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Chemical Control of Weeds in Burley Tobacco Plant Beds

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The University of Tennessee
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Summary

The results presented concern the effect of chemicals at different rates, methods, and times of application on weed control and the production of burley tobacco plants suitable for transplanting to the field. The experiments were conducted during 1956-1960 at the University of Tennessee Tobacco Experiment Station, Greeneville, Tennessee.

• Chemicals evaluated were methyl bromide; sodium-*N*-methyl dithiocarbamate (SMDC); a mixture of allyl alcohol and ethylene dibromide; calcium cyanamide with and without 20% superphosphate added; 3, 5-dimethyltetrahydro-1, 3, 5, 2*H*-thiadiazine-2-thione (DMTT); a liquid form of cyanamide; and an experimental product containing a mixture of propargyl alcohol and 1, 2-dibromoethane.

• Some products were tested only one season, but promising materials were tested more than once. Several treatments resulted in good weed control and an adequate supply of early plants. Others failed in one or both characteristics.

• Excellent weed control and plant production were obtained with methyl bromide. 41% SMDC at the minimum rate of 8 quarts per 100 square yards gave good weed control and plant production. When this chemical was confined with gasproof covers, 4 quarts per 100 square yards performed well. DMTT performed similarly to the regular SMDC treatment. SMDC and DMTT gave more erratic results and were slightly inferior to methyl bromide. They were superior, however, to calcium cyanamide and allyl alcohol-ethylene dibromide applications. Seemingly SMDC was superior to DMTT as a tobacco plant bed treatment when applied in spring. A reduction in legume weeds by SMDC applied with water and sealed with a gastight cover was obtained in one experiment.

• A liquid form of cyanamide was not promising as a late-winter treatment because rates that controlled the weeds were toxic to tobacco. A lower rate, which allowed good plant production, did not control weeds. Calcium cyanamide was toxic to tobacco plants in one of the 2 years tested. Adding 2 pounds of 20% superphosphate per square yard to 1½ pounds of cyanamide per square yard decreased, but did not eliminate, the toxic effects of the latter in the year this comparison was made. In the same experiment better control of grass weeds was obtained by adding superphosphate.

• Allyl alcohol-ethylene dibromide and propargyl alcohol-1,2-dibromoethane materials at the rates used were inferior to methyl bromide in the production of early plants and slightly below it in weed control.

Acknowledgment

Grateful acknowledgment is hereby made to Superintendent J. Hugh Felts of the Tobacco Experiment Station, Greeneville, Tennessee, for his assistance in conducting the tests reported in this bulletin; and H. E. Heggestad, Principal Agronomist, Crops Research Division, Agricultural Research Service, USDA, Beltsville, Md., for suggestions and corrections in preparing the manuscript.

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by

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Introduction

An adequate supply of early transplants is desirable for good burley tobacco production. Weed competition is one of the most important factors limiting production of early, vigorous transplants of desirable size. Hand-weeding is laborious and time-consuming and it may spread tobacco mosaic (13) and wildfire (15), two common tobacco diseases. Uncropped woods soil was frequently used for the tobacco plant bed site in the past, but lack of new ground has largely eliminated this practice. Burning the bed site with wood or other material to control weeds is used to some extent, but the scarcity of materials to burn and the high labor cost have resulted in gradual reduction of use of this method. Steaming, used in a few areas, provides excellent weed control (9); but because of lack of available steamers, this method, also, is gradually disappearing. Using chemicals for plant bed weed control has hastened the diminishing use of the aforementioned methods. Calcium cyanamide and methyl bromide are among the chemicals most often used.

Beginning with a spring treatment in 1956, experiments have been conducted at the Tobacco Experiment Station, Greeneville, Tennessee, on the use of several chemicals for weed control in burley tobacco plant beds. Results of these experiments are reported here.

The recommended practice has been to prepare plant beds in the fall, when temperatures and rainfall normally are suitable for applying chemical treatments to the tobacco bed sites. Spring treatment with chemicals requires compounds that rapidly dissipate from the soil to prevent injury to the tobacco seed and to avoid reduced germination or growth. In late winter or early spring, unfavorable weather may delay treatment or seeding. Nevertheless, many plant beds in the area are treated in late winter. The experiments reported include both fall and spring treatments. Fall

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treatments were usually made in October and spring treatments in late winter or early spring.

Materials and Methods

All plant beds were plowed and harrowed in the fall. Seed of the variety Burley 21 was used to prevent confounding the results with wildfire and mosaic (7). Methods of seeding and plot layout closely followed those reported by Nichols and McMurtrey (11). Unless otherwise stated, a randomized block design was used with the treatments replicated four times.

