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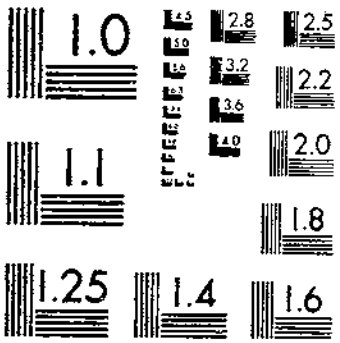

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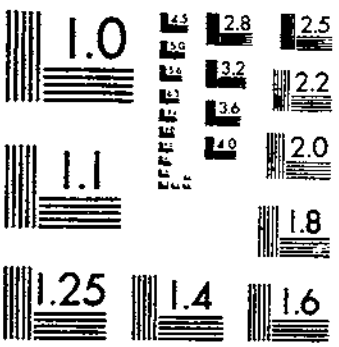

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Technical Bulletin No. 1174

Chickweed Control in ALFALFA

U. S. DEPARTMENT OF AGRICULTURE
in Cooperation with the
NEW JERSEY AGRICULTURAL
EXPERIMENT STATION

CONTENTS

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Chickweed Control in ALFALFA

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CHICKWEED (*Stellaria media*) is one of the most serious weed pests in alfalfa in much of the Atlantic seaboard area from Massachusetts south. It is a particular problem in alfalfa seeded in August or early September, since it may emerge with the legume and offer serious competition for the establishment of the alfalfa seedlings.

The weed is an annual or winter annual and a most prolific seed producer (*3*).[2] It is difficult to prevent seed production by cultural means in alfalfa, as the weed will grow and seed throughout the late fall, winter, and spring. Rapid growth of the weed in spring starts prior to alfalfa regrowth, thus providing serious competition for first growth of the crop. Chickweed continues growing after alfalfa becomes dormant in the fall, which suggests that chemicals might be used safely during late fall and winter.

EARLY INVESTIGATIONS

In 1945, 4,6-dinitro-ortho-secondary butyl phenol (DNBP) was reported effective on weeds as a dormant spray in established alfalfa (*6*). Reports in 1949 and 1950 indicated isopropyl N-phenylcarbamate (IPC) to be effective on chickweed (*4, 5*). Isopropyl N-(3-chlorophenyl) carbamate (CIPC) was introduced in 1950. Since 1950, DNBP and CIPC have been studied extensively for chickweed control in alfalfa (*1, 2, 3, 7, 8, 9, 10, 11*).

PURPOSE OF THE STUDY

Cooperative studies of chickweed control in alfalfa were initiated with the New Jersey Agricultural Experiment Station in 1950. The purposes of the studies were: (1) To evaluate chemicals for control; (2) to determine the effect of rate and date of treatment and volume of water used on control with DNBP and CIPC; (3) to determine the effect of chickweed control on stands and yields of alfalfa; and (4) to determine some effects of DNBP and CIPC on alfalfa plants.

[1] Report of cooperative investigations of the Crops Research Division, Agricultural Research Service, United States Department of Agriculture, and the New Jersey Agricultural Experiment Station.

[2] Italic numbers in parentheses refer to Literature Cited, p. 13.

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EXPERIMENTAL METHODS

Rates of application indicated for the herbicides are in pounds per acre of the active ingredient. Chickweed control and alfalfa stands were recorded in April following treatment in all tests. A strip 38 inches wide by the length of the plot was cut from the center of each plot for yield measurements. A moisture sample dried at approximately 200° F. for 48 hours was used to calculate dry-weight yield. All yields are of alfalfa after removal of chickweed. Results from studies in 1950–51 showed most pronounced increases in yield of newly seeded alfalfa; increases in yield were greater in the first cutting for both seedling and established stands. Observations in the field suggested also that stands of newly seeded alfalfa might be reduced by chickweed. Therefore, studies were confined to seedling alfalfa in the years 1952–56, inclusive, and only first cutting yields were recorded.

Comparison of Chemicals

The herbicides disodium 3,6-endoxohexahydrophthalate (endothal), ammonium salt of DNBP, sodium isopropylxanthate, and potassium cyanate (KOCN) were compared for chickweed control in alfalfa seeded September 2, 1950. Applications were made October 25, 1950, and January 19, 1951, in 100 gallons of water per acre. Plots were 6 by 25 feet in a randomized block experimental design with 3 replications. Chickweed was upright and 4 to 6 inches tall when treated in October and it was matted when treated in January.

The herbicides used on seedling alfalfa were also compared in established stands. In addition, CIPC was included at rates of 3, 6, and 12 pounds. Applications to established stands were made October 18, 1950, and January 18, 1951, using 100 gallons of water per acre. Plots were 6 by 50 feet in a randomized block design with 3 replications.

