Weed Seed Kill In Soil by Chemicals, Fertilizers

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The removal of weeds from seedbeds, newly planted turf, gardens, and field crops, whether by hand or by cultivation, requires time and expense. Various chemicals and fertilizers have been applied to soils contaminated with weed seeds in a series of studies carried on for several years in the greenhouse and field at the Rhode Island Agricultural Experiment station. Results of these experiments indicate the practical use of such chemicals and fertilizers for killing weed seeds in soils prior to planting turf or other crops.

Materials are available which will destroy weed seeds in the seedbed, leave little or no toxic residue for future plantings, and at the same time add fertility to the soil, thus saving much time and money involved in weeding and maintenance.

Materials, Methods and Results

Chemicals and fertilizers used for treating soil contaminated with weed seeds were as follows: Acrylon, allyl alcohol, ammonium nitrate, ammonium sulfamate, ammonium sulfate, ammonium thiocyanate, Biuret, Granular "Aero" Cyanamid, dimethylourea, limestone, Miloganite, Milarsenite, sodium nitrate, ammonium nitrate, Uramon, and 2,4-dichlorophenoxyacetic acid including the ammonium, calcium, potassium and sodium salts, and the butyl ester of 2,4-D. Rates of application were on the basis of 1,000 sq. ft. One-eighth pound of white clover, ¼ pound of Rhode Island Colonial bent or ¼ pound redtop, and 1 pound weed seed obtained from a bent grass cleaning process were thoroughly mixed with the upper 3 inches of the weedy field soil a few days before the treatments were applied. The chemicals and fertilizers were applied dry or in solution and were worked into the soil either with a rake or a hand wheel-cultivator. Grasses and radishes were planted at weekly intervals in the treated soils in order to determine the time required for the dissipation of toxic material. Observations were made on the germination and growth of weeds and crops.

Tests were conducted in the greenhouse and in the field to determine: (1) the concentration of the materials which would effectively prevent germination of the weed seeds in the soil; (2) how soon after the application of the materials, grasses and other crops could be safely seeded or transplanted; and (3) the influence of the materials on the pH, NH_3-nitrogen and NO_3-nitrogen and conductivity of the soil.

The results of tests in the greenhouse during 1946 are given in Table 1. All materials used for soil treatment gave very good inhibition of clover, grass and weeds and, in general, after a few weeks did not leave toxic residue sufficient to hinder growth of ryegrass and redtop.

Ammonium sulfamate at 2 and 3 pounds inhibited nearly all weeds in flats; plantings of ryegrass 2, 4 and 6 weeks after treatment were satisfactory, but a lapse of 6 weeks after treatment appeared necessary for good germination and growth of redtop where 3 pounds of this chemical were used.

Ammonium thiocyanate at the 3-pound rate also inhibited nearly all weeds and appeared to need a lapse of 4 weeks after treatment for satisfactory ryegrass and 6 weeks for redtop to grow. Biuret at 3 and 5 pounds gave good control of weeds but the soil needed more than 6 weeks to lose toxicity so that ryegrass and redtop could be grown. Twenty-five pounds of sodium nitrite were needed to kill all weed seeds and good growth of ryegrass and redtop resulted when planted at intervals of 2, 4 and 6 weeks after treatment.

Cyanamid at 50 pounds gave control of weeds in the flats and good growth of ryegrass was obtained from plantings at the end of 4 weeks; good growth of redtop resulted at the end of 6 weeks. Uramon also gave control of weeds at the 50-pound rate in flats.

Ammonium, calcium, potassium and sodium salts of 2,4-D gave fairly satisfactory inhibition of weeds in the flats. Plantings of ryegrass 2, 4 and 6 weeks after treatment were satisfactory but, in general, redtop required more time in comparison for satisfactory germination and growth.

The materials used and the results of field tests in 1946 are presented in Table 2. After the treatments were applied to plots 10' x 10', plantings of radishes, perennial ryegrass and Colonial bent were made at intervals of 2, 4, 6, 8 and 11 weeks in rows across the plots. All the chemicals, fertilizers and combinations at the rates used,

TABLE 1. Weed control in seedbed, greenhouse test, 1946. Materials and rates; residual toxicity as shown by growth response of ryegrass and redtop planted 2, 4 and 6 weeks after treatment; per cent of weeds and grass in treated soil.

