Seed Characteristics and Control of Goosegrass, *Eleusine indica.*

BY JAMES R. FULWIDER AND RALPH E. ENGEL

Former Research Assistant and Research Specialist in Turf Management, respectively, Rutgers—the State University, New Brunswick, N. J.

Both laboratory and field trials were conducted during 1957 and 1958 at Rutgers University, to explore control methods and learn characteristics of goosegrass. This widely distributed annual weed, also known as silver crabgrass, hard crabgrass, and yardgrass, creates difficult problems in heavily used turf areas. Cultural methods relating to turf weed control have received much observation, but no adequate procedure has been given for goosegrass. Specific control of the weed has been the subject of very little research.

The objectives in this study were to determine (1) the effects of light and temperature on germination of goosegrass seed, (2) the effects of herbicides applied prior to germination of goosegrass seed, (3) the effects of herbicides applied to the established plant and (4) the effects of late season herbicidal applications on viability and set of seed.

Germination of Goosegrass

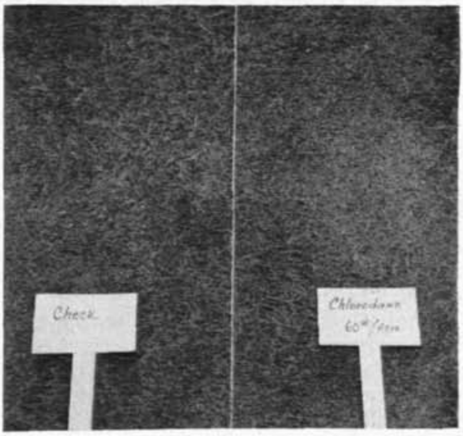
Observations regarding goosegrass, especially on golf courses, reveal that denseness of grass cover and divot holes influence goosegrass infestations. Since these conditions appear to influence germination a study was made on the effect of temperature and light on germination of seed of goosegrass as follows:

Goosegrass seed was harvested approximately 6 months prior to the study and placed in cold dry storage. Four plates of 100 seeds each were subjected to nine different temperature and light conditions. The temperature and light conditions were 20 degrees C., 30 degrees C., 35 degrees C., 30 degrees C, DL, 20-30 degrees C., 20-30 degrees C. DL., 20-35 degrees C. DL, and 20-35 degrees C. Comparable values for centigrade and Fahrenheit readings are 20 degrees C. or 68 degrees F., 30 degrees C. or 86 degrees F., and 35 degrees C. or 95 degrees F. A single numeral indicates a constant temperature; two numerals separated by a dash indicate an alternation of temperatures in which the test was held at the first temperature for approximately 16 hours. The symbol DL indicates light was provided for a 16 hour period. No symbol indicates the test was held in a dark germinator.

Germination conditions of 20-30 degrees C. DL, 20-35 degrees C. DL, 20-35 degrees C., and 30 degrees C. DL gave germination of 91 per cent or better (Table 1). Treatments of 20 degrees C. failed to produce appreciable germination and germination did not occur at a constant temperature of 35 degrees C. with or without light.

Light was found to be an important factor for good germination at 30 degrees C. where maximum germination percentages were obtained with alternating light and dark. Germination with complete darkness at 30 degrees C. was very poor. Under conditions of continuous darkness, the only appreciable germination obtained was fair germination at 20-30 degrees C. and good germination at 20-35 degrees C. Germination was also delayed more at the 20-30 degrees C. temperature than at 20-35 degrees C. temperature. Since light was more important at the 20-30 degrees C. temperature than the 20-35 degrees C. temperature, the optimum maximum germinating temperature appears to be somewhere between 30 degrees C. and 35 degrees C. Under conditions of alternating temperature of 20-35 degrees C. with and without light, the importance of light seems to be compensated by ideal temperatures.

When varied germination conditions such as the above occur in nature, they could produce great influence on goosegrass development. Goosegrass has been known to appear in startling abundance in turf areas where the grass cover has been destroyed suddenly. Other studies concerning control measures for goosegrass which follow in this paper, suggest this relationship. For example, plots receiving injury from chemical treatment often contained more goosegrass plants than many of the untreated plots. Loss of turf from the injurious treatment may



The turfgrass on the right shows chlordane control of goosegrass as compared with the untreated turfgrass on the left.

have increased light and temperatures which are an aid to better germination of goosegrass.