DNBP Treatments

Evaluations of date and rate of treatment with an alkanolamine salt of DNBP were made in the years 1952–53, 1954–55, and 1955–56. Rates of ¾, 1, and 1½ pounds of DNBP were used. Two dates of treatment were compared in each test, and 40 gallons of water per acre was used for the application. One-third of the plots in each test received these rates on the first date, one-third were treated on the second date, and one-third received half of the rates—that is, three-eighths, one-half, and three-fourths pound—on both dates. Treatments were made December 19 and February 5 the first year, October 20 and February 18 the second year, and October 19 and December 1 the last year. Plots were 6 by 25 feet in a randomized block design with 4 replications. In the tests chickweed was upright on the first date treated; on the second date it was treated, the chickweed was matted the first 2 years and only partially matted the third year.

Tests were conducted during 1951 and 1952 to evaluate gallonage as it affects control with DNBP. Alfalfa seeded September 7, 1951, was treated with 1 pound of an alkanolamine salt of DNBP applied in 10, 20, 40, and 100 gallons of water per acre. Applications were made October 12, 1951, December 27, 1951, and February 7, 1952. Repeat treatments were also included of all combinations on 2 of the 3 dates. Plots were 6 by 25 feet in a randomized block experimental design with 4 replications. The chickweed was upright the first date of treatment, but it was matted by the second application date.

CIPC Treatments

Rate of application of CIPC was studied in detail in 1952–53 and 1955–56, and date of treatment was studied in 1955–56. Rates of ½, 1, and 2 pounds were compared. Applications were made December 19 the first year, at which time chickweed was 3 to 5 inches high. In 1955–56, applications were made October 20 and December 1, 1955, and February 14, 1956. Chickweed was upright in growth on the first 2 dates of treatment, but it was matted on February 14. Applications were made in 40 gallons of water per acre. Plots were 6 by 25 feet in a randomized block design with 4 replications.

During 1951 and 1952, tests were made to evaluate gallonage and date of treatment with CIPC. CIPC was applied at 3 pounds in each treatment of 10, 40, and 100 gallons of water per acre to spring-seeded and fall-seeded alfalfa. Treatments were made October 25, 1951, December 27, 1951, and February 7, 1952. Chickweed was upright October 25, but it was matted on the last two dates. Plots were 6 by 50 feet in a randomized block design with 3 replications.

RESULTS

Comparison of Chemicals

DNBP was the only chemical used October 25, 1950, that controlled chickweed without reducing stands of seedling alfalfa (table 1). Chickweed was not adequately controlled by 0.45 pound of DNBP, which was the lowest rate used, but it is nevertheless significant that 56 percent control was obtained. Nearly complete control was obtained with the medium and high rates of DNBP applied in October, whereas only the highest rate gave satisfactory control with the treatment January 19. Both rates of KOCN and the highest rate of endothal and sodium isopropylxanthate controlled chickweed satisfactorily when applied October 25, but did not effectively control the weed when applied January 19. However, rates of these three herbicides that controlled chickweed caused pronounced reductions in alfalfa stands.

In established alfalfa CIPC and DNBP effectively controlled chickweed without damaging the legume (fig. 1), whereas the other herbicides were unsatisfactory. Control was adequate with all applications of CIPC, although 3 pounds applied October 18 was somewhat less effective than 6 and 12 pounds; all rates were equally effective when applied January 18. Chickweed was not adequately controlled by DNBP applied in October. It was observed in this test and those in subsequent years that control of chickweed with CIPC usually was not apparent until 3 to 5 weeks after treatment.

Twelve pounds of CIPC applied January 18 resulted in some stunting of alfalfa and reduced yields by 243 pounds of dry matter per acre. Alfalfa dry matter yields were increased 574, 751, and 669 pounds per acre with 3, 6, and 12 pounds of CIPC, respectively, applied October 18, and by 465 pounds with 3 pounds applied January 18.

