Herbicidal Control of Weeds in Coffee Seeded in Plastic Bags[1]

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INTRODUCTION

The first objective in coffee production is to acquire healthy seedlings. It has been customary to sprout the seeds in special seedbeds, usually sand, and transplant the young seedlings into shaded nurseries where they are grown until they are ready to plant in the field.

It has become a common practice in Puerto Rico in recent years to transplant from the original seedbed into perforated plastic bags. The plants are grown in these bags in the nursery until ready for transplant in the field. Control of weeds in the bags can be a problem. One reason coffee is not seeded directly into bags, thus saving one transplanting operation, is the cost of weed control and the competition by weeds during the long period of germination and development. Another reason is the poor and often erratic germination of coffee seeded directly into soil.

With the many herbicides now available, it was believed possible to develop procedures that would permit direct seeding and weed-free development of coffee plants in the plastic bags. Little information is available in the literature on the use of such chemicals in such a procedure, although considerable research has been reported on the employment of herbicides in field plantings. Mention is often made of fumigation of the seedbed but usually to control nematodes or disease organisms rather than as a weed control measure.

MATERIALS AND METHODS

Two methods of application were investigated. First, the soil was fumigated prior to seeding the coffee. Second, pre-emergence herbicides were applied to the soil surface immediately after the seeds were planted in the bags.

The experiments were conducted in the greenhouse. Five-inch diameter perforated black plastic bags were filled to their brims with regular transplanting soil mix. The fumigants used were allyl alcohol, sodium-methyldithiocarbamate (SMDC) and methyl bromide. The first two were applied directly and thoroughly watered into the medium. Three different methods of handling the methyl bromide were tried. In the first, the soil was fumi-

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gated in a loose pile; in the second, loosened soil was fumigated in the plastic bags; and in the third, tightly packed soil was fumigated in the bags. Rates of treatment were 1½ lb./acre for the SMDC, 1½ gal./100 sq. ft. for the allyl alcohol and 4 lb./1,000 cu. ft. for 24 hours for the methyl bromide.

The pre-emergence herbicides tested were ethyl N,N-di-n-propylthiocarbamate (EPTC) at 4, 8 and 12 lb./acre; the amine salt of 4,6-dinitro-o-sec-butylphenol (DNBP) at 4 and 8 lb./acre; 3-(p-chlorophenyl)-1,1-dimethylurea (Monuron) at 2 and 4 lb./acre; 3-(3,4-dichlorophenyl)-1,1-dimethylurea (Diuron) at 2 and 4 lb./acre; 1-n-butyl-3-(3,4-dichlorophenyl)-1-methylurea (Neburon) at 4 and 8 lb./acre; 2-chloro-4,6-bis-(ethylamino)-s-triazine (Simazine) at 2, 4 and 8 lb./acre; 2-chloro-4-ethylamino-6-isopropylamino-s-triazine (Atrazine) at 2, 4 and 8 lb./acre; Simazine-amitrole mixture (Amizine) at 2, 4 and 8 lb./acre; and dimethyl ester of tetrachloroterephthallic acid (Dacthal) at 10 and 20 lb./acre.

The fumigants were applied 2 weeks prior to seeding. The other herbicides were applied immediately after seeding, in 50 ml. of water carefully distributed over the soil surface in each bag. An additional 200 ml. of water were applied immediately after treatment. Ten replicates of each treatment were set up with four coffee seeds per bag. The bags were watered as needed to keep the soil with sufficient moisture from the time of seeding. Each replicate series was randomized on the greenhouse bench. Notes were taken at various intervals on the number of weeds in each bag and on the number and stage of development of the coffee seedlings.

RESULTS AND DISCUSSION

Table 1 gives the weed counts at 30, 60 and 90 days after seeding and the number of coffee seedlings in different stages of development at 90 days. There were only a few weed seedlings in the bags. The totals for the 10 bags in each treatment are given in table 1.

