4-1983

Results of Herbicide Evaluation in Burley and Dark Fire-Cured Tobacco

University of Tennessee Agricultural Experiment Station

G. N. Rhodes Jr.

L. S. Jeffery

T. H. Morgan Jr.

L. M. Safley

See next page for additional authors

Authors
University of Tennessee Agricultural Experiment Station, G. N. Rhodes Jr., L. S. Jeffery, T. H. Morgan Jr., L. M. Safley, and D. D. Howard

Results of

Herbicide Evaluation

in Burley and Dark Fire-Cured

Tobacco

G. N. Rhodes, Jr., L. S. Jeffery,
T. H. Morgan, Jr., L. M. Safley,
D. D. Howard

Bulletin 619
April 1983

The University of Tennessee
Agricultural Experiment Station
Knoxville, Tennessee
D. M. Gossett, Dean

Results of Herbicide Evaluation in Burley and Dark Fire-Cured Tobacco 1970-1981

G. N. Rhodes, Jr., L. S. Jeffery,
T. H. Morgan, Jr., L. M. Safley,
and D. D. Howard*

This report is a summary of various weed control experiments in burley and dark fire-cured tobacco conducted at the University of Tennessee from 1970 to 1980.

Proper weed control is an important input in the total tobacco management process, both in the plant bed and the field. Broadleaved and grass weeds are strong competitors with tobacco plants for sunlight, moisture, and nutrients. Also, weeds such as morningglory (*Ipomea* spp.) make tobacco harvesting much more difficult, and more time consuming.

Reliable plantbed weed control may be achieved by chemical application of the fumigant, methyl bromide, or temporary soil sterilants such as sodium N-methyl dithiocarbamate (Vapam).

These treatments applied to the plantbed in either late fall or early spring have proven highly successful for the control of most annual and perennial weed species, but are not practical as field applications. It is therefore necessary to implement a weed control program of cultivation, or herbicide applications accompanied by timely cultivation. Preplant incorporated, preemergence, and post-transplant herbicides have been tested in both burley and dark fire-cured tobacco, and have provided various degrees of success. As with all other agronomic crops, the success of a herbicidal application hinges upon the ability of the chemical to keep weeds in check without causing unacceptable injury to the crops.

*Former Grad. Res. Asst., Plant and Soil Science Dept., Univ. of Tennessee, now field development representative, Rohm and Haas Co., Glen Allan, Mississippi; Prof. Plant and Soil Science Dept., Univ. of Tennessee (Knoxville); Former Asst. Prof., Univ. of Tennessee (Spring Hill), now Station Superintendent, Stauffer Chemical Co., Sanford, Florida; Station Superintendent, Highland Rim Experiment Station, Springfield, Tennessee; and Station Superintendent, Tobacco Experiment Station, Greeneville, Tennessee.

METHODS AND MATERIALS

Herbicide evaluations tests in burley tobacco were conducted at the Tobacco Experiment Station, Greeneville, in 1970-81; and at the Middle Tennessee Experiment Station, Spring Hill, in 1974, 1975 and 1978. All of the dark fire-cured tobacco experiments were conducted at the Highland Rim Experiment Station between 1970 and 1981. All experiments were conducted on soils well suited to tobacco production. Fields were fertilized and limed according to soil test results.

Proper land preparation practices were followed prior to transplanting. Transplanting of healthy tobacco plants was done by a one or two tractor-mounted mechanical transplanter. Herbicides were applied using bicycle or back-pack sprayers with CO_2 as a pressure source. Spray volume was generally 20 gallons per acre applied under a pressure of 30 pounds per square inch. Preplant herbicides were incorporated with a tractor, using either a disk or power driven roto-tiller. Plot size was either three or four 42-inch rows wide by 36 feet long.

All herbicide rates used in this report are in terms of active ingredient per acre. Common, code, commercial, and chemical names of herbicides are given in Table 1.

Tobacco vigor reduction ratings were made using a visual scale of 0-100% where 0 indicates no apparent injury, and 100 indicates complete kill.

Weed control ratings were made either by species, or by type (annual grasses or broadleaved weeds) using a visual scale of 0-100% in which above 90% is considered excellent, 75-89% as good, 60-74% as fair, and less than 60% as poor.

All tobacco observations, including percent vigor reduction, flowering, weed control, and yield were taken from the center one or two rows of each plot. All experiments were replicated at least twice. Check plots used for comparison varied from test to test, but were basically weedy and weed-free checks. A weedy check denotes a plot where no weed control inputs were used. A weed-free check is a plot which had been maintained in a weed-free condition by cultivation and/or hand hoeing.

RESULTS AND DISCUSSION

For convenience, the discussion of results will be divided into two sections, the first dealing with burley tobacco, and the second with dark fire-cured tobacco. Among all of the experiments, rates, times and methods of applications, size of tobacco, and weed populations and species varied considerably. Also, some materials were included in some experiments, but not in others. Therefore, the discussion of results within each section will be presented for each herbicide or herbicide combination, rather than for each experiment. Experimental results are included in a series of tables in the Appendix.

Section I
Burley Tobacco

Alachlor (Lasso)

Alachlor was tested as both preemergence and post-transplant treatments at different rates in several experiments (Table 2) between 1970 and 1973. Control of annual grasses was generally excellent (88-100%). Some injury to tobacco occurred. Indication was given that registration for use in burley tobacco would not be pursued, and therefore testing was discontinued.

Benefin (Balan)

Benefin was tested at all locations during all years of study (Tables 2 and 3). All applications were preplant incorporated at rates of 1.1, 1.5 and 2.2 lb/A. Control of annual grasses ranged from fair (60-75%) to excellent (≥ 90%). Improved herbicide efficacy was observed at the highest rate (2.2 lb/A) in some instances. Control of certain broadleaved weeds ranged from poor (≤ 50%) to excellent (≥ 90%).

Vigor reduction caused by benefin applications was generally slight (0-12%), but injury increased in some cases when the rate was increased to 2.2 lb/A.

Where burley tobacco yield information was available, results were somewhat variable. Moderate yield decreases to slight yield increases were observed when benefin-treated plots were compared to weed-free check plots. In general, the highest rate (2.2 lb/A) caused greater yield reduction than the lower rates tested. When compared to the weedy check plots, considerable yield increases were noted from benefin application.

