sion are increased because of an increase in the availability of sugar.

Storage

Studies in which radioactive carbon dioxide ($^{14}CO_2$) was supplied to sugar beets and the subsequent distribution followed in various parts of the plant, have indicated that 60% of the radioactive sugars formed were translocated from leaves to the root within 1½ to 2 hours. However, it seems unlikely that these sugars were immediately located in their final storage sites because radioautographic studies have shown that as much as 72 hours may elapse before radioactive sugars have completely moved from the region adjacent to the transporting cells of the vascular ring into the tissues between the rings. Also, radioactive carbon was found to accumulate steadily in cell wall and protoplasmic materials of the storage root for 72 hours after the radioactive sugar had arrived in the roots.

These data suggest that before newly-arrived sugar may be stored in the root, new cells must be formed which, on expansion, accumulate sugars in their vacuoles. This might explain the apparent anomaly of how sugars are moved from the leaf, against a concentration gradient, to the root where the concentration may be as high as 15% to 20%. If sugars move into young actively growing regions where the sugar utilization is high, then the sugar concentration at the site of utilization is probably diminished to a very low level.

Thus, the evidence suggests that sugar storage in beets is brought about by the continuous addition of new cells which accumulate sugars on enlargement. It seems unlikely that much sugar storage will be accomplished in beet roots if conditions are unfavorable for cell division. It is clear that there is a substantial internal control over root development because of the strong dependence of root size on top size during growth, but the top-to-root relationship, as determined by internal factors, may also be modified to a considerable extent by environmental factors, particularly temperature. How the internal control (from the genotype) over cell division in the root is mediated warrants further study.

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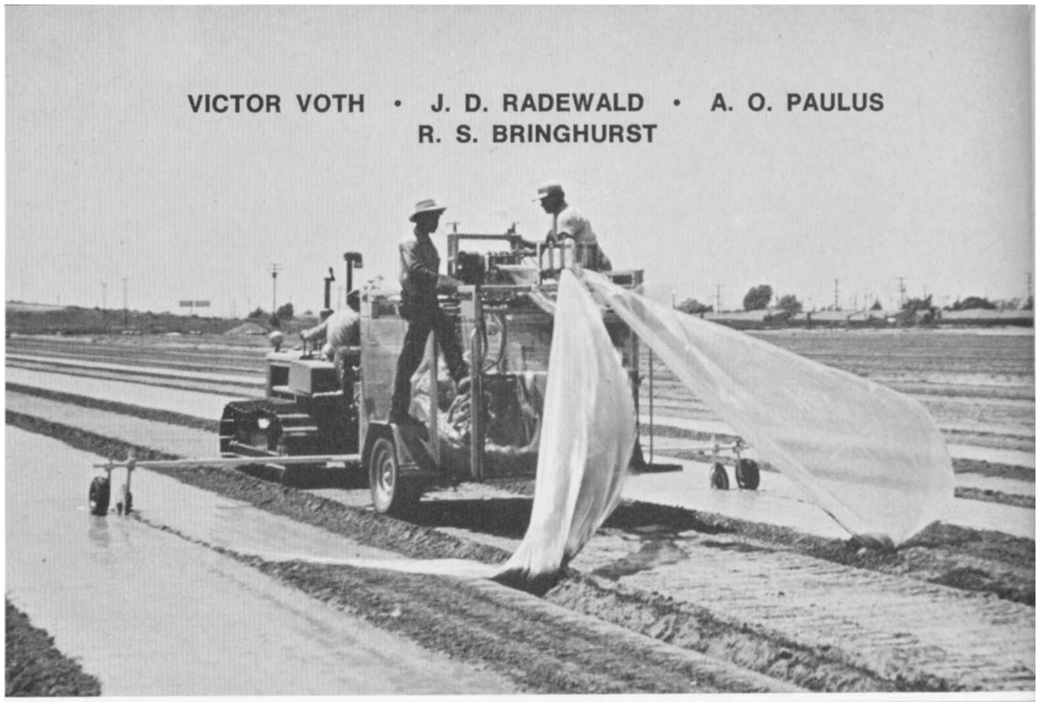

