SUMMARY OF ALTERNATIVE FUMIGANT TRIALS IN NEW ZEALAND STRAWBERRIES, 1998-2006

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Since 1998, a number of trials have been carried out in New Zealand strawberry gardens, testing various potential soil treatments to replace methyl bromide (MB). This paper summarises the trials where fruit production data were obtained, to give an overall picture of the relative performance of the various treatments.

The fumigants tested have been chloropicrin, Telone®C35, Basamid® (=Dazomet), Fumasol™ (metam sodium), and methyl iodide (50:50 mix with chloropicrin). Mustard oil (Voom) and compost have also been tested in a recent trial. Trials were carried out in replicated blocks, with plot size ranging from 15 to 20 m rows in research orchard trials to 100 m rows in commercial garden trials. MB/chloropicrin 70:30 (pre-2003) or 50:50 (from 2003 onwards), was used as the standard treatment and, where possible, untreated controls were included for comparison. Fumigant rates were generally 500 kg/ha total product unless otherwise stated (see Table 1). Ground preparation and planting followed standard New Zealand practices, with fumigation in late summer/early autumn, and planting in autumn. Fruit was harvested and weighed throughout the main harvest season of October to January (= early to mid summer).

More than half the trials were on HortResearch's Roselea Research Orchard in Hawke's Bay. This site has a silty-clay-loam soil, typical of many New Zealand strawberry gardens. Prior to strawberries, the site had a history of apple culture, and had moderate levels of *Phytophthora cactorum* in the soil. Before the first strawberry planting, this site was deliberately infested with *P. cactorum, P. fragariae* and *Verticillium*, using inoculum prepared on oat grains, strawberry plants and agar cultures, respectively. The purpose was to ensure high and even pathogen presence in the soil, so that the various alternative fumigants could be compared under high disease pressure. For the first four years, the same treatments were re-applied to the same plots each year. In the second year, some plots were split; half the ground was re-treated then replanted, and plants in the other half were retained to crop a second season. This was to test plant longevity with alternative products. Trials were not carried out on most of the Roselea block from 2002 until early 2005. Over this period, a 'fallow strawberry crop' was grown, whereby a strawberry plant/weedy fallow was maintained to ensure survival of various strawberry pathogens and thus high disease pressure in later trials.

Commercial strawberry garden trials were carried out in Auckland and Hawke's Bay, with soils predominantly clay loams or silt loams. These trials were on ground with a history of strawberry culture and methyl bromide treatment. Background disease pressure was generally lower than on the Roselea research block.

In the Roselea research garden, in the four consecutive years of re-application of the same treatments, there was a steady increase in disease and decrease in fruit yield in the untreated control plots (Table 1). This trend was not seen with the various fumigant treatments, although yield in the alternative fumigants generally lagged slightly behind MB. However, the difference was never statistically significant. In later trials (2003 and 2005), root and crown disease levels were very high and fruit production was poor in untreated controls. Again, fruit yield with all the alternative fumigants trialled lagged behind that with MB by varying amounts, though rarely significant statistically. Fumasol (metam) was the poorest of the fumigants in these trials, and mustard oil and compost were little better than untreated controls. Disease assessments (data not presented) mirrored fruit results, with plant health of the alternatives lagging slightly behind MB.

In the Roselea garden trial where plants were left in the ground and cropped for a second season (Table 1, Rose'99 2nd yr), differences between fumigants were exposed. Methyl bromide treated plots continued to crop well in the second season, but all crops with the alternative products lagged well behind.

In the commercial garden trials (Table 2), fruit production with alternative fumigants was generally similar to that with MB. Unfortunately, many of the commercial garden trials did not have untreated controls, so it is difficult to gauge the background disease pressure. There appeared to be very little background disease pressure at Perry's in 1998, 1999 and 2000. A non-treated row included in 2000 showed few plant health problems. Fruit yield in this and alternative fumigant treatments (chloropicrin, Telone C35 and Basamid) was similar to that with methyl bromide in each of these years. In 2001, the third year of continuous treatment of the same plots, there was more disease pressure, and the one alternative fumigant tested in this season (Telone C35) resulted in significantly lower fruit yield than the methyl bromide treatment.

Overall, the alternative fumigants Telone C35, chloropicrin and methyl iodide have performed well, particularly where background disease pressure was low. However, their performance consistently lagged behind MB where disease pressure was higher.

