of low or fair fertility will make very rapid growth where the land has been prepared, where three cultivations have been given, and where a complete fertilizer has been added.

Deduction from the results of these experimental plantings indicate:

(1) That the locust used in gullies or on badly eroded areas for erosion control should be planted on prepared land and given the first year sufficient cultivation to remove competing vegetation and sufficient complete fertilizer to induce a vigorous growth.

(2) That the cost of establishing the locust satisfactorily makes this species too costly to use in large-scale reforestation programs or for large-scale plantings on abandoned agricultural land.

(3) That the locust planted for fence posts should be handled as a crop the first year, the land being prepared, and the plants given two or three cultivations and about four-tenths pound per plant of a 2-8-4 (N-P-K) fertilizer supplemented with about one-tenth of a pound of nitrate of soda.

(4) That the cost of plants and materials for establishing a planting of locust for posts should not exceed one cent per post assuming only one post from each plant set, and assuming that no intercrop is grown.

(5) That cotton, grown as an intercrop, may be expected to bear the cost of preparing land and cultivating and fertilizing both crops, thus establishing the locust planting with little or no initial cost.