Bifenox (MoDown)

Bifenox was tested as a 1.5 lb/A application at Greeneville in 1976, and Spring Hill in 1978; as a 3.0 lb/A application at Greeneville in 1976 and 1977 (Table 2), and Spring Hill in 1978; and as a 6.0 lb/A application at Greeneville in 1976. All applications were made preemergence. A split application, bifenox at 1.5 + 1.5 lb/A, preemergence + post-transplant, was tested at Greeneville in 1977. The 1.5 lb/A rate tested at Greeneville in 1976 gave fair control (67%) of goosegrass, and good control (82%) of crabgrass; fair control (65% and 73%) of carpetweed and pigweed, respectively, and excellent control (95%) of mustard. This application performed poorly when tested in 1978 at Spring Hill where poor control (< 60%) was noted for selected annual grasses and broadleaved weeds. Improved herbicide efficacy was noted when the rate was increased to 3.0 lb/A at Greeneville in 1976 and 1977. Control of annual grasses and selected broadleaved weeds was excellent (≥ 92%) at Greeneville as with the 1.5 lb/A rate. Control was poor at Spring Hill in 1978. The highest rate tested (6.0 lb/A) provided excellent control (94%) at Greeneville in 1976. The split application of bifenox, 1.5 lb/A, preemergence + post-transplant, provided excellent control (≥ 96%) of annual grasses and selected broadleaved weeds when tested at Greeneville in 1977.

Single preemergence applications of bifenox did not reduce tobacco vigor. The postemergence portion of the split application caused 22% vigor reduction. Burley tobacco yield data were available only for the test at Greeneville in 1977. Neither the 1.5 or 3.0 lb/A rate reduced yield.

Butralin (Amex or A-820)

Butralin was tested as a preplant incorporated application at 1.5 and 2.5 lb/A at Greeneville in 1971, and 2.0 lb/A at Greeneville and Spring Hill in 1975, and at Greeneville in 1976 (Tables 2,3).

At Greeneville in 1971, both the 1.5 and 2.5 lb/A rates performed poorly. The 1.5 lb/A rate gave fair control (63%) of annual grasses, and poor (37%) control of broadleaved weeds. Poor control (53% and 27%) of annual grasses and broadleaved weeds was provided by the 2.5 lb/A rate. Tobacco vigor reduction was slight with either application. Tobacco yield was lower when compared to the weed-free check, probably due to early weed competition. At the 2.0 lb/A rate, control of annual grasses and selected broadleaved weeds was generally excellent ($\geq$ 90%) with the exception of fair control (75% and 71%) of annual grasses and broadleaved weeds at Greeneville in 1976. Weed control was erratic between rates and years. Butralin caused little to no vigor reduction and had no effect on yield.

Dinitramine (Cobex)

Dinitramine was tested as a preplant incorporated application at 0.5 lb/A at Greeneville and Spring Hill in 1974 and 1975 (Table 2). A higher rate, 0.7 lb/A, was tested at Greeneville and Spring Hill in 1974. Excellent control ($\geq$ 90%) of both annual grasses and broadleaved weeds was noted for the 0.5 lb/A rate at Spring Hill in 1976 and 1975. However, at Greeneville in 1974, control of selected annual grasses was fair to good (67-78%), with good control of broadleaved weeds (85%). At Greeneville in 1975, fair control (62%) of annual grasses, and poor control (50%) of broadleaved weeds was observed from the 0.5 lb/A application. Increasing the rate to 0.7 lb/A provided no consistent improvement in herbicide efficacy.

Burley tobacco vigor reduction caused by the 0.5 lb/A rate was generally slight to moderate (10-32%), and moderate (32%) for the 0.7 lb/A rate. Burley tobacco yields from dinitramine treated plots were lower.

Diphenamid (Enide)

Diphenamid has been the most frequently tested herbicide in these studies. It was included in all tests at both locations over the past eleven years. Treatments most frequently tested were post-transplant applications of 4.0 or 6.0 lb/A.

The 4.0 lb/A post-transplant application gave excellent control (≥ 90%) of annual grasses in most cases (Tables 2, 3). Exceptions to this were fair control (60-70%) at Greeneville in 1976, and Spring Hill in 1978. The same rate generally gave good to excellent control (75-100%) of broadleaved weeds, except poor control (10%) of morningglory and fair control (63%) of pigweed at Spring Hill in 1978.

Vigor reduction was slight (0-10%) for both rates in all tests. Where yield data were available tobacco treated with either post-transplant rate yielded high quality tobacco comparable to the weed free checks.

Although the majority of diphenamid applications are made post-transplant, it has been tested as preplant incorporated and preemergence applications. A preplant incorporated application of 6.0 lb/A was tested at Greeneville in 1977 and gave excellent control (≥ 90%) of annual grasses and selected broadleaved weeds, with no tobacco vigor reduction.

A preemergence application of 4.0 lb/A at Greeneville in 1976 provided only fair control (63-65%) of selected annual grasses, and poor to excellent control (22-90%) of selected broadleaved weeds. A higher preemergence rate (6.0 lb/A) was tested at Greeneville in 1977. Excellent control (≥ 90%) of both annual grasses and broadleaved weeds was noted. No vigor reduction was caused by these applications.

All previously discussed applications of diphenamid were made with a 50% wettable powder formulation (50W). A newer formulation, a 90% wettable powder (90W) has been tested at 4.0 and 6.0 lb/A at Spring Hill in 1978 and at 6.0 lb/A at Greeneville in 1977. All applications were made post-transplant. The 4.0 lb/A application provided excellent control (93 and 97%) of crabgrass and pigweed, respectively, but only poor control (10%) of morningglory. The 6.0 lb/A application gave excellent control (≥ 90%) of both annual grasses and broadleaved weeds, except for good control (77%) of pigweed, and poor control (3%) of morningglory at Spring Hill in 1978. This formulation caused no apparent vigor or yield reductions in burley tobacco.

