Industry Wide Assessments of Methyl Bromide Alternatives in Florida Strawberry.

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The Sting nematode, *Belonolaimus longicaudatus*, is a major yield limiting pest of Florida strawberry. Soil applied broad spectrum fumigants like methyl bromide have been extensively used in most commercial strawberry fields for pest control and crop production. Even with fumigant treatment however, significant yield losses frequently occur due to suboptimal environmental conditions at the time of treatment which degrade fumigant movement, persistence, and efficacy. With Sting nematode, any loss of nematode control typically results in a higher incidence of plant stunting. Plant stunting and yield losses are generally very well correlated with initial soil population density of the nematode. A significant amount of field research is currently focusing on characterizing field distributions of the nematode with incidence maps characterizing counts of different strawberry plant sizes in the field. Previous research has demonstrated that both end of season plant size assessment and of fruit stem counts per plant provide a chronological record of total fruit picked from the plant during the season and for estimating relative differences in fruit yield between plants of different canopy dimension. The over arching goals of the studies reported herein were 1) to compare large plot yields with relative yield assessments from characterization of plants sizes with plots; and 2) to evaluate and compare plant size distributions (canopy diameter) and estimates of relative yield in commercial strawberry fields as meaningful indicators of strawberry yield within large scale field blocks differentially treated with methyl bromide alternative treatments.

Methods: For objective one, a commercial strawberry field in Dover, Fl was selected in 2008 to evaluate single preplant applications of methyl bromide chloropicrin and various alternative fumigants for their resultant impacts on strawberry yield. In this field, strawberry plants were arranged in staggered double rows per bed, with plants 12 inches apart across the plant bed and spaced 14 to 15 inches apart along the row. Strawberry fruit were harvested on 2 to 3 day intervals season long from 48 individual plots, each plot representing 436 plants and 240 linear feet of plant row. At the end of the strawberry harvest season in March 2009, plant size distribution were determined by walk survey, counting the number of small, medium, and large plants per plot. At each site, plant stand density was also determined to account for any dead or missing plants within each plot. To characterize plant sizes, a long T-handled measuring stick (an 18” ruler bolted to the end of a 1 inch PVC pipe) was used to measure plant

canopy diameter in both within and between row directions. Based upon canopy diameter, plants were enumerated into three plant canopy diameter categories, including small (<6 inches), medium (>6 and < 12 inches) and large (>12 inches) plant sizes. Relative strawberry yield within each plot was then estimated from the cumulative plant count data from the three plant size categories. Using the plant count data, strawberry fruit yields, relative to large plants were calculated according to the following relationship: Small =17%; Medium = 48%; and Large = 100%. The relationship between actual strawberry yield (lb/plot) provided by grower cooperator and relative yield, cumulatively estimated from plant size distributions and divided by highest yield potential of having all large plants within plots, was then examined using the regression procedure of Minitab (Minitab Inc.,State College, PA).

Objective 2 of the studies reported herein were to evaluate the performance of methyl bromide alternative chemicals in over 60 commercial field locations. Fumigants evaluated include individual and or combined use of methyl bromide, chloropicrin, 1, 3-dichloropropene, metam sodium, and methyl iodide. A diversity of drip fumigants were also evaluated for relative strawberry yield determinations based on yield potentials extrapolated from end of season plant size distributions within each field. Plant size categories included small (<15 cm), medium (>15 cm and < 30 cm) and large (>30 cm) plants. In each surveyed field, plant sizes were enumerated in at least 42 randomly selected 15 m sections of row in each commercial field location. Each surveyed field was well-recognized for history of recurring problems with the sting nematode, *Belonolaimus longicaudatus*. Previous research demonstrated unique, but well correlated relative yield relationships with plant sizes. For these field surveys, an average relative yield based on plant size category were averaged and differences in relative strawberry yield between size categories were as follows: small 17%, medium 48.4. and large 100% of potential strawberry yield. Given typical levels of plant attrition during the course of the season (3-5%), relative yield field evaluated in the surveyed fields never achieved 100 percent.

Results and Discussion: The relationship between observed (lb/plot) and relative strawberry yield was well described by linear function (**Figure 1**). At the Dover yield site, where individual harvest plots consisted of 436 plants, 82% of the variability in observed fruit yield was explained by overall changes in the number of plants per plot within the three plant size categories (ie., overall changes in plant canopy diameter). These data suggest that a reasonable close fit between observed and predicted yield can be achieved in fields where nematode damage is expressed and large numbers of plants can be enumerated into the three plant size categories.

Meaningful differences in plant size distribution and of relative yield were

observed between various alternative to methyl bromide chemical treatments. In general, fields receiving no fumigant treatment were the most variable and produced relative strawberry yields which were over 50% lower than that observed with methyl bromide chloropicrin. Drip applied Telone Inline produced the highest relative yields compared to methyl bromide chloropicrin treated fields. Due in general to higher incidence and severity of Sting nematode stunting of plants, relative strawberry yield was observed to decrease with field application rate of chloropicrin. Overall, field scale changes in strawberry crop productivity due to sting nematode and chemical treatment can be meaningfully determined, on a farm by farm basis, from post harvest assessments of counts of different plant sizes.