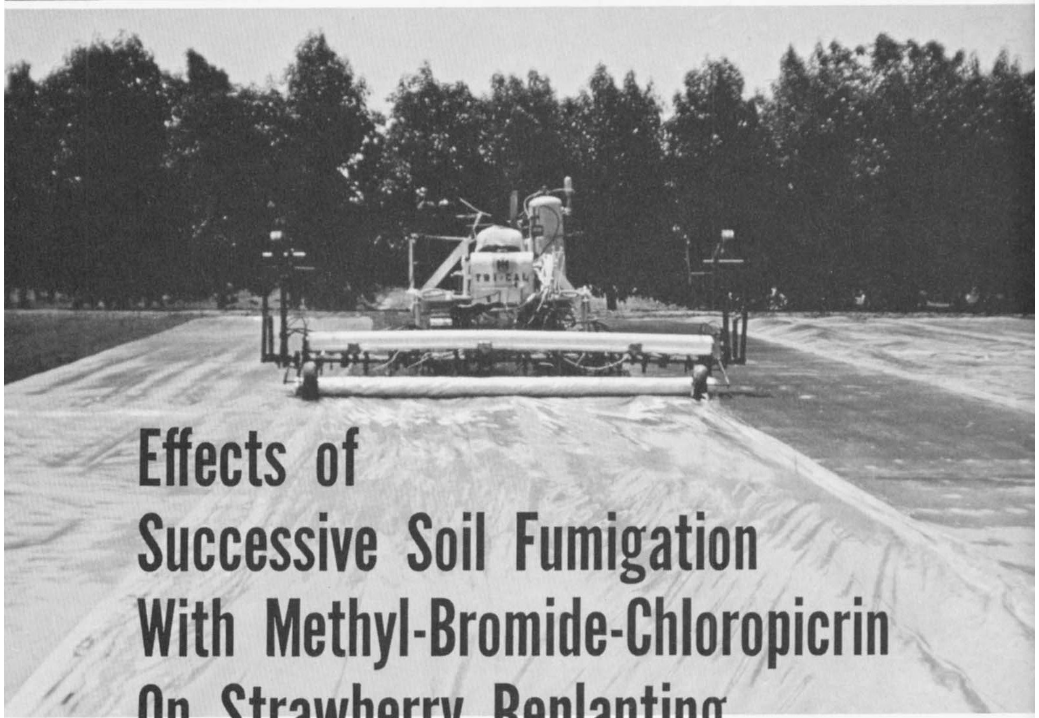

Effects of Successive Soil Fumigation With Methyl-Bromide-Chloropicrin On Strawberry Replanting

Annual fumigation with methyl-bromide-chloropicrin mixtures is still a paying proposition after six successive years of strawberry cropping on the same soil in Southern California.

SOIL FUMIGATION with methyl-bromide-chloropicrin mixtures covered with natural polyethylene tarp contributes greatly to the high average strawberry yields in California. Yields in 1970 averaged about 17 tons per acre and accounted for almost 60 per cent of the U. S. crop on about 15 per cent of the acreage. Of the 12,000 to 15,000 acres of cropland (including fruit plantings and nurseries) fumigated annually in California, over 8,000 acres are planted to strawberries. Some southern California soils have been fumigated and replanted to strawberries annually for as long as 13 years.

Little information has been available on the effect of repeated annual fumigation on the performance of fruiting strawberry plants. These experiments were conducted to find answers to such questions as: (1) Is repeated fumigation necessary when strawberries are replanted on the same soil year after year? (2) While methyl bromide may be required for weed control each year, is the repeated application of chloropicrin needed? (3) Would the full benefits of soil fumigation be possible without polyethylene tarp cover? (4) Do all varieties respond equally to soil fumigation?

Methyl bromide fumigation alone was compared with the conventional 2-to-1 methyl bromide-chloropicrin mixture on a soil that had been replanted to strawberries for six consecutive years with five successive, conventional fumigations. In addition, an experimental gel mixture of the same fumigants (Agel-67) was included. Agel-67 (manufactured by Great Lakes Chemical Corp.) is a gel formulation of methyl bromide-chloropicrin. When injected into the soil a thixotropic reaction occurs; that is, the liquid combination of the two materials in the cylinder becomes a jelly substrate in the soil. The theory behind this formulation is that the gel brings about a longer release period for the chemicals in the soil, and theoretically a longer period of time exists where the detrimental organisms are exposed to the biocide.

TABLE 1. COMPARING THE RESULTS OF STRAWBERRY FUMIGATION TREATMENTS OVER VARIETIES, FOR YIELD IN GRAMS OF FRUIT PER PLANT AND SIZE IN GRAMS PER FRUIT
(1000 grams per plant = about 25 tons per acre)

Treatments		Yield		
Material	Rate	Fruit weight per plant	Change	Fruit size
	lbs/acre	gr	%	gr
None	0	1006a*	Check	14.4ab*
Methyl bromide	300	952a	–5	14.1a
Conventional	300	1282c	+27	15.8c
Gel	300	1143b	+11	14.8b
Gel	400	1141b	+11	14.8b

* Differences significant if no letter in common.

