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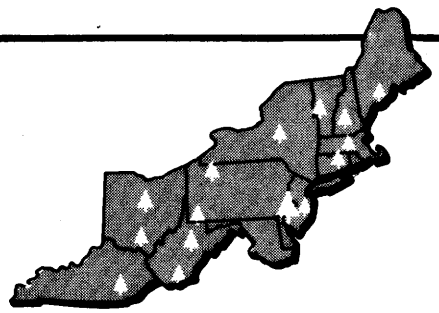

FOREST SERVICE, U.S. DEPT. OF AGRICULTURE, 6816 MARKET STREET, UPPER DARBY, PA. 19082

REQUIREMENTS FOR ADVANCE REPRODUCTION IN ALLEGHENY HARDWOODS — AN INTERIM GUIDE

Abstract.—Reproduction tallies on 65 areas planned for clearcutting were compared with reproduction 2 to 4 years after cutting. As a result, we recommend that 70 percent of the area be stocked with at least 5,000 black cherry seedlings or 30,000 seedlings per acre of desirable species before cutting. If this requirement had been used on these 65 areas, the proportion of regeneration successes would have been raised from 54 to 92 percent.

The Problem

When mature stands in most hardwood regions of the East are clearcut for regeneration under even-aged management, some kind of more or less complete tree cover is normally re-established in a short time. This does not always occur in the Allegheny hardwood region of northern Pennsylvania, however. Numerous clearcut areas in this region have failed to regenerate adequately to tree seedlings and are now stocked mainly with ferns and grasses, with or without some beech or striped maple.

Fencing studies have shown that browsing by the large population of white-tailed deer on the Allegheny Plateau is a major cause of these regeneration failures (*Grisez 1957 and Huntzinger 1967*). Ground cover competition, poor seed sources, site, and other factors may also be important — alone, or in combination with browsing damage.

Of course, prompt regeneration after clearcutting is vital to even-aged management. Without it, regeneration cuttings must be deferred or large costs must be borne to assure adequate restocking. The longer the interval between cutting and restocking, the more difficult the process becomes, due to the build-up of competing herbaceous vegetation.

It is generally agreed that adequate advance reproduction is necessary for securing prompt and satisfactory regeneration (*Pa. Forest. Assoc. 1970*). Observations indicate that good regeneration usually follows clearcutting in spite of heavy deer browsing where advance seedlings were abundant. Conversely, regeneration failures are likely where advance seedlings were scarce before cutting.

But how many advance seedlings are needed to insure successful regeneration? This is a report on results of correlations between the stocking of advance seedlings present before cutting and the success of regeneration 2 to 4

years after cutting. It provides an interim guide to the selection of stands for clearcutting.

Methods

Advance reproduction tallies were made in late summer each year in 65 areas scheduled for clearcutting over the period 1967-69. Seedlings were counted on a cluster of 9 milacre plots in each area. Tallies included — at the minimum — estimates of the number of black cherry seedlings and the total number of seedlings of all desirable species. On about half of the plots — which are part of a more detailed research study — tallies included numbers by species, two age classes of seedlings, and numerous other variables.

In December 1971, all clearcuts where counts of advance reproduction had been made were reexamined. Ocular estimates were made of the size and density of reproduction on the clearcuts. Each clearcut was judged as being *apparently successful* or *apparently unsuccessful.* All areas were classified, even though several were questionable. Successful or satisfactory regeneration was defined as having at least 70 percent of the area stocked with desirable species (all commercial species except birch, beech, hemlock, and aspen). Desirability is based on value for timber production only.

The success ratings were then compared to seedling tallies made before cutting. This was done by assuming a variety of different minimum stocking levels and then examining the data to find out how many of the 65 areas would have qualified for clearcutting under each of the assumed levels. Seedling tallies were used in two different kinds of stocking requirements: (1) in terms of the average number of seedlings on all 9 plots, and (2) in terms of the minimum number of seedlings on 6 of the 9 plots (table 1). The former is the same as thousands of seedlings per acre, because these were milacre plots. The latter was used because it is close to the 70-percent requirement for a successfully regenerated clearcut.

