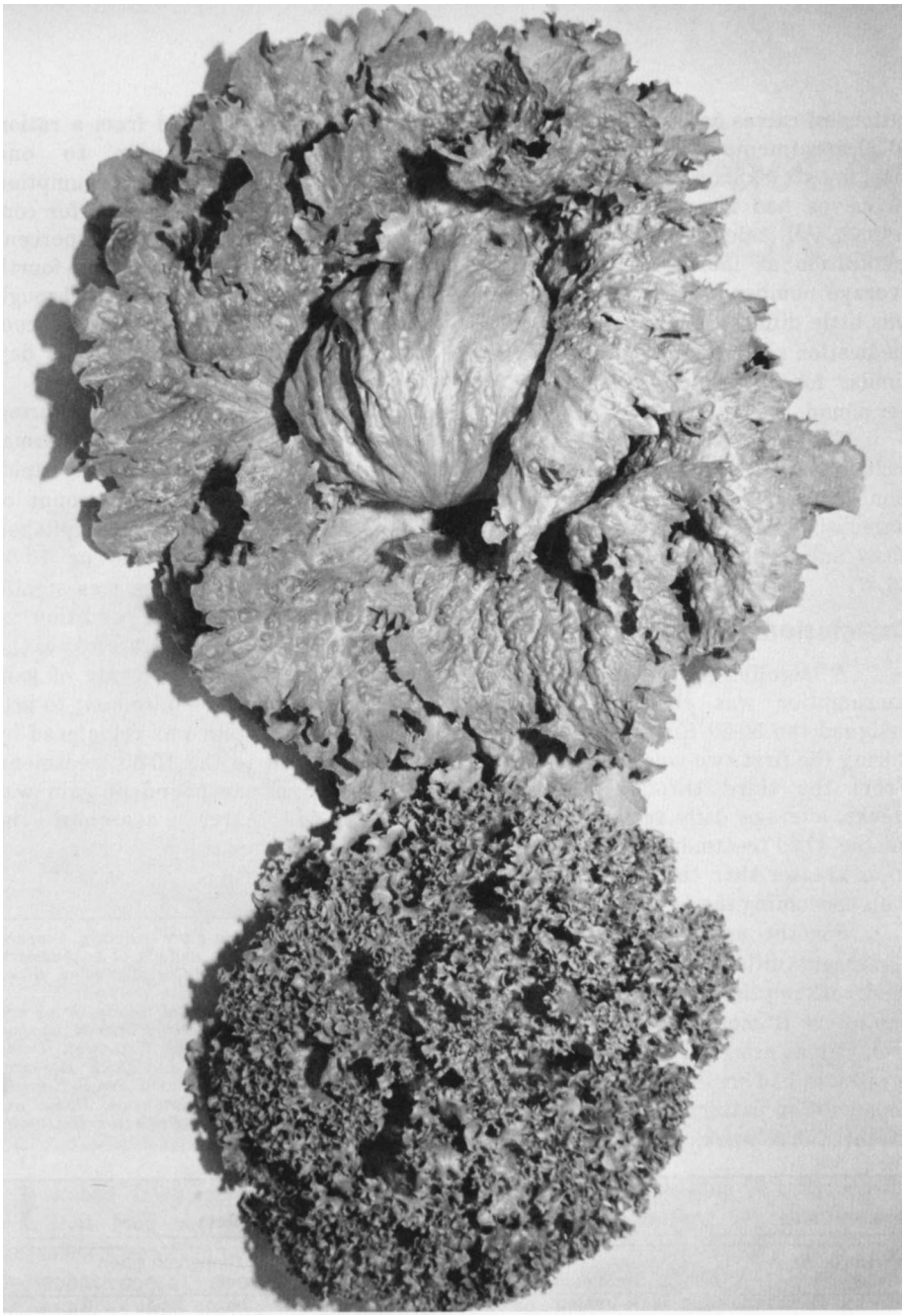

Fig. 1. The effects of big vein disease of lettuce are clearly seen here. (Above—healthy plant; below—severely diseased plant.