TABLE 2. COMPARING STRAWBERRY VARIETIES IN NON-FUMIGATION AND CONVENTIONAL FUMIGATION TREATMENTS FOR YIELD IN GRAMS OF FRUIT PER PLANT AND IN GRAMS PER FRUIT

Cultivar	Yield			Fruit Size	
	Check	Fumigated	Change	Check	Fumigated
	gr	gr	%	gr	gr
Shasta	608	919*	+51	15.1	17.2*
Fresno	1071	1395*	+30	13.4	14.3*
Tioga	1256	1569*	+25	14.1	15.4*
Torrey	1088	1244*	+14	15.1	15.1

* Differences significant at 5% level.

All fumigation was completed at least three weeks before the plantings were made.

The experiments were conducted during 1969–70 at the South Coast Field Station near Santa Ana on a Moreno sandy loam soil that is typical of the area. The treatments were as follows: 1.) no fumigation; 2.) conventional 2-to-1 methyl bromide-chloropicrin mixture at 300 lbs per acre tarped with 1 mil natural polyethylene for 72 hours; 3.) methyl bromide alone at the same rate, in the same manner for the same duration; 4.) the experimental 2-to-1 gel mixture at the same rate without the tarp; and 5.) the experimental gel mixture at 400 lbs per acre as in number 4.

Four California cultivars were included in each treatment, each planted at the optimum date for that area: 'Tioga,' August 1; 'Fresno,' August 10; 'Torrey,' August 20; and 'Shasta,' September 1. There were 10 plants in each plot and each entry was replicated four times in each treatment in a randomized, complete block design. The plants were spaced 14 inches apart in the rows on a standard 40-inch double row, raised bed, giving a net plant density of approximately 22,800 plants per acre.

Culture and data recording

Optimum nitrogen fertility levels were maintained uniformly over all treatments. The plots were sprinkler-irrigated from planting time until the last week in January when clear polyethylene bed mulch was applied, and furrow irrigated thereafter, which is customary for summer planting. Weeds were counted and removed three times between planting time and the time that the mulch was applied.

Fruit was harvested each week, March through June. Only marketable fruit was harvested and yields were measured by weighing the harvested fruit. The results were converted to grams per plant for the analysis of variance. At each harvest, 10 fruits were picked at random from each plot and weighed as a measurement of fruit size.

Performance

Pooling the results over all varieties, the conventional methyl bromide-chloropicrin treatments outyielded all other treatments—exceeding the controls by 27 per cent (table 1), and the fruit was larger. The gel treatments were also better than the controls but not nearly as effective as conventional fumigation, and increasing the application rate did not help. Methyl bromide fumigation alone did not have a significant effect and if there was a difference, it was a decrease, since for each variety, the difference was negative.

The response of Shasta variety to conventional fumigation was by far the greatest and that of Torrey the least (table 2). Tioga and Fresno were intermediate with Fresno responding somewhat more. These results were consistent with those reported by growers. Torrey has always performed reasonably well without fumigation.

Yield increase

The net increase in yield per acre for Tioga and Fresno was about 8 tons and for the Shasta variety, over 7. Thus under the conditions of the experiment, conventional refumigation before replanting strawberries paid off well in terms of yield, particularly with the three most important cultivars involved.

Methyl bromide at 300 lbs per acre and 2-to-1 mixture of methyl bromide-chloropicrin tarped with one mil polyethylene were similar, with at least an indication that a higher amount of methyl bromide might give slightly better weed control (table 3). The gel treatments were intermediate in weed control when compared with no fumigation, and again, increasing the rate did not help.

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TABLE 3. COMPARISON OF EFFECT OF FUMIGATION ON WEEDS DIFFICULT TO CONTROL WITH FUMIGATION (PREDOMINANTLY MALVA AND MEDICAGO WITH SOME CONVOLVULUS) AND THOSE MORE EASILY CONTROLLED (PORTULACA, EUPHORBIA, AND AMARANTHUS

TREATMENTS		WEEDS		
Material	Rate	Difficult	Easy	Total
	lbs/acre	average no.		
None	0	130	120	250
Methyl bromide	300	56	6	62
Conventional	300	70	8	78
Gel	300	86	28	114
Gel	400	90	32	122