Material	Lbs. per 1000 sq. ft.	Growth response. number weeks after treatment Ryegrass 2	Ryegrass 4	Ryegrass 6	Redtop 2	Redtop 4	Redtop 6	Per cent weeds and grass in treated soil 1 month after treatment Weeds	Grass
Ammonium sulfamate	1	E*	E	E	G	G	E	10	40
Ammonium sulfamate	2	G	E	E	G	O	E	T**	T
Ammonium sulfamate	3	G	E	E	F	P	O	0	T
Ammonium thiocyanate	2	F	E	E	O	F	E	1	5
Ammonium thiocyanate	3	P	G	E	P	O	E	1	4
Biuret	3	O	F	P	O	O	G	T	1
Biuret	5	P	F	F	O	P	F	T	T
Sodium nitrate	15	G	G	G	G	F	E	2	3
Sodium nitrate	25	G	E	G	G	F	G	0	1
Ammonium nitrate	50	F	G	F	G	F	F	0	3
Ammonium nitrate	75	F	F	G	O	O	G	0	3
Cyanamid	50	P	G	E	P	P	E	0	0
Cyanamid	75	P	G	F	P	P	F	0	0
Uramon	50	G	G	F	G	G	F	0	0
Uramon	75	G	G	G	F	P	P	0	T
2,4-D ammonium	⅛	G	E	E	P	P	E	3	2
2,4-D ammonium	¼	F	E	E	P	O	E	T	2
2,4-D calcium	⅛	E	E	E	F	F	E	3	2
2,4-D calcium	¼	G	E	E	G	F	O	2	2
2,4-D potassium	⅛	G	E	E	P	G	G	6	3
2,4-D potassium	¼	E	E	E	P	P	P	1	2
2,4-D sodium	⅛	G	E	E	P	P	P	2	2
2,4-D sodium	¼	G	E	E	F	P	O	2	2
Check	None	E	E	E	E	E	E	100	100

*P,F,G,E=Poor, fair, good or excellent growth response of crops planted after treatment.
**T=trace, less than 1%.

except Acrylon and Biuret, gave good control of weeds.

Eight weeks after treatment no weeds had appeared where the following were used: Cyanamid 75 pounds plus ⅛ pound of sodium salt of 2,4-D; ¼ pound of sodium 2,4-D; ½ pound of 2,4-D ester; 4 and 6 pounds ammonium thiocyanate, 125 pounds Cyanamid; 75 and 100 pounds of Uramon; 100 pounds of ammonium nitrate, ammonium sulfate, or sodium nitrate.

Individual plantings of perennial ryegrass and Colonial bent, made as soon as 2 and 4 weeks after treatment, responded with satisfactory germination and growth in soil where many of the treatments had been applied and excellent control of weeds had been obtained.

Cyanamid at 75 pounds per 1,000 square feet was one of the treatments which appeared to give promise of inhibiting weeds in the turf seedbed without leaving a toxic residue for too long a time and of adding fertility to the soil. Very little difference in degree of weed control occurred from the two methods of application of Cyanamid. Both cultivating and a combination of cultivating and raking gave very good control.

The 2,4-D materials gave good control of weeds and, in general, appeared to have a longer toxic duration for bent grass than for ryegrass, whereas with the other chemicals and fertilizer bent grass appeared more tolerant than ryegrass. Radishes appeared to be more affected by the residual toxicity than either ryegrass or bent grass.

Tests were made also on 5 new putting greens at 2 nearby golf courses. Treatments with Cyanamid at 50 and 75 pounds per 1,000 sq. ft. were used and it was estimated that 75% to 95% control of undesirable grasses and other weeds was obtained. When the treated soil was seeded with velvet bent 6 to 8 weeks after treatment, satisfactory growth occurred.

