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LAND CLEARING IN ALABAMA BOTTOM LANDS

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There are 5,000,000 acres of reclaimable bottom land in Alabama. Undrained this land has little or no value for crop production. Although it is some of the best land in the State, its purchase price is so low that the total cost is nearly represented by the cost of reclamation.

To determine what should be done with it a study was made of its condition, and some experimental work done in land clearing. The clearing consisted of removing standing timber and brush, and then the removal of stumps by pulling and blasting, both while they were green and after they had undergone a period of decay.

This circular is a record of this study and experimental work and an explanation as to how it was done.

PROCEDURE

Plots were selected in the Fayette-Lamar Drainage District and in the bottom lands of Clay County.

Two and one quarter acres on the outer edge of the bottoms drained by the Fayette-Lamar Canal were cleared at Millport in Lamar County; one and one half acres at Winfield, in Marion County; one acre at Covin, in Fayette County; and two acres at Bluff Springs, in Clay County.

The soil of these acres is Ochlochnee sandy loam deposited by the streams near the canal. There is no sub-soil within several feet of the surface.

Soil conditions of the plots studied are typical of those throughout the drainage districts of the State.

Blasting was done by placing powder under the stump; and, in case of tap-rooted stumps, beside the tap root with a soil auger or driving bar and sledge. Large stumps (15 inches and over) were blasted by loading in a spring hole made by shooting 1/3 stick of dynamite at the desired depth under the stump. The fuse and cap methed of firing was used.

The cooperating agencies were: The Hercules Powder Company, the DuPont Powder Company, the land owners of the land where the work was done, and the Tom Houston Manufacturing Company, Columbus, Georgia.

The number and condition of the stumps are shown in Table 1 which follows:

Table I.—Area, Location, Number, and Condition of Stumps.

Plot	Location	Acres	Pine	Gum	Oak	Bay	Misc.	Total	Condition
No. 1	Lamar Co. Millport	1 1-8	50	16	14	7	16	103	Green
No. 2	Lamar Co. Millport	1 1-2	14	42	5	3	40	76	Green
No. 3	Fayette Co. Winfield	1-2		6	10		17	33	Green
No. 4	Fayette Co. Winfield	1-2		10	8	3	4	25	Green
No. 5	Fayette Co. Winfield	1-2		9	7	3	6	25	Green
No. 6	Fayette Co. Winfield	1	25	16	21		2	64	Decay-ed 1 yr.
No. 7	Clay Co. Bluff Spr'gs	1-2	8	12	6		18	45	Green
No. 8	Clay Co. Bluff Spr'gs	1 1-2	14	60	23		45	142	Green

Plots 1, 2, and 7 had similar soil conditions, had the timber removed the same year as the blasting, and were fired with three different but comparable kinds of explosives. Test shots gave the load requirements. All were shot with approximately the same degree of efficiency by the same blasting crew.

Table II is a record of the relation of the diameter of stump to cost of removal.

Table II.—Relation of Diameter of Stump to Cost of Removal.

Plot	Explosive	Average Diameter of Stumps	Lbs. of Explosive Loaded	Actual cost per Stump	Cost per Stump (powder at $22 per 100 lbs.
1	Hercules Special	11.7	.62	.25	.25
2	Sodatol*	14.9	1.25	.27	.41
7	Durox	17.3	3.50	.85	.85

From the above data, it is seen that when the cost of explosive is the same per pound the final cost per stump is not in proportion to the diameter. For each increase of three inches in diameter the cost per stump is nearly doubled.

EFFECT OF SOIL CONDITIONS ON BLASTING EFFICIENCY

The period from December to March is preferable for land-clearing because farm labor is not busy with other work during this period. From a technical standpoint this is true also be-

*Sodatol is a war salvaged explosive, equal in strength to 40-per cent dynamite. Durox and Hercules Special are equal to 30 per cent dynamite and similar in speed and power. This in all probability accounts for the relatively lower cost of 14.9-inch stumps.

cause most bottom lands have a high free-water content at this time.

There is no subsoil in these bottoms sufficiently close to the surface for a foundation for the blast, due to the alluvial nature of the soil. The soil is loose, friable, and soft; and, with a low free water content, the blast is forced into the earth by the heavy-rooted hardwood stump above. An extra large charge will heave the soil through the roots and leave the stump intact, indicating that the force of the blast compressed the soil upon the bottom and sides of the shot hole. The result is that the line of least resistance is then upward. The loose, friable soil, instead of holding together and acting as a shoulder for the blast to life against the stump, will sift between the roots, the result being a stump left in place with a large hole under it.