TABLE 1.—*Chickweed control and alfalfa seedling stands in the spring as affected by 4 chemicals applied in 100 gallons of water per acre the preceding October 25, 1950, and January 19, 1951*

Chemical	Application rate per acre	Alfalfa plants on 2 sq. ft., April 10, 1951 [1]		Chickweed control, April 10, 1951	
		Treated Oct. 25, 1950	Treated Jan. 19, 1951	Treated Oct. 25, 1950	Treated Jan. 19, 1951
	Pounds	*Number*	*Number*	*Percent*	*Percent*
DNBP	0.45	29.8	25.7	55.6	52.2
Do	.90	29.0	27.4	93.3	62.8
Do	1.80	31.3	28.9	92.2	91.1
Endothal	1.0	5.3	25.2	32.2	44.4
Do	2.5	2.3	29.9	31.7	36.1
Do	5.0	.3	23.2	87.8	21.7
KOCN	8.0	22.9	31.0	88.3	38.9
Do	16.0	16.2	27.9	98.9	66.7
Sodium isopropylxanthate	10.0	17.9	26.3	57.8	28.9
Do	20.0	11.1	32.3	93.3	58.3
Untreated		28.8	24.7		

[1] Least significant difference at
5-percent level: Treatment, 5.7; date × treatment, 8.0.
1-percent level: Treatment, 7.6; date × treatment, 10.8.

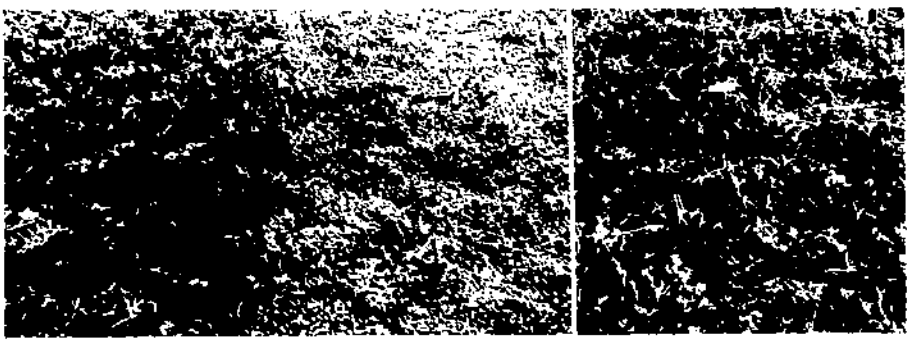

FIGURE 1.—Chickweed control in established alfalfa in the spring of 1951. An untreated area is shown in the center. The area left of the check received 3 pounds of CIPC January 19, 1951, and the area right of the check received 1.8 pounds of DNBP October 25, 1950.

Studies with DNBP

Rate and Date of Treatment.— Data from experiments that compared rates and dates of treatment with DNBP in 1954–55 and 1955–56 are summarized in tables 2 and 3. Observations of control were made in the 1952–53 test, although tabular data are not presented. All treatments caused considerable contact damage to chickweed and retarded its growth. The effect was noticeable within a few days after treatment and was related to the rate of DNBP used. Differences shortly after the first treatment among 1½, 1, and ¾ pounds were slight, but one-half pound of DNBP was clearly less effective and three-eighths of a pound was least effective in all tests.

TABLE 2.—*Chickweed control, alfalfa stands, and first cutting yields in the spring of 1955 as affected by rate and date of application of an alkanolamine salt of DNBP the preceding fall and winter*

Date treated and pounds of DNBP applied per acre	Chickweed control, Apr. 4, 1955	Alfalfa per acre (dry matter)	Alfalfa plants per square foot, Apr. 4, 1955
Oct. 20, 1954:	*Percent*	*Tons*	*Number*
Untreated	0	0.41	17.8
¾	47.5	.75	15.4
1	50.0	.68	22.1
1½	75.0	.61	16.2
Average for date	43.1	.62	17.9
Feb. 18, 1955:			
Untreated	2.5	.53	15.6
¾	43.8	.42	17.3
1	52.5	.37	17.0
1½	58.1	.50	16.0
Average for date	39.2	[1].46	16.5
October and February:			
Untreated	1.8	.42	16.0
¾ ¾, October – ¾, February	41.2	.64	22.3
1 ½ October – ½ February	46.2	.60	20.1
1½ ¾ October – ¾ February	68.1	.68	19.3
Average for date	39.3	.59	19.4
Average of rates:			
Untreated	1.4	.45	16.5
¾	44.2	.60	18.3
1	49.6	.55	19.7
1½	67.1	.60	17.2
Least significant differences at—			
5-percent level	7.8	.09	..
1-percent level	10.5	.12	..

[1] Significantly less at the 1-percent level than the average for October, and October plus February.

Control of chickweed in the spring did not agree closely with initial observations and varied considerably from year to year. The highest rate used (1½ pounds) gave incomplete but significantly better control than the lower rates when applied in October (table 2).

Satisfactory control was obtained with 1½ pounds applied in December of 1952 and 1955. The superiority of December treatments is the result partly of less opportunity for regrowth of chickweed than with applications in October. Also chickweed was protected less by alfalfa on the later date. Treating in February was least satisfactory.

