REGIONAL TESTS WITH CONTACT AND SYSTEMATIC TOBACCO SUCKER CONTROL AGENTS III. FIRE-CURED TOBACCO[1]

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Field experiments were conducted in Kentucky and Tennessee in 1966-1968 to evaluate the effects of chemical agents for sucker control on fire-cured tobacco. Maleic hydrazide, a systemic type agent, and three contact type agents, methyl caprate, a mixture of fatty alcohols (1-decanol and 1 octanol) and Penar were used in the studies.

Maleic hydrazide gave the highest degree of sucker control (92 to 99%) followed by the fatty alcohols (82 to 90%), methyl caprate (77 to 79%) and Penar (76 to 80%). The yield and acre value of tobacco treated with Penar were significantly lower at both locations than the yield and value for the other chemical agents. The value per 100 pounds was not significantly affected by chemical treatments when compared with hand suckered tobacco. The chemicals gave only slight or no leaf injury.

INTRODUCTION

The production of high yields and high quality fire-cured tobacco (*Nicotiana tabacum L.*) requires that the plants be topped to 12 to 14 leaves when in the bud or very early flower stage. Manual control of the resulting axillary sucker growth during the four to six weeks between topping and harvest requires that the tobacco be hand suckered two to four times.

The systemic plant growth regulator 6-hydroxy-3 (2H) pryidazinone (maleic hydrazide), is widely used on flue-cured and Burley tobacco to inhibit the growth of axillary buds. Although effective sucker control with this chemical has been obtained on fire-cured tobacco, its use has not been readily accepted by many growers for several reasons. At maturity a high quality fire-cured crop, as considered by most growers, should be glossy, dark green with only a faint yellow mottled appearance. Treatment with maleic hydrazide usually results in premature yellow coloring of the plants in the field. Furthermore, the cured leaf from plants treated with maleic hydrazide may have a slight yellowish cast but usually the color is not greatly affected. In addition, there may be a decrease in yield when compared to the hand suckered plants because the top leaves remain relatively smaller if treated with maleic hydrazide.

Various emulsifiable petroleum based oils (2) are used on fire-cured tobacco to kill the suckers by applying a sufficient volume of a solution to the top of the plant to run down the stalk and contact the sucker buds. These oils have not been entirely satisfactory because of the damage to the plant either from leaf drop, stalk girdling at the base or from burning the leaves by the oil emulsion. Furthermore, the application of these materials requires more labor than do applications made by spraying.

Tso (6) found that emulsions of fatty acid methyl esters with chain lengths of 8 to 12 carbon atoms could be applied as sprays to kill suckers without damaging the more mature leaf tissue. Later studies (7) showed that the methyl ester of the C_{10} acid, methyl caprate, was the most effective ester tested on tobacco of several types. Other chemicals also control suckers by contact, viz., dimethyldodecylamine acetate (Penar)[6] (1) and fatty alcohols (5).

A regional cooperative program is in effect among the State Agricultural Experiment Stations of the major tobacco-producing areas and the U.S. Department of Agriculture to aid in the orderly development and testing of new sucker control agents and methods.

The Regional Growth Regulator Committee[7] reported the effects of contact and systemic sucker control agents on flue-cured (3) and Burley (4) tobacco. The results reported herein are from studies conducted in Kentucky and Tennessee to determine the effects of a systemic chemical, three contact sucker control agents and hand suckering on sucker growth, cured leaf yield and quality of fire-cured tobacco, type 22, as measured by Federal grades.

MATERIALS AND METHODS

Four chemical sucker control agents were avaluated for fire-cured tobacco at the Western Kentucky Substation, Princeton, Kentucky and at the Highland Rim Experiment Station, Springfield, Tennessee, during 1965 through 1968. These chemicals were: maleic hydrazide, methyl caprate, a fatty alcohol mixture (Off-Shoot T)[6] and Penar. The active ingredients in these materials are given in **Table 1.** Unsuckered and hand suckered tobacco treatments were also included in the tests.

