STRAWBERRY NURSERY SOIL FUMIGATION AND RUNNER TRANSPLANT FRUIT PRODUCTION

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California has the world's largest strawberry plant propagation industry, with annual production of about one billion runner plants (transplants) that are sold worldwide. To ensure production of high-quality, disease-free transplants, the California Strawberry Certification Program requires that meristem plants be clonally propagated by means of runners (daughter plants) during a 4-5 year period following prescribed standards of cleanliness and isolation (Table 1). As a single meristem plant can produce as many as 90,000,000 daughter plants in five years, the introduction of plant pathogens in any step of the propagation cycle can result in large-scale epidemics. Currently, California strawberry nurseries rely on preplant soil fumigation with mixtures of methyl bromide (MB) and chloropicrin (CP) to control soilborne pathogens as well as weeds and competitive microbes. The impending ban on the production and use of MB requires that studies be conducted to quantify the effectiveness of alternative soil fumigants when used throughout the strawberry propagation cycle, from low elevation nurseries in the San Joaquin Valley, to high-elevation nurseries on the California-Oregon border, and finally to the fruiting fields in the coastal areas of California where 89% of the U.S strawberry crop is produced.

A previous report demonstrated enhanced nursery runner productivity with use of MB+CP compared to alternative materials (Larson, K.D. and D.V. Shaw, 2000. HortScience 35: 642-646). The current report presents information from three two-year studies in which runner plants propagated in high elevation nurseries treated with MB+CP or various alternative treatments were transplanted to coastal fruiting fields also treated with MB+CP and various alternative soil treatments. For these studies, yield performance was determined as a function of high elevation nursery soil treatment as well as fruiting field soil treatment.

The current report also includes information obtained from a four-year study in which runner plants were serially propagated during a three-year period in both low- and high-elevation nurseries using MB+CP and various alternative soil treatments before being planted in coastal fruiting fields where fruit yield performance was quantified as a function of the various nursery soil treatments as well as fruiting field soil treatments. In year one (Y1) of this trial, two strawberry cultivars were vegetatively propagated in plots treated with either MB+CP, CP or no fumigation (NF) in a low elevation nursery. In Y2, runner plants of both cultivars produced in Y1 were again propagated in a low-elevation nursery using identical soil treatments (i.e., plants propagated with NF in Y1 were propagated with NF in Y2, etc., etc,). Also in Y2, runner plants produced using the three soil treatments in Y1 were propagated in each of six different soil fumigation regimes (MB+CP, two rates of CP, two rates of CP + Telone, and NF) in a high-elevation nursery (i.e., runner plants produced with NF in Y1 were propagated in each of the six high-elevation soil treatments). In Y3, runner plants produced at low-elevation using the three soil treatments in Y2 were propagated in each of six soil fumigation regimes (MB+CP, two rates of CP, two rates of CP + Telone, and NF) in a high-elevation nursery. Also in Y3, runner plants produced at high elevation nursery in Y2 were transplanted to fruiting fields in Irvine and Watsonville, California. These runner transplants derived from 18 different soil treatment regimes (3 low elevation soil treatments X 6 high elevation soil treatments). Yield performance was recorded weekly or 2X-weekly in both Irvine and Watsonville during a 6-month fruiting season. In Y4, runner plants produced at high elevation nursery in Y3 were transplanted to fruiting fields in Irvine and Watsonville, California. These runner transplants again derived from 18 different soil treatment regimes (3 low elevation soil treatments X 6 high elevation soil treatments), but here the transplants had been produced using a specific low elevation soil treatment in each of two years. Yield performance was recorded weekly or 2X-weekly in both Irvine and Watsonville during a 6-month fruiting season.

Results for analysis of variance indicate highly significant effects ($P \leq 0.01$) of both low- and high-elevation nursery soil treatment, as well as highly significant effects of fruiting field soil treatment on fruit production; overall, yield obtained with any alternative was inferior to that of MB+CP. As nursery and fruiting field yield reductions are additive, yield reductions due to the loss of MB+CP in nurseries and fruiting fields are expected to be highly significant.

Table 1. California Strawberry Certification Program nursery propagation system

Year	Propagation phase	Increase ratio
1	meristem plant	1
2	first runner generation (screenhouse)	200:1
3	foundation block (isolated field location)	150:1
4	low-elevation increase (field location)	100:1
5	high-elevation increase (field location)	30:1

Table 2. Results for ANOVA for low- and high-elevation nursery and fruiting field soil treatments on fruit production in Irvine and Watsonville, CA in 1996.

	Irvine		Watsonville	
Source	df	MS	df	MS
Low elev (L)	2	12281	2	204
High elev (H)	2	373224**	2	130732**
Fruiting field (F)	3	5783341**	3	1765503**
L X H	4	1408	8	27088
L X F	6	3326	6	6396
H X F	6	6900	12	19823
L X H X F	12	2481	24	18857

** indicates highly significant effect of soil treatment on fruit yield ($P \leq 0.01$).