Fertilization was at the rate of ½ pound of 4-12-8 commercial fertilizer per square yard except on plots treated with liquid or dry form of cyanamide. These plots received a ½-pound rate of 0-12-8 fertilizer immediately before seeding. Nitrogen was omitted on these treatments because cyanamide contains much nitrogen.

Insect control was provided with the wettable form of DDT applied by a pressure sprayer. Beds were watered as necessary to provide moisture for seed germination and growth of plants.

Early plant stands were based on plant counts in four 1-square-foot areas in each plot. Two or more pullings of plants considered of adequate size for transplanting were made in each test in each experimental series. Weeds were removed and counted before the first plant pulling. The weeds were classified as grass, legume, or non-leguminous broadleaf. Weed counts express the number pulled or removed, regardless of size. The photographs were made before weed pulling.

Methyl bromide gas was applied under a plastic cover at the equivalent rate of 1 pound per 100 square feet. It was necessary to mound the soil near the center of the plot so as to place the edge of the plastic cover at a desirable depth near the boards enclosing the plot. Liquid chemicals were mixed with water and applied with a sprinkling can. Dry materials were divided into two portions, with one part worked into the top 2-3 inches of soil and the remainder raked into the top surface.

When new or different chemicals and methods of application proved unacceptable, they were eliminated after one trial. Others with promise were included more than 1 year. The larger tests in the 1957 and 1958 seasons included the same treatments.

Bed sites were changed annually and the soils were all of relatively fine texture. The locations used in 1956, 1959, and 1960 were classified as Dewey silt loam. The 1957 and 1958 sites were classified as Nolichucky silt loam.

Table 1. Materials Used for Treatments of Burley Tobacco Plant Beds.

Material*	Active ingredients	Common name	Method of application
Methyl bromide	98% Methyl bromide plus 2% Chloropicrin		Gas
Vapam	41% Sodium-*N*-methyl-dithiocarbamate	SMDC	Drench
Mylone 85-W	85% 3,5-Dimethyltetrahydro-1,3-5,2*H* thiadiazine-2-thione	DMTT	Broadcast
Bedrench	81% Allyl alcohol plus 11.5% Ethylene dibromide		Drench
ME 6256	83% Propargyl alcohol plus 12% 1,2-Dibromoethane		Drench
Cyanamid	60-63% Calcium cyanamide		Broadcast
Liquid cyanamid	25% Cyanamide		Drench

* Trade names are given for the purpose of identifying the product used in the experimental work. Mention of a specific commercial product does not constitute an endorsement by the United States Department of Agriculture over similar items not named.

1956 EXPERIMENT

The plant bed in 1956 (Table 2) was located in fine-textured soil that had been turned and harrowed in the fall. On March 6, after the plots had been boxed with boards and the soil had settled, the soil was loosened and raked. Soil temperature was 66° F. at a 3-inch depth during treatment. Vapam (SMDC) was used at two rates, 8 and 12 quarts per 100 square yards. The check plots were also raked, but water or chemicals were not applied. Methyl bromide was applied as previously mentioned. Fifteen days later, on March 21, the soil surface was loosened to approximately a 3-inch depth, fertilized, and raked. Seed was then sown.

1957 EXPERIMENT

In the fall of 1956 a new site was chosen. Vapam (SMDC) was used in both fall and spring, and other chemical treatments were applied in fall (Table 3).

The fall application was made October 25 with the soil temperature between 64° and 66° F. at a 3-inch depth. Spring treatments were applied March 15 with a soil temperature of 62°. All beds were shallowly-cultivated on March 22 to allow more rapid dissipation of chemicals. The beds were raked, fertilized, and sown March 28, 13 days after spring treatment.

1958 EXPERIMENTS

Bed A (Table 4) was a duplicate of the test made in 1957, except for watering of the plots treated with Mylone (DMTT) to

Table 2. Stand Counts, Number and Type Weeds Removed, and Plants Obtained in 1st, 2nd, and Total Pullings with Different Rates of Chemicals Applied to Tobacco Plant Bed, 1956.