KEY POINTS:

- Relative yield determination is a simple process conducting within a few days of seasons end.

- Functionally, relative yield estimates easily derived from well correlated variables characterizing distributions of plant sizes within the field.

- Strawberry yields ascertained from commercially harvested small plots were well correlated with relative yield values determined as a cumulative sum of relative yield contributions from plants of different sizes within the small plots.

- Nematode induced crop losses on a field scale can be easily and economically derived from simple end of season plant size assessments rather than by hand harvesting over a 12 to 15 week harvest period.

- These data would suggest that the impacts of various chemical and soil fumigant treatments can also be meaningfully determined, on a farm by farm basis, from post harvest assessments of counts of different plant sizes.

Table 1. Relationship between relative strawberry yield, functionally determined from a cumulative sum of individual contributions from the number of small (≤8"), medium (>8"and ≤ 12") and large (>12") size plants within replicate plots of 300 linear feet of plant row compared with actual yield (lb/300 ft) determine from commercial harvest of 48 individual 300 ft plots at the Florida Strawberry Research and Education Farm, Dover, FL. 2008-09.

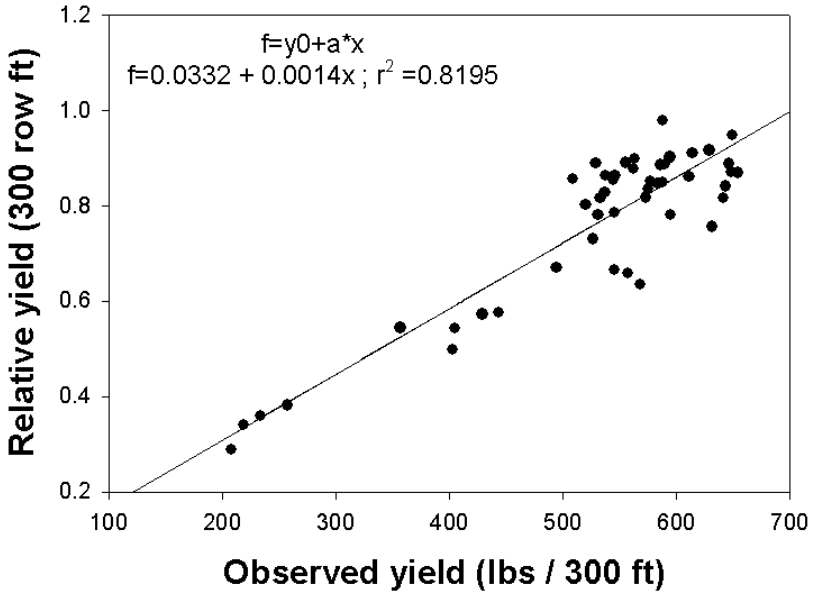


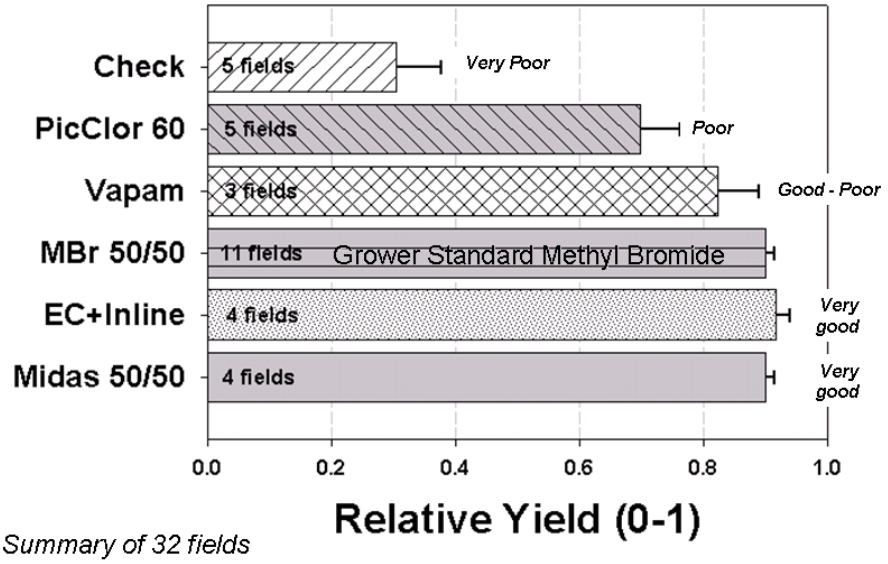
Table 1. Summary of relative strawberry yield and percentage differences in plant size distributions among various large scale grower field demonstration trials conducted in Dover, Fl during the 2008 – 2009 strawberry production season. Overall crop performance within differentially treated plots is characterized as relative strawberry yield, functionally determined as a cumulative sum of individual contributions from averages of the number of small (≤8"), medium (>8"and ≤ 12") and large (>12") size plants within replicate plots of 48 to 50 feet of plant row.