Throughout the research programme, most of the trials have been carried out in good soil conditions. This does not necessarily reflect the conditions growers often face, where frequent late-summer rainfall combined with heavy soils can make soil preparation and fumigation conditions less than optimal. Evidence from other trials and from growers suggests alternative fumigant performance is poor in such conditions. Current trials at Roselea and Auckland gardens are addressing this issue, by carrying out soil preparation and fumigation in soils wetter than ideal, and following up by over-watering plots to simulate disease-conducive conditions.

Table 1. Summary of strawberry yield (fruit weight) data from alternative fumigant trials in the Roselea Research Gardens. Values are percentage difference from the standard MB:chloropicrin 70:30 treatment before 2003, or MB:chloropicrin 50:50 treatment from 2003 onwards. All fumigants applied at 500 kg/ha, unless otherwise stated.

Site, year[a], (years in same plots[b])	Vari -ety[c]	Untreated	MBr/Chl 30:70	Chloro-picrin	Telone C35 5-600 kg/ha	Methyl iodide/ chloro 50:50	Basamid	Fumasol (800 L/ha)	Mustard Oil (500 L/ha)	Compost (12-15 cm)
Roselea '98 (1)	Paj	-16.8*	+0.8	-1.0	-3.6		-8.8	-6.4		
Roselea '99 (2)	Paj	-35.6*	-8.4	-7.8	-4.2		-9.7	-7.8		
Roselea '00 (3)	Paj	-28.7*	-7.4	-1.8	-11.2		-3.1	-5.5		
Roselea '01 (4)	Paj	-76.0*	-19.1	-2.5	-12.7		-5.8	-9.5		
Rose'99 2nd yr[d] (2)	Paj	-74.6*	-27	-39.6	-30.5		-48.9*	-40.8		
Roselea B '00 (1)	Paj	-27.5	+0.6	-7.5	-2.8			-11.6		
Roselea '03 (1)	Paj	-36.4*			+0.5	-2.7				
Roselea '05 (1)	Paj	-67.5*		-16.0	-29.2	-7.1		-44.3*	-58.2*	-47.6*
Roselea '05 (1)	Cam	-62.0*		-8.8	-6.3	-0.4		-44.1*	-50.4*	-59.9*
Roselea '05 (1)	Gav	-62.8*		-14.9	-14.1	-12.9		-43.3*	-44.8*	-47.9*
Average[e]		-45.9	-6.7	-7.5	-9.3	-5.8	-6.9	-21.6	-51.1	-51.8

* an asterisk indicates statistically significant differences ($P<0.05$) from the standard MB/chl treatment for a given trial

[a] planting year

[b] number of years that treatments were applied to the same plots

[c] varieties = Paj = 'Pajaro', Cam = 'Camarosa', Gav = 'Gaviota'

[d] plants retained in treated plots and cropped for a second season, without re-fumigation

[e] average of all Roselea data, excluding the second year crop from the same plants (Rose'99 2nd yr)

Table 2. Summary of strawberry yield (fruit weight) data from alternative fumigant trials in commercial gardens. Values are percentage difference from the standard MB:chloropicrin 70:30 treatment. All fumigants applied at 500 kg/ha, unless otherwise stated.

Site, year[a], (years in same plots[b])	Vari-ety	Untreated	MBr/Chl 30:70	Chloro-picrin	Telone C35 5-600 kg/ha	Basamid
Perry '98 (1)	Paj	-	+1.2	+9.5	+6.2	+2.8
Perry '99 (1)	Paj	-	-	+5.6	+4.3	+0.9
Perry '00 (2)	Paj	+5.2[c]	-	+1.4	+4.2	+4.3
Perry '01 (3)	Paj	-27.3[c]*	-	-	-9.9*	-
Springwood '99 (1)	Paj	-	-	+13.0	+5.7	-
Manning '99[d] (1)	Paj	-	-	-16.6	-38.1*[d]	-
Brittin '00 (1)	Paj	-24.7*	-	-	+7.2	-
Brittin '01 (1)	Paj	-31.4*	-	+2.9	-4.4	-
Average[e]		*-19.6*	*+1.2*	*+2.6*	*+1.9*	*+2.7*

* an asterisk indicates statistically significant differences ($P<0.05$) from the standard MB/chl 70:30 treatment for a given trial

[a] planting year

[b] number of years that treatments were applied to the same plots

[c] based on one untreated row only, and only in years 2 and 3

[d] probable errors with Telone C35 fumigant application at Manning '99, data excluded from average calculations

[e] average of all trials (excluding Manning'99 Telone C35)

Paj = 'Pajaro'