Treatment		Season of application	Av. early tobacco plants per sq. ft. (May 1)	Weeds per sq. yd. (May 22) Broad leaf (non-legume)	Legume	Grass	Total	Tobacco plants per sq. yd. 1st pulling (May 29)	2nd pulling (June 12)	Total
No.	Chemical*									
1	None (Check)	—	67	135	18	116	269	71	166	237
2	Vapam	Spring	67	6	27	1	34	231	186	417
3	Vapam	Spring	65	5	19	1	25	250	203	453
4	Liquid cyanamid	Spring	65	109	13	67	189	214	178	392
5	Liquid cyanamid	Spring	47	28	26	12	66	257	131	388
6	Liquid cyanamid	Spring	35	6	8	4	18	102	131	233
7	Methyl bromide	Spring	74	7	13	0	20	278	187	465
Treatment L.S.D.	(.05)		16	28	NS	17	34	76	NS	117
	(.01)		22	39		24	47	104		161

* Application rate per 100 sq. yd.: No. 2, 8 qt. in 50 gal. water sealed with 75 gal. water; No. 3, 12 qt. in 50 gal. water sealed with 75 gal. water; No. 4, 12½ qt. in 100 gal. water; No. 5, 25 qt. in 100 gal. water; No. 6, 37½ qt. in 100 gal. water; No. 7, 9 lb.

Table 3. Stand Counts, Number and Type Weeds Removed, and Plants Obtained in 1st, 2nd, and Total Pullings with Different Times, Methods, and Rates of Applying Chemicals to Tobacco Plant Bed, 1957.

Treatment No.	Treatment Chemical*	Season of application	Av. early tobacco plants per sq. ft. (April 24)	Weeds per sq. yd. (May 4) Broad leaf (non-legume)	Weeds per sq. yd. (May 4) Legume	Weeds per sq. yd. (May 4) Grass	Weeds per sq. yd. (May 4) Total	Tobacco plants per sq. yd. 1st pulling (May 23)	Tobacco plants per sq. yd. 2nd pulling (June 1)	Tobacco plants per sq. yd. Total
1	None (Check)	—	48	453	7	67	527	61	125	186
2	Vapam	Fall	59	13	3	2	18	250	130	380
3	Vapam	Fall	54	15	3	1	19	236	117	353
4	Vapam	Spring	45	11	3	8	22	239	107	346
5	Vapam	Spring	50	10	3	3	16	217	118	335
6	Vapam	Fall	57	38	4	10	52	260	125	385
7	Mylone	Fall	61	28	3	4	35	287	133	420
8	Bedrench	Fall	62	43	2	6	51	189	194	383
9	ME6256	Fall	52	30	2	12	44	205	140	345
10	Methyl bromide	Fall	58	7	4	2	13	334	98	432
Treatment L.S.D.	(.05)		NS	90	NS	14	89	59	NS	62
	(.01)			121		19	120	80		83
Chemical L.S.D.	(.05)		NS	21	NS	NS	27	61	NS	64
	(.01)			NS			NS	82		NS

* Application rate per 100 sq. yd.; No. 2, 9 qt. in 50 gal. water sealed with 50 gal. water; No. 3, 9 qt. in 100 gal. water; No. 4, 9 qt. in 50 gal. water sealed with 50 gal. water; No. 5, 9 qt. in 100 gal. water; No. 6, 6¾ qt. in 50 gal. water sealed with 50 gal. water; No. 7, 6¾ lb.; No. 8, 6 qt. in 100 gal. water; No. 9, 6 qt. in 100 gal. water; No. 10, 9 lb.

Table 4. Stand Counts, Number and Type Weeds Removed, and Plants Obtained in 1st, 2nd, and Total Pullings with Different Times, Methods, and Rates of Applying Chemicals to Tobacco Plant Bed A, 1958.

Treatment		Season of application	Av. early tobacco plants per sq. ft. (May 13)	Weeds per sq. yd. (May 13) Broad leaf (non-legume)	Legume	Grass	Total	Tobacco plants per sq. yd. 1st pulling (June 2)	2nd pulling (June 19)	Total
No.	Chemical*									
1	None (Check)	—	49	504	7	136	647	22	112	134
2	Vapam	Fall	69	9	7	5	21	119	199	318
3	Vapam	Fall	65	16	8	2	26	168	127	295
4	Vapam	Spring	70	9	10	2	21	159	203	362
5	Vapam	Spring	56	4	5	1	10	172	181	353
6	Vapam	Fall	71	7	8	3	18	135	196	331
7	Mylone	Fall	63	34	11	6	51	168	167	335
8	Bedrench	Fall	62	8	5	3	16	138	183	321
9	ME6256	Fall	60	8	10	3	21	144	173	317
10	Methyl bromide	Fall	64	2	11	2	15	166	219	385
Treatment L.S.D. (.05)			NS	38	NS	34	33	61	NS	61
(.01)				51		45	45	83		82
Chemical L.S.D. (.05)			NS	11	NS	3	11	NS	NS	NS
(.01)				15		NS	15			

* Application rate per 100 sq. yd.; No. 2, 9 qt. in 50 gal. water sealed with 50 gal. water; No. 3, 9 qt. in 100 gal. water; No. 4, 9 qt. in 50 gal. water sealed with 50 gal. water; No. 5, 9 qt. in 100 gal. water; No. 6, 6¾ qt. in 50 gal. water sealed with 50 gal. water; No. 7, 6¾ lb. watered with 50 gal. water; No. 8, 6 qt. in 100 gal. water; No. 9, 6 qt. in 100 gal. water; No. 10, 9 lb.