	Field Location	Treatment	Number Replicate Plots	Relative Yield	% Small Plants	%Medium Plants	% Large Plants
1	location	trmt	obs	relyld.	%small	%medium	%large
2	T_Alexanc	MBr	88	0.8646	0.03625	0.17506	0.7737
3	T.Alexand	chisel	64	0.92684	0.003362	0.10028	0.87777
4	T.Alexand	nochisel	64	0.91344	0.00732	0.13865	0.8451
5	TimBlake-	Inline	48	0.92488	0.00547	0.1281	0.862
6	TimBlake-	Inline	48	0.93854	0.00643	0.08976	0.89403
7	Blanco	MBr	80	0.8567	0.0588	0.1548	0.7719
8	M_Brown		72	0.85352	0.02508	0.21238	0.7465
9	Chancey	chisel	40	0.97656	0.001804	0.03351	0.96005
10	Chancey	nochisel	50	0.97912	0.000825	0.02474	0.96701
11	M.Council	PicClor 60	84	0.8708	0.01689	0.2172	0.7629
12	M.Council	Midas50/5	60	0.91658	0.00736	0.1355	0.8498
13	M.Council	Midas98/2	48	0.91264	0.01042	0.1328	0.8467
14	M.Council	MBr50/50	69	0.89618	0.01736	0.1555	0.818
15	Duke_Farm		80	0.7632	0.05887	0.3452	0.5863
16	FL_Pacific	Dazitol	124	0.84051	0.05829	0.17634	0.7453
17	FL_Pacific-W		124	0.86044	0.02988	0.18909	0.7639
18	RonGoodson-1		72	0.86811	0.03019	0.1972	0.7676
19	RonGoodson-2		56	0.85952	0.02087	0.2349	0.7423
20	RonGoods	EC+Inline	48	0.95464	0.0058	0.077	0.9164
21	RonGoods	EC+Inline	48	0.96943	0.003165	0.03982	0.94963
22	RussellGo	Telone EC	52	0.88973	0.01901	0.15778	0.71919
23	RussellGo	EC+Inline	64	0.93318	0.01213	0.10752	0.87911
24	Green		56	0.89142	0.01692	0.1781	0.8024

	Field Location	Treatment	Number Replicate Plots	Relative Yield	% Small Plants	%Medium Plants	% Large Plants
25	C_Grooms	MBr	60	0.93519	0.00608	0.11164	0.88016
26	C_Grooms	Midas	48	0.94267	0.00562	0.09623	0.89517
27	C_Grooms	Paladin	48	0.94045	0.00397	0.10384	0.88955
28	C_Grooms	MBr	36	0.92894	0.001792	0.1313	0.8651
29	C_Grooms	Vapam	48	0.92592	0.00907	0.11458	0.86895
30	P.Haire-N	Vapam	56	0.846	0.02701	0.2393	0.7257
31	P.Haire-S	Vapam	54	0.6951	0.1287	0.3644	0.497
32	EddieMercer-1		50	0.8614	0.03646	0.2005	0.7582
33	EddieMercer-2		48	0.84996	0.02123	0.17183	0.5528
34	Peacock-1		56	0.3343	0.4783	0.4156	0.052
35	Peacock-2		48	0.559	0.2711	0.389	0.3248
36	Peacock-3		48	0.28839	0.556	0.3451	0.02708
37	Sapp-1	PicClor 60	48	0.5626	0.2498	0.2646	0.3922
38	Sapp-2	PicClor 60	48	0.84784	0.03501	0.1993	0.7455
39	Sapp-3	PicClor 60	48	0.8549	0.0636	0.1631	0.7652
40	Skeeter-1	none	108	0.734	0.0877	0.3292	0.5598
41	Skeeter-2	none	50	0.20346	0.2945	0.2635	0.026
42	Skeeter-3	Telone	90	0.13698	0.4574	0.1226	0
43	Stickles-C	Inline	56	0.86938	0.02102	0.2104	0.764
44	Stickles-C	Inline	56	0.87435	0.02057	0.2055	0.7715
45	Stickles-Charlie	Taylc	64	0.85978	0.03343	0.2079	0.7536
46	Stickles-MooreLake-		48	0.87008	0.03286	0.19631	0.7695
47	Stickles-MooreLake-		48	0.87529	0.02298	0.2021	0.77363
48	Stickles-MooreLake-		48	0.90401	0.01313	0.15917	0.82479

* ***Each observation represents plant size distributions (no. of s,m,l,dead) within 48-50 feet of plant row***

Figure 2. Summary and comparison of relative strawberry yield among various large scale grower field demonstration trials and fumigant treatments conducted in Dover, Fl during the 2008 – 2009 strawberry production season. Relative yield is a defined as cumulative differences in plant sizes as indirect measures individual plant contributions to relative strawberry yield. All field sites used for treatment comparison below are Sting nematode (*Belonolaimus longicaudatus*) infested fields with long histories of reoccurring problems. General performance evaluations of the different fumigant treatments are compared to the performance of the methyl bromide standard.



Summary of 32 fields

Figure 3. Example of how relative strawberry yield methodology (differences in plant sizing caused by nematode induced stunting of strawberry plants within treated areas) is being used to provide Florida Strawberry growers with quantitative measures of treatment differences among different Methyl bromide alternative treatment within nematode infested commercial fields.