Isopropalin (Paarlan)

All applications of isopropalin tested were made preplant incorporated, and ranged from 1.0 to 2.0 lb/A. The 1.0 lb/A rate was tested at Greeneville in 1970 and 1971 (Tables 2, 3). The intermediate rate, 1.5 lb/A, was tested at Greeneville from 1973 through 1977 and at Spring Hill in 1974, 1975 and 1978. The 2.0 lb/A rate was tested at Greeneville from 1970 through 1974 and at Spring Hill in 1974.

The 1.0 lb/A rate gave excellent control (≥ 91%) of annual grasses and broadleaved weeds, with the exception of poor control (30%) of pigweed during the first year of testing. Tobacco vigor reduction caused by this application was never over 6%.

At the 1.5 lb/A rate, control of annual grasses was generally good to excellent (78-100%), with the exception of fair control (62-75%) at Greeneville in 1973 and 1981, and at Spring Hill in 1978. Control of broadleaved weeds was good to excellent (83-100%), except, fair control (73%) of purslane at Greeneville in 1973, and poor control (58 and 53%) of morningglory and pigweed at Spring Hill in 1978. Excellent control (95%) of redroot pigweed was obtained in 1979. In a few experiments a slight amount of tobacco vigor reduction was noted. Where yields were taken tobacco yields from plots treated at the 1.5 lb/A rate were comparable to the weed-free check plots.

The 2.0 lb/A rate provided fair to excellent control (70-97%) of annual grasses (Table 2). Control of broadleaved weeds at this rate was somewhat erratic (35-94%) and tobacco vigor reduction was generally slight (< 20%) (Table 2). No yield reduction was noted.

Metolachlor (Dual)

Metolachlor was applied preplant incorporated, preemergence and post-transplant at 2.0 and 2.5 lb/A in 1979 and post-transplant at 1.5 and 2.0 lb/A in 1980. Control of large crabgrass, goosegrass, and fall panicum was excellent in 1980. These annual grasses were not present in the plots in 1979. Control of annual broadleaved weeds such as redroot pigweed, common lambsquarter, carpetweed and henbit was excellent whenever they were present in the experimental area.

Metolachlor applied as a preplant incorporated treatment in 1979 reduced tobacco vigor more than when it was applied preemergence or post-transplant (12-15%). The post-transplant treatments caused 22 to 45% vigor reduction in 1980. The degree of burley tobacco vigor reduction caused by the preemergence and post-transplant applications in 1979 would probably be commercially acceptable but the degree of vigor reduction caused by metolachlor applied post-transplant in 1980 would not be acceptable.

Napropamide

Napropamide was tested at Greeneville in 1976, 1980 and 1981, (Table 2). In 1976 the preplant incorporated application of 3.0 lb/A gave excellent control (≥ 93%) of annual grasses and broadleaved weeds with the exception of only good control (78%) of mustard. Due to the variability of tobacco transplants, no data were collected on tobacco response to this application.

Napropamide applied at 1.0 and 2.0 lb/A in 1980 gave excellent control of all annual grasses and broadleaved weeds except that control of henbit was only fair.

Oryzalin (Surflan)

Oryzalin appears to be one of the more promising herbicides which might be registered for use in tobacco. It has been tested preemergence at 1.0 lb/A at Greeneville in 1977, and at Spring Hill in 1978 (Tables 2, 3) and at 1.5

lb/A at Spring Hill in 1975 and at Greeneville in 1975 and 1976. Post-transplant applications of 1.0 and 1.5 lb/A were tested at Greeneville and Spring Hill in 1974. The 1.0 lb/A preemergence application performed well at Greeneville in 1977, giving excellent control (95%) of annual grasses, and good to excellent control (88-95%) of selected broadleaved weeds, with no apparent tobacco vigor or yield reduction. However, the same application at Spring Hill in 1978 gave only poor control, (53%, 33%, and 50%), of crabgrass, morningglory, and pigweed, respectively.

The highest preemergence rate 1.5lb/A generally provided good to excellent control (78-99%) of annual grasses and broadleaved weeds. No burley tobacco vigor reduction was apparent, where observations were made.

Post-transplant applications of oryzalin at either 1.0 or 1.5 lb/A generally gave excellent control (≥ 90%) of annual grasses and broadleaved weeds, with only slight (< 10%) vigor reduction. No apparent yield reduction occurred at either location.

Pebulate (Tillam)

Pebulate has been tested frequently as a preplant incorporated treatment of 4.0 lb/A (Table 2, 3).

At the 4.0 lb/A rate, results were somewhat erratic from year to year among the two locations. Excellent control (≥ 90%) of annual grasses was noted at Greeneville in 1970, 1972, 1976 and 1977. At Greeneville in 1973, excellent control (93%) of crabgrass, but only fair control (76%) of goosegrass was observed. Fair control (67-70%) of annual grasses was noted at Greeneville in 1976, but only poor control (47%) at Greeneville in 1971. These erratic results may have been a partial response to inadequate soil moisture and poor incorporation techniques at the time of application.

Control of broadleaved weeds was excellent (≥ 93%) at Greeneville in 1972 and 1977 and at Spring Hill in 1975. In other tests, mainly where broadleaves were rated by species, control ranged from poor to excellent (38-100%). (Tables 2, 3).

Where observations were made, vigor reduction (Table 2) was slight (≤ 10%). Tobacco treated with pebulate at 4.0 lb/A generally produced yields comparative to the weed-free check.

The 6.0 lb/A rate was included in two experiments. This rate increase offered little advantage in weed control. As with the 4.0 lb/A rate only slight vigor reduction was observed.

Pendimethalin (Prowl)

Pendimethalin was tested as preplant incorporated application at rates of 0.75, 1.0 and ;1.5 lb/A, and as a preemergence application at 1.0 lb/A.

As a preplant incorporated treatment at Greeneville in 1976, the 0.75 lb/A rate gave excellent control (90%) of annual grasses, excellent control (100%) of carpetweed, good control (89%) of pigweed, and fair control (69%) of purslane. Mustard was not controlled.