If the stocking requirement had been set extremely low, say only 2,000 seedlings per acre of desirable species, all of the 65 stands would have qualified for cutting; and the results would have been just as actually happened — 35, or 54 percent, are apparently successful. If the requirement had been set higher than the stocking of seedlings found on any of the areas, none of the areas would have qualified; and the 35 stands that could have been regenerated would not have been cut.

As table 1 illustrates, when the stocking requirements are more stringent, the number of stands that qualify decreases and the prediction accuracy or percentage of success increases among those that qualify. At the same time, the number of stands that are not qualified, but would be successful if cut, increases. What we were looking for was a stocking-level requirement that provides high success among the stands that qualify for cutting without disqualifying too many stands that would actually regenerate successfully.

Many different stocking-level requirements were tried, in terms of both the average number of seedlings on all 9 plots and a minimum number on 6 of the 9 plots. These included various numbers of black cherry alone, various numbers of desirable species, various numbers of black cherry *or* desirable species, and various numbers of black cherry *and* desirable species (table 1). Stocking-level requirements were also tried that involved only first-year seedlings, and only second-year and older seedlings of each of the following: black cherry, desirable species, and all tree species. These data were available only on the 31 research-plot clusters.

Results

Stocking requirements based on the age-class groups from the research-plot data either had low value for predicting success or disqualified too many stands. However, these plots did show that first-year black cherry seedlings were equally as good predictors as older ones.

For all 65 areas, requirements based on only 5 or 10 black cherry seedlings of both age classes on 6 out of 9 plots had remarkably high predictive value — 95 to 100 percent of the stands that qualified under such require-

Table 1.—*Outcome of stand regeneration on 65 areas under various advance regeneration stocking requirements*

Stocking required (number of seedlings)	Stands qualified for cutting	Stands apparently regenerated successfully		Stands not qualified but apparently regenerated successfully
	No.	*No.*	*Pct.*	*No.*
IN TERMS OF AVERAGE NUMBER ON ALL NINE PLOTS				
5 black cherry	33	27	82	8
10 black cherry	24	20	83	15
15 black cherry	19	18	95	17
20 desirable species	39	29	74	6
25 desirable species	34	27	79	8
30 desirable species	30	24	80	11
40 desirable species	27	22	81	13
50 desirable species	16	15	94	20
5 black cherry or 25 desirable species	40	31	78	4
5 black cherry or 35 desirable species	37	29	78	6
5 black cherry or 45 desirable species	33	27	82	8
10 black cherry or 25 desirable species	34	27	79	8
10 black cherry or 35 desirable species	31	25	81	10
10 black cherry or 45 desirable species	27	23	85	12
10 black cherry or 55 desirable species	26	22	85	13
15 black cherry or 25 desirable species	33	27	82	8
15 black cherry or 35 desirable species	30	25	83	10
15 black cherry or 45 desirable species	25	23	92	12
15 black cherry or 55 desirable species	22	20	91	15
5 black cherry and 20 desirable species	28	24	86	11
5 black cherry and 25 desirable species	26	23	88	12
10 black cherry and 20 desirable species	23	20	87	15
10 black cherry and 30 desirable species	22	19	86	16
IN TERMS OF MINIMUM NUMBER ON SIX OUT OF NINE PLOTS				
5 black cherry	19	18	95	17
10 black cherry	12	12	100	23
15 black cherry	10	10	100	25
10 desirable species	39	29	74	6
20 desirable species	25	19	76	16
25 desirable species	20	17	85	18
30 desirable species	17	15	88	20
35 desirable species	14	12	86	23
5 black cherry or 20 desirable species	30	24	80	11
5 black cherry or 25 desirable species	27	24	89	11
5 black cherry or 30 desirable species	25	23	92	12
5 black cherry or 35 desirable species	22	20	91	15
10 black cherry or 20 desirable species	27	21	78	14
10 black cherry or 25 desirable species	23	20	87	15
10 black cherry or 30 desirable species	20	18	90	17
10 black cherry or 35 desirable species	18	16	89	19
15 black cherry or 20 desirable species	25	19	76	16
15 black cherry or 25 desirable species	21	18	86	17
15 black cherry or 30 desirable species	19	17	89	18
15 black cherry or 35 desirable species	16	14	88	21
5 black cherry and 15 desirable species	17	15	88	20
5 black cherry and 20 desirable species	15	14	93	21
5 black cherry and 25 desirable species	13	12	92	23

ments are successfully regenerating. But these criteria excluded from cutting 17 to 23 stands that are also regenerating successfully. The stocking of seedlings of desirable species was generally not as good in predicting success as black cherry alone; or where it was (at high levels of stocking), it disqualified more successful stands.

