PROGRESS REPORT ON COOPERATIVE WEED CONTROL PROJECT - EASTERN AREA

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In 1970 we began a cooperative weed control program sponsored by the Southeast Area, State and Private Forestry, USFS and the forestry organizations in 12 states. For the first two years of the program, we have concentrated on annual weed and grass control in pine seedbeds. We have conducted a large number of experiments and collected a great deal of data. Time and space does not permit us to include a complete summary here. Our 1971 annual report was 54 typed pages and included very little discussion. We will cover some of the highlights and our conclusions from our work in the eastern nurseries.

FIELD TESTS

1971 Uniform Test in Loblolly and Slash Pine - Last year we conducted a uniform test at each of the nurseries shown in Table 1. The herbicides (Table 2) were applied to 5x20 foot plots immediately after sowing and mulching and followed with irrigation (0.5 to 0.75 inches). No other herbicide was applied to these plots and hand-weeding times were recorded by the nurseryman. Two samples of trees were lifted from each plot at the end of the growing season for counting, grading and weighing. Handweeding times are shown in Tables 3-8 and seedling production in Tables 9-14. We had fair to good weed control in most locations. Tilghman Nursery, S.C., had so few weeds that we could not show much effect at the time of the first weeding, but differences were apparent later (Table 5). Weed populations were so variable at New Kent Nursery, Va. that we could not show significant differences although several treatments were consistently below control over most of the season (Table 6).

Prometryne was the most consistent material for broad spectrum weed control. But use of this material at 2 lb/A or higher involves a certain element of risk. From soil samples collected in every plot, we were able to account for some of the variation in weed control due to organic matter but we could not attribute seedling tolerance to any soil properties or mulching practices. Kentucky and Tennessee were the only two locations throughout the region where we significantly reduced seedling production. Perhaps some climatic factors are involved.

GS-16068 also gave excellent weed control at most locations but the future availability of this material is uncertain and we do not plan to conduct further tests with it until it is placed on the market.

Diphenamid and trifluralin appeared to be quite safe and gave good to excellent weed control where sensitive weed species were dominant. These two compounds are effective against grasses but weak against sedges and many broadleaf weeds. For example, at Munson Nursery, Fla. (Table 2), trifluralin at 1 lb/A gave excellent weed control but performed poorly at Page-Walker Nursery, Ga. (Table 3) and Goldsboro Nursery, N.C. (Table 4). At Tilghman Nursery, S. C. (Table 5), trifluralin has been used operationally for several years but was the poorest performing material in our tests. This result is probably due to the reduction in weeds sensitive to trifluralin by previous use. It is essential that the herbicide used be selected on the basis of the weed population to be controlled. This population can vary within a given nursery and from one season to the next. For example, at Kentucky Dam Nursery, diphenamid gave better weed control than trifluralin in 1971. So far this year, trifluralin is superior to diphenamid. Trifluralin was the best performer in 1971 at the Munson Nursery but this year, in another part of the nursery, yerba-de-tago, (Eclipta alba), a broadleaf weed, dominates the plots and trifluralin is ineffective.

Weed growth varied between nurseries and this fact could influence control practices. For example, maximum weed growth at New Kent Nursery occurred during the first 50 days after planting, but at Goldsboro, the peak in the weed populations didn't occur until 80 to 100 days after planting (Figure 1). Therefore, longer residual weed control will be needed at Goldsboro or a post-emergence application might be considered.

1972 Operation Trials - This year we established tests in the cooperating nurseries using fewer treatments and larger plots. Most tests occupy one or more riser lines. Treatments were selected on the basis of the 1971 results and vary between nurseries. Most tests involve diphenamid at 4 lb/A or trifluralin at 1 lb/A alone and in combination with 1 lb/A prometryne. Table 15 lists the treatments and weed control data obtained to date. So far, all of our trials are looking good. The combination treatments seem to be particularly effective at some locations. In this years test, the nurserymen are applying mineral spirits routinely so the data in Table 15 indicates reduction in weed populations in addition to mineral spirits. It appears that mineral spirits in combination with pre-emergence herbicides gives much better control than either treatment alone.