SOIL FUMIGANTS

All of the soil fumigants markedly reduced the number of weed seedlings. Methyl bromide was the most effective and allyl alcohol the poorest for controlling weeds. None of the three methods of handling the methyl bromide resulted in significant differences in the weed count or in the development of coffee seedlings. This is important since it is often easier and less costly to bag the soil first, then treat and plant. The packed soil was included since the bags may be filled ahead of time and left out in the open where the soil can become soaked and packed before treatment. The results indicate that even the packed soil in the plastic bags can be fumigated satisfactorily. Notes on coffee seedling development indicate highly satisfactory germination and rapid development with allyl alcohol showing

TABLE 1.—*Number of weeds at various intervals after planting and number of coffee seedlings after 90 days showing their growth condition. (Figures are totals for the 10 replicates.)*

Treatment	Weed count			Coffee seedling development[1]					
				90 days					
	30 days	60 days	90 days	C[2]	M[3]	OC[4]	O[5]	T[6]	Total
Check	29	32	29	3	0	0	9	20	32
Check—weeded	26	27	31	4	0	0	12	20	36
SMDC	0	1	2	0	0	1	2	33	36
Allyl Alcohol	1	1	6	1	0	2	1	31	35
Methyl bromide—loose soil	0	0	0	1	0	0	2	35	38
Methyl bromide—soil in bags	1	1	1	0	0	0	0	38	38
Methyl bromide—packed soil	0	0	1	0	1	1	1	36	39
EPTC—4 lb./acre	1	4	7	4	0		11	7	23
EPTC—8 lb./acre	3	5	6	4	0		20	5	33
EPTC—12 lb./acre	2	2	5	4	0	1	14	0	19
DNBP—4 lb./acre	4	3	2	1	1	1	6	22	31
DNBP—8 lb./acre	1	1	3	5	0	1	4	27	37
Monuron—2 lb./acre	13	18	25	9	0	0	6	16	31
Monuron—4 lb./acre	5	8	14	2	0	0	3	22	27
Diuron—2 lb./acre	4	3	11	4	0	1	2	21	28
Diuron—4 lb./acre	1	3	6	6	0	0	8	17	31
Neburon—4 lb./acre	5	17	16	6	0	0	5	24	35
Neburon—8 lb./acre	6	8	11	0	0	0	1	37	38
Simazine—2 lb./acre	5	4	2	5	0	0	7	19	31
Simazine—4 lb./acre	4	0	4	0	1	0	4	32	37
Simazine—8 lb./acre	3	2	3	0	0	0	30	10	40
Atrazine—2 lb./acre	1	0	4	1	0	0	3	33	37
Atrazine—4 lb./acre	5	1	C	2	0	2	7	24	35
Atrazine—8 lb./acre	9	1	1	1	0	0	30	4	35
Amizine—2 lb./acre	0	0	0	5	0	0	2	23	30
Amizine—4 lb./acre	0	0	0	8	0	0	5	17	30
Amizine—8 lb./acre	2	0	0	10	0	0	18	9	37
Dacthal—10 lb./acre	10	14	18	5	0	0	14	16	35
Dacthal—20 lb./acre	6	10	11	8	1	4	13	6	32

[1] Development stages identified are:
[2] C—crook showing.
[3] M—matchstick, seedling straight with seed coat on.
[4] OC—cotyledons showing but seed coat not shed.
[5] O—cotyledons open and free of seed coat.
[6] T—true leaves opened out.

a slight lag as well as a slight reduction in total germination. In two of the 10 replications in which packed soil was treated with methyl bromide there was a slight wrinkling of the cotyledons, which seems to be indicative of residual toxicity.

EPTC

This chemical gave fair weed control but its effect on the planted coffee was most harmful. Total germination was reduced by 25- to 50-percent and the delay in development of the seedlings was even more marked. A number of seedlings were still in the crook stage even after 90 days and only a few (none at the highest rate) had produced true leaves. The plants were all dwarfed, with characteristic dark green puckered cotyledons some of which turned yellow.