Chemical Treatments

Pre-emergence Treatment of Goosegrass

Elimination of weeds at the time of germination is a most desirable method. Preemergence tests were conducted during 1957 and 1958. The 1957 treatments were on a mixed turf of Kentucky bluegrass, colonial and creeping bentgrasses. Goosegrass was seeded on this test area June 5 and several chemicals were applied 3 days after a rain. The 1958 test area was on a golf course fairway which had a history of goosegrass infestation.

The pre-emergence treatments with dry applications of chlordane at the rate of 60 pounds per acre, with clay as a car-

Table. 1. The effect of several herbicides applied pre-emergence on control of goosegrass Eleusine indica on turf injury. June 8, 1957. September 1957, New Brunswick, N. J.

Treatment	Rate per acre	No. of Plants 9/5/57*	Percent of Check**	Turfgrass injury***
PMA	7 pts.	18	257	0
PMA + 2,4-D	7 pts. + ½ lb.	8	114	1
Lead arsenate	653 lbs.	13	186	0
Sesin	3 lbs.	13	186	0
Chlordane	60 lbs.	1	14	0
Neburon	2 lbs.	11	157	1
Neburon	4 lbs.	9	128	3
Check		7		

* Average number of goosegrass plants in a 2.2 square foot frame quadrat.
** Percent of goosegrass plants compared with check from counts taken 9/5/57.
*** Injury ratings: 0 equals none, 1 equals slight, 2 equals moderate, 3 equals severe, 4 equals very severe.

rier, gave a consistently lower number of goosegrass plants than other treatments in the 1957 test (Table 1). The chlordane plots also showed no turf grass injury. This factor is important especially where control of goosegrass is desired on closely cut bentgrass, as encountered on golf course greens.

The sesin, arsenate of lead and neburon treatments showed some pre-emergence control. The value of the neburon treatment at 4 pounds per acre was reduced by turf injury.

The effectiveness of time of application on goosegrass control was a prime objective of the 1958 fairway test and treatments made on three different dates were compared for chlordane, arsenate of lead, and an arsenical complex. Also chlordane was used at 40, 60 and 80 pounds per acre.

Table 2. Goosegrass control, based on plant counts, as influenced by winter and spring applications of pre-emergence herbicides to fairway turf. October 1958. Trenton, N. J.

Treatment and Date of Application	Rate per acre	Av. No. of Plants per 10 Sq. Ft.	Percent of Check
Chlordane			
March 13	40	4.3	187
	60	1.0	43
	80	4.6	200
April 18	40	0.3	13
	60	0.0	0
	80	0.0	0
June 2	40	2.3	100
	60	6.0	261
	80	1.0	43
Arsenate of lead			
March 13	871	6.3	278
April 18	871	1.0	43
June 2	871	2.0	87
Arsenical complex			
March 13	1350	1.0	43
April 18	1350	2.6	113
June 2	1350	6.6	287
Check		2.3	

Chlordane (on clay) again proved to be the superior treatment in the 1958 test for goosegrass pre-emergence control (Table 2). Comparisons of application dates of chlordane show that the April 18 date resulted in better control than March 13 or June 2 dates of application. No goosegrass was observed in the mid-April plots when chlordane was applied at 60 or 80 pounds per acre. Results with chlordane on control of crabgrass, **Diqitaria** spp., also show the importance of timing pre-emergence applications of this chemical (Table 3).

Arsenate of lead treatment was not effective in controlling goosegrass in the fairway trial and the treatment with the arsenical complex gave some control when applied March 13.

Table 3. Crabgrass control, based on plant counts, as influenced by winter and spring applications of pre-emergence herbicides on fairway turf. October 1958. Trenton, N. J.