We are also testing 0.5 and 1.0 lb/A rates of prometryne applied post-emergence after seedlings are 4 to 6 weeks old. Such treatments appear very promising.

Other Studies - In 1971 we conducted a number of screening tests on several species but only one hardwood, black locust. Trifluralin at 1 lb/A was the only material tested which gave significant weed control without seedling injury. This year we have tests in sweetgum seedbeds and cottonwood cuttings at the Winona Nursery, Mississippi but we have not had time to evaluate these studies.

We have begun some preliminary studies on fumigation. We would like to compare rates of application, depth of injection, etc. We also have one test with sodium azide which looks promising for nut-sedge (Cyperus rotundus and C. esculentus) control. At the Auburn Nursery, we selected one bed which had a uniform stand of nut-sedge. The bed was roto-tilled and treatments were applied on May 24. Sodium azide was applied to the soil surface as an 8% granule and roto-tilled. Methyl bromide was applied from one pound containers under plastic tarp but not soil injected. Plots were 20 feet long and one bed wide (6 feet). There were three replications. Tarps were removed after seven days and pine seed planted. Nut-sedge counts made 6 weeks after treatment are shown in Table 16. The 160 lb/A rate of azide without tarp appears very promising. This material is still in the experimental stage and much testing is needed. But the advantages of using a granular material are appealing and avoiding the use of plastic tarp would be a big advantage. But we do not know what the cost will be and it is too early to say the material is as dependable as methyl bromide.

Our experience indicates that in many instances we will need pre-emergence herbicides even where we have good soil fumigation. The seed of several sedges are highly resistant to methyl bromide. The Columbia Nursery in Louisiana had a heavy population of Cyperus compressus in fumigated beds and Ashe Nursery had a similar experience with Cyperus iria. Fortunately, these species are annuals and do not form tubers, but they are not easily controlled with mineral spirits either. Morning-glory (Ipomoea sp) and sickle pod (Cassia obtusifolia) are also difficult to control with methyl bromide. Fumigated beds may also be re-populated with weed seed from mulch, irrigation water, surface water or wind dissemination. Deep plowing or roto-tilling after fumigation can expose unfumigated soil and negate the effect of the fumigation treatments.

FUTURE PLANS AND PROBLEMS

Calibration of Nursery Equipment - If a nurseryman is going to use pre-emergence herbicides on his seedbed, we believe he should purchase or build a sprayer specifically for the purpose. Most fermate or mineral spirits sprayers are not sufficiently accurate. The applicator

must be certain that his tractor and sprayer are accurately calibrated and operated and that his chemicals are accurately and properly measured and mixed. For this reason, the very best man available should do the job. Careful attention must be given to weighing or measuring the concentrate and records should be kept on the amount of water and chemical and the area covered by each batch. Pressure gauges and strainers should be checked frequently. The spray tank should be equipped with a good agitator. We always talk and write in terms of active ingredients and the nurseryman should do the same. No herbicide that I know of is 100% active in the commercial form.

It appears unlikely that we can obtain good weed control and have more than two X tolerance on the trees. With all our precautions on our experimental plots, we must settle for plus or minus 10% accuracy. Under operational conditions, a nurseryman should achieve plus or minus 25%. If he is not careful, he will get too low and obtain no weed control or too high and stunt or kill his seedlings.

Future Studies - We hope to do some studies on nut-sedge control. In addition to fumigants, there are several promising experimental herbicides for nut-sedge which may be marketed in the near future.

We have a few preliminary studies on riser line weed control but we hope to do more. Of course, we would like to do some work in hardwood seedbeds as the production of hardwood seedlings increases.

There appears to be considerable variation in the effectiveness of mineral spirits between nurseries. We don't know if this is due to variations in the oil, methods of application, or both. We would like to develop a standard bioassay for mineral spirits which could be used to compare different lots.

Of course, we hope to continue to work closely with nurserymen in developing and improving our weed control practices in pine seedbeds.