Split applications of ½ pound of DNBP on each of 2 dates gave significantly better control than single applications of 1 pound on either of 2 different dates in 1955–56, and equaled the control obtained from split applications made at the ¾-pound rate. In 1954–55, three-fourths pound applied twice was superior to lower rates, and control with this treatment was not significantly different from a single application of 1½ pounds in October. Two factors may explain the rela-

TABLE 3.—*Chickweed control, alfalfa stands, and first cutting yields in the spring of 1956 as affected by rate and date of application of an alkanolamine salt of DNBP the preceding fall and winter*

Date treated and pounds per acre of DNBP applied	Chickweed control, Apr. 3, 1956	Alfalfa per acre (dry matter)	Alfalfa plants per square foot, Apr. 3, 1956	
			Live	Dead
	Percent	*Tons*	*Number*	*Number*
Untreated	1.2	1.85	21.4	7.9
Oct. 19, 1955:				
1	20.0	2.08	22.9	20.8
1½	64.4	1.85	18.6	28.5
Dec. 1, 1955:				
¾	74.5	2.09	23.1	14.3
1	74.4	2.12	23.4	7.8
1½	86.3	1.95	25.2	14.8
October and December:				
¾ (⅜ October + ⅜ February)	46.4	1.84	21.6	19.3
1 (½ October + ½ February)	86.6	2.00	20.8	21.3
1½ (¾ October + ¾ February)	89.4	1.92	22.6	21.5
Least significant difference at—				
5-percent level	10.6	[1]	[1]	14.1
1-percent level	14.3	[1]	[1]	[1]

[1] Nonsignificant.

tively poorer control with repeat treatments in 1954–55: The 4-month interval allowed extensive regrowth of chickweed; and relatively cooler temperatures possibly reduced activity of DNBP applied in February.

Pronounced increases in yield were obtained in 1955, although chickweed control was not so effective in that year as it was in 1956 (tables 2 and 3). This difference between years presumably was caused by more chickweed early in the fall of 1954. Although fall treatments in that year did not result in lasting control, they did retard chickweed growth, thus enabling the alfalfa plants to make increased growth. All treatments October 20, 1954, and combination treatments that were applied on this date resulted in significantly higher yields of alfalfa in 1955 than did treatments on February 18, although February treatments were nearly as effective in controlling chickweed as the October treatments (table 2).

Differences in yield were small in 1956, but the average yield of alfalfa on plots treated at the rate of 1 pound per acre was significantly higher than the yield for no treatment. Yields in 1955 did not differ significantly for the 3 rates of DNBP, whereas in 1956 the average yield for 1 pound was significantly higher than for 1½ pounds. In both years yields with treatments in October tended to be less with 1½ pounds than with lower rates. Damage to alfalfa plants with 1½ pounds was probably greater than these yields indicate, since some of the damage was offset by the benefits from chickweed control.

Alfalfa stands in the spring were not affected significantly by treatment, although those with repeat treatments in 1954–55 and December treatments in 1955 tended to to have more plants than with no treatment. Controlling chickweed

had an important effect on establishment of alfalfa in 1955–56, however, as shown by the effect of treatment on number of dead plants (table 3). The average number of dead plants of alfalfa for plots treated October 19 and October and December was significantly higher than for no treatment. The average number of dead plants for plots treated in December did not differ significantly from that for the untreated. Since the number of live plants was not altered significantly, it may be assumed that treating in October checked chickweed sufficiently for additional alfalfa plants to become established but these plants were too weak to survive the winter. Some of these plants might have made enough growth to survive if the treatment had been made 2 to 3 weeks earlier.

Weight of alfalfa roots in the spring was reduced significantly by application of 1¼ pounds of DNBP on October 20, 1955, when weight of roots was compared with the average for all other treatments (table 4). Presumably the reduced weight of roots was caused by excessive contact damage from the herbicide.

TABLE 4.—*Alfalfa root weights, April 4, 1956, as affected by rate and date of application of an alkanolamine salt of DNBP the preceding fall and winter*

Date treated and pounds of DNBP applied per acre	100 roots of alfalfa (dry matter)
	Grams
Untreated	8.94
Oct. 20, 1955: 1¼	7.00
Oct. and Dec. 1, 1955:	
¾	8.76
1	7.60
1¼	8.19

Gallonage and Date of Treatment.—The effect of date of treatment and gallonage with DNBP on chickweed control is summarized in table 5. The average control for application of the herbicide in 10 gallons of water was only slightly less than for applications in 20, 40, or 100 gallons, although the difference was significant. There were no differences among the higher three gallonages. Date of application had a more pronounced effect on chickweed control than did gallonage used for the treatment. Control was relatively poor with all amounts of water with single treatments December 27 and February 7. However, control with 10 gallons was considerably less than with the higher gallonages on these dates. All repeat treatments controlled chickweed completely regardless of gallonage.