Soil Sterilization Practical

A series of experiments in the greenhouse and field showed that several fertilizers and chemicals inhibited weed growths either by killing the seeds or by killing seedlings shortly after germination. The materials were applied dry or as spray solutions and thoroughly mixed by cultivation or raking into the upper 2 or 3 inches of soil.

The period of time after treatment before grass and radishes could be planted safely varied with the different materials and the amounts applied.

Treatments of certain fertilizers or

TABLE 2. Weed control in seedbed, field test 1946, materials and rates; time interval in weeks before satisfactory plantings of radish, ryegrass and Colonial bent were obtained; weed content of treated soils 2 and 8 weeks after treatment.

Plot	Material	Lbs. per 1,000 sq. ft.	Number of weeks after treatment before satisfactory plantings were obtained: Scarlet Globe Radish	Perennial Ryegrass	Colonial Bent	Weed content 2 and 8 weeks after treatment: 2 wks.	8 wks.
							per cent
1	Cyanamid + Ammonium salfamate	75 2	6	4	4	none	6
2	Cyanamid + Ammonium thiocyanate	75 2	6	4	4	"	3
3	Cyanamid + 2,4-D sodium	75 ⅛	6	4	4	"	0
4	2,4-D sodium	⅛	6	4	4	many†	3
5	2,4-D sodium	¼	6	2	4	"	0
6	2,4-D sodium	½	6	2	6	trace	1
7	2,4-D ester	⅛	2	2	2	many	23
8	2,4-D ester	¼	6	2	4	none	1
9	2,4-D ester	½	8	4	4	"	0
10	Check	none	–	–	–	many	100
11	2,4-D ammonium	⅛	8	2	4	trace	2
12	2,4-D ammonium	¼	8	2	4	"	1
13	2,4-D ammonium	½	8	2	4	none	T
14	Ammonium thiocyanate	2	6	2	2	"	7
15	Ammonium thiocyanate	4	6	4	2	"	0
16	Ammonium thiocyanate	6	8	T	2	"	0
17	Ammonium sulfamate	2	6	T	2	trace	15
18	Ammonium sulfamate	4	6	T	2	"	6
19	Ammonium sulfamate	6	T*	T	4	none	6
20	Alcohol, allyl	2	6	T	2	"	8
21	Alcohol, allyl	4	6	2	2	"	9
22	Alcohol, allyl	6	6	4	2	"	3
23	Sodium nitrate	20	6	2	2	"	4
24	Sodium nitrate	30	11	4	2	"	T
25	Cyanamid, cultivated	50	2	2	2	"	3
26	Cyanamid, cultivated	75	6	4	2	"	2
27	Cyanamid, cultivated	100	6	4	2	"	1
28	Cyanamid C50, R25**	75	6	2	2	none	4
29	Cyanamid C75, R25	100	6	4	4	"	1
30	Cyanamid C100, R25	125	6	4	2	"	0
31	Biuret	3	6	2	2	few	28
32	Check	none	–	–	–	many	100
33	Biuret	4	6	T	2	"	29
34	Biuret	5	6	4	4	"	8
35	Uramon	50	6	2	2	few	8
36	Uramon	75	T	T	T	none	0
37	Uramon	100	T	T	T	"	0
38	Ammonium nitrate	100	T	T	2	"	0
39	Ammonium sulfate	100	T	T	2	"	0
40	Sodium nitrate	100	6	6	2	"	0
41	Acrylon	10	6	T	2	many	45
42	Acrylon	20	2	2	2	"	86

†Many germinated but died shortly thereafter.
*T = still toxic at end of 11 weeks after treatment.
**C = cultivated in, R = raked into soil.

chemicals applied in the spring or summer should be very practical for providing weed-free seedbeds for permanent planting of turf in early September; likewise, treatments in the fall should prepare weed-free seedbeds for planting the following spring. Increase in moisture seemed beneficial in decreasing toxic residue of materials.

Sterilizing soil with fertilizers or chemicals appears to be a very practical method of controlling weeds and fertilizing seedbeds in one operation. This is especially true of fertilizers which do not appreciably alter the soil complex, and which do not leave residual toxicity for long periods.

GSA Convention Paper