Herbicide Registration - Our biggest problem at present is the fact that nurserymen want and need recommendations from us on what treatments to use and we are in a very precarious position to make recommendations. None of the pre-emergence herbicides we are testing are registered for use in nursery seedbeds and none of the manufacturers we have contacted are willing to apply for registration. The manufacturers feel that the cost of registration and the risk of damage claims are too great for the small potential market. We are dealing with a crop valued at several thousand dollars per acre and no one is willing to risk injury of this magnitude for a few dollars worth of herbicides. The people in ornamental horticulture have the same problem. At present, federal law does not prohibit the use of herbicides for purposes not on the label but there is now legislation pending in Congress which will do so. I don't know what state laws

there may be to cover this situation. The data on performance and tolerance which we are collecting together with the fact that we are dealing with very low acreages and a non-food crop should be sufficient to warrant registration by EPA. But who is going to provide the time and expense necessary to obtain the registration? At present, we could obtain registration with the various state governments but I understand that the pending federal legislation will do away with state labels. I do not know what we can do about this problem but I hope you will understand our reluctance to make specific recommendations.

As I mentioned, we are not the only group with this problem and we hope to explore ways of solving the problem through the Weed Science Society of America and the U.S.D.A.

Acknowledgement and Appreciation - In conclusion, Bob and I want to thank all of the nurserymen who have worked with us in this study. We could not ask for more whole-hearted cooperation and encouragement than we have received from these people. Over the last two years, we have worked in 23 nurseries in 12 states and established over 40 separate tests. Not one of these tests has been lost through carelessness or inattention on the part of the nurseryman. We have had only one study that was a complete failure and this was the result of poor planning on our part. We also want to thank Dr. LeRoy Jones who was the primary organizer of the project and the U.S.F.S. whose financial support made the project possible. We are looking forward to continued progress and cooperation for the remaining period of the program.

Table 1. Locations and planting dates of weed control experiments in slash or loblolly pine seedbeds.

Nursery	City	State	Planting date	Soil Texture	Organic Matter (%)
John R. Miller Nursery	Autaugaville	Alabama	4/20/71	Sandy loam	3.29
Bluff City Nursery	Bluff City	Arkansas	4/13/71	Loamy sand	1.61
Munson Nursery	Milton	Florida	4/19/71	Loamy sand	2.59
Walker Nursery	Reidsville	Georgia	4/12/71	Loamy sand	1.72
Kentucky Dam Nursery	Gilbertsville	Kentucky	4/27/71	Sandy loam	2.61
Columbia Nursery	Columbia	Louisiana	4/13/71	Sandy loam	2.29
Waynesboro Nursery	Waynesboro	Mississippi	4/21/71	Sandy loam	5.48
Claridge Nursery	Goldsboro	North Carolina	4/30/71	Sandy loam	2.68
State Tree Nursery	Broken Bow	Oklahoma	4/5/71	Sandy loam	1.92
Horace L. Tilghman Nursery	Wedgefield	South Carolina	3/25/71	Sandy loam	4.21
Pinson Nursery	Jackson	Tennessee	4/27/71	Loam	2.85
New Kent Forestry Center	Providence Forge	Virginia	4/29/71	Loamy sand	3.12

1/ Loss on ignition.

Table 2. Treatments included in the regional test in loblolly and slash pine seedbeds.

Common Name	Formulation	Chemical Name	Trade Name and Manufacturer
Diphenamid	80 wp	N,N-dimethy1-2,2-diphenylacetamide	Dymid, Enide, Elanco Products and Tuco Products
Trifluralin	4 lb/gal EC	a,a,a-trifluoro-2,6-dinitro-N,N,dipropyl-	Treflan, Elanco Products
Prometryne	80 wp	2,4-bis(isopropylamino)-6-mercapto-s-triazine	Caparol, Geigy Agricultural Chemicals
GS-16068	80 wp	2-(ethylthio)-4,6-bis (isopropylamino)-s-**triazine**	Geigy Agricultural