Yields of alfalfa were increased significantly by effective chickweed control (table 6). The average yield for all treated plots was 35 percent greater than that for untreated plots. Although the average yield of plots treated with DNBP in 100 gallons of water per acre was considerably above that for untreated plots, this yield was significantly less than for plots that received 20 gallons of water. It is possible that the alfalfa plants were wetted more thoroughly with the highest gallonage, resulting in more contact damage than was true with lesser amounts of water.

TABLE 5.—*Chickweed control in the spring of 1952 as affected by gallonage and date of application of 1 pound per acre of an alkanolamine salt of DNBP the preceding fall and winter*

Gallons of water per acre with DNBP	Chickweed control, Apr. 16, 1952 [1]						
	Treated Oct. 12, 1951	Treated Dec. 27, 1951	Treated Feb. 7, 1952	Treated October and December [2]	Treated October and February [2]	Treated December and February [2]	Average
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Untreated	0	0	5.3	1.7	0	5.3	2.0
10	87.7	56.7	45.7	99.3	100.0	97.7	81.2
20	83.3	69.0	76.0	100.0	100.0	100.0	88.0
40	91.7	81.0	72.7	100.0	100.0	96.0	90.2
100	97.3	74.3	68.3	100.0	100.0	100.0	90.0
Average	72.0	56.2	53.6	80.2	80.0	79.8	

[1] Least significant differences at
5-percent level: For gallonages, 2.5; for dates, 3; for gallonages × dates, 6.
1-percent level: For gallonages, 3.3; for dates, 4; for gallonages × dates, 7.9.
[2] Split treatments, ½ pound per acre of DNBP applied each month.

TABLE 6.—*Alfalfa yields in 1952 as affected by gallonage and date of application of 1 pound per acre of an alkanolamine salt of DNBP the preceding fall and winter*

Gallons of water per acre with DNBP	Alfalfa per acre (dry matter) [1]						
	Treated Oct. 12, 1951	Treated Dec. 27, 1951	Treated Feb. 7, 1952	Treated October and December [2]	Treated October and February [2]	Treated December and February [2]	Average
	Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Untreated	1.85	1.85	1.85	1.85	1.85	1.85	1.85
10	2.43	2.15	1.73	2.58	2.93	2.62	2.41
20	2.90	2.45	2.26	2.88	2.69	2.68	2.64
40	2.86	2.06	2.04	2.96	2.61	2.61	2.53
100	2.55	1.98	2.03	2.60	2.61	2.47	2.37
Average	2.68	2.16	2.02	2.76	2.68	2.60	2.49

[1] Least significant differences at
5-percent level: For gallonages, 0.20; for dates, 0.22; for dates×gallonages, 0.49.
1-percent level: For gallonages, 0.26; for dates, 0.29.
[2] Split treatments, ½ pound per acre of DNBP applied each month.

Alfalfa stands were increased considerably by effective chickweed control (table 7). The mean stand was increased approximately 30 percent by treatment. The average stands followed quite closely the percentage control shown in table 5. However, stands of alfalfa for the October plus February treatment and for the December plus February treatment were less than stands for the October plus December treatment, although control of chickweed was equal for the three

treatments. The component of variance for the mean of plots treated October 12 and October plus December 27 differed significantly from the mean of the remaining plots at the 1-percent level. This indicates again the importance of early control and of avoiding a long interval between repeat treatments.

Studies with CIPC

Rate and Date of Treatment.—Applications of 1 and 2 pounds of CIPC controlled chickweed completely in the 1952–53 test, and ½ pound controlled the weed quite satisfactorily (fig. 2). Date of treatment had an important influence on control in the 1955–56 test; treatments in December and February were much more effective than comparable rates in October (table 8). Negligible control was obtained with one-half pound and 1 pound applied in October, and control with one-half pound was significantly less than with 2 pounds on the remaining dates. Nevertheless, control obtained with one-half pound applied in December or February was undoubtedly adequate from the standpoint of removing competition from chickweed in alfalfa.

