TWO HERBICIDES REDUCE WEEDING COSTS IN WASHINGTON NURSERY TRIALS[1]

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Weed control in forest nurseries is essential, but high costs of present methods require that better means be found. Herbicides are often cheaper, more convenient, and less damaging to nursery stock than the conventional machine cultivation, hand weeding, and contact sprays. The indiscriminate use of promising herbicides, however, can be dangerous. Many herbicides are very insoluble and may build up to toxic levels, particularly in heavy soils. Other herbicides are effective only against a few weed species. New herbicides need to be evaluated, first, for their weed control effectiveness, and secondly, for any damage to tree seedlings.

Many evaluations have been made of new herbicides in forest nurseries *(1, 2, 5, 6, 7, 8, 9, 11, 12)* . However, most of this research evaluates a herbicide only for its potential use and not for costs. Because a chemical gives some degree of weed control does not necessarily mean it may be economical to use. Such factors as price, method of application, application cost, and quantities used need to be considered.

Preliminary weed control research at the L.T. "Mike" Webster Forest Nursery, near Olympia, Wash., has evaluated potential herbicides for weed control and seedling injury over a period of several years. It utilized small plots, with limited replications, and rated weed control and plant damage by a numerical index based on visual observation (4). The economic values of the chemicals were not rated. Because of this, the following experiment was established on an operational basis with four promising herbicides to determine their economic worth.

Methods and Procedures

Plot Layout and Herbicide Application.-Four herbicides (Dowpon[2], Simazine[3], Propazine[4], and

1 Forest Land Management Division Research Report No. 3, An Economic Evaluation of Four Herbicides Used For Weed Control in a Forest Nursery.

2 2-2 dichloroproprionic acid manufactured by Dow Chemical Co.

3 2--chloro-4, 6-bis (ethylamino) -s-triazine manufacutred by Geigy Chemical Corp.

4 2-chloro-4, 6-bis (isopropylamino) -s-triazine manufactured by Geigy Chemical Corp.

Kloben[5]) were used as pre-emergence sprays on newly transplanted two-year-old Douglas-fir, (Pseudotsuga menziesii (Mirb.) Franco), in plots 1/4 acre in size (three 600-foot transplant beds) , during the early summer of 1962. Transplant beds were sprayed by two men using a conventional nursery sprayer. Five treatments (four herbicides and a control) were randomly applied within each of four blocks located across a transplant field. This then gave a total of 1 acre sprayed per herbicide and a 1-acre control.

Dowpon was applied at 10 lbs. active material per acre (113/ lbs. total) and Simazine, Propazine, and Kloben were applied at the rate of 4 lbs. active material per acre (5 lbs. total, except 8 lbs. for Kloben). Herbicides were applied on June 15, 1962, and a 6-foot strip was sprayed for each- bed. Contents of the spray tank were kept in constant agitation, and the spray was applied to the beds at 100 lbs. pressure.

Plot Measurement and Analysis.-All plots were hand weeded three times during the summer of 1962, and the time taken to hand weed individual

lots was recorded and converted to hours per acre.

The weeding time per acre was subjected to the analysis of variance, and the "J.S.D." test (Just Significant Difference) was applied to the significant parts of the analysis. The "J.S.D." value represents the minimum difference between the averages which is significant at a given probability level, i.e., 95 percent or 99 percent. "J.S.D." is sometimes referred to as the "L.S.D.", the least significant difference, in some statistical references.

Weeding time per acre for the summer was determined for each herbicide and the control and a total cost evaluation was made by including the application and material costs.

Results and Discussion

The analysis of variance for weeding time per acre (table 1) showed blocks, weeding date, and treatments to be highly significant. Of the five treatments (four herbicides and control) Simazine significantly reduced the weeding time per acre for each weeding date over all other treatments (fig. 1). All four herbicides were significantly better than the control in reducing the average weeding time at each weeding date (fig. 1) and for the entire summer (fig. 2).