Increasing the rate to 1.0 lb/A provided excellent control (> 90%) of both annual grasses and broadleaved weeds at Greeneville in 1977. The same application at Spring Hill in 1978 gave excellent control (97%) of crabgrass, fair control (69%) of morningglory, and poor control (55%) of pigweed (Table 3). This application also gave excellent control of all annual broadleaf and grass species except goosegrass, at Greeneville in 1980 and 1981. Goosegrass control was only 64% in 1980.

At the highest preplant incorporated rate tested, 1.5 lb/A, pendimethalin provided excellent control (≥ 92%) of both annual grasses and broadleaved weeds at Greeneville in 1976 and 1977.

Very little tobacco vigor reduction was noted. Yields were approximately the same as the weed-free checks.

As a preemergence treatment (Table 2) pendimethalin at 1.0 lb/A provided poor to excellent control of annual grasses, and good to excellent control (80-100%) of selected broadleaved weeds. No vigor reduction occurred as a result of this application. Yield of burley tobacco was not reduced.

Perfluidone (Destun)

Perfluidone was tested as a preemergence and post-transplant application (Table 2).

The preemergence application (2.0 lb/A), tested at Greeneville in 1976, gave good to excellent control (82-98%) of broadleaved weeds, with the exception of poor control (58%) of pigweed and no apparent tobacco injury.

Post transplant application of perfluidone at 1.5 and 2.5 lb/A at Greeneville in 1977 gave excellent control (≥ 91%) of both annual grasses and broadleaved weeds, including pigweed. No tobacco vigor or yield reduction was observed for either rate.

The intermediate post transplant rate, 2.0 lb/A, gave excellent control (92%) of annual grasses and broadleaved weeds at Greeneville in 1975 with very slight tobacco vigor reduction (3%). Good control (86%) of late season grasses was observed. Control of selected broadleaved weeds ranged from poor (43% for purslane) to good (80% for prickly sida). Slight tobacco vigor reductions were observed.

Combination Treatments

Most frequently, one herbicide alone will not control an adequate spectrum of broadleaved and grass weeds. It is often desirable to employ a combination of two or more herbicides. Several of these combinations have been tested in burley tobacco.

Metolachlor + Diphenamid (Dual + Enide)

Metolachlor + diphenamid was applied in various rate combinations in 1979 and 1980. Control of annual weeds was excellent. This combination reduced tobacco vigor by 17% in 1979 and 33 to 47% in 1980. While weed control may be excellent, consistent tobacco injury is more than is commercially acceptable.

Pebulate + Diphenamid (Tillam + Enide)

Pebulate + diphenamid at 5.0 + 4.0 lb/A applied preplant incorporated, was tested at Spring Hill in 1974. Excellent control (96%) of annual grasses and broadleaved weeds was noted. No vigor reduction was observed. Tobacco treated with this combination yielded as well as the weed-free check.

Another combination, pebulate + diphenamid at 4.0 + 4.0 lb/A, preplant incorporated + post-transplant was tested (Table 2). This combination gave excellent control (≥ 90%) of annual grasses and broadleaved weeds in all tests, with the exception of poor control (3%) of morningglory at Spring Hill in 1978. Tobacco vigor reduction was slight (≤ 3%). Tobacco yields compared favorably with the weed-free checks, where yields were taken.

Pebulate + Isopropalin (Tillam & Paarlan)

Pebulate + isopropalin at 4.0 + 1.5 lb/A applied preplant incorporated at Greeneville in 1973 gave excellent control (96 and 97%) of crabgrass and goosegrass. Good control (87%) of purslane, and fair control (73%) of mustard was also observed. Slight tobacco vigor reduction (3%) was noted, and tobacco yield was excellent.

Pebulate + Napropamide (Tillam & Devrinol)

Pebulate + Napropamide at 4.0 + 1.0 lb/A, applied preplant incorporated has received frequent testing since 1974.

Excellent control (≥ 93%) of both annual grasses and broadleaved weeds was noted at Spring Hill in 1975. Good to excellent control (80%+) of annual grasses and broadleaved weeds was observed at Greeneville each year (1973-81) with the exception of fair control (66%) of mustard in 1973 and 1976, and fair control of barnyardgrass and goosegrass in 1974.

Tobacco vigor reduction caused by this application was slight (≤ 6%) where ratings were made. Tobacco treated with this combination of herbicides yielded as well as the weed-free checks.

Pendimethalin + Diphenamid (Prowl + Enide)

Pendimethalin + Diphenamid 0.7 + 4.0 lb/A applied preplant incorporated + post-transplant was tested at Greeneville in 1976. Excellent control of selected annual grasses and broadleaved weeds (97% of crabgrass and goosegrass, 93% of carpetweed, mustard, and purslane), and good control (83%) of pigweed was observed. No tobacco injury has been noted due to this application.

Section II
Dark Fire-Cured Tobacco
Location — Springfield

Alachlor (Lasso)

Alachlor was tested as a preemergence application at 2.5 lb/A in 1971 and 1972. It was also tested as a post-transplant application at 2.0 lb/A in 1970, and at 2.5 lb/A in 1970-72 (Table 4).

The preemergence application provided excellent control (94-99%) of broadleaved weeds, (mainly pigweed) and excellent control (94-97%) of annual grasses. Vigor reduction caused by this application was moderate (20-34%). The preemergence application did not affect tobacco yield.

The 2.0 lb/A post-transplant application provided excellent control (> 93%) of both annual grasses and broadleaved weeds, and caused slight vigor reduction. The 2.5 lb/A post-transplant application provided excellent control (> 93%) of both annual grasses and broadleaved weeds. Vigor reduction was slight (10%) in 1970, and severe (60-65%) in 1971 and 1972. No yield data were available for the 2.0 lb/A application. Tobacco treated with the 2.5 lb/A rate yielded approximately the same as the weed-free check in 1971, and considerably less in 1972.

Benefin (Balan)

Benefin at 1.1 lb/A has been tested extensively as a preplant incorporated treatment, 1.5 lb/A in 1976, at 2.25 lb/A in 1974 (Table 4).