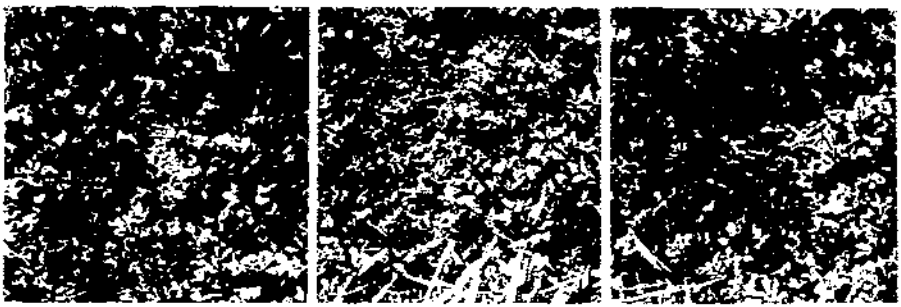

FIGURE 2.—Chickweed control April 23, 1953, with 1 pound of CIPC on the left and with one-half pound on the right, as compared with the untreated check in the center. CIPC was applied the preceding December 19.

TABLE 7.—*Alfalfa stands in 1952 as affected by gallonage and date of application of 1 pound per acre of an alkanolamine salt of DNBP the preceding fall and winter*

Gallons of water per acre with DNBP	Alfalfa plants per 2 square feet, Apr. 16, 1952 [1]						
	Treated Oct. 12, 1951	Treated Dec. 27, 1951	Treated Feb. 7, 1952	Treated October and December [2]	Treated October and February [2]	Treated December and February [2]	Average
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Untreated	27. 7	27. 7	27. 7	27. 7	27. 7	27. 7	27. 7
10	46. 7	33. 3	20. 7	35. 0	37. 0	36. 0	34. 8
20	42. 3	34. 7	31. 0	39. 3	37. 3	33. 0	36. 3
40	43. 7	31. 0	29. 0	14. 7	36. 0	38. 0	37. 1
100	37. 3	26. 0	41. 0	52. 0	34. 3	42. 3	38. 8
Average	42. 5	31. 2	30. 4	12. 8	36. 2	37. 3	36. 8

[1] Least significant difference at 5-percent level: For gallonages, 6.9; for dates, 7.2.
[2] Split treatments, ½ pound per acre of DNBP applied each month.

TABLE 8.—*Chickweed control, alfalfa stands, and first cutting yields in the spring of 1956 as affected by rate and date of application of CIPC the preceding fall and winter*

Date treated and pounds of CIPC applied per acre	Chickweed control Apr. 3, 1956	Alfalfa per acre (dry matter)	Alfalfa plants per square foot, Apr. 3, 1956	
			Live	Dead
Oct. 20, 1955:	*Percent*	*Tons*	*Number*	*Number*
Untreated	0	1.86	21.9	3.2
½	0	1.97	23.4	8.0
1	4.4	1.86	20.7	5.2
2	85.0	2.20	21.3	8.4
Dec. 1, 1955:				
Untreated	2.4	1.86	21.9	3.2
½	85.6	2.16	25.4	3.6
1	91.8	2.16	26.4	7.7
2	98.1	2.15	28.4	4.5
Feb. 14, 1956:				
Untreated	1.3	1.80	21.9	3.2
½	92.0	2.08	20.9	5.8
1	99.1	2.23	23.1	5.8
2	100.0	2.12	23.8	4.5
Least significant differences at—				
5-percent level	7.3			
1-percent level	9.9			
Average of rates:				
Untreated	1.2	1.86	21.9	3.2
½	59.2	2.07	23.2	5.8
1	65.1	2.08	23.4	6.2
2	94.4	2.16	24.5	5.8
Least significant differences at—				
5-percent level	4.9	.08		
1-percent level	6.6	.11		
Average of dates:				
Oct. 20, 1955	22.5	1.97	21.8	6.2
Dec. 1, 1955	69.5	2.08	25.3	4.8
Feb. 14, 1956	75.6	2.07	22.4	5.1
Least significant differences at—				
5-percent level	4.3			
1-percent level	5.8			

Yields obtained in 1956 were closely related to chickweed control (table 8). Increases averaged approximately 17 percent for those treatments that controlled chickweed.

Number of live alfalfa plants in the spring was not affected significantly by treatment. However, stands from plots treated December 1, 1955, tended to be greater than untreated, and the number of dead plants was increased significantly by treatment in October. This agrees with data reported previously for DNBP in an adjacent test and is additional evidence of the potential hazard to stands from applications of herbicide to chickweed.

Observations of alfalfa plants in the spring following February

treatment with 2 pounds of CIPC indicated some stunting from the herbicide. This was not reflected in reduced yield, but possible damage would be at least partially offset by the benefits of chickweed control.

Gallonage and Date of Treatment.—Chickweed was effectively controlled with 3 pounds of CIPC in gallonages of 10, 40, and 100 per acre, applied October 25 and December 27, 1951, and February 7, 1952. Chickweed control was satisfactory on all dates, but control was somewhat better with the December and February treatments.

