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Mr. Dean C. Storkan
Trical, Inc.
400 Casserly Road
Watsonville, CA 95076

Dear Dean:

I'm happy to write this letter detailing some of the "spin off" benefits, to use the growers' term, derived from preplant soil fumigation of strawberry lands with chloropicrin and/or chloropicrin/methyl bromide mixtures. As you know I've been involved in this development since its beginning in 1948 and for years worked closely with your esteemed father, Dick Storkan. Without your father's engineering skills, the methods of applying the above chemicals both safely and accurately as to dosage would not have advanced beyond the hand injection stage.

Foremost, the soil fumigation, by controlling a wide range of injurious soil borne fungus diseases which destroy strawberry roots, has made it possible for growers to realize the full yield potential of the strawberry plant and then to replant their same lands year after year instead of abandoning them to search for new or virgin lands every time the crop is finished. Virgin lands no longer exist. I clearly remember back in the early 1950's when the yields of around ten tons of strawberries/acre, the second year after planting, (there was no yield the first year) was a distinctly notable achievement. Today, and for the past 30 years, availability of the instant and reliable control of soil borne diseases of the strawberry, which soil fumigation provides, has made first year yields of 25 to 45 tons of berries/acre the consistent and dependable expectation of the growers.

The general practice today, is to terminate the planting immediately after completing the harvest of the first year; this makes the total field life of a strawberry planting somewhat less than 12 months. The impact of this cultural practice on reducing pesticide usage for control of aphids and other insects, mites (especially the two-spotted and cyclamen mites), snails and slugs, root and crown destroying weevils, and of two different leaf spot fungus diseases, has been dramatic. The above are all

disease and pest problems which spread above ground and for which repeated pesticide applications were required to achieve control. I can remember clearly that to control cyclamen mites, from a tablespoon to half a cup of "parathion" dust, an organo-phosphate pesticide was applied by hand to the heart leaves of every strawberry plant of some fields. Also there were times when arsenic containing baits were spread throughout fields with the hope of reducing ravages of snails, slugs and earwigs; and during wet weather, especially early in the season, the fungicides Captan, Benlate and the Coppers were applied regularly to control Ramularia and Dendrophoma leaf spots. The infestations were primarily a carry over from the build up of the leaf spot diseases during the first year of plant growth.

Thus, the systems of annual planting of strawberries made possible by soil fumigation, has inadvertently minimized seriousness of a host of pest problems that migrate into strawberry fields from other fields or from other crops. California produced fruit is free and has been free for years from blemishes due to feeding of snails, slugs, earwigs and from residues of dangerous pesticides. The California Strawberry industry has worked together with a strong determination to consistently produce attractive, perfect fruit, free from blemishes and pesticide residues of any kind. Consistently, the most attractive, largest and blemish free fruit is produced on first year plants. The control of root diseases by soil fumigation has made this first year production possible.

We also now know that without soil fumigation, the recently recognized fruit destroying fungus disease known as Anthracnose survives in the soil and under wet conditions increases rapidly. Chloropicrin readily controls this fungus. By way of diversion, at the 1991 meeting of the North American Strawberry Growers' Association held in St. Petersburg, Florida, we learned that the major chemical bill of around \$1,200./acre was for Anthracnose control alone. During the two, only, months of fruit production, Florida fields typically are routinely sprayed every fourth day and under favorable disease conditions, twice a day. In California, soil fumigation with chloropicrin and the availability of planting stock free of the fungus, has largely brought the disease under control.

An additional soil fumigation benefit is reduced use of commercial, nitrogen containing fertilizers. Applications of 800 pounds per acre of actual nitrogen as commercial fertilizers were pretty standard during the pre-soil-fumigation period. Still the plant growth response was poor. Nitrogen applications were also made by irrigation which was by furrow. It was apparently a fairly common practice in those early days to dump sacks of fertilizer directly in wells and then use the water for irrigation. This practice could have contributed or even been responsible for the present nitrate levels detectable in many of the Pajaro Valley wells.

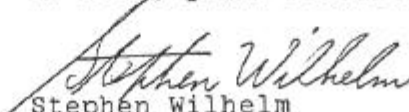
Today, after 35 years of soil fumigation, 160 to 200 pounds of actual nitrogen per acre is probably the maximum annual fertilizer usage. Strawberry root systems since soil fumigation are extensive and massive, and extend several feet deep where subsoil conditions permit. In deep loam soils the main supporting roots have been traced to more than ten feet in depth, thus permitting the strawberry plant root system to mine a large volume and depth of soil.

The "spin off" of soil fumigation benefits extends to lettuce and other growers. Strawberry land that has been fumigated once or many times and correspondingly cropped is in demand by vegetable growers. Those who stand to gain the most are lettuce growers because the fumigation with chloropicrin controls one of the most destructive diseases of lettuce, namely the "big vein disease". The lettuce heads are rendered unsalable by the disease. Lettuce big vein disease is caused by a virus which is resident in the cytoplasm of a very small root infecting fungus known as Olpidium. The Olpidium fungus infects lettuce roots and thus carries the big vein virus into the root tissues. Soil fumigation, even though performed many years before the land is planted to lettuce, controls the big vein disease. Celery growers also vie for land coming out of strawberries.

Today, as for the past more than 30 years, strawberry fields of Pajaro and Salinas Valleys, San Andreas and Oxnard, not to mention Southern California, are a masterpiece of ecology, i.e., of management of the environment to enhance strawberry production. The fields are beautiful throughout their fruiting periods and the land, instead of being abandoned as worn out after each planting cycle, continues year after year to be highly productive. This high productivity of the soil results from controlling soil fungi which kill the small feeder rootlets of strawberries and thus prevent the absorption of nutrients from the soil.

A note in passing, I learned the other day that Japan is the world's largest user of chloropicrin for soil fumigation.

As ever, yours sincerely,


Stephen Wilhelm
Professor Emeritus of
Plant Pathology

SW:bc