Table 5. Stand Counts, Number and Type Weeds Removed, and Plants Obtained in 1st, 2nd, and Total Pullings with Different Forms of Applying Chemicals to Tobacco Plant Bed B, 1958.

Treatment		Season of application	Av. early tobacco plants per sq. ft. (May 8)	Weeds per sq. yd. (May 16)				Tobacco plants per sq. yd.		
No.	Chemical*			Broad leaf (non-legume)	Legume	Grass	Total	1st pulling (June 3)	2nd pulling (June 19)	Total
1	Cyanamid (coarse)	Fall	67	7	10	5	22	149	136	285
2	Cyanamid (fine)	Fall	65	14	10	3	27	129	176	304
3	Vapam	Fall	65	7	7	2	16	165	182	347
Treatment L.S.D. (.05)			NS	NS	NS	NS	NS	NS	NS	NS

* Application rate per 100 sq. yd.; No. 1. 150 lb. plus 200 lb. 20% superphosphate; No. 2, 150 lb. plus 200 lb. 20% superphosphate; No. 3, 8 qt. in 50 gal. water.

help activate the chemical. Fall applications were made October 16, 1957, when soil temperature at a 3-inch depth was 64° F. Spring treatments were made March 10, when the soil temperature at a 3-inch depth was 54° to 55°. Beds could not be seeded until April 9, 30 days after application of chemicals, because of cold, wet weather.

A smaller experiment with three replications was carried out the same season. The treatments were made on Bed B (Table 5) on the same date as on Bed A. The same soil temperature was recorded.

1959 EXPERIMENTS

A plant-bed test including different chemicals or treatments was conducted in 1959. Both fall and spring treatments were made on Bed C (Table 6).

The spring treatments on Bed C were made on March 19, when the soil temperature was 54° F. The bed was seeded April 1, 12 days after spring treatments were applied.

1960 EXPERIMENT

The 1960 experiment (Table 7) included all spring-applied chemicals. Treatments 2, 3, 6, 7, and 9 were made in the afternoon of March 24, with the soil temperature of 46° F. at a 3-inch depth. The following morning ice was noted on the underside of some of the plastic covers and the untreated soil surface was frozen. The gasproof covers were removed from plots of treatment 9, 48 hours after application, when the soil temperature was 63°. Covers were removed from plots of treatment 3 on March 29. At that time treatment 4 was applied and the soil temperature of these plots was 52°. On April 1 covers were removed from plots of treatment 4. Soil moisture was high at that period and treatments 5 and 8 were made at a soil temperature of 67°. Less water was used with treatment 5 than the other similar treatments because of moist soil conditions. Covers used for treatments 5 and 8 were removed 24 hours later. Soil temperature in plots of treatment 8 at that time was 71-72°. Plots of treatment 5 with the water added had a soil temperature of 64-65°. The bed was seeded April 8.

Results and Discussion

Effects of Time and Rate of Applying Chemicals

Tobacco Plant Stands

Fall treatments allowed more time before sowing for toxic chemicals to dissipate than did spring treatments. The early stand counts indicated no differences within tests between the fall-applied chemical treatments.

Table 6. Stand Counts, Number and Type Weeds Removed, and Plants Obtained in 1st, 2nd, and Total Pullings with Different Times, Methods, and Rates of Applying Chemicals to Tobacco Plant Bed C, 1959.

Treatment No.	Chemical*	Season of application	Av. early tobacco plants per sq. ft. (April 28)	Weeds per sq. yd. (May 1): Broad leaf (non-legume)	Legume	Grass	Total	Tobacco plants per sq. yd.: 1st pulling (May 19)	2nd pulling (May 28)	Total
1	None (Check)	—	64	166	2	1330	1648	13	114	127
2	Vapam	Fall	75	12	8	41	63	71	218	289
3	Vapam	Fall	80	13	4	41	58	82	238	320
4	Vapam	Spring	70	4	6	69	79	36	248	284
5	Mylone	Fall	73	10	6	30	46	60	274	334
6	Mylone	Spring	67	2	3	39	45	18	211	229
7	Cyanamid	Fall	71	36	4	160	200	0	30	30
8	Cyanamid	Fall	66	5	4	97	106	1	170	171
9	Methyl bromide	Spring	74	3	4	23	30	81	282	363
10	Methyl bromide	Fall	77	3	6	2	11	81	256	337
Treatment L.S.D.	(.05)		NS	42	NS	85	98	28	60	85
	(.01)			57		115	132	38	81	115
Chemical L.S.D.	(.05)		NS	NS	NS	59	58	29	78	85
	(.01)					79	78	39	106	116

