CHEMICAL CONTROL OF WEEDS IN VEGETABLE SEEDBEDS

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The increasing cost of agricultural labor in the years since the beginning of World War II has created greater and greater demands for weed eradicating chemicals. Some such materials were already available by 1941 and others have been developed since then. Our interest at the Vegetable Crops Laboratory (11) has been directed primarily toward an investigation of the herbicidal materials which might be usable for the control of weeds in vegetable seedbeds. Both Uramon and Cyanamid have become widely used as weed control materials for tobacco seedbeds in the southeast during the last 3 years. Clark (1) and Kincaid (7) working in North Florida recommend use of these materials individually or as a mixture applied to the soil 3 months in advance of planting. Henderson (4) makes the same recommendations for Virginia. Another chemical having herbicidal properties is Chlorpicrin (manufactured and sold under the trade name "Larvacide"). This compound has been used extensively both as a weed killer, (10) (6) (2), and a nemacide (5). Chlorpicrin is currently recommended as a soil fumigant for tobacco seedbeds by Swanback (12), in Connecticut. The use of 2 4-dichlorophenoxyacetic acid as a soil treatment for weed control has recently been pointed out (3). The material used in proper concentration may act either as a stimulant to soil organism (9) or may greatly accelerate the initiation of root primordia in the stems of plants produced on treated soil (8). These three herbicidal materials have been used as seedbed soil treatments during the past crop season. All experiments were set up so that data could be subjected to statistical analysis. The soils used were of both sandy (Leon) and heavy (Manatee) types which were known to be infested with seeds of our common weeds.

Seedbeds to be treated were made up and the herbicides applied to each randomized block in such order that a single bed having all 3 herbicides could be planted at 1 time. Fertilizers were applied 1 week in advance of planting at the rate of 2000 pounds per acre. Two kinds of irrigation were employed, 1 set of beds was watered from overhead by means of a hose and sprinkling nozzle, the other was watered by seepage whereby water ran along either side of the bed in a shallow ditch. To accentuate the effects of herbicide as regards weeds 2 crops were employed, tomatoes, a short term crop and celery a long term crop.

A 3:1 Uramon + Cyanamid mixture was used; 1.5 lbs. per sq. yd. on the heavy soil, and 0.5 lbs per sq. yd on the light soil. The material was broadcast uniformly over the soil surface and then mixed thoroughly to a depth of 4 inches. Intervals of 4 and 10 weeks were allowed to pass before planting.

Chlorpicrin was applied at the rate of 2.5 cc per sq. ft. as recommended by the manufacturer. Intervals of 2 and 8 weeks were allowed before sowing.

The ammonium salt of 2, 4-dichlorophenoxyacetic acid was applied as a liquid application equivalent to 10 lbs. per acre. As with Uramon + Cyanamid periods of 4 and 10 weeks intervened between seedings.

Plant counts were made after germination to determine the total number of seedlings. Final harvest records separated the plants into two categories, number ones, and culls. With tomatoes, a plant which measured 4 inches from the soil surface to the bud was considered a number 1 plant. With celery, a plant which measured 4 inches from the soil surface to the tip of the longest leaf was a number 1 plant.

A consideration of crops shows that germination (Table 1) of tomato seeds was not reduced by any of the 3 herbicides. Chlorpicrin was significantly better than 2, 4-D. With celery, the check plots were better than Uramon + Cyanamid which in turn was better than 2, 4-D. Chlorpicrin plots showed no reduction in plant stand.

A consideration of date shows the same relative position of significance for the 3 herbicides for plots seeded in December. On plots seeded in January there is no significant difference in the number of seedlings produced. The reduction in germination in the Uramon + Cyanamid and 2, 4-D plots took place mainly in celery plots sown 4 weeks after application of the herbicides. A study of the figures on irrigation reveal a significant reduction in germination on the Uramon + Cyanamid and 2, 4-D plots which were seep irrigated. This reduction in germination of celery (field observations showed some loss of tomato plants) can be attributed to sowing Uramon + Cyanamid and 2, 4-D plots too soon after treatment. Soil tests* show that this reduction is due to a concentration of salts which have been translocated by the irrigation water into the centers of the seedbeds. This loss often represented all of the plants in the center of the bed.

At final harvest (Table 2) the production of tomato plants was reduced significantly by the 2, 4-D treatment. The yield of number one celery plants in Uramon + Cyanamid and Chlorpicrin plots was significantly better than the checks which in turn were better than the 2, 4-D treatments.

The figures for date indicate that for December seedlings Chlorpicrin plots were significantly better than Uramon + Cyanamid or Check plots which in turn were better than 2, 4-D. January showed Chlorpicrin and Uramon + Cyanamid no better than the checks and only Uramon + Cyanamid significantly better than 2, 4-D. There was significant loss in plant production due to type of irrigation. With overhead irrigation, Chlorpicrin was significantly better than Uramon + Cyanamid or Check plots which in turn were better than 2, 4-D. With seep irrigation Chlorpicrin, Uramon + Cyanamid, and Check plots were better than 2, 4-D.