With a high free-water content in the soil, the blast meets positive resistance upon the bottom and sides of the shot hole, due to the free water rendering it less compressible. The line of expansion of the blast is upward after a relatively small downward and outward expansion. Instead of soil working through the roots, as it does with drier soils, it will hold together, due to its adhesive and cohesive qualities, and act as a shoulder for the force of the blast to life against.

The results at Winfield where the plots were well drained and at Millport where they were poorly drained will serve to show the tremendous effect of free water upon blasting efficiency.

Table III, which follows, shows the relation of moisture to blasting efficiency.

*Table III.—Relation of Moisture to Blasting Efficiency**

Explosive	Diameter of Stump	Poorly Drained	Well Drained
40% Ammonia	16.0		56. %
60% Ammonia	12.4		56. %
20% Ammonia	17.5		30.3%
30% (Dumorite)	16.5		64. %
30% (Hercules Special	11.7	93%	
40% (Sodatol)	14.9	94.2%	
30% (Hercules Special)	12.8	100%	

THE LABOR AND MATERIAL COST

The final cost of pulling and blasting is determined by the labor cost and the material cost.

The following is a summary of the cost of a pulling operation and blasting operation to show what percentage of the final cost in each case is labor and material:

*Efficiency is percentage of stumps completely removed after optimum charge had been determined by trial shots.

Operation	Labor	Material
Pulling 10.9 inch stumps	68%	32%
Blasting 11.7 inch stumps	39%	61%

The above is a comparison in which all labor is figured at the same rate. This does not include depreciation or interest charge of the stump puller. The materials used in pulling include gasoline and oil for a power stump puller and dynamite for loosening large stumps and breaking them up after they were pulled.

KIND OF EXPLOSIVE TO USE

In dry land, as previously shown, none of the explosives were highly efficient. Twenty-per cent ammonia dynamite, with a speed of 9600 feet per second was found too slow. It blew the dirt from under the stump, leaving the stump practically in place and difficult to remove. Sixty-per cent dynamite with a speed of 16,000 feet per second was found more satisfactory than the 20-per cent. However, sixty-per cent dynamite was too fast. It shattered the stump without removing it.

The most satisfactory explosive tried was the 30-per cent and the 40-per cent dynamites, including sodatol. These had a speed of 12,000 to 14,000 feet per second.

Any of the explosives named proved satisfactory in wet soils. There is little or no difference in the performance of the high counts (explosives having approximately three sticks to the pound) of 30-per cent dynamite and 40-per cent dynamite; but, high-count explosives are cheaper, and they should be used for this reason. They are sufficiently strong to blast out green stumps and fast enough to be used in mud capping, which is breaking up stumps that have been removed with a stump puller.