* Application rate per 100 sq. yd.; No. 2, 8 qt. in 100 gal. water; No. 3, 9 qt. in 100 gal. water; No. 4, 9 qt. in 100 gal. water; No. 5, 6¾ lb. and watered with 100 gal. water; No. 6, 6¾ lb. and watered with 100 gal. water; No. 7, 150 lb.; No. 8, 150 lb. plus 200 lb. 20% superphosphate; No. 9, 9 lb. (hot method); No. 10, 9 lb.

Table 7. Stand Counts, Number and Type Weeds Removed, and Plants Obtained in 1st, 2nd, and Total Pullings with Different Times, Methods, and Rates of Applying Chemicals to Tobacco Plant Bed, 1960.

No.	Treatment Chemical*	Season of application	Av. early tobacco plants per sq. ft. (May 6)	Weeds per sq. yd. (May 18) Broad leaf (non-legume)	Legume	Grass	Total	Tobacco plants per sq. yd. 1st pulling (June 2)	2nd pulling (June 10)	Total (3 pullings)
1	None (Check)	—	44	68	29	296	393	57	84	180
2	Vapam	Spring	41	2	32	6	40	126	106	255
3	Vapam	Spring	47	1	12	1	14	136	122	285
4	Vapam	Spring	52	1	31	0	31	115	104	263
5	Vapam	Spring	46	0	26	0	26	88	131	240
6	Mylone	Spring	37	1	18	2	21	81	102	234
7	Mylone	Spring	30	1	17	0	18	62	112	201
8	Methyl bromide	Spring	44	1	54	3	57	154	109	294
9	Methyl bromide	Spring	49	4	34	33	73	140	127	320
Treatment L.S.D.	(.05)		11	12	22	40	42	38	NS	58
	(.01)		NS	17	NS	54	57	51		79
Chemical L.S.D.	(.05)		15	NS	23	12	22	57	NS	79
	(.01)		NS		NS	16	31	NS		NS

* Application rate per 100 sq. yd.: No. 2, 8 qt. in 125 gal. water 15 days before seeding; No. 3, 4 qt. in 125 gal. water 15 days before seeding and covered with plastic first 5 days; No. 4, 4 qt. in 125 gal. water 10 days before seeding and covered with plastic first 3 days; No. 5, 4 qt. in 75 gal. water 7 days before seeding and covered with plastic first day; No. 6, 12 lbs. 50% active material with ½ worked into a 2-inch depth and remainder surface applied 15 days before seeding followed by 125 gal. water irrigation; No. 7, 12 lbs. 50% active material surface applied 15 days before seeding and followed by 125 gal. water irrigation; No. 8, 9 lb. 7 days before seeding and covered for 1 day; No. 9, 9 lb. 15 days before seeding and covered for 2 days.

Stand counts differed between some spring treatments. In the 1956 test (Table 2), as the rates of the liquid form of cyanamide were increased, the average early plant stand decreased.

In the plant bed of the 1960 test (Table 7), DMTT (Mylone) applied to the surface and watered in reduced the original plant stand significantly below the check and several of the other chemical treatments. In the other DMTT treatment (treatment 6), with part of the chemical incorporated into the soil, less stand reduction occurred. This stand reduction was significant in comparison with some of the better stands obtained with other chemicals.

Reportedly stands in the general range of 50 to 100 plants per square foot can usually be expected to give satisfactory plant production provided some injurious factor does not interfere later (11). Most plants counts were in the lower half of this range.

Weed Control

Many man-hours are spent on hand-weeding tobacco plant beds. Weeds compete with the tobacco plants for moisture, light, minerals, and space; and other factors may also be involved. Weeding should be done early to reduce competition of weeds with tobacco seedlings. Proper treatment of tobacco beds with certain chemicals will obviate or materially reduce hand weeding.

Legume seeds were difficult to kill with chemicals. None of the chemical treatments significantly reduced the number of legume plants below those in the check plot. White clover was the principal legume observed in these experiments.