Table 3. Weed Control in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Miller Nursery, Autaugaville, Alabama
Species: Pinus taeda (Loblolly pine)
Date planted: 4/20/71
Date treated: 4/20/71

Treatment	Rate1/	Hand Weeding Time2/ Days After Planting	
		41	76
Prometryne	2	2.1*	2.9*
Prometryne	4	1.7*	2.9*
Trifluralin	1	4.4*	6.1*
Trifluralin	2	2.8*	6.1*
Siduron	2	10.2	8.5
Siduron	4	7.1	8.1
GS-16068	2	4.4*	6.7*
GS-16068	4	1.9*	4.0*
Control	0	13.9	12.9
Control	0	19.8	13.1

1/ Rate expressed as pounds active ingredients per acre.

2/ Time expressed as man minutes per 100 ft. bed.

* Significantly different from controls at 5% level.

Table 4. Weed Control in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Munson Nursery, Munson, Florida
Species: Pinus elliottii (Slash pine)
Date planted: 4/19/71
Date treated: 4/20/71

Treatment	Rate1/	Hand Weeding Time2/ Days After Planting
		29
Prometryne	2	40.0*
Prometryne	4	21.8*
Trifluralin	1	26.6*
Trifluralin	2	22.5*
Diphenamid	4	56.5*
Diphenamid	8	23.1*
GS-16068	2	106.0
GS-16068	4	47.5*
Control	0	151.4
Control	0	127.3

1/ Expressed as pounds active ingredients per acre.

2/ Time expressed as minutes required for one man to weed 100 feet of bed.

* Significantly different from controls at 5% level.

Table 5. Weed Control in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Page-Walker Nursery, Reidsville, Georgia
Species: Pinus taeda (Loblolly pine)
Date planted: 4/12/71
Date treated: 4/13/71

Treatment	Rate1/	Hand Weeding Time2/ Days After Planting	
		49	7R
Prometryne	2	43.9*	151.4
Prometryne	4	11.2*	49.1*
Trifluralin	1	265.9*	245.6
Trifluralin	2	87.3*	211.0
Diphenamid	4	91.0*	217.3
Diphenamid	8	74.8*	131.0 *
GS-16068	2	61.7*	146.5
GS-16068	4	16.0*	69.8*
Control	0	501.4	251.5
Control	0	794.6	332.7

1/ Expressed as pounds active ingredients per acre.

2/ Time expressed as minutes required for one man to weed 100 feet of bed.

* Significantly different from controls at 5% level.

Table 6. Weed Control in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Claridge Nursery, Goldsboro, North Carolina
Species: Pinus taeda (Loblolly pine)
Date planted: 4/30/71
Date treated: 4/30/71

Treatment	Rate-/	Hand Weeding Time2/ Days After Planting			
		50	66	87	114
Prometryne	2	19.5*	74.0	73.0	67.4
Prometryne	4	6.7*	22.1	30.2	73.8
Trifluralin	1	35.2	43.6	47.5	55.9
Trifluralin	2	29.9	38.8	60.1	59.6
Diphenamid	4	14.4*	64.0	67.0	68.8
Diphenamid	8	20.6*	97.9	122.6	93.3
GS-16068	2	23.6	45.2	71.5	78.1
GS-16068	4	20.3*	100.4	80.1	97.1
Control	0	47.9	68.3	67.3	50.9
Control	0	47.0	36.3	47.9	44.2

1/ Expressed as pounds active ingredients per acre.

2/ Time expressed as minutes required for one man to weed 100 feet of bed.

* Significantly different from controls at 5% level.

Table 7. **Weed Control** in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Tilghman Nursery, Wedgefield, South Carolina
Species: Pinus taeda (Loblolly pine)
Date planted: 3/25/71
Date treated: 3/26/71

Treatment	Rate 1/	Hand Weeding Time 2/ Days After Planting		
		29	45	81
Prometryne	2	6.4	7.0*	9.2
Prometryne	4	3.8	5.6*	5.0
Trifluralin	1	6.1	9.4	6.3
Trifluralin	2	6.4	9.2	8.3
Diphenamid	4	5.0	6.2*	5.5
Diphenamid	8	4.1	4.4*	6.1
GS-16068	2	6.6	7.9*	9.9
GS-16068	4	3.7	6.4*	5.5
Control	0	9.5	13.1	8.8
Control	0	6.4	11.8	8.7

1/ Expressed as pounds active ingredients per acre.