In 1970, the 1.1 lb/A rate gave excellent control (93%) of grasses, but only fair control (73%) of broadleaved weeds. Vigor reduction initially was slight (20%). Some early stunting of tobacco plants occurred although it had no lasting effect. In 1971, the same rate exhibited poor control (< 50%) of both annual grasses and broadleaved weeds. In 1972, poor early control (53%) of both annual grasses and broadleaved weeds was rated, but control of late season grasses was excellent (93%). Control of pennsylvania smartweed, common-ragweed and large crabgrass was poor in 1979 but control of smooth crabgrass and large crabgrass was excellent in 1980. Some vigor reduction in the form of early stunting occurred most years. This had little effect on yield when compared to the weed-free check.

The 1.5 lb/A rate in 1976 gave good control (88%) of annual grasses, but only poor control (10%) of common ragweed. No tobacco vigor reduction was observed. Yield data were not taken because the experiment as a whole was very non uniform due to poor transplants.

The 2.25 lb/A rate caused slight vigor reduction (17%), and tobacco yielded slightly less than the weed-free check. Weed control data, where available, were excellent.

Bifenox (Modown)

Bifenox was tested as a preemergence application at rates of 1.5, 3.0, and 6.0 lb/A (Table 4). The 1.5 lb/A rate provided poor control (42 and 55%) of annual grasses and broadleaved weeds. Slight tobacco vigor reduction was noted.

Improved herbicide efficacy was observed where the rate was increased above 1.5 lb/A. Bifenox at 3.0 lb/A provided fair control (74%) of annual grasses and good control (78%) of common ragweed. Changing the rate to 6.0 lb/A provided good control (83%) of annual grasses, and excellent control (93%) of common ragweed. Tobacco vigor reductions were 14 and 20% for the 3.0 and 6.0 lb/A rates, respectively.

Butralin (Amex, A-820)

Butralin was tested as a preplant incorporated treatment at rates of 1.5 and 2.5 lb/A in 1971 and at 2.0 lb/A in 1975 and 1976 (Table 4). The 1.5 lb/A rate provided good control (78%) of broadleaved weeds, and fair control (68%) of annual grasses. Increasing the rate to 2.5 lb/A did not improve overall herbicide efficacy. Vigor reduction initially was slight ($\leq$ 10%) for either rate. The 2.0 lb/A rate gave good to excellent control of a number of annual grasses and broadleaf weeds in 1975 but gave poor control of annual grasses and common ragweed in 1976. Slight tobacco vigor reduction occurred each year, with no reduction in final yield.

Dinitramine (Cobex)

Dinitramine was tested as a preplant incorporated treatment at rates of 0.5, and 0.7 lb/A (Table 4). Slight (23%) to moderate vigor reduction (42%) was noted. This degree of vigor reduction occurred consistently and was unacceptable. Weed control was excellent.

Diphenamid (Enide)

Diphenamid, one of the herbicides recommended for weed control in tobacco in Tennessee, has been included as a comparison in most of the trials (Table 4). Generally, it was applied immediately after transplanting over-the-top of the newly transplanted tobacco.

In general, the 4.0 lb/A rate provided good to excellent control of annual grasses, with exception of 1975 when very poor control of crabgrass was obtained. Control of broadleaved weeds ranged from fair (68%) to excellent (91%).

Increasing the rate to 6.0 lb/A gave excellent control ($>$ 90%) of grasses in all tests. Control of broadleaved weeds was good (80%) to excellent (99%). Weed control from the 6.0 lb/A rate was more consistent over years than was the 4.0 lb/A rate. Vigor reduction caused by either rate was never more than slight.

Tobacco yields from diphenamid treated plots were equal to yields from the weed free check wherever yield data were taken.

Isopropalin (Paarlan)

Isopropalin was applied as a preplant incorporated treatment most of the years. Application rates varied from 1.0 to 2.0 lb/A. Control at the 1.0 lb/A rate was somewhat erratic (Table 4). At the 1.5 lb/A rate excellent control of annual grasses was obtained each year except in 1972 and 1976 when it was only poor (53%) to fair (68%). Isopropalin gave poor to excellent control of broadleaved weeds depending on the years, but was exceptionally weak on some large-seeded broadleaved weeds in 1971, such as common ragweed. When isopropalin was applied at the 2.0 lb/A rate it gave poor control of annual grasses and broadleaved weeds in 1971, but excellent control in 1970 and 1974. Isopropalin caused very little reduction in tobacco vigor. Dark-fired tobacco yields from isopropalin treated plots were approximately equal to yields from the weed-free plots.

Napropamide (Devrinol)

Napropamide was tested once, as a 3.0 lb/A preplant incorporated application in 1976. Excellent control (97%) of annual grasses and common ragweed was obtained with no visible tobacco vigor reduction.

Napropamide was applied post transplant in different years at the 1.0 and 2.0 lb/A rate. The 1.0 lb/A was inadequate for consistent control under Tennessee conditions (Table 4). The 2.0 lb/A rate gave good to excellent control of annual grasses and excellent control of small seeded broadleaf weeds with only slight injury (6% vigor reduction) and no yield reduction.

Oryzalin (Surflan)

Oryzalin was tested as a preemergence application of 1.5 lb/A in 3 years and as a post-transplant application at 1.0 and 1.5 lb/A in 1974. The preemergence application provided fair to excellent control (52-99%) of annual grasses and broadleaved weeds depending on the year with only slight vigor reduction in one year. The post-transplant application gave excellent control of annual grasses and annual broadleaved weeds. The 1.0 and 2.0 lb/A caused slight (5 and 12%) vigor reduction with no yield reduction.

Pebulate (Tillam)

Pebulate has been tested frequently as a preplant incorporated application, at 4.0 lb/A. A higher rate, 6.0 lb/A was tested in 1970 and 1971. The 4.0 lb/A rate in 1970 performed well, providing excellent control (98 and 96%) of grasses and broadleaved weeds, respectively, with only slight (8%) vigor reduction. However, the same rate in 1971 gave only good control (88%) of grasses, and fair control (67%) of broadleaved weeds, with moderate (30%) vigor reduction. In 1972, the 4.0 lb/A rate provided fair control (72%) of annual grasses, and good control (83%) of broadleaved weeds. Excellent late season control (96-98%) was noted for fall panicum, large crabgrass, and smooth crabgrass. Vigor reduction was slight (15%). Good to excellent weed control data were obtained from the 1974 test, where tobacco treated with

pebulate at 4.0 lb/A exhibited slight (12%) vigor reduction. In 1975 excellent control of all weeds except purslane (68%) was obtained. In 1976, 1980, and 1981 this application gave good to excellent control (88-100%) of annual grasses. Poor control (20%) of common ragweed was obtained in 1976, and fair control (68%) of redroot pigweed in 1981, with little or no tobacco vigor reduction. Where tobacco yield data were taken, little difference was noted between yields from pebulate treated plots and from the untreated weed-free plots.