The degree of weed control by the herbicides was influenced by weeding date and blocks, as shown by the significant interactions in the analysis of variance. As the summer progressed, the average weeding time per acre increased. This is probably due to weeds going to seed adjacent to the nursery area and blowing into the transplant beds. As the length of weeding time increased during the summer, the effects of Simazine became even more pronounced.

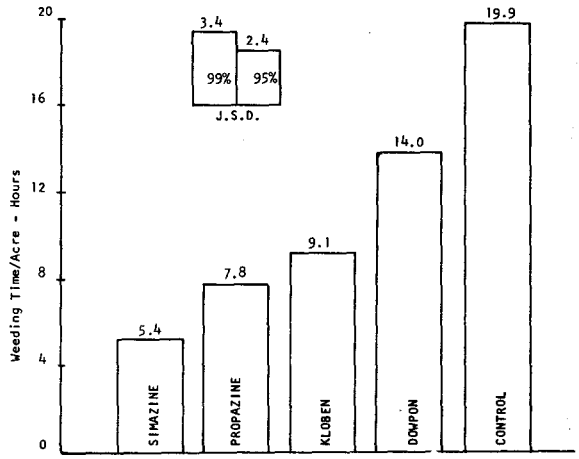

Figure 1.—The effects of four herbicides on weeding time per acre, averaging out blocks and weeding date, for 2–1 Douglas-fir transplants grown at the Webster Forest Nursery, Olympia, Wash.

At the first weeding (July 27), Simazine reduced weeding time about 6 hours per acre over the control. At the last weeding (Sept. 17), Simazine reduced the weeding time per acre 21 hours over the control. The interaction between blocks and treatments reflects the amount of weeds present in each block. One of the four blocks had relatively few weeds and none of the treatments were significantly better than the control.

The effectiveness of Dowpon decreased with time and, although still significantly better than the control at the last weeding date, required almost twice as much hand weeding as the next best herbicide, Kloben. This indicates that the effectiveness of Dowpon is short-term and that repeated applications would be necessary for acceptable weed control.

5 1-n-butyl-3- (3, 4-dichlorophenyl) -1-methylurea manufactured by E. I. Dupont de Nemours & Co. (Inc.).

TABLE 1.—*Analysis of variance of weeding time per acre (hours) for four herbicides and a control on 2-1 Douglas-fir transplant beds at the Webster Forest Nursery*

Degrees of Freedom	Source of Variation	Sum Squares	Mean Squares	F Ratio	F [1] Table	Significance
59	Total	4,179.64				
3	Blocks	401.97	133.99	14.95	4.72	**
2	Weeding Date	841.83	420.92	46.98	5.61	**
4	Treatments	1,596.35	399.09	44.54	4.22	**
6	B × W	58.79	9.80	1.09	2.51	NS
12	B × T	576.94	48.08	5.37	3.03	**
8	W × T	488.76	61.10	6.82	3.36	**
24	Error	215.00	8.96	—	—	—

** Significant at the 1% level.
NS Non-significant.
[1] Tabular values of F from Snedecor (10) pp. 246–249, pp. 276–279.

TABLE 2.—*A Comparison of total weeding cost per acre[1] and cost per thousand for four herbicides and a control applied to 2–1 Douglas-fir transplants grown at the Webster Forest Nursery*

	Treatment and Rate				
COST PER ACRE	Simazine 5 lbs./acre	Propazine 5 lbs./acre	Dowpon 12 lbs./acre	Kloben 8 lbs./acre	Control
Weeding labor [2]	$20.09	$29.22	$52.38	$34.29	$74.56
Materials [3]	12.50	12.50	16.68	44.40	—
Application labor [4]	6.59	6.59	6.59	6.59	—
Total Cost	$39.18	$48.31	$75.65	$85.28	$74.56
Trees per acre	180,000	180,000	180,000	180,000	180,000
Weeding cost/M	$0.22	$0.27	$0.42	$0.47	$0.41

[1] Costs based on 1962 data.
[2] $1.25/hour.
[3] Dowpon @ $1.39/lb., Simazine @ $2.50/lb., Propazine @ $2.50/lb., Kloben @ $5.55/lb.
[4] Tractor—1 hour @ $2.00/hour., 2 man = 1 hour each @ $2.15/hour and $2.44/hour.