Plant bed areas were changed each year. Depending on sites, grasses or broad-leafed weeds were predominant. Methyl bromide, a very satisfactory treatment in these tests and so reported in other areas (1, 2, 4, 6, 8), was considered a standard for each series of treatments in which it was included. It was effective against seeds of both broad-leafed weeds and grasses (Fig. 1). In only one experiment did any of the other chemicals significantly exceed methyl bromide in controlling any one of the three types of weeds or the total weeds. This occurred in the spring-treated bed in 1960 (Table 7), when the temperatures were extremely cool. In treatment 8 with methyl bromide confined by a cover for 24 hours in wet soil, the data indicate more legume weeds in plots with this treatment than in the check plots, possibly because of stimulation of germination of hard seed by the chemical or the reduction in competition from grass and broad-leafed weeds. In plots of treatment 9, with methyl bromide confined for 48 hours at

Figure 1. Weed control in a burley tobacco plant bed by methyl bromide, 1957.

Figure 2. Reduction of weed competition in a burley tobacco plant bed by SMDC (Vapam), 1957.

low temperatures for the greater part of this period, some grass appeared in all four replications.

As mentioned previously, it was necessary to mound the soil in the small plots to obtain a good seal for the gastight covers. Consequently, the depth of penetration would have to be greater in those plots. Although the soil depth probably contributed to the lack of effectiveness of methyl bromide in this one experiment, the high soil moisture for treatment 8 and the extremely cool temperatures for treatment 9 were possibly of greater importance.

Weed control with calcium cyanamide has been inconsistent, particularly in growers' plant beds. Results in plant Bed B in 1958 (Table 5) indicated satisfactory control of weeds with this material applied with 2 pounds of 20% superphosphate per square yard. Toxic effects from calcium cyanamide application is a problem in plant beds, and adding superphosphate fertilizer helped lower toxicity (12). Results from the 1959 Bed C test (Table 6) revealed that the additional phosphate fertilizer with calcium cyanamide resulted in better weed control than with calcium cyanamide alone. The additional fertilizer produced a significant increase in control of grass weeds and a highly significant increase in control of total weeds. However, both treatments were inferior to the regular methyl bromide treatment.

Results with SMDC showed erratic differences in comparisons of fall and spring applications. In 1957 (Table 3) there was no difference between fall and spring applications. The same rates and methods of application were used. In 1958 (Table 4) Bed A data indicated that SMDC applied in the spring without a separate water seal (treatment 5) was significantly superior in weed control to that water seal (treatment 4) applied at the same time and to the two fall treatments (treatments 2 and 3) applied at the same rate. In the 1959 test on Bed C (Table 6) no differences between fall and spring applications were found. In general, the 8-quart or higher rate of Vapam (SMDC) approached methyl bromide in weed control (Figs. 1 and 2); but considering tests over a period of years, even the 9-quart rate for 100 square yards of bed was inferior to the regular methyl bromide treatment.

An exception occurred in the spring-treated bed in 1960 (Table 7). In this particular test SMDC in all four treatments resulted in better weed control, primarily legumes, than treatment 8, with methyl bromide. The same four treatments with this liquid chemical also controlled grass weeds significantly better than treatment 9, with methyl bromide. Apparently the application of water and the confinement of SMDC by a gasproof cover permitted the chemical to penetrate and kill the weed seeds. The application of water with SMDC, together with confinement of the chemical with gas-proof covers, for legume weed control should be investigated more thoroughly.

DMTT, a dry powder, is frequently applied by watering in. The toxic effects and weed control obtained with this chemical were similar to those described for SMDC (Fig. 2 and 3). DMTT also tended to reduce legumes in the 1960 test (Table 7).

Figure 3. Weed control in a burley tobacco plant bed by DMTT (Mylone), 1957.

A mixture of allyl alcohol and ethylene dibromide (Bedrench) gave good results in 1958 (Table 4) but not in 1957 (Table 3) as compared with methyl bromide (Figs. 1 and 4). The propargyl alcohol-1,2-dibromoethane mixture (ME6256) performed similarly to allyl alcohol-ethylene dibromide.

Methyl bromide applied in the normal manner of forcing the liquid into a container under a plastic cover gave consistently good results. The cover was left in position for 24 hours or more. Methods of applying it "hot"—that is, as a gas when the soil temperatures are low—have been successful even with a very short confinement (3, 5). Previously methyl bromide has normally been expelled as a liquid under pressure into evaporating trays. It is possible to increase temperatures to allow the chemical to escape