In 1970, the 6.0 lb/A rate provided excellent control (98 and 97%) of grasses and broadleaved weeds respectively, with slight (12%) vigor reduction. In 1971, the same application gave good control of grasses and broadleaved weeds (87 and 88%), respectively, with slight (10%) vigor reduction. Tobacco treated at this rate yielded approximately the same as the weed free check in 1971. No yield data were available for the 1970 test.

Pendimethalin (Prowl)

Pendimethalin was tested in 1976 as a preplant incorporated application at rates of 0.75 and 1.5 lb/A. Both rates provided good control (75% and 88%) of annual grasses. Similarly, both rates provided poor control (20-45%) of common ragweed. Neither application caused any vigor reduction. In 1980 and 1981 pendimethalin was applied both preplant incorporated and preemergence at a 1.0 lb/A rate. Control of annual grasses was excellent with the preplant incorporated treatments but when applied preemergence control of grasses was erratic. Excellent control (100%) was obtained in 1980 but only 45% control was obtained in 1981.

Combination Treatments

Metolachor + Diphenamid (Dual + Enide)

Metolachor + Diphenamid was applied in 1979, 1980 and 1981. This combination caused slight vigor reduction (,8-10%) to dark-fired tobacco. Control of annual broadleaf weeds and annual grasses was good to excellent (Table 4).

Pebulate + Diphenamid (Tillam + Enide)

Pebulate + Diphenamid (4.0 + 5.0 lb/A applied as a split application of preplant incorporated and post-transplant, respectively) were tested in 1974. This treatment gave excellent control of annual grasses, but was weak on annual broadleaved weeds, but the application caused no vigor reduction. This application had no effect on tobacco yield.

Pebulate + Napropamide (Tillam + Devrinol)

The combination of pebulate + napropamide (4.0 + 1.0 lb/A) applied preplant inorporated was tested in 6 years between 1974 and 1981. This application provided excellent control of annual grasses, and annual broadleaved weeds in each year. Vigor reduction was slight (3-15%). Yields were not affected by this herbicide combination.

Pendimethalin + Diphenamid (Prowl + Enide)

Pendimethalin + Diphenamid (a split application of 0.7 + 4.0 lb/A, applied preplant incorporated + post-transplant) gave excellent control (93%) of annual grasses, and good control (88%) of common ragweed in a single test in 1976. No tobacco vigor reduction occurred from this application.

SUMMARY

Several of the herbicides tested in this study have shown considerable selectivity and desirable weed control in burley and dark fire-cured tobacco. In most cases, selectivity was greater in burley tobacco than in dark fire-cured tobacco. Several of these herbicides and herbicide combinations are:

- Benefin, 1.1 - 1.5 pounds per acre as a preplant incorporated application.

- Diphenamid, 4.0 - 6.0 pounds per acre as a post-transplant application.

- Isopropalin, 1.5 pounds per acre applied as a preplant incorporated application.

- Pebulate, 4.0 pounds per acre, applied as a preplant incorporated application. Immediate thorough soil incorporation is especially important with pebulate.

- Pebulate + diphenamid, 4.0 + 4.0 pounds per acre. Pebulate must be applied preplant incorporated and diphenamid should be applied post transplant.

- Pebulate + napropamide, 4.0 + 1.0 pounds per acre, tank-mixed and applied as a preplant incorporated application.

- Pendimethalin, 1.0 pounds per acre, applied as a preplant incorporated application.

Many of the herbicides tested in this study are neither labeled with the Environmental Protection Agency nor recommended by the University of Tennessee for use in tobacco. Therefore, the farmer should carefuly read the label, and if necessary, consult his County Extension Agent before purchasing a herbicide for use in tobacco.

Utilization of herbicides is but one of the practices available to the farmer to incorporate into an efficient weed management program. Proper land preparation, crop rotation, crop plant competition, and timely post-transplant cultivation should also be employed for maximum weed control.

Table 1 **Identification of Herbicides Used in This Study**

Common Name or Code No.	Commercial Name	Chemical Name	Manufacturer
Alachlor	Lasso	2-chloro-2^1, 6^1-diethyl-N-(Methoxymethyl) acetanilide	Monsanto Ag. Products Co.
Benefin	Balan	N-butyl-N-ethyl-α ,α ,α -trifluoro-2,6-dinitro-p-toluidine	Elanco Products Co.
Bifenox	MoDown	mythyl5-(2,4,-dichlorophenoxy)-2-nitrobenzoate	Mobil Chemicals
Butralin	Amex	4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzenamine	Am Chem Products, Inc.
Dinitramine	Cobex	N^4, N^4-diethyl-α ,α ,α -trifluoro-3,5-dinitrotoluene-2,4-diamine	U.S. Borax
Diphenamid	Enide	N, N-dimethyl-2, 2-diphenylacetamide	Upjohn Co.
Isopropalin	Paarlan	3, 6-dinitro-N, N-diprophleumidine	Elanco Products Co.
Metolachor	Dual	2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide	Ciba-Geigy Corp.
Napropamide	Devrinol	2-(a-naphthoxyl)-N, N-diethylpropionamide	Stauffer Chemical Co.
Oryzalin	Surflan	3, 5-dinitro N^4, N^4-dipropylsulfanilamide	Elanco Products Co.
Pebulate	Tillam	S-propylbutylethylthiocarbamate	Stauffer Chemical Co.
Pendimethalin	Prowl	N-(1-ethylpropyl)-3,4 dimethyl-2,6 dinitrobenzeneamine	American Cyanamid
Perfluidone	Destun	1,1,1-tribluoro-N-{2-methyl-4-(phenylsulfonyl)phenyl} methanesulfonamide	3M
Vernolate	Vernam	S-propydipropylthiocarbamate	Stauffer Chemical Co.