2/ Time expressed as minutes required for one man to weed 100 feet of **bed.**

*** Significantly different** from controls at 5% level.

Table 8. Weed Control in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: New Kent Forest Center, Providence Forge, Virginia
Species: Pinus taeda (Loblolly pine)
Date planted: 4/29/71
Date treated: 4/29/71

Treatment	Ratel/	Hand Weeding Time?! Days After Planting			
		57	79	101	140
Prometryne	1	31.6	35.7	27.2	38.0
Prometryne	2	17.7	24.2	21.4	42.5
Trifluralin	0.75	81.8	55.1	37.7	49.1
Trifluralin	1.5	51.1	28.1	29.5	37.7
Diphenamid	4	65.5	54.7	28.4	49.3
Diphenamid	8	43.1	29.8	22.7	30.2
GS-16068	1.5	43.1	42.5	34.7	23.5
GS-16068	3.0	**15.7**	22.1	23.5	33.7
Control	0	187.6	51.4	23.8	31.9
Control	0	243.9	100.8	43.9	55.5
Siduron	2	95.5	47.5	31.6	34.1
Siduron	4	126.2	53.2	28.0	45.1

1/ Rate expressed as pounds active ingredients per acre.

2/ Time expressed as man minutes per 100 ft. bed.

* Significantly different from controls at 5% level.

Table 9. Seedling Production in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Miller Nursery, Autaugaville, Alabama
Species: Pinus taeda (Loblolly pine)
Date planted: 4/20/71
Date treated: 4/20/71

Treatment	Rate-	Seedling Production		
		Seedlings/sq.ft.	Plantables/sq.ft.	Dry Weight/sq.ft. (gr.)
Prometryne	2	18	17	67
Prometryne	4	21	18	72
Trifluralin	1	22	20	**81**
Trifluralin	2	26	23	**95**
Siduron	2	17	14	**65**
Siduron	4	11*	9*	44*
GS-16068	2	20	**19**	80
GS-16068	4	24	22	87
Control	0	17	15	70
Control	0	19	18	72

1/ Rate expressed as pounds active ingredients per acre.

* Significantly different from controls at 5% level.

Table 10. Seedling Production in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Munson Nursery, Munson, Florida
Species: Pinus elliottii (Slash pine)
Date planted: 4/19/71
Date treated: 4/20/71

		Seedling Production		
Treatment	**Rate- 1/**	**Seedlings/sq.ft.**	**Plantables/sq.ft.**	**Dry Weight/sq.ft. (gr.)**
Prometryne	2	22	19	63
Prometryne	4	23	21	58
Trifluralin	1	29	26	63
Trifluralin	2	26	24	72*
Diphenamid	4	29	26	58
Diphenamid	8	24	20	57
GS-16068	2	28	25	68
GS-16068	4	25	23	73*
Control	0	26	23	53
Control	0	22	20	53

1/ Rate expressed as pounds active ingredients per acre.

* Significantly different from controls at 5% level.

Table 11. Seedling Production in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Page-Walker Nursery, Reidsville, Georgia
Species: Pinus taeda (Loblolly pine)
Date planted: 4112171
Date treated: 4113/71

Treatment	Rate[1]	Seedling Production		
		Seedlings/sq.ft.	Plantables/sq.ft.	Dry Weight/sq.ft. (gr.)
Prometryne	2	38	33	55
Prometryne	4	36	31	57
Trifluralin	1	28	25	43
Trifluralin	2	39	35	59
Diphenamid	4	40	35	58
Diphenamid	8	36	32	56
GS-16068	2	28	25	49
GS-16068	4	33	31	57
Control	0	32	31	50
Control	0	28	26	45

11 Rate expressed as pounds active ingredients per acre.

Differences between treatments not significant.