The fact that all the herbicides significantly reduced weeding time as compared to the control was not a good measure of their economic success. In comparing the total weeding cost for the summer for each herbicide and the control, the application cost and material cost need to be added to the hand weeding cost. This is shown in table 2 and changes the picture. Both Dowpon and Kloben show total costs above the cost of hand weeding; alone. This is due to the high rate of Dowpon (almost 12 lbs.) coupled with only fair weed control, and the high cost of Kloben ($5.55/lb.) 6 and] the fact that it contains only 50 percent active material.

6 Costs based on 1962 data.

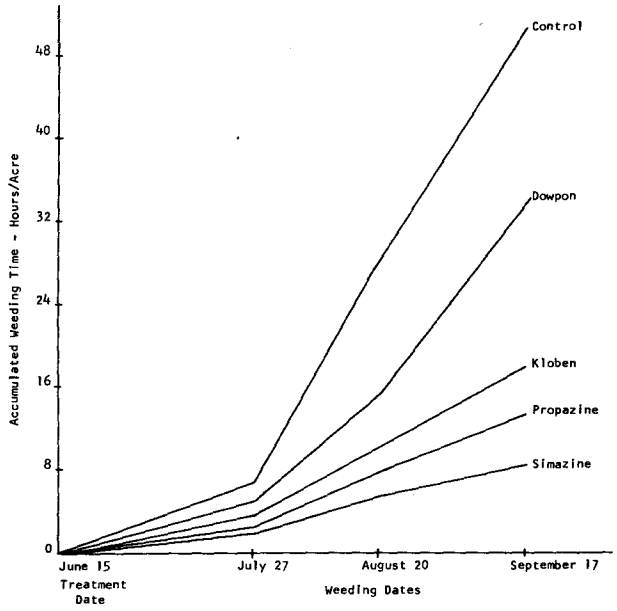

Figure 2.—The effects of four herbicides on weeding time (hrs/acre) for 2–1 Douglas-fir transplants grown at the Webster Forest Nursery during the summer of 1962.

Simazine and Propazine, with low application rates, 80 percent active material, lost cost per pound, and excellent weed control, show a decisive savings in total cost when compared to the control. Propazine shows a savings of better than $26 per acre per year over hand weeding alone, while Simazine shows a savings of better than $35 per acre per year. This is in close agreement with Aldhous (1) who found a net savings of approximately $30 per acre per year following an application of 4 lbs. active Simazine per acre.

Since the production of 2-1 transplants at the Webster Forest Nursery is approximately 180M per acre (12 beds-15M per bed) the savings in cost per M can be calculated and is shown in table 2. This amounts to $0.19/M for Simazine and $0.14/M for Propazine.

Conclusions

Simazine was the best herbicide utilized in this trial. Not only did it significantly reduce weeding time per acre, but more important, also reduced weeding cost by almost /2 the cost of hand weeding alone. Next best was Propazine. Dowpon and Kloben, although significantly reducing weeding time, did not reduce the cost per acre compared to the control because of high application rates and material costs.

Simazine, Propazine, and Kloben were able to maintain significant weed control throughout the summer with only one application. Dowpon, on the other hand, showed a reduction in effectiveness as the summer progressed, indicating the need for repeated applications to insure good weed control.

Use of the triazines or Kloben in a nursery soil could lead to residual problems because of their relatively slow decomposition. Periodic checks would be required with these materials, either by the use of a sensitive cover crop between transplant crops, or by the use of a greenhouse bio-assay (3) to assure that toxic levels were not reached.

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