Table 2. Summary of Burley Tobacco and Weed Response to Herbicides, at Spring Hill and Greeneville, Tenn., 1970-81.

Herbicide	Stage[1]	Rate lb/A a.i.	TOBACCO Vigor Reduction % # Exp.	Range[2]	Avg.	WEED CONTROL Broadleaves % Control Exp.#	Range[2]	Avg.	Annual Grasses % Control Exp.#	Range[2]	Avg.
Alachlor	Pre	2.5	3	3-30	10	2	95-100	98	2	88-100	94
Alachlor	Post	2.0	2	0	0	2	95-100	100	1	95-100	95
Alachlor	Post	2.5	3	17-22	19	—	—	—	2	100	100
Benefin	PPI	1.1	14	3-22	10	7	47- 98	76	9	60- 98	89
Benefin	PPI	2.2	3	3-27	13	3	23- 95	58	3	79- 93	86
Bifenox	Pre	1.5	2	0	0	2	30- 73	51	2	23- 82	53
Bifenox	Pre	3.0	3	0	0	3	57- 98	82	3	27- 98	74
Bifenox	Pre	6.0	1	0	0	1	90- 98	94	1	95-100	97
Butralin	PPI	1.5	2	0-14	7	2	31- 37	34	1	50- 80	63
Butralin	PPI	2.0	3	0- 3	1	3	71- 99	87	3	75- 98	90
Butralin	PPI	2.5	2	0- 6	3	2	27-100	59	2	53-100	76
Dinitramine	PPI	0.5	2	10-25	18	4	50-100	83	3	62-100	87
Dinitramine	PPI	0.7	1	15-50	32	2	65- 78	72	1	95-100	98
Diphenamid	Post	4.0	9	0- 7	3	12	22- 90	96	12	65-100	93
Diphenamid	Post	6.0	6	0- 7	3	7	77-100	94	8	88-100	97
Isopropalin	PPI	1.0	3	0- 6	3	3	20- 97	70	3	23- 95	70
Isopropalin	PPI	1.5	11	2-23	10	10	83-100	88	8	67- 97	88
Isopropalin	PPI	2.0	2	8-20	9	4	35- 94	78	4	70- 97	85

Table 2. (Continued) Summary of Burley Tobacco and Weed Response to Herbicides, at Spring Hill and Greeneville, Tenn., 1970-81.

			TOBACCO			WEED CONTROL					
			Vigor Reduction %			Broadleaves			Annual Grasses		
						% Control			% Control		
Herbicide	Stage[1]	Rate lb/A a.i.	# Exp.	Range[2]	Avg.	Exp.#	Range[2]	Avg.	Exp.#	Range[2]	Avg.
Metolachlor	Post	1.5	2	13-22	17	1	100	100	3	37-100	75
Metolachlor	Post	2.0	3	12-45	30	1	97-100	99	3	60-100	83
Napropamide	Post	1.0	1	0	0	1	95-100	98	1	95-100	97
Napropamide	Post	2.0	1	0	0	1	95-100	97	2	93- 97	95
Oryzalin	Post	1.0	2	0-10	5	4	50- 99	80	2	95-100	97
Oryzalin	Post	1.5	2	0- 9	5	6	88- 99	94	4	88-100	94
Pebulate	PPI	4.0	9	0-10	5	9	53- 94	77	10	47- 99	90
Pebulate	PPI	6.0	2	0-10	9	2	77- 92	85	2	88- 99	92
Pendimethalin	PPI	1.0	4	0- 7	4	2	95- 98	97	4	92-100	97
Pendimethalin		1.5	2	0-12	6	2	92- 98	95	2	97-100	98
Pendimethalin	Pre	1.0	4	0- 3	1	2	80- 90	85	3	54- 96	76
Perfluidone	Pre	2.0	2	0- 3	2	2	58- 91	80	2	97- 98	97
Meto. + Diph.	Post	2.0 + 4.0	1	10-30	17	1	100	100	1	97-100	98
Meto. + Diph.	Post	1.5 + 2.0	1	10-50	33	1	100	100	1	100	100
Pebu. + Diph.	PPI + Post	4.0 + 4.0	3	0	0	3	93-100	96	3	96- 99	98
Pebu. + Napro.	PPI	4.0 + 1.0	7	0-23	6	6	67-100	88	5	83- 98	92

[1]Abbreviations: lb/A = pounds per acre; a.i. = active ingredient; #Exp. = # of experiments from which data were obtained; Ave. = average; PPI = preplant incorporated; Pre = Preemergence; Post = postemergence.

[2]Range = the extremes in vigor reduction or control between experiments if treatment was included in 2 or more experiments and between replications if included in only one reduction.

Table 3. A Summary of Control of Large Crabgrass, Goosegrass, Purslane, and Redroot Pigweed Obtained with Various Herbicides Applied to Tobacco. Spring Hill and Greeneville, Tenn., 1970-1981.