Big vein disease of lettuce in Imperial Valley

Demetrios G. Kontaxis

Big vein, first reported in the Imperial Valley in 1934, is an endemic local disease of lettuce. Statewide, the disease costs California lettuce growers about $30 million annually. In the Imperial Valley, where more than 40,000 acres are planted to iceberg type lettuce, it is estimated that loss to the disease each year is at least 700,000 cartons of the crop, the market value of which exceeds $2.8 million. At present, big vein is the most important disease of lettuce in the county.

The nature of the big vein agent (BVA) is not known with certainty. Possibly it is a viroid, a type of infectious nucleic acid. It has been determined by various workers that BVA is neither a typical virus nor a mycoplasma.

The causal agent of the disease can persist for a long time in the soil, and it can develop even in fields not planted to lettuce for many years. For instance, more than 50 percent of the 1977 crop of a local field last planted to lettuce in 1950 was infected with big vein. The record does not show whether the 1950 crop had any big vein incidence. The disease can be severe in both heavy and sandy soils.

All cultivars of commercial iceberg-type lettuce are susceptible to big vein, and chemical or reliable cultural control of the disease is not available. When infection of plants takes place close to harvesting, the disease is of minor economic significance since the infected plants usually form good size, marketable "heads." Early infections, however, result in stunted, disfigured, unnatural and, therefore, unmarketable plants (fig. 1). In the Imperial Valley, early infections are common, rendering this disease an economic problem.

The systemic fungicides, pyroxychlor (2-chloro-6-methoxy-4-[trichloromethyl] pyridine) and CGA48988 (N-[2,6-dimethylphenyl]-N-[methoxyacetyl]-alanine methyl ester), as well as two soil fumigants, were tested against the disease during the past three years. In addition, the effect of big vein on lettuce production was assessed during the 1977-78 season.

Materials, methods, and results

Granular pyroxychlor 5G (1976). The chemical was spread by hand on top of beds and was slightly incorporated into the soil at the rate of 9.7 pounds a.i./acre at planting (November 1, 1976) and again at 5 pounds a.i./acre 37 days later. The treatment was randomized and replicated six times (50-foot-long beds/two plant rows per bed). The disease incidence in the treated and nontreated plots was evaluated periodically. The crop was harvested March 2, 1977.

The cultivar treated was a 'Calmar' type. Pyroxychlor significantly reduced big vein from 36.4 percent in the nontreated to 12.3 percent in the treated plots. In addition, it improved yield, but this improvement was statistically not significant (fig. 2). The chemical was not phytotoxic to lettuce.

CGA48988 5G (1977). The chemical, at the rate of 14 ounces active ingredient per acre, was spread on top of 50-foot-long lettuce beds and was incorporated about 1/8 inch into the soil before the first irrigation. There were six randomized replications in each field.

All plots were commercially planted, were sprinkler- or furrow-irrigated, and received commercial fertilization, weed control, and other cultural practices. The plots were examined periodically for big vein. The chemical was not phytotoxic to lettuce. No control of big vein disease was observed. Table 1 summarizes the results.

Soil fumigation (1974-75 and 1975-76). Telone C (1,3-dichloropropene and related chlorinated aliphatics 85 percent, chloropicrin 15 percent), at the rate of 20

gallons per acre, was injected on October 21, 1974 12 to 13 inches deep, two shanks per bed. The width of the beds was 40 inches, center to center, and there were two plant rows per bed. Four-bed plots, 1220 feet long each, were treated. The field was planted to lettuce cultivar 'Vanguard' (coated seed) on November 6, 1974. The treatment was replicated four times. Plots of same length were not treated and served as controls. The disease incidence was recorded on February 14, 1975. One bed in each replication was selected at random and the plants on 100 feet were examined for big vein incidence. Only plants with clear big vein symptoms were counted as diseased (table 2, field 1).

Telone C was again tested in 1975-76 in another field. Eight gallons per acre were preplant injected 12 inches deep, one shank per bed. Four-bed plots across the field were treated. The width of the beds was 40 inches, center to center, and there were two rows of plants per bed. The chemical was applied on September 28, 1975. The soil temperature at the time of application (10:30 a.m.), at 9 inches deep, was 28.3° C (83° F). The field, planted to lettuce cultivar 'Calmar,' was first sprinkled on October 2, 1975. The treatments were replicated five times. Three hundred plants per treatment were examined for disease symptoms (table 2, field 2) on December 29, 1975.

