ALTERNATIVE FUMIGANTS FOR STRAWBERRY NURSERY PRODUCTION IN CALIFORNIA: A SUMMARY

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Strawberry mother runner plant production in California starts in low elevation nurseries (LEN) followed by daughter runner plant production in high elevation nurseries (HEN). Daughter runner plants from the HEN are transplanted into fruiting fields for fruit production. The availability of healthy strawberry plants for fruit production is dependent upon nursery production fields that are fumigated with methyl bromide (MB) to ensure that the soil is as pest free as possible. The upcoming phase out of MB makes the task of producing healthy plants more difficult for the strawberry nursery industry. Pre-plant soil fumigation treatments of methyl bromide plus chloropicrin (MBPic) 450 kg ha^{-1}, iodomethane plus Pic (IMPic) 392 kg ha^{-1}, and a nonfumigated control (NF) were evaluated for strawberry (var. Camarosa) runner plant production during two seasons (2000-01 and 2001-02) at a commercial LEN near Ballico, CA and one season (2000) at a commercial HEN near Susanville, CA. Additionally, pre-plant soil treatments with MBPic, IMPic, 1,3-dichloropropene plus Pic mixture (TC35) 300 L ha^{-1} followed by (fb) dazomet (DZ) 280 kg ha^{-1}, Pic 336 kg ha^{-1} fb DZ 280 kg ha^{-1} and NF were evaluated at a commercial HEN near Macdoel, CA (2001 and 2002). Plants produced at the Ballico LEN were transplanted at the Macdoel HEN to measure the effects of soil fumigant history on plant health and runner plant production. Plants produced at the Susanville and Macdoel HENs were evaluated for productivity in commercial fruit production fields at Watsonville during the 2000-01, 2001-02 and 2002-03 seasons and at Oxnard during the 2001-02 and 2002-03 seasons. At Ballico (Fig.) and Susanville, runner plant yield from soil treated with IMPic at 392 to 400 kg ha^{-1} did not differ from that in soil fumigated with MBPic at 450 kg ha^{-1}, and both treatments yielded more plants than NF plots. At Macdoel in 2001 (Table 1) and 2002, runner plant production was similar in plots previously fumigated with either MBPic or alternative fumigants, and all fumigation treatments had higher runner plant production than the NF plots planted with NF plants from Ballico. Evaluations of nursery carryover effects into fruiting fields were conducted at Oxnard and Watsonville, CA in soils previously fumigated with MBPic or Pic. Generally, fruit yields from nursery plants produced on soils fumigated with IMPic, Pic fb DZ or TC35 fb DZ were similar to those from plants produced on MBPic fumigated soils. Fruit yields from nursery plants grown on Pic fumigated fruiting field soils were

comparable, on the average, to fruit yields from plants grown on MBPic fumigated fruiting field soils, however, fruit yields on Pic fumigated soils were more variable (Table 2). Overall, our results indicate that pre-plant soil treatments with IMPic, Pic fb DZ, and TC35 fb DZ are potential alternatives to MBPic fumigation for strawberry runner plant nurseries. The variable, although sometimes superior, performance of Pic in fruiting fields relative to MBPic, indicates that additional research is needed to optimize its use for fruiting fields.

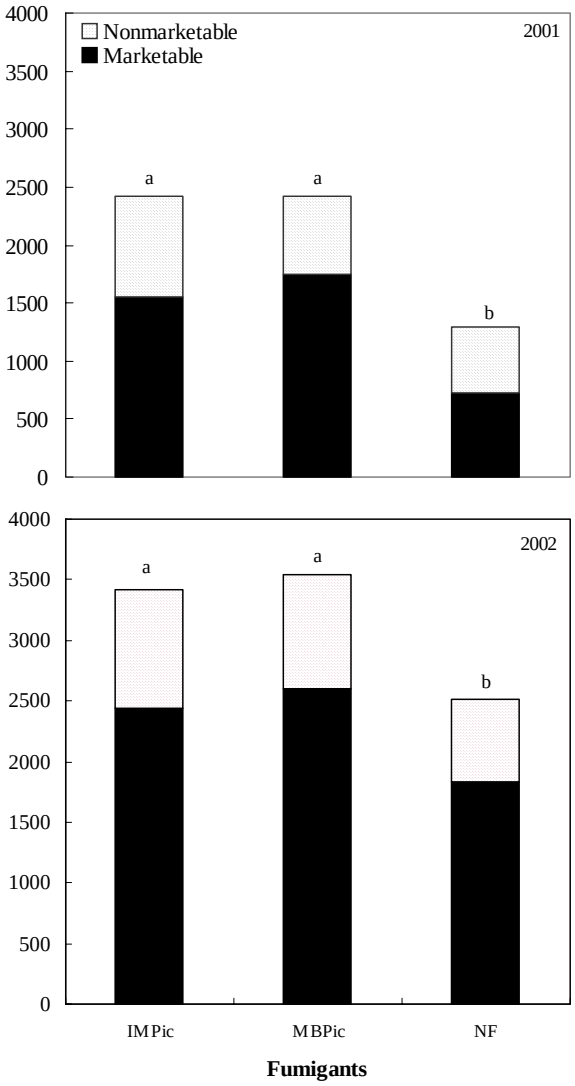

Fig. Number of marketable and nonmarketable runner plants harvested from the low elevation nursery in Ballico, CA both in 2001 and 2002. Plots were fumigated with IMPic, MBPic or non fumigated control (NF). Different letters on the bars indicate significant differences in total numbers of plants (LSD P=0.05).

