Converting low-grade hardwood forests to Japanese larch with fenuron herbicide

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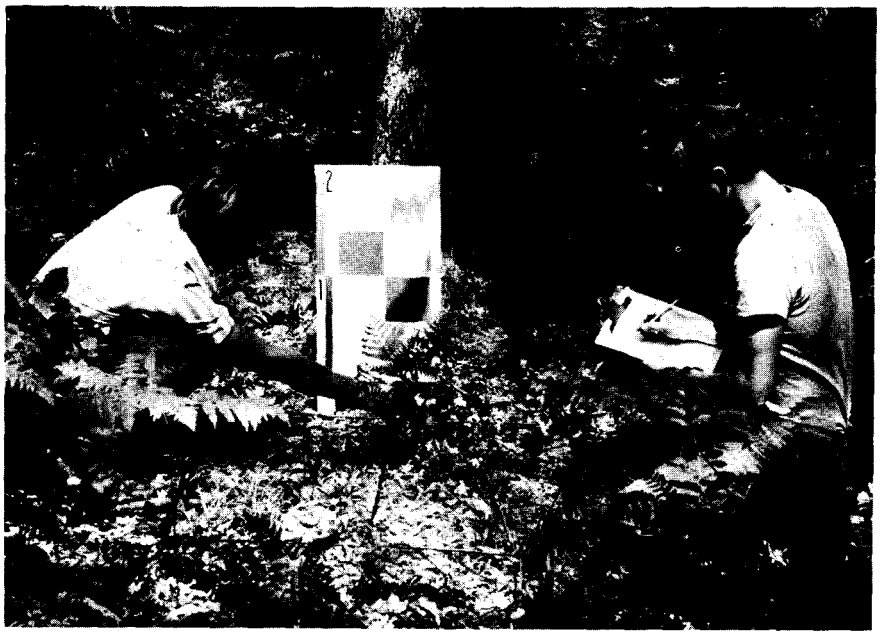
Millions of acres of mixed-oak forests in the Northeast are poorly stocked with naturally occurring tree reproduction. These areas include our most heavily used and accessible forest lands, but many are marginal sites not fertile enough to grow quality hardwoods.

Twenty ears ago most foresters would have been reluctant to attempt a conversion from native hardwoods to conifers, especially exotic ones. However, with the development of effective herbicides of low toxicity to non-target organisms and their use in controlling unwanted hardwoods and other vegetation, converting stands from one species to another is a sound technique both ecologically and economically. If the operation is well planned in advance and properly executed, the problems involved can be minimized.

The results described in this article show that low-grade, undesirable hardwood trees can be successfully controlled with fenuron (3-phenyl-1, 1-dimethylurea), a dry, pelleted, soil-applied herbicide. Defoliation and killing of the overstory "weed" trees improved the survival and rapid juvenile growth rate of underplanted Japanese larch (*Larix leptolepis* Sieb. and Zucc.) seedlings, depending upon the amount and placement of the herbicide. An increased production of ground vegetation, shrubs, forbs and grasses, well-suited for wildlife food and cover, were found on the herbicide-treated areas. Thirty-six individual plant species were identified on the treated area 5 years after treatment (fig. 1) . This was approximately double the frequency of occurrence of species

Figure 1.—Five years after stand conversion twice as many deer browse species were found on fenuron-treated plots when compared with adjoining untreated hardwoods.



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found on adjacent untreated areas.

Annual deer browsing of the larch seedlings during the 5-year post-treatment period showed a minimal reduction in growth and tree form. Simultaneous underplanting and herbicide application has resulted in the replacement of low-grade hardwoods with Japanese larch, a species that is compatible with deer browsing, grows rapidly, and has acceptable sawtimber and pulping characteristics.

Procedure

The experimental procedure has been described in detail in an earlier report.[2] Briefly, in May, 1965 2-year-old Japanese larch seedlings were planted at a 6 x 6 foot spacing beneath the canopy of a lowquality, 50-60-year-old oak-hickory stand, located on the Allegheny Plateau in Central Pennsylvania. Soils on the experimental site are highly acid, well-drained, sandy loams derived from underlying sandstone and shale.

Nine duplicate one-tenth acre plots, including untreated controls, were assigned at random. Each plot was designated as a treatment (method by rate) combination. Approximately one month following planting, all plots were treated with fenuron, applied directly to the soil surface at rates per acre ranging from 0 to 45 lbs. per acre in grid, band, and broadcast methods. Annual measurements of the degree of overstory defoliation, seedling height growth and survival, and the amount of deer browsing have been recorded since 1966.

Results

Throughout a 5-year period, the treated overstory trees have died gradually; their leaves, branches and hark falling to the forest floor. The mulch thus formed has reduced soil evaporation and conserved moisture, and thereby improved the microsite characteristics for the developing new forest (fig. 2) . As the overstory was eliminated, increased amounts of sunlight and precipitation allowed the profuse development of ground vegetation. Highly preferred browse species such as sassafras, red maple, witch hazel, and pokeberry have increased substantially, thus supplying the (leer with added nutrition and cover where minimum amounts existed before herbicide treatment.