Since gallonage had no effect on alfalfa yield, the average yield for the 3 volumes of water used is presented in table 9. Treating in December was definitely superior to treating in October, owing presumably to better control of chickweed with the later treatment. The yields also indicate a more pronounced increase of alfalfa growth with chickweed control in the fall-seeded stand.

TABLE 9.—*Alfalfa yields in 1952 as affected by date of application of 3 pounds of CIPC per acre the preceding fall and winter*

Date treated	Alfalfa per acre (dry matter)	
	Spring-seeded alfalfa	Fall-seeded alfalfa
	Tons	*Tons*
Oct. 25, 1951	1.22	1.49
Dec. 27, 1951	1.52	1.91
Feb. 7, 1952	1.38	1.47
Untreated	1.08	1.18
Least significant differences at—		
5-percent level	.14	.27
1-percent level	.19	.38

SUMMARY

Alfalfa yields were usually increased by chickweed control with herbicides. Increases were proportionately greater with effective control of chickweed in seedling alfalfa than in established stands of the legume. The amount of the increase in new stands varied considerably from year to year, caused apparently by differences in competition from chickweed in the fall. Most pronounced increases were obtained by control in those seasons conducive to early germination and rapid growth of chickweed. Under these conditions yields were highest with the earliest treatments. When chickweed started more slowly in the fall, all dates of control were equally satisfactory but increases in alfalfa stands were less pronounced.

A most important consideration in seedling alfalfa fields is the possibility of improving alfalfa stands by controlling chickweed effectively. Stand in the spring was increased significantly in one test by effective control of chickweed in October. If the treatment was made in the fall, stands in all other tests were usually higher on treated plots than on untreated plots, although the differences among treatments were not statistically significant. In two

tests the total number of alfalfa plants was increased significantly by early control of chickweed, although the number of plants surviving in the spring was not greatly affected. Early control of chickweed presumably allowed additional alfalfa plants to become established, but these plants were too weak to survive the winter. Since the first herbicidal treatments were made October 19 and 20 in these tests, it is conceivable that earlier treatment might have provided time for some of the alfalfa seedlings to produce sufficient food reserves to survive after the chickweed was controlled.

Most effective chickweed control with DNBP was associated with early treatment while chickweed was still upright and 1 to 3 inches high. Single applications of DNBP did not control chickweed satisfactorily after it had matted. Chickweed control in the spring following single applications of DNBP in October varied from year to year and was dependent on growing conditions following treatment. Rate of DNBP influenced control, but even the highest rate of 1½ pounds per acre was inadequate in those seasons favorable to germination and growth of chickweed after treatment in October. Single applications of 1 and 1½ pounds in October were adequate in those years not conducive to continued germination and growth of chickweed. However, 1 and 1½ pounds of DNBP applied in October frequently caused considerable contact damage to alfalfa. Stands and yields of alfalfa tended to be lower with 1½ pounds of DNBP than with lower rates, and in one test 1½ pounds of the herbicide reduced weight of alfalfa roots the following spring.

Split applications of lower rates of DNBP consistently provided satisfactory control. Effective control was usually obtained with 2 applications of one-half pound, although repeat applications of three-quarters pound were superior in the year when 4 months separated the treatments. Although these rates were not evaluated as single treatments, it is apparent that a second treatment would not be needed unless regrowth or new germination of chickweed occurred.

Although the amount of water used for applying 1 pound per acre of DNBP affected control, this factor was not so important as date of treatment. Very little difference in control occurred among 10, 20, 40, and 100 gallons of water with applications made in October when chickweed was 1 to 2 inches tall. In December and February, application of 10 gallons was less effective than higher gallonages, but control was not so satisfactory with any of the gallonages as it was with October treatments.

Control with CIPC was quite different from that with DNBP in that best results were obtained with CIPC when it was applied during December, January, and February. Also, the effects of CIPC on chickweed usually were not evident until 3 to 5 weeks after treatment. At least 2 to 3 pounds of CIPC applied in October were necessary to control chickweed effectively, and these treatments were consistently somewhat less effective than later treatments. Rates of ½ and 1 pound were effective when applied in December or February. Volume of water used for applying CIPC had no appreciable effect on results. This was to be expected, since effect of CIPC is manifested primarily through the soil. Alfalfa was very tolerant of fall and early-winter applications CIPC, as indicated by only min stunting with 12 pounds of the herbicide. Observations of plants indicated that the legume was somewhat less tolerant of late-winter applications of CIPC.