Maleic hydrazide was applied at the rate of 340 to 500 mg of maleic hydrazide per plant as MH-30[6] as an

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[6] *Mention of a trade name does not constitute a guarantee or warranty of the product by the U. S. Department of Agriculture or State Experiment Stations and does not imply its approval to the exclusion of other products that may also be suitable.* [7] *The members of the Regional Tobacco Growth Regulator Committee at the present time are: W. O. Atkinson, Univ. of Ky., Lexington, Ky; C. E. Bortner, U.S.D.A., Lexington, Ky.; Fred Clark, Univ. of Fla., Gainesville, Fla.; Z. T. Ford, U.S.D.A., Florence, S. C.; L. A. Link, V.P.I., Glade Spring, Va.; H. W. Lundy, Univ. of Fla., Live Oak, Fla.; J. D. Miles, U.S.D.A., Tifton, Ga.; R. C. Newman, Univ. of Wis., Madison, Wis.; B. C. Nichols, U.S.D.A., Greeneville, Tenn.; M. J. Rogers, V.P.I., Chatham, Va.; H. F. Ross, N. C. State Univ., Waynesville, N. C.; Heinz Seltmann, U.S.D.A., Raleigh, N. C.; H. C. Smith, Univ. of Tenn., Knoxville, Tenn.; O. E. Street, Univ. of Md., College Park, Md.; G. L. Steffens, U.S.D.A., Beltsville, Md.; and J. O. Yocum, Pa. State Univ., Landisville, Pa.*

Table 1. Composition of Chemicals Used in Sucker Control Treatments.

Chemical	Active Materials
Methyl Caprate[1]	95% C_{10}, 3% C_8, 2% C_{12}; Surfactant: Tween 20[2] or Tween 60 and Span 85
Fatty Alcohol[3] (Off-Shoot-T)	1-octanol and 1-decanol, approx. 40-50% C_8 and 50-60% C_{10}; Surfactant: Tween 80[2]
Penar	Dimethyldodecylamine acetate
Maleic hydrazide (M-H-30)	Diethanolamine salt of 6 hydroxy-3-(2H) pyridazinone

[1] *Code number in Regional Sucker Control Tests: T-43.*
[2] *Tween 20®—Polyoxyethylene (20) sorbitan monolaurate, Tween 60®—Polyoxyethylene (20) sorbitan monostearate, Tween 80®—Polyoxyethylene (20) sorbitan monooleat, Span 85®—Sorbitan trioleate.*
[3] *Code number in Regional Sucker Control Tests: T-148.*

aqueous solution. This material was applied as a fine spray, at approximately 30 psi, to the leaves on the upper one-third of the plants. Methyl caprate, the fatty alcohol mixture and Penar were applied as a coarse spray at approximately 10 psi over the top of the plant so that the liquids ran down the stalk and contacted the young buds in the axils of the leaves. Methyl caprate was applied as 6 or 7% of the final emulsion and the fatty alcohol as 5 or 6% of the emulsion. Penar was applied twice; the second application was made 7 days after the first treatment. Penar was applied at the rate of 100 mg of active material per plant for each application. All other materials were applied once.

The volume of liquid applied was 20 ml per plant for each chemical. Prior to the application of the sucker control chemicals, plants were topped to about 14 leaves per plant when in the bud to early flower stage and all suckers over one inch long were removed by hand. Suckers were removed three or four times from plants in the hand suckered treatments between the time of topping and before harvest.

Immediately before harvest, suckers were removed from 30 competitive plants in each plot, counted and weighed. The degree of sucker control was calculated as percent reduction in weight of suckers of chemically treated or hand suckered plants compared with sucker weights from topped but not suckered plants. After curing, leaves of each plot were sorted, weighed and graded by Federal Tobacco Graders. The value per one hundred pounds and value per acre were calculated using the average market prices for the appropriate grades. Techniques of chemical applications and experimental field design were the same as given previously for flue-cured tobacco (3). The culture, harvest and curing practices were those recommended for the production of fire-cured tobacco.

RESULTS AND DISCUSSION

Experiment 1

Sucker Control

The 1965-67 results of the experiment using methyl caprate and maleic hydrazide in Tennessee are given in Table 2; and for 1965-1966 in Kentucky in Table 3. Rapid growth of suckers was obtained each year on the topped but not suckered, plants. Hand suckering reduced the fresh weight of suckers by 76% in Tennessee and 63% in Kentucky.