		Rate	Large Crabgrass			Goosegrass			Purslane			Redroot Pigweed		
		lb/A	#	% Control		#	% Control		#	% Control		#	% Control	
Herbicide	Stage[1]	a.i.	Exp.	Range[2]	Avg.	Exp.	Range[2]	Avg.	Exp.	Range[2]	Avg.	Exp.	Range	Avg.
Alachlor	Pre	2.5	1	90- 95	92	1	95-100	98	2	92- 98	95	1	93- 98	95
Alachlor	Post	2.5	1	90- 98	94	1	95-100	98	2	94-100	97	1	99-100	94
Benefin	PPI	1.1	7	68- 98	87	5	70- 98	84	4	17-100	71	7	57- 94	76
Benefin	PPI	2.25	1	90- 98	94	—	—	—	1	0- 60	23	—	—	—
Bifenox	Pre	3.0	2	27- 96	62	—	—	—	1	95- 98	96	3	57- 98	82
Diphenamid	Post	4.0	7	67- 99	89	5	63- 99	87	4	88-100	93	8	22-100	80
Diphenamid	Post	6.0	5	92-100	95	3	80-100	93	4	93-100	93	6	77-100	92
Isopropalin	PPI	1.0	4	20- 94	74	2	61- 91	72				3	20- 90	68
Isopropalin	PPI	1.5	7	67- 98	95	5	61- 93	74	3	73-100	87	6	53- 95	86
Oryzalin	Post	1.0	2	53- 89	71	—	—	—	—	—	—	2	50- 88	69
Oryzalin	Post	1.5	2	96- 97	97	2	95- 97	96	1	95-100	97	1	85- 90	88
Pebulate	PPI	4.0	4	67-100	90	3	70- 95	80	4	42-100	84	5	38- 95	82
Pendimethalin	PPI	0.75	2	99-100	99	1	95- 98	96	3	69-100	89	3	89- 95	86
Pendimethalin	PPI	1.0	4	92- 99	47	2	64- 97	81	—	—	—	3	55- 98	83
Pendimethalin	PPI	1.5	1	100		1	95-100	97	2	93- 98	96	2	93- 98	95
Pendimethalin	Pre	1.0	3	45- 96	76	2	40- 59	50	—	—	—	2	80- 90	85

[1]For definition of abbreviations see Footnote 1, Table 2.

[2]Range = the extremes in vigor reduction or control between experiments if treatment was included in 2 or more experiments and between replications if included in only one reduction.

Table 4. Summary of Dark-Fired Tobacco and Weed Response to Herbicides. Highland Rim Experiment Station, Springfield, 1970-81.

			TOBACCO			WEED CONTROL					
		Rate	Vigor Reduction %			Broadleaves			Annual Grasses		
		lb/A	#			% Control			% Control		
Herbicide	Stage[1]	a.i.	Exp.	Range[2]	Avg.	Exp.#	Range[2]	Avg.	Exp.#	Range[2]	Avg.
Alachlor	Pre	2.5	2	20-34	25	3	94- 99	96	1	95-100	98
Alachlor	Post	2.0	1	10-15	12	1	90- 99	93	1	90- 99	95
Alachlor	Post	2.5	3	10-65	35	2	98-100	99	1	95- 99	98
Benefin	PPI	1.1	10	1-20	6	5	0- 93	45	4	43- 95	69
Benefin	PPI	2.2	1	10-25	17	1	—	—	1	85- 95	90
Bifenox	Pre	1.5	2	0- 3	2	2	45- 65	54	2	7- 75	42
Bifenox	Pre	3.0	2	5-23	14	2	78- 85	81	2	33-37	35
Bifenox	Pre	6.0	1	10-30	20	1	90- 95	93	1	80- 85	83
Butralin	PPI	1.5	1	5-15	10	1	70- 85	78	1	50- 95	68
Butralin	PPI	2.0	2	2-10	6	2	5- 98	52	1	80- 95	88
Butralin	PPI	2.5	1	5-10	7	1	70- 85	78	1	80- 95	85
Dinitramine	PPI	0.5	2	13-32	23	1	100		1	95-100	96
Dinitramine	PPI	0.7	1	30-50	42	1	70- 85	80	1	98-100	99
Diphenamid	Post	4.0	11	0- 7	5	5	60- 97	68	5	80- 99	91
Diphenamid	Post	6.0	8	0-13	6	4	70- 99	86	4	94- 99	97
Isopropalin	PPI	1.0	4	0-10	5	2	55- 87	71	4	58-100	86
Isopropalin	PPI	1.5	7	0-22	8	2	23-100	61	2	53-100	76
Isopropalin	PPI	2.0	3	10-15	12	2	55-100	83	3	53-100	83
Metolachlor	Pre	2.0	1	0- 2	1	—	—	—	1	85- 98	88
Metolachlor	Post	2.0	4	3-18	10	—	—	—	1	95- 98	97

Table 4. (Continued) Summary of Dark-Fired Tobacco and Weed Response to Herbicides. Highland Rim Experiment Station, Springfield, 1970-81.

			TOBACCO			WEED CONTROL					
			Vigor Reduction %			Broadleaves % Control			Annual Grasses % Control		
Herbicide	Stage[1]	Rate lb/A a.i.	# Exp.	Range[2]	Avg.	Exp.#	Range[2]	Avg.	Exp.#	Range[2]	Avg.
Napropamide	PPI	3.0	1	0	0	1	95- 99	97	1	90- 95	93
Napropamide	Post	1.0	2	0- 7	2	—	—	—	2	63- 68	65
Napropamide	Post	2.0	2	5- 7	6	1	100	100	2	80- 97	88
Oryzalin	Pre	1.5	3	0-20	10	3	68- 87	70	3	52- 90	70
Oryzalin	Post	1.0	1	0-10	5	1	100	100	1	95-100	98
Oryzalin	Post	1.5	1	5-15	12	1	100	100	1	95-100	98
Pebulate	PPI	4.0	8	0-30	8	4	40- 98	77	4	72- 98	79
Pebulate	PPI	6.0	2	10-12	11	2	88- 97	93	2	87- 98	93
Pendimethalin	PPI	1.0	2	5- 7	6	1	95-100	98	2	98-100	99
Pendimethalin	PPI	1.0	2	3- 8	6	2	67- 85	76	2	45-100	73
Pendimethalin	Pre	1.5	1	0- 5	2	—	—	—	1	85- 90	88
Meto. + Diph.	Post	1.5 + 4.0	3	8-10	9	2	85-100	92	2	91- 98	95
Pebu. + Diph.	PPI + Post	4.0 + 4.0	2	0- 3	2	2	94-100	97	2	90-100	95
Pebu. + Napro.	PPI	4.0 + 1.0	6	0-15	6	2	98-100	99	3	98-100	99
Pend. + Diph.	PPI	0.7 + 4.0	1	0		1	85- 90	88	1	90- 98	93

[1]For definition of abbreviations see Footnote 1, Table 2.

[2]Range = the extremes in vigor reduction or control between experiments if treatment was included in 2 or more experiments and between replications if included in only one reduction.

THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION
KNOXVILLE, TENNESSEE 37916

E11-1107-03-003-83