Nemagon (1, 2-dibromo-3-chloropropane), at 0.7 gallons plus 4.3 gallons kerosene per acre, was applied as Telone C (table 2, field 2a) in the same field and the same day, September 28, 1975. The treatment was replicated three times. A "spot" on one bed was selected at random and the plants examined. Three hundred plants per treatment were examined on December 29, 1975.

The data show that big vein incidence was high in both fields (table 2). Note that the disease was prominent in this field's sandy to sandy-loam soils. Such soils are normally of low water-holding capacity. The average soil moisture in two of these fields (table 2, fields 2 and 2a) was around 14 percent during lettuce development.

The consistent effect of the soil fumigants tested was that they tended to favor the disease. It was expected that they would either reduce or not affect the disease incidence, as reported by other researchers in northern California. Chemicals may unexpectedly favor an organism or a plant by altering the soil microflora. For instance, an increase of soft rot of crisphead lettuce has been reported to occur after soil fumigation with chloropicrin. The data presented do not justify application of Telone C and Nemagon for control of big vein disease in the Imperial Valley.

Big vein disease and lettuce production

Several fields were examined to estimate the loss because of the disease. In each field an area with big vein was selected, and in each area six beds were selected at random. Fifty consecutive diseased and fifty healthy plants were examined in each bed. The examined plants were checked for head formation five to fifteen days before harvest. Only plants with clear symptoms were counted as diseased. The fields examined were planted to cultivars 'Climax,' 'Calmar,' or 'Winter Haven.' Table 3 summarizes the results.

It was estimated that not more than 10 percent of the diseased plants would be marketable, whereas more than 90 percent of the healthy lettuce would be of marketable size and of good quality. It is obvious that the disease had a dramatic retardation effect upon the development of lettuce.

Conclusion

The data presented show that big vein can reduce yield substantially and that control of the disease through chemicals, resistance, or soil fumigants has not been resolved. Pyroxychlor could be of value in controlling big vein, but unfortunately the chemical has been withdrawn by the manufacturer. It is noteworthy that a systemic fungicide controlled the disease, indicating that big vein can be controlled with chemicals.

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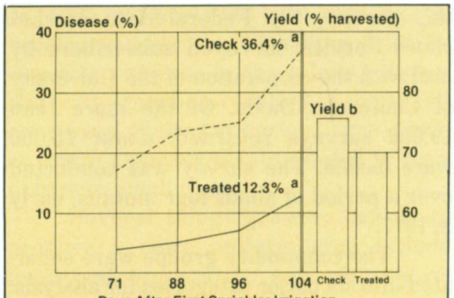
TABLE 1. Big Vein Incidence in CGA48988-Treated and Nontreated Lettuce

Field	Plant population diseased (%)		Date observed
	Treated	Non-treated	
1	45	51	12/20/77
2	59	69	12/21/77
3	59	52	12/21/77
4	23	27	1/13/78
5	9	9	1/18/78
6	44	43	1/25/78

Fig. 2. Big vein disease of lettuce and yield in pyroxychlor-treated and nontreated plots.



a Data statistically significant at 0.1% level in favor of treatment.
b Statistically not different.

TABLE 2. Soil Fumigation and Big Vein Incidence on Lettuce (1974-75 and 1975-76)

Field	Treatment	Plants Examined	Plants Diseased	Percent disease (average of all replications)
1	Telone C	1869	309	16.5a
	Nontreated (check)	1760	148	8.5
Data taken February 14, 1975				
2	Telone C	1500	354	23.6b
	Nontreated (check)	1500	274	18.2
Data taken December 29, 1975				
2a	Nemagon	900	273	30.3b
	Nontreated (check)	900	177	19.6
Data taken December 29, 1975				

aStatistically significant at 1% level.
bNot significantly different.

TABLE 3. Big Vein Disease and Lettuce Development

Field	Date examined	Heads formed out of 300 healthy and 300 diseased plants[a]	
		Diseased[b]	Healthy[c]
1	12/21/77	45	267
2	12/21/77	173	291
3	12/20/77	21	291
4	1/5/78	28	272
		267	1121

aAverage of six replications
bOf plants that formed heads, 22% had diseased heads averaging 0.5-to-3.2-inch diameters.
cOf plants that formed heads, 94% had healthy heads averaging 3.2-to-5.0-inch diameters.