Table 1. Mean strawberry runner plant production at Macdoel in 2001. The effects of Macdoel (2001) fumigants and the carryover effects of Ballico fumigants (2000) on runner plant production compared with the MBPic-to-MBPic standard.

Ballico[1]	Macdoel	Marketable	Total
		--------number of runner plants ha^{-1}---------	
	Contrast single treatments vs. MBPic-to-MBPic standard		
MBPic[2]	**MBPic**	**1,235,118**	**2,167,507**
MBPic	NF	939,785 (0.01)[4]	1,643,848 (0.01)
MBPic	IMPic	1,128,177 (0.29)	1,965,697 (0.25)
MBPic	Pic fb DZ	1,191,858 (0.67)	2,111,364 (0.78)
MBPic	TC35 fb DZ	1,149,026 (0.43)	2,175,698 (0.97)
IMPic	MBPic	1,243,633 (0.93)	2,244,404 (0.70)
IMPic	NF	928,767 (0.01)	1,616,381 (0.01)
IMPic	IMPic	1,322,546 (0.39)	2,337,585 (0.40)
IMPic	Pic fb DZ	1,127,556 (0.29)	2,120,724 (0.81)
IMPic	TC35 fb DZ	1,077,743 (0.39)	1,907,503 (0.20)
NF	MBPic	1,071,225 (0.11)	1,904,244 (0.19)
NF	NF	769,620 (0.01)	1,512,505 (0.01)
NF	IMPic	1,154,092 (0.42)	1,930,315 (0.21)
NF	Pic fb DZ	1,173,800 (0.54)	1,917,590 (0.95)
NF	TC35 fb DZ	1,124,608 (0.27)	2,060,979 (0.59)

Anova[3]	----------P values----------	
Ballico	0.09	0.03
Macdoel	<0.01	<0.01
Ballico(Mac)	0.21	0.21

[1]Ballico column indicates the fumigant used for runner plant production at the low elevation nursery in 2000 and the Macdoel column indicates the fumigant at the high elevation nursery for 2001.

[2]Abbreviations: MBPic, methyl bromide plus chloropicrin, IMPic, iodomethane plus chloropicrin, Pic fb DZ, chloropicrin followed by dazomet, TC35 fb DZ, Telone C35 followed by dazomet, NF, nonfumigated control.

[3]Analysis indicates the main effects of Macdoel treatments and the carryover effects of the Ballico treatments. The Macdoel nursery experiment was nested within Ballico experiment.

[4]P value of single degree of freedom contrasts compared to strawberry runner plant production with the MBPic-to-MBPic standard from Ballico nursery-to-Macdoel nursery.

Table 2. Strawberry fruit yields at Watsonville in 2001-02.

Macdoel[1]	Watsonville	Marketable	Total
		----------grams plant^{-1}----------	
	Contrast single treatments vs. MBPic-to-MBPic standard		
MBPic[2]	**MBPic**	**1474.0**	**2070.3**
NF	MBPic	1520.3 (0.53)[4]	2120.4 (0.60)
IMPic	MBPic	1526.8 (0.47)	2151.8 (0.40)
Pic fb DZ	MBPic	1634.5 (0.03)	2275.1 (0.03)
TC35 fb DZ	MBPic	1434.1 (0.59)	2068.1 (0.98)
MBPic	Pic	1235.8 (0.01)	1786.6 (0.01)
NF	Pic	1301.7 (0.02)	1837.3 (0.02)
IMPic	Pic	1278.2 (0.01)	1803.3 (0.01)
Pic fb DZ	Pic	1388.4 (0.24)	1963.4 (0.27)
TC35 fb DZ	Pic	1346.4 (0.08)	1899.7 (0.08)

Anova[3]	----------P value----------	
Macdoel	0.04	0.07
Watsonville	<0.01	<0.01
Macdoel(Watson)	0.47	0.73

[1]Macdoel column indicates the fumigant used for runner plant production at the high elevation nursery in 2001 and the Watsonville column indicates the fumigant at the fruiting field for 2002.
[2]Abbreviations: same as Table 2 with additional abbreviation Pic, chloropicrin.
[3]Analysis indicates the main effects of Watsonville treatments and the carryover effects of the Macdoel treatments. The Watsonville fruiting field experiment was nested within Macdoel nursery experiment.
[4]P value of single degree of freedom contrasts comparing strawberry fruit yield with the MBPic-to-MBPic standard from Macdoel nursery-to-Watsonville fruiting field.