The criterion that seems to offer the best compromise is the requirement that 70 percent of the milacres examined contain at least 5 black cherry seedlings *or* 30 seedlings of desirable species (table 1). This combination gives a good prediction without disqualifying too many potentially successful cases.

Had this criterion been used prior to cutting these 65 stands, only 25 would actually have been cut. Twenty-three (92 percent) of these are apparently regenerating successfully. Only 12 of the other 40 stands that did not qualify for cutting under this criterion are apparently regenerating.

The same results would have been obtained on these 65 areas if the required stocking had been an average of 15 black cherry seedlings or 45 of desirable species on the 9 plots. We prefer to use the minimum stocking on 6 out of 9 plots because it requires that the seedlings be well distributed. The 25 stands that qualified under one method are not the same 25 that qualified under the other; 3 of them are different.

There are probably several reasons why relatively small numbers of black cherry seedlings indicate a good chance of regeneration success. Even small first-year black cherry seedlings apparently have a high rate of survival when the overstory is removed. And these seedlings grow rapidly when released, particularly in the absence of dense ground cover.

Areas with advance black cherry seedlings are also likely to have ungerminated seeds in the litter and humus from the most recent seed crop, thus increasing chances that successful reproduction will be obtained. More definite information about this should result from studies now under way.

And finally, regeneration assessed only 2 to 4 years after cutting, as was done here, may be more apt to be rated good if it is mainly black cherry than if it were a slower growing species that would be smaller and more difficult to see at the time of the assessment.

Application of Results — an Interim Guide

In the examination of stands for cutting or other silvicultural treatment, many factors of stand condition and site should be taken into account (stocking, maturity, proportion of acceptable growing stock, etc.). The stocking of advance seedlings is another factor that should be considered before any harvest cutting is prescribed in Allegheny hardwoods. As a basis for evaluating advance regeneration, we suggest the following:

- Advance reproduction must be sampled to estimate amount and distribution. Twenty to 30 sample points in each stand are desirable; more may be required if the area is large or diverse; fewer may suffice if the area is small and uniform; but 10 should be an absolute minimum. These points should be selected by some random procedure, and they may be the same points used for examination of other stand characteristics such as volume.

- Each sample point is rated as being either stocked or not stocked, on the following criteria:
  Stocked: Contains at least 15 advance seedlings of black cherry *or* at least 80 advance seedlings of any desirable species within a 6-foot radius of the sample-point center. The values of 15 and 80 seedlings per 6-foot-radius plot correspond to 5,000 and 30,000 seedlings per acre (5 and 30 per milacre). Estimates rather than actual seedling counts are adequate, once some experience has been gained. (The 6-foot plot radius was selected because of a tie-in to standard stocking guides for stands of northern hardwoods that have an average d.b.h. of 5 inches.)
  Not stocked: Contains less than above.

- When all sample points have been rated, the percentage of plots stocked by the above criteria is determined. If 70 percent or more are stocked, the stand can be ex-

pected to regenerate after clearcutting. If fewer than 70 percent are stocked, chances of regeneration failure after clearcutting are high; and final cutting should usually be postponed.

This stocking guide is considered an interim guide because it should be possible to improve it with further research and experience. A study to determine the size, age, or vigor of advance seedlings that survive and develop into the succeeding stand is under way. Use of such information should improve the reliability of the guide. The results that other users of this guide might have in regenerating Allegheny hardwoods will also be useful in checking its reliability or in modifying it, and we welcome such information.

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—TED J. GRISEZ and MAURICE R. PEACE*

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*Ted J. Grisez is a Research Forester, Northeastern Forest Experiment Station, and Maurice R. Peace is a Forester, Allegheny National Forest. Both are stationed at Warren, Pa.