Sucker growth on plants treated with the contact type material, methyl caprate, was because of the "escapes" in leaf axils not contacted. Often at topping time the small top leaf of fire-cured tobacco will be left standing erect. This shields the leaf axil if the spray is directed from only one angle. Also, if a plant is leaning the liquid tends to run down the lower side and miss leaf axils on the upper side. These few escape suckers often grow faster than those on untreated tobacco. Methyl caprate greatly reduced the number of suckers per plant, but on the basis of fresh sucker weight produced, the total sucker weight was not very different from that of the hand suckered treatment.

The control of sucker weight was much greater with maleic hydrazide than with methyl caprate (92% versus 79% in Tennessee and 99% versus 77% in Kentucky). Suckers which grew on the maleic hydrazide treated plants were relatively small. These suckers were most abundant near the bottom of the plants and were abnormal in shape. If left on the stalk, they would not have interferred with harvesting or stripping.

To be considered a suitable sucker control agent, a contact material must kill the buds but cause little or no damage to the leaves or stalks. Methyl caprate caused very slight or no leaf injury to the leaf and the injury did not affect the grade of tobacco produced. Leaf drop or stalk girdling, which are sometimes problems with the use of certain contact type materials, did not occur in these tests. Maleic hydrazide caused no phytotoxic effects; however, a premature yellowing of the upper leaves was observed in all years.

Yield and Value

The cured leaf yield was much lower for the unsuckered tobacco than from the treated or hand suckered tobacco, and averaged over 500 pounds less per acre in Tennessee **(Table 2).** The unsuckered tobacco was not harvested in the Kentucky tests. The yields for the hand suckered and chemical treatments were not significantly different in Tennessee but the maleic hydrazide treatment produced a significant increase in yield over the hand suckered tobacco in Kentucky **(Table 3).**

Fire-cured tobacco is usually topped low in the early bud stage and the spraying of the young top leaves with maleic hydrazide may reduce the ultimate leaf size. In Tennessee, the length and width of the top leaf of 10 plants in each replication were obtained for the hand suckered and maleic hydrazide treatments, immediately before harvest for the three years of the study. The average length and width of the top leaves on hand suckered plants were 78.3 and 34.5 cm respectively and for the maleic hydrazide treatment they were 69.2 and 32.2 cm. This 7% reduction in width and 11% reduction in length may explain in part the lack of yield increase from maleic hydrazide. The top leaves were usually 25 to 30 cm in length at the time of spraying. A relatively larger yield response to maleic hydrazide in Kentucky was probably because the treatment was applied at a slightly more advanced growth stage.

Table 2. Effect of Treatments on Sucker Control and Agronomic Characteristics of Fire-Cured Tobacco (Springfield, Tennessee).

Treatment	Sucker Growth: Sucker[2] Control	Sucker Growth: Suckers/ Plant	Sucker Growth: Wgt/ Sucker	Cured Leaf[3]: Yield/ Acre	Cured Leaf[3]: Value /cwt[3]	Cured Leaf[3]: Value /Acre
	%	no.	g	lb.	$	$
			1965-1967			
Not Suckered	0	14.0	82.6	1649	43.66	720
Hand Suckered	76	30.6[4]	8.6	2173a	44.40a	965a
Methyl Caprate	79	1.5	150.3	2197a	44.97a	988a
Maleic Hydrazide	92	6.2	11.3	2195a	43.42a	953a
			1966-1968			
Not Suckered	0	15.5	75.7	1709	43.42	742
Hand Suckered	80	29.9[4]	7.7	2261a	44.18a	999a
Maleic Hydrazide	94	4.9	10.0	2295a	43.22a	992a
Penar (2 times)	76	3.0	94.7	2122b	44.39a	942b
Fatty alcohol	90	1.0	117.0	2350a	43.96a	1033a

[1] *Treatments with a common letter are not significantly different (.05 level). Data from not suckered treatment not included in statistical analysis.*
[2] *Percent by which sucker fresh weight was reduced compared with not suckered check (1156 g per plant 1965-67; 1173 g, 1966-68).* [3] *Value based on average prices for federal grades.* [4] *Total number for three suckerings.*

Table 3. Effect of Treatments on Sucker Control and Agronomic Characteristics of Fire-Cured Tobacco (Princeton, Kentucky).