RELATION OF STUMP DIAMETER AND SIZE OF CHARGE

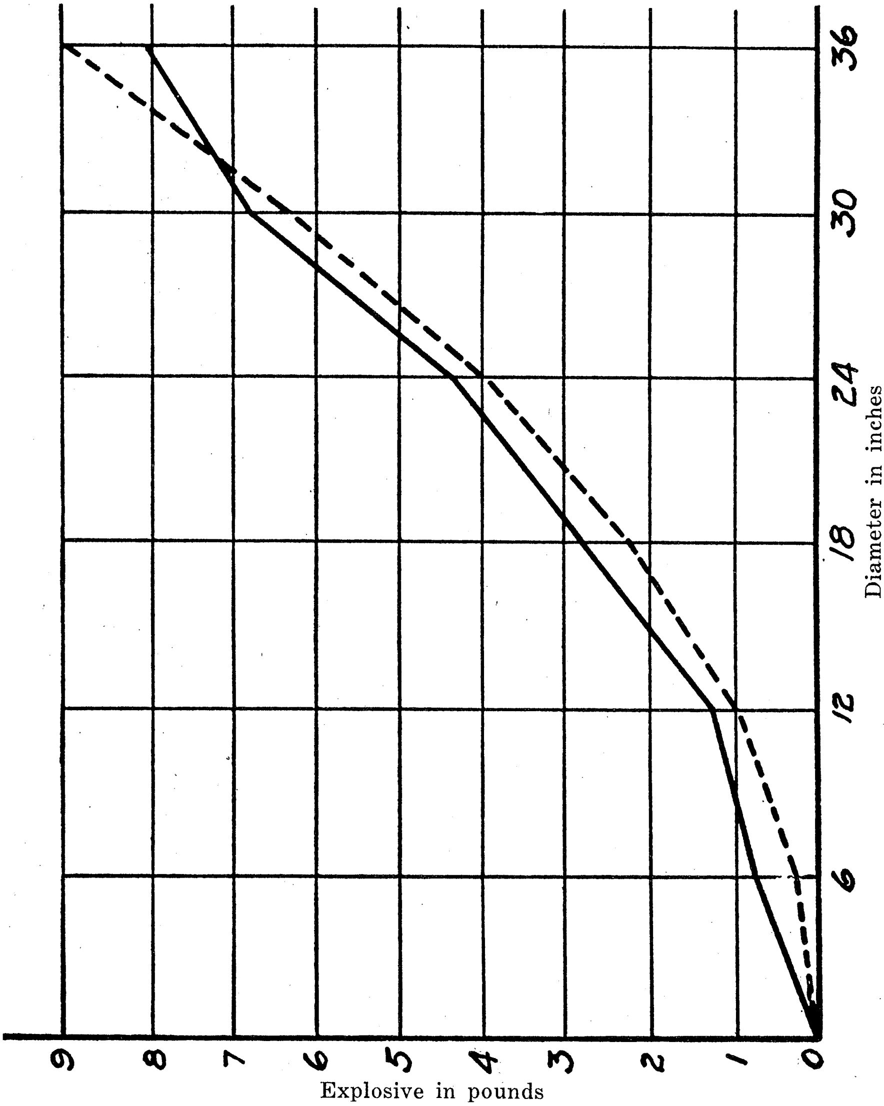
The graphs on page 6 show two curves, one of which was plotted from the records of loads used in shooting 463 stumps in experimental work and the other by using E. D. Strait's rule: "Roughly, the load in pounds required to shoot a stump clear of the ground is the same as the square of the diameter of the stump in feet at the cut-off." (U. S. Dept. of Agr. Farmers' Bulletin No. 974).

It is noted that the $L = D^2$ curve is less by an average of 0.4 pounds than the actual curve, except in the case of 36-inch stumps. Here the L equals D^2 curve is greater by one pound than the actual load cruve. J. R. Mattern says: "In clearing land of stumps, the rule L equals D^2 overestimates the load for stumps 36 inches and above." (Proceedings of the Institute of Makers of Explosives).

Although neither of these authorities mentions type of soil, grade of dynamite, or type of stump, there is a close relation between their statements and the result as indicated on the graphs.

Using 0.1 pound of dynamite as a factor of safety and adding the average difference between the two curves, the following

LOADING CHART



Actual load curve ————————

Curve based on L = D² - - - - - - - - -

rule is formulated:

$$L \text{ equals } D^2 \text{ plus } 0.5$$

L equals load in pounds of high-count dynamite (Durox, Hercules Special, and Dumorite) and D equals the diameter of the stump in feet 14 inches from the ground. This rule holds for green hardwood stumps in bottom land that has a relatively high free-water content. It will serve as a guide for blasting under a wide range of conditions.

Table IV, which follows, is a summary of the experiments reported in this circular.

Table IV—Summary

Time	Condition of Soil	Means	Stumps per Acre	Inches Diameter	Material	Labor	Brushing	Total	Cost per Stump	Quality of Work
1st. yr.	Wet	Herc. Special	103	11.7	16.62	9.30	17.70	53.62	.25	Good
1st. yr.	Wet	Sodatol	76	14.9	12.19	8.25	17.70	38.17	.27	Fair
2nd yr.	Wet	Herc. Special	64	12.8	21.60	10.20	16.00	47.80	.49	Perfect
1st. yr.	Wet	20% Ammonia	66	17.5	27.28	16.40	12.80	56.48	.63	Failure
1st. yr.	Wet	Dumorite	50	16.5	20.80	14.60	12.80	48.20	.67	Fair
1st. yr.	Dry	40% Ammonia	50	16.0	22.50	16.40	12.80	49.70	.74	Fair
1st. yr.	Dry	Durox	90*	17.3	69.16	7.30	13.10	90.36	.85	Perfect
1st. yr.	Dry	Tractor Puller	94*	10.6	10.03	21.21	19.87	51.11	.33	Perfect

*Carried only to the burning stage.