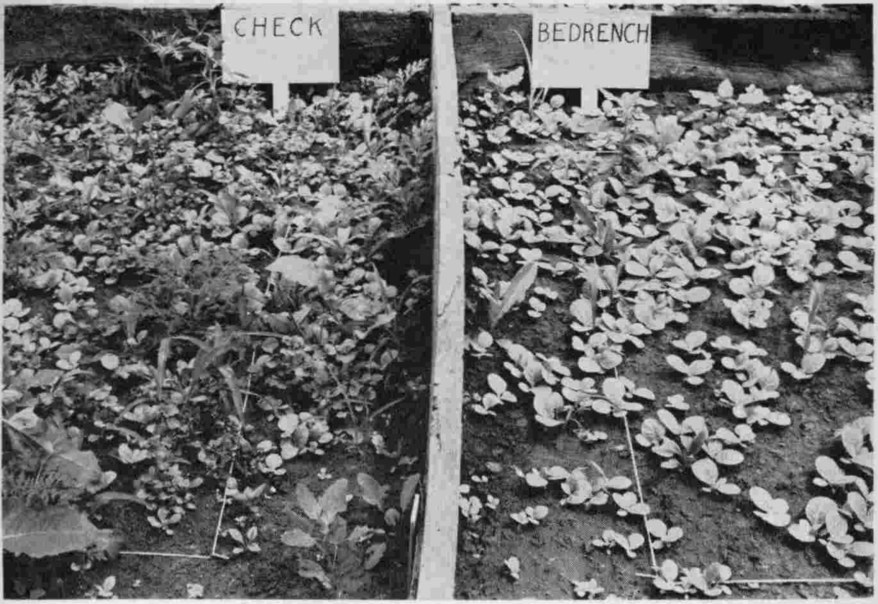

Figure 4. Reduction in weeds in a burley tobacco plant bed by allyl alcohol-ethylene dibromide mixture (Bedrench), 1957.

in the gaseous form. In 1959 the "hot" method of applying methyl bromide was tested. In Bed C (Table 6) the temperature of the water in the container holding the metering instrument ranged from 135° F. at the beginning of the application down to 126° at the end. The plastic cover was left on for 17 hours, and results approached those of regular fall treatment of methyl bromide.

Plant Production

Weeds were removed before the first pulling, because counting and classifying the weeds without removing them was considered too laborious and inaccurate. Plots with many weeds removed undoubtedly gave better plant production than if the weeds had been left in place.

More weight is given to the first pulling since earliness is desirable. A treatment providing early plants may not have as many left for the second pulling as one that provides as many total plants in two pullings, but has a majority of plants available for transplanting later.

In the 1956 experiment (Table 2) competition from weeds removed 7 days before the first pulling severely reduced the number of plants at first pulling and the total number of plants from the untreated check. The lowest rate of liquid cyanamide resulted in inadequate weed control and a reduction in the number of plants in the first pulling. The heaviest rate of liquid cyanamide proved toxic to the tobacco plants.

The usual method of applying methyl bromide provided an excellent standard for both the first and the total pulling of plants. At the first pulling it was rarely exceeded. The largest excess was six plants per square yard in 1958 (Table 4) with the SMDC treatment, one-tenth of the least significant difference at the 5% level. In 1959 (Table 6) plant production when using the regular methyl bromide treatment was exceeded, but, not significantly, by only the "hot" methyl bromide treatment.

In 1958 (Table 5) the two forms of calcium cyanamide with 20% superphosphate added performed about equally with the 8-quart rate of Vapam (SMDC) in Bed B. Data for Bed C in 1959 (Table 6) revealed the occasional toxic effects of calcium cyanamide. Experimental work in Kentucky (14) indicated ammonia as the toxic material. Seay (12) reported much benefit to plant production by adding 2 pounds of 20% superphosphate per square yard to 1½ pounds of cyanamide per square yard in the normal fall treatment. Data of Bed C (Table 6) indicated the beneficial effect of applying 2 pounds of 20% superphosphate per square yard with calcium cyanamide. Plants were late in comparison with the other treatments within the test. Practically no plants in the first pulling from the calcium cyanamide-treated plots were usable. At the second pulling, calcium cyanamide-treated plots without 20% superphosphate averaged 30 usable plants per square yard, significantly fewer than the check. At the second pulling calcium cyanamide-treated plots with phosphate added produced an average of 170 plants per square yard, which approached, but did not reach, significance above the check.

As in weed control, the effect of SMDC on plant production varied. In 1956 (Table 2) SMDC approached the methyl bromide treatment in plant production in both the first and total pullings. In 1957 (Table 3) methyl bromide exceeded significantly all SMDC treatments in number of plants produced at the first pulling. In fact, it exceeded all except the lowest rate of SMDC at the 1% level. For total plant production, methyl bromide was significantly better than 3 of the 5 SMDC treatments, and it also exceeded the other two treatments. Spring application of SMDC was slightly inferior to fall application in plant production in 1957 and 1959 (Tables 3 and 6). In 1958 (Table 4) the SMDC treatments compared very favorably with the methyl bromide treatment at the first pulling. Although usable plants from the methyl bromide plots were larger at the time of the first pulling, some of the SMDC-treated plots slightly exceeded them in numbers of plants produced (Table 4). No significant differences in plant production were found when chemical treatments alone were analyzed. There was a trend for the fall application of SMDC to be poorer in plant production than the spring application in 1958 (Table 4). In 1959, the test (Table 6) indicated a possible toxic effect on the first pulling from the SMDC applied 12 days before seeding. Plant production was significantly below that from the fall treatment applied at the same rate.