Table 12. Seedling Production in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Claridge Nursery, Goldsboro, North Carolina
Species: Pinus taeda (Loblolly pine)
Date planted: 4/30/71
Date treated: 4/30/71

Treatment	Rate1/	Seedling Production		
		Seedlings/sq.ft.	Plantables/sq.ft.	Dry Weight/sq.ft. (gr.)
Prometryne	2	43	40	77
Prometryne	4	41	32	65
Trifluralin	1	41	37	76
Trifluralin	2	38	34	70
Diphenamid	4	39	36	67
Diphenamid	8	45	41	74
GS-16068	2	40	29	58
GS-16068	4	44	40	74
Control	0	39	34	72
Control	0	35	32	68

1/ Rate expressed as pounds active ingredients per acre.

Differences between treatments not significant.

Table 13. Seedling Production in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: Tilghman Nursery, Wedgefield, South Carolina
Species: Pinus taeda (Loblolly pine)
Date planted: 3/25/71
Date treated: 3/26/71

Treatment	Rate[1/]	Seedling Production		
		Seedlings/sq.ft.	Plantables/sq.ft.	Dry Weight/sq.ft. (gr.)
Prometryne	2	27	23	92
Prometryne	4	33	29	102
Trifluralin	1	32	28	96
Trifluralin	2	34	29	93
Diphenamid	4	27	25	102
Diphenamid	8	31	27	89
GS-16068	2	32	26	93
GS-16068	4	29	25	93
Control	0	35	29	98
Control	0	33	28	104

1/ Rate expressed as pounds active ingredients per acre.

Differences between treatments not significant.

Table 14. Seedling Production in the Regional Weed Control Test on Loblolly and Slash Pine Seedbeds.

Location: New Kent Forestry Center, Providence Forge, Va.
Species: Pinus taeda (Loblolly pine)
Date planted: 4/29/71
Date treated: 4/29/71

Treatment	Rate-/	Seedling Production		
		Seedling/sq.ft.	Plantables/sq.ft.	Dry Weight/sq.ft. (gr.)
Prometryne	1	30	25	53
Prometryne	2	26	18	42
Trifluralin	0.75	30	26	60
Trifluralin	1.5	30	23	54
Diphenamid	4	37	26	58
Diphenamid	8	34	27	56
GS-16068	1.5	32	25	54
GS-16068	3.0	33	27	53
Control	0	32	26	60
Control	0	28	25	59
Siduron	2	36	29	63
Siduron	4	23	19	49

1/ Rate expressed as pounds active ingredients per acre.

Differences between treatments not significant.

Table 15. Early results from 1972 weed control trials in pine seedbeds.

Treatments1/		Handweeding Time (min/100ft) Ala.	Fla.	N. C.	S. C.	Va.
Diphenamid	4	1.9	-	2.6	21.3	3.4
Diphenamid + Prometryne	4 + 1	1.6	-	1.7	11.7	-
Diphenamid + GS-16068	4 + 2	-	-	-	-	2.9
Trifluralin	1	-	12.8	-	-	-
Trifluralin + Prometryne	1 + 2	-	3.2	-	-	
Control		3.6	19.2	5.2	78.0	7.1

1/ Treatments applied at planting time. Weeding after 30 days. Statistical analyses not yet available. Rates are applied in pounds active ingredients per acre.

Table 16. Living nut-sedge plants (C. rotundus and C. esculentus) 6 weeks after application of different fumigation treatments.

Treatments		Plants per 10 ft2/ 1/
NaN3	80 lb/A Under Plastic	19.0
	160 lb/A Under Plastic	1.1
	160 lb/A w/o Plastic	3.7
Methyl Bromide	360 lb/A Under Plastic	9.0
Control		57.2

1/ All treatments significantly reduced nut-sedge populations below control. ($P<0.05$).

Figure 1. Seasonal variation in weeding time for control plots between two nurseries.