Treatment & Date of Application	Rate per acre	Av. No. of Plants per 10 Sq. Ft.	Crabgrass Plants in per cent of Check
Chlordane			
March 13	40	8.6	108
	60	4.6	58
	80	1.0	13
April 18	40	5.6	70
	60	4.3	55
	80	1.6	20
June 2	40	6.6	83
	60	10.6	133
	80	10.0	125
Arsenate of lead			
March 13	871	3.3	41
April 18	871	5.3	66
June 2	871	5.0	63
Arsenical complex			
March 13	1350	4.6	58
April 18	1350	4.0	50
June 2	1350	11.6	145
Check		8.0	

Post-emergence tests were made on turf that was predominantly annual bluegrass and bentgrass in September 1957. Work centered largely on evaluation of several chemicals and the effect of the chemicals on the goosegrass seed crop.

Disodium methyl arsonate (DSMA) treatments gave 63 per cent control and 73 per cent control when in combination with 2,4-D. This chemical gave moderate turfgrass injury. An experimental chemical, FW-450 also showed promise as a post-emergence type herbicide. It appeared to be nearly as effective as DSMA and somewhat less injurious. (Table 4).

Table 4. The effect of post-emergence herbicidal treatments on seed set and viability of goosegrass seed. September 1957.

Treatment	Average Number of Seeds from 2.2 Square Feet	
	Harvested	Live Seed
DSMA	52.7	30.0
DSMA + 2,4-D	68.7	32.0
FW-450*	318.0	160.0
ACP 406*	206.7	156.6
Sodium arsenite	359.0	193.3
Sodium arsenite + 2,4-D	278.9	198.3
Check	452.3	315.7

Differences not significant at .05 level.
*Experimental materials from the Amchem Chemical Corporation.

A check on seed set in the September post-emergence test showed that plants from plots which had been treated with DSMA with and without 2,4-D, yielded an average of 53 and 68 seed respectively as compared with 452 seed from plants of the untreated plots. All chemically treated plots gave lower seed counts than the check.

Seed which was procured from plants of chemically treated plots and subjected to laboratory germination studies gave germination which ranged from 45 per cent to 57 per cent. The check plot seed germinated 70 per cent. The lowest per cent germination of seed from all treatments occurred when 2,4-D was combined with sodium arsenite or DSMA. Seed from plants treated with sodium arsenite plus 2,4-D and DSMA plus 2,4-D, germinated at the rate of 45 per cent and 47 per cent respectively. Germination was 54 per cent and 57 per cent, respectively, when these arsenicals were used without 2,4-D.

Conclusions

Study of goosegrass emphasizes the importance of a good turfgrass cover for weed control.

Goosegrass germination is suppressed by a lack of light and low temperatures.

Chlordane (on clay) gave excellent control of goosegrass when applied prior to germination. Some trials at other locations since the start of this study support these results. More information on consistency of chlordane performance and injury potential should be obtained. Field work should be considered exploratory and limited in scope. Chlordane preparations on a granular clay, spread uniformly at 1½ to 2 pounds of actual chlordane per 1000 square feet, should be timed several weeks in advance of anticipated germination. Also, other pre-emergence herbicides may be worthy of trial.

Goosegrass can be suppressed by late season chemical treatments. DSMA appeared to be the most effective of the several chemicals used.

Chemical treatments applied in mid-September gave up to 90 per cent reductions in viable seed set. This shows the fallacy in curtailing treatment of goosegrass even though cool weather has slowed growth of this weed.

Eleusine indica. M. S. thesis, Rutgers—the State University of New Jersey, 1959 and unpublished data.

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A Control Valve for the Travelling Sprinkler

BY EDWARD J. CASEY

Superintendent, Baltusrol Golf Club, Springfield, N. J.

Superintendents who use travelling sprinklers of one type or another are aware of certain operational weaknesses and subsequent risks of turf damage. A weakness experienced has been with one of the type utilizing a moving base with a 20 foot radius supply pipe to sprinkler head. Assuming that normal irrigation procedure is to have the sprinkler operate for nine or ten hours through the night without supervision, any malfunction during this time results in varying degrees of turf damage. The fundamental weakness of the sprinkler is the lack of an automatic cut-off valve to stop the flow of water in the event of some malfunction. If the power wire or the guide wire breaks, or the anchor stake is pulled out of the ground, the sprinkler will continue to operate in its circular pattern, even though its linear movement has ceased. A situation of this sort results in severe turfgrass damage if the sprinkler operates in one position for hours.