TABLE 1

EFFECT OF HERBICIDES ON GERMINATION OF TOMATO AND CELERY SEEDS

Soil Treatments	Crops		Date Planted		Irrigation	
	Tomato	Celery	December	January	Overhead	Seep
Check	9493	6665	7700	8458	8609	7549
Uramon + Cyanamid	9746	5425	6854	8317	8456	6715
2, 4-D	9274	3637	4997	7914	7722	5189
Chlorpicrin	10192	6516	8479	8229	8721	7987
Difference for Sig. 5% level	809	809	809	809	809	809

*Made in conjunction with the seedbed work by Dr. E. L. Spencer, Soils Chemist.

TABLE 2

EFFECTS OF HERBICIDES ON THE PRODUCTION OF NUMBER 1 PLANTS AT FINAL HARVEST AND TOTAL NUMBER OF WEEDS

Soil Treatment	Crops		Date Planted		Irrigation		Total No.
	Tomato	Celery	December	January	Overhead	Seep	Weeds
Check	2123	2551	2403	2271	2894	1780	13846
Uramon + Cyanamid	2398	3646	3293	2751	3246	2798	8387
2, 4-D	462	1085	57	1490	927	620	5950
Chlorpicrin	3121	3731	4389	2463	4481	2371	10566
Difference for Sig. at 5% level	1075	1075	1075	1075	1075	1075	3515

For weed control 2, 4-D was significantly better than Uramon + Cyanamid, Check or Chlorpicrin plots. Uramon + Cyanamid was significantly better than Check plots but not better than Chlorpicrin.

Weeds found growing on the heavier type Manatee soil were mostly of a succulent nature: smooth and spiny pigweed, purslane, and sow thistle. The sandy type soil was heavily infested with such grasses and woody annuals as: red top, goose grass, sorrel, dog fennel and Jerusalem oak. Nutgrass, Bermuda grass and crabgrass were common to both soils. Chlorpicrin failed to give adequate control of crabgrass and gave only a mediocre control of redtop and purslane. Observations at time of seeding the beds indicated a good control of all weeds by chlorpicrin but as the season progressed more and more crabgrass germinated in these plots. Subsequent trials with Chlorpicrin, in which steamed soil was sowed with crabgrass seed and then treated, indicate that Chlorpicrin inhibits seed germination for several weeks but does not kill the seeds. Uramon + Cyanamid gave good weed control on heavier type soil where the application was sufficiently high. 2, 4-D gave excellent control of all weeds and grasses named except Bermuda grass. The figures given in Table II represents this species almost altogether.

CONCLUSIONS

The results obtained in these experiments as regards the control of weeds by soil application of herbicidal material correlated with crop, time of planting and irrigation indicate that:

1. Uramon + Cyanamid is effective as a herbicide. Regardless of type of irrigation seed should not be sowed for at least 6 weeks after treatment.
2. Chlorpicrin is stimulative in its effect on tomato (not significantly so) and celery plants. It gives adequate control of all native weeds other than crabgrass. It should not be used as a herbicide in soils known to be heavily infested with seeds of crabgrass. Best results are obtained by planting 2 weeks after treating the seedbed.
3. The Ammonium salt of 2, 4-dichlorophenoxyacetic acid cannot be recommended as a herbicide for vegetable seedbeds.

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OBSERVATIONS OF CERTAIN FACTORS GOVERNING EFFICACY OF SOIL FUMIGANTS

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Compared with efforts expended in foliage problems, control of below-the-ground pests and pathogens has been a neglected field. Although little is yet known regarding the nature of organisms causing damage through plant roots, the enormous extent of crop losses from such organisms has been strikingly demonstrated by the use of soil fumigants. Soil fumigation appears to offer a logical and practical means of controlling harmful and undersirable soil organisms and increasing crop yields and quality. There are now four or five manufacturers of fumigants carrying on an intensive screening program with volatile chemicals. Literally hundreds of fumigants have been tested against various soil fungi, insects, nematodes and weed seeds and many promising ones have been found. Also much fundamental knowledge is gradually being acquired regarding factors affecting the performance of fumigants. There is a great need for intensive work along these lines by local experiment station workers, and it is hoped that the following generalized discussion will be a thought provoker and research stimulator.

The fumigants now being used commercially in Florida are chlorpicrin (Larvacide), methyl bromide (Iscobrome), dichloropropene-dichloropropane mixture (D-D) and ethylene dibromide (Soilfume 60-40, Soilfume 80-20 and Dowfume W-40). Their respective merits have been discussed in other papers. All of these fumigants are relatively insoluble in water, but vary considerably in their molecular weights, boiling points and vapor pressures. They are all applied beneath the soil surface as liquids and function in the soil as gases.

Spacing and Depth of Applications—Studies of fumigant diffusion in soil have shown