Both DNBP and CIPC effectively controlled chickweed without damaging alfalfa. The choice of

materials will depend on the seeding mixture, time of treatment, and relative cost of the herbicides. CIPC is toxic to grasses, although rates up to 2 pounds per acre would probably not damage plants in established stands. This rate would not be safe on seedling grasses. DNBP would be more economical for early-fall applications and thus would appear to be more satisfactory in seedling alfalfa, since early control is important. CIPC would seem to be the preferable material for chickweed in established stands, as early control is not so critical as in seedling stands. Excellent control was obtained with single applications of 1 pound of CIPC during late fall and winter, whereas control with single applications of DNBP varied considerably from year to year and was generally unsatisfactory with treatments made during the winter.

The cooperative investigations on the chemical control of chickweed for the period 1950–56 reported herein, may be summarized as follows:

1. The effective chemical control of chickweed usually resulted in increased yields of alfalfa. Alfalfa yield increases were greatest in seedling stands, and were most pronounced in the first hay cutting.

2. Early-fall applications of herbicides that were effective in controlling chickweed resulted in increased stands of seedling alfalfa.

3. CIPC and DNBP were the most effective chemicals included in this study for the selective control of chickweed in alfalfa. Several other herbicides, including endothal, KOCN, and sodium isopropylxanthate, were ineffective.

4. DNBP, applied as split treatments at rates of one-half or three-fourths pound per acre, gave consistently effective chickweed control. A single application of DNBP at rates of 1 to 1½ pounds per acre was not always effective, and under certain conditions, these rates damaged alfalfa seedlings. Single applications of DNBP were relatively ineffective in controlling lodged, matted, vigorously growing chickweed.

5. CIPC effectively controlled chickweed on all dates of application, but 2 to 3 pounds per acre were required for effective control in October, while ½ to 1 pound per acre gave satisfactory chickweed control in December and February.

6. There was no difference in the effectiveness of DNBP and CIPC applied in volumes of 10, 20, 40, and 100 gallons of water per acre on upright, unlodged, unmatted chickweed. When chickweed was lodged and matted in December and February, DNBP was more effective when applied in volumes of 20, 40, and 100 gallons of water per acre than in 10 gallons per acre. The volumes of carrier included in this study had no effect on the efficiency of CIPC for the control of chickweed.

LITERATURE CITED

(1) Aldrich, R. J.
1954. Continued studies of chickweed control in alfalfa. Northeast. Weed Control Conf. Proc. 8: 327–328.

(2) ——— and Baylor, J. E.
1953. Chickweed control in alfalfa. Northeast. Weed Control Conf. Proc. 7: 221–230.

(3) Berggren, F. W., and Peters, R. A.
1953. Chemical chickweed control and its influence on yields of alfalfa-grass mixtures. Northeast. Weed Control Conf. Proc. 7: 205–212.

(4) Carlson, R. F., and Moulton, J. E.
1949. Chickweed control in strawberries with IPC. Amer. Soc. Hort. Sci. Proc. 54: 200–204, illus.

(5) FREED, V. H., and BIERMAN, H. E.
1950. IPC, A NEW WEED KILLER. Oreg. Agr. Expt. Sta. Sta. Bul. 483, 8 pp., illus.
(6) HARVEY, W. A., and RIDDLE, O. C.
1946. CONTROLLING ALFALFA WEEDS WITH CHEMICAL SPRAYS. Calif. Agr. Expt. Sta. Mimeo. Cir. [Processed.]
(7) MITCHELL, W. H., and PHILLIPS, C. E.
1953. CONTROL OF CHICKWEED IN ALFALFA. Northeast. Weed Control Conf. Proc. 7: 231–234.
(8) MORRIS, L. F., JR., and KUHN, A. O.
1953. A FIELD STUDY OF RATES AND DATES OF APPLYING CERTAIN CHEMICALS FOR CONTROL OF CHICKWEED IN ALFALFA. Northeast. Weed Control Conf. Proc. 7: 213–219.
(9) RALEIGH, S. M.
1952. CONTROL OF CHICKWEED IN ALFALFA. Northeast. Weed Control Conf. Proc. 6: 257–258.
(10) ———
1954. CHICKWEED CONTROL IN ALFALFA IN PENNSYLVANIA. Northeast. Weed Control Conf. Proc. 8: 329.
(11) WILCOX, M., and KUHN, A. O.
1954. A FIELD STUDY OF RATES AND DATES OF APPLYING CERTAIN CHEMICALS FOR CONTROL OF WEEDS IN ALFALFA. Northeast. Weed Control Conf. Proc. 8: 341–350.

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