Treatment	Sucker[2] Control	Sucker Growth Suckers/ Plant	Wgt/ Sucker	Cured Leaf[1] Yield/ Acre	Value /cwt[3]	Value /Acre
	%	no.	g	lb.	$	$
		1965-1966				
Not Suckered	0	9.1	143.7	—	—	—
Hand Suckered	63	21.1[4]	19.5	2004b	43.86a	879b
Methyl Caprate	77	2.2	127.0	2124ab	43.40a	922ab
Maleic Hydrazide	99	1.7	6.7	2217a	43.43a	963a
		1966				
Not Suckered	0	14.0	104.3	—	—	—
Hand Suckered	55	27.7[4]	23.6	2038b	43.82a	893b
Maleic Hydrazide	99	3.0	3.3	2259a	43.87a	991a
Penar (2 times)	80	2.4	122.5	2131ab	43.59a	929ab
Fatty alcohol	82	3.1	87.1	2262a	43.24a	978a

[1] *Treatments with a common letter are not significantly different (.05 level).* [2] *Percent by which sucker fresh weight was reduced compared with not suckered check, (1308 g per plant, 1965-66; 1460 g, 1966).* [3] *Value based on average market prices for federal grades.* [4] *Total number for all suckerings, 3 times in 1965 and 4 times in 1966.*

The value per 100 pounds of leaf was not significantly different among the chemical and hand suckered treatments. The values per acre, therefore, were in the same relation as the yield per acre.

Experiment 2

Sucker Control

The results of this experiment with maleic hydrazide, Penar, and a fatty alcohol (Off-Shoot-T) in 1966-68 in Tennessee are given in **Table 2;** and for 1966 in Kentucky in **Table 3.** Penar and the fatty alcohol are contact type sucker control chemicals. The fatty alcohol gave a somewhat better sucker control than Penar but not as good as maleic hydrazide when averaged for the two locations. The suckers which escaped the Penar and fatty alcohol were similar in size to those mentioned in experiment 1 with methyl caprate. It should be noted that Penar was applied twice and the fatty alcohol only once. Following the killing of the primary suckers in the leaf axils, more secondary buds developed on Penar treated plants than on those treated with fatty alcohol. The very slight phytotoxic effects, such as leaf burn, for the contact chemicals were of minor importance.

Yield and Value

The Penar treated tobacco gave a lower yield than the hand suckered or other chemical treated tobacco at both locations but was not significantly different for the one year tested in Kentucky. Plants treated with maleic hydrazide produced a greater yield than the hand suckered plants at both locations but the increase was significant only in Kentucky. The fatty alcohol treated tobacco gave the highest yield at both locations but the difference from the maleic hydrazide treatment was not significant.

As in experiment 1, the value per 100 pounds was not significantly affected by treatment, therefore the values per acre were closely related to yield.

SUMMARY

Field experiments were conducted to study the effects of chemical agents for control of suckers on fire-cured tobacco, type 22. These were located at the Highland Rim Experiment Station, Springfield, Tennessee (1965-1968) and at the Western Kentucky Substation, Princeton, Kentucky (1965-1966). Contact type agents, methyl caprate, Penar, and a fatty alcohol (Off-Shoot-T) were compared to topped and not suckered and hand suckered tobacco for degree of sucker control, yields, values, and for leaf injury. Maleic hydrazide (MH-30) a systemic type agent was also included in the tests.

MH-30 gave 92% or better sucker control in all tests on the basis of reduced fresh weight of sucker growth compared to a topped not suckered check treatment. Off-Shoot-T produced 82% to 90% sucker control in the tests. Penar and methyl caprate gave about equal control varying from 76% to 80%. In these tests the hand suckered treatment gave 55% to 80% control.

Tobacco treated with the fatty alcohol (Off-Shoot-T) produced the highest yields; however, yields were not significantly higher than those from tobacco treated with MH-30. The yield of Penar treated tobacco was less than that treated with Off-Shoot-T or MH-30; the difference was not significant in Kentucky. Sucker control treatments did not affect the leaf quality as measured by federal grades at either location. The chemicals gave only very slight or no phytotoxic effects.

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