As anticipated, the survival and height of Japanese larch was directly related to the amount, method and spatial distribution of fenuron application (table 1) . The "best" average height obtained after five growing seasons occurred when pellets were applied in grid fashion between the rows of planted trees at a 15 pound per acre rate. Japanese larch on these plots were 5 feet taller than those planted in the untreated controls. Only the grid and band methods of application were successful in terms of adequate survival and growth. Herbicide injury reduced survival and height of Japanese larch with broadcast applications, attributable to the random and nondirected placement of the pellets.

Deer browsed the Japanese larch every year, beginning in 1966. As shown in Table I, the mean level of browsing for all treatments was 70 percent in 1966, gradually increased to 96 percent in 1968, and then dropped abruptly to 43 percent in 1970. Thus, in spite of annual browsing for five consecutive years, by 1970 the available browse was reduced as a result of the increase in tree height. The results clearly show that Japanese larch is essentially "deer proof" during the critical first years of establishment, and that compatibility between the growing of timber and wildlife production is possible - an eternal problem in converting northeastern forests where (leer populations are high.

Discussion

In past attempts at stand conversion, critically important economic, ecological, and physiological questions involving the planted or seeded species were often not fully studied or predicted. For example, will the added increase in timber, wildlife, and recreational values be equal to or exceed the dollar investment in herbicide? What introduced species will have the best chance for rapid growth, acceptable sawtimber or pulping characteristics, and withstand browsing by deer and other rodents during the early establishment period?

In our initial stand conversion trials with underplanted red and white pine seedlings, approximately

Figure. 2.-In the new forest of Japanese larch after 5-year's development, trees are 8-10 feet high. Dead overstory oaks show extent of fenuron kill, which releases the larch and allows (leer browse plants to develop on the forest floor.

2 Shipman, R. D. Establishment and early release of underplanted Japanese larch with soil-applied fenuron. Tree Planters' Notes, 20 (1) : 23-27. 1969.

TABLE 1.—*Effect of fenuron herbicide on the growth, survival and deer browse of underplanted Japanese larch*

Fenuron Treatment[1]		Year after planting											
		1966			1967			1968			1970		
	Rate	Height	Seedling Survival	Deer Browse	Height	Seedling Survival	Deer Browse	Height	Seedling Survival	Deer Browse	Height	Seedling Survival	Deer Browse
Method	lbs/A	*In.*	*Pct.*	*Pct.*	*In.*	*Pct.*	*Pct.*	*In.*	*Pct.*	*Pct.*	*In.*	*Pct.*	*Pct.*
Grid	45.0	20.3	82	76	29.6	81	86	41.8	81	93	108.4	81	26
Grid	15.5	20.6	78	78	27.7	78	92	36.4	76	97	92.1	76	38
Grid	13.7	20.6	90	59	29.0	89	96	39.0	88	98	91.0	88	38
Grid	7.0	16.5	83	74	21.9	82	88	29.2	82	99	65.9	81	58
Band	30.0	20.0	82	69	28.4	81	84	36.6	80	96	90.3	79	41
Band	15.0	19.5	83	66	27.1	82	94	36.1	82	97	89.3	82	34
Broad-cast	30.0	18.5	38	81	25.3	37	87	34.5	37	96	84.7	36	49
Broad-cast	15.0	16.4	53	58	20.4	53	91	26.9	52	94	60.2	51	58
Control	0.0	13.7	85	89	14.5	82	93	15.9	78	99	29.9	75	46
Mean All Treatments		19.1	74	70	26.2	73	90	35.1	72	96	85.2	72	43

[1] 25 percent active formulation of fenuron (3-phenyl-1, 1-dimethylurea) applied to duplicate one-tenth acre plots per method.

95 percent were damaged because deer browsed the terminal bud. Most pines have an excurrent type of branching and if the apical bud is removed, height growth is reduced and trees of this kind will eventually become "bushlike."

The larches, however, possess a deliquescent or indeterminate type of branching; if a browsing animal removes the terminal bud from this species, a new one forms rapidly so that the tree's growth potential is not seriously impaired (fig. 3). The more rapidly a seedling grows beyond the reach of deer, the less time it will be exposed to browse damage. This is a vital consideration in predicting the success of a stand conversion operation.

While temporary improvement and a greater diversity of wildlife populations occurs, it is likely that after about 10 years (as trees begin to close with one another) , the area will lose- value in providing cover and diversity of habitat. However, a thinning at approximately age 20 will once again open the stand for wildlife production.

Larch stands, just coming into volume production, can grow $1\frac{1}{2}$ cords per acre per year of pulpwood. The best that the adjoining 50-60-year-old oak stands can produce on these sites is approximately $\frac{1}{2}$ cord per acre per year. Thus, a threefold increase in volume production is possible when low-grade oak stands have been successfully converted to Japanese larch.

Figure 3.-Despite loss of terminal branch to deer, this 2-year-old Japanese larch formed a new one and growth is unim paired.

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Caution: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife-if they are not handled or applied properly. Use all pesticides selectively and carefully as described. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.