SMDC can affect tobacco plants by remaining toxic for some time after application. Late-winter or spring treatments which preceded sowing at 7, 10, 12, 13, 15, and 30 days in the study gave an indication of possible toxicity for 7, 10, and 12 days. This was in the 1959 test (Table 6) at the first plant pulling and the 1960 test (Table 7). The first plant pullings from SMDC plots treated 7 and 10 days before sowing were significantly below the better methyl bromide-treated plot in 1960 (Table 7). Lack of penetration in fine-textured soils may allow the chemical to dissipate faster than in coarse-textured soils. A study on penetration of the chemical applied by drenching has been reported (10). Total plant production after soil treatment with SMDC followed the general pattern of the first pulling of plants for this chemical.

DMTT (Mylone) was similar to SMDC in effects on plant production. Spring treatment with DMTT in 1959 (Table 6) indicated possible toxic effects, since the number of plants in both first and total pullings was significantly below that of fall treatment 5 with the same chemical. In 1960 (Table 7) DMTT applied 15 days before seeding and watered in reduced stand and the number of plants in the first and total pullings as compared with the better methyl bromide treatments. Cool temperatures were unfavorable for a more rapid dissipation of the chemical.

The allyl alcohol-ethylene dibromide treatment (Bedrench) was significantly below the regular methyl bromide treatment in numbers of plants in the first pulling in 1957 (Table 3) and ranked below it in 1958 (Table 4). In both years the total plant production was below that in methyl bromide-treated plots.

In plant production propargyl alcohol-1,2-bromoethane (ME 6256) performed similarly to allyl alcohol-ethylene dibromide.

The "hot" methyl bromide treatments appeared to be satisfactory in plant production. Data presented (Table 6) show it to be equivalent to the regular methyl bromide treatment. The usual recommendation for soil temperatures between 50° and 60° F. with regular application is to keep the plastic or other gasproof cover on for 48 hours. This "hot" treatment was applied at 3:30 p.m. with the soil temperature between 53° and 54°. The plastic cover was removed 17 hours later at 8:30 a.m.

The regular methyl bromide treatment was at or near the top in all tests in production of usable plants at the first pulling and in total plants pulled. This treatment was used all 5 years as either a fall or spring treatment. The results were consistently good.

EASE OF APPLICATION

Of the chemicals reported here methyl bromide was the only one that required a gastight cover. Special applicators of various types must be used. Handling the gastight cover in windy weather or when the ground is muddy is difficult and should not be attempted. The normal method is rapid in both application and dissipation. With the "hot" method, length of exposure can be reduced to a few hours.

Dry materials such as calcium cyanamide may be applied with a fertilizer spreader and worked into the soil. Moisture is required for activating them and water may have to be hauled to the bed sites. Some chemicals are provided as fine powders; and they are difficult to spread by hand on windy days. Liquid chemicals can be applied with spray rigs or sprinkling cans. Hauling water may present problems.

The plant bed soil should be well plowed and cultivated to break down clods which may not be penetrated by chemicals. Soil with moderate moisture and in fine tilth for several days before chemical treatment permits better weed control with the applied chemicals.

EFFECT OF WEATHER

Weather in the area of the tests is normally more favorable for fall applications with chemicals than for late-winter or spring treatments, because temperatures are mild and rainfall moderate so that soils usually have good moisture content for treatment. Spring treatments may result in delaying seed sowing past the optimum time. In 1958, for example, cool weather and rain delayed treatment until March 10. A period of approximately 2 weeks after treatment is desired before sowing seed to allow the chemicals to escape. Rain prevented further working and sowing of the beds until April 9. Unfavorable temperatures occurred also in 1960. The first half of March is considered desirable for plant-bed-sowing in this area.

Soil temperatures below 50° F. are generally unfavorable for chemical treatments, but the "hot" method of applying methyl bromide appears to perform adequately at lower temperatures (3, 5). All treatments were made at higher temperatures except in 1960. The preferable soil temperature for most of the soil treatments is above 60°. Extremely warm soil could vaporize and dissipate some chemicals so rapidly that poor weed control would occur. Complete or partial covering would then be necessary. Ordinarily, extremely high temperatures do not occur in this area during the periods when tobacco plant beds are treated.

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