DNBP

Dinitro gave surprisingly good weed control over a period of 90 days but with some deleterious effects on seedlings, particularly those emerging late. Possibly the repeated watering in the greenhouse carried some of the chemical deeper into the soil. All the plants with true leaves were healthy at 90 days, but those in which only the cotyledons had developed were yellowing.

SUBSTITUTED UREAS

Three substituted ureas (Neburon, Monuron and Diuron) were tested. Weed control was not outstanding with any of them although Diuron, at the higher rate of 4 lb./acre, was the most effective. It is possible that Monuron was too soluble and Neburon too insoluble under these particular moisture conditions and with this soil mixture. Neburon was least toxic to coffee, as might be expected from its low solubility. Both Monuron and Diuron produced a definite delay in germination and depressed the percent of germination. Observations made at the end of 90 days indicate a yellowing of all plants devoid of true leaves. Plants with true leaves did not show ill effects. Again, the effects on coffee were a little less marked with Diuron, perhaps indicating less leaching into the root zone. Of the three, Diuron appears to be the most promising herbicide for use in connection with bagged coffee.

TRIAZINES

Two triazines (Simazine and Atrazine) were tested. Both gave good weed control, particularly the more soluble Atrazine. The lower weed count at 90 days indicates delayed control. This probably is due to the slow release of the herbicide from the colloidal complex of the soil. However, Atrazine caused more severe damage to coffee although germination was good. The higher rate of Simazine and the two higher rates of Atrazine resulted in dwarfed and chlorotic plants. Symptoms became more severe with passage of time. Only the lower rates thus show promise and then only with established plants.

AMIZINE

A Simazine and Amitrole mixture was included among the chemicals tested in an attempt to reduce the amount of Simazine. This mixture furnished excellent weed control; even at the lowest rate, as good as the best of the soil fumigants. Perhaps even lower rates would have shown to be effective. There was a slight effect on the cotyledons even at the lowest rate and a more pronounced effect at the higher rate. Again, most of the effect is shown on the late developing plants. It is possible that plants may become less susceptible once they are beyond the cotyledon stage. The highest rate was definitely beyond the tolerance limit of coffee seedlings. This mixture is most promising at the lower rates for seedlings because of the excellent weed control it furnishes and the slight effect it has on coffee.

DACTHAL

This compound was included in the trials as a possible control for grassy weeds. However, control was poor at both rates and there were definite, injurious effects on the coffee seedlings. Control was unsatisfactory for either grasses or broad-leaved weeds.

CHECKS

Two control series were included, one was hand-weeded at various intervals and the other left undisturbed. It was found necessary to weed both series after a 2-month period to prevent seeding of surrounding treatments. The hand-weeded check was slightly ahead of the unweeded one in development although neither was as good as some of the chemically treated lots.

SUMMARY

Results of a screening experiment using three soil fumigants and nine pre-emergence herbicides on coffee seeded in plastic bags indicate that it is possible to seed coffee directly in bags and grow the plants for at least 90 days with excellent growth and satisfactory control of weeds.

Fumigation of the soil in the bags with methyl bromide before planting was a highly effective treatment. SMDC was slightly less effective and allyl alcohol gave extremely poor results.

Pre-emergence applications of DNBP, and 2-lb. treatments with Diuron, Simazine or Atrazine were reasonably effective.

Amizine at 2 lb./acre was highly effective for controlling weeds in plastic bags.

RESUMEN

Los resultados de pruebas experimentales de invernadero, en las que se aplicaron tres compuestos fumigantes y nueve yerbicidas preemergentes, comprueban que es

enteramente posible sembrar la semilla de café directamente en bolsas plásticas y obtener un excelente crecimiento de las plántulas además de un control satisfactorio de los yerbajos por lo menos durante 90 días.

El bromuro de metilo como agente fumigante resultó muy efectivo contra las malas yerbas superando ligeramente al SMDC. En cambio, el alcohol alílico no dio buenos resultados.

Las aspersiones con DNBP y con 2 libras de Diuron, Simazine y Atrazine por acre controlaron las malas yerbas con relativa efectividad.

También el Amizine, a razón de 2 libras por acre, fue muy efectivo para controlar las malas yerbas.