An Overview of Methyl Bromide Alternative Research on the Central Coast of California

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ZOOM Virtual 2/15/2022

The Direction We are Headed: Integrated Pest Management of Soil Pathogens

Introduction

- Continuing tests of alternative fumigants.
- Use of crop termination for cultivation in *Fusarium* infested soils.
- Addition of amendments to enhance effect of fumigation.
- Continual testing and understanding of biological controls.
- Plant resistance

Various pathogens in California soils

- *Verticillium*
- *Phytophtora*
- *Macrophomina*
- *Fusarium*

Fusarium oxysporum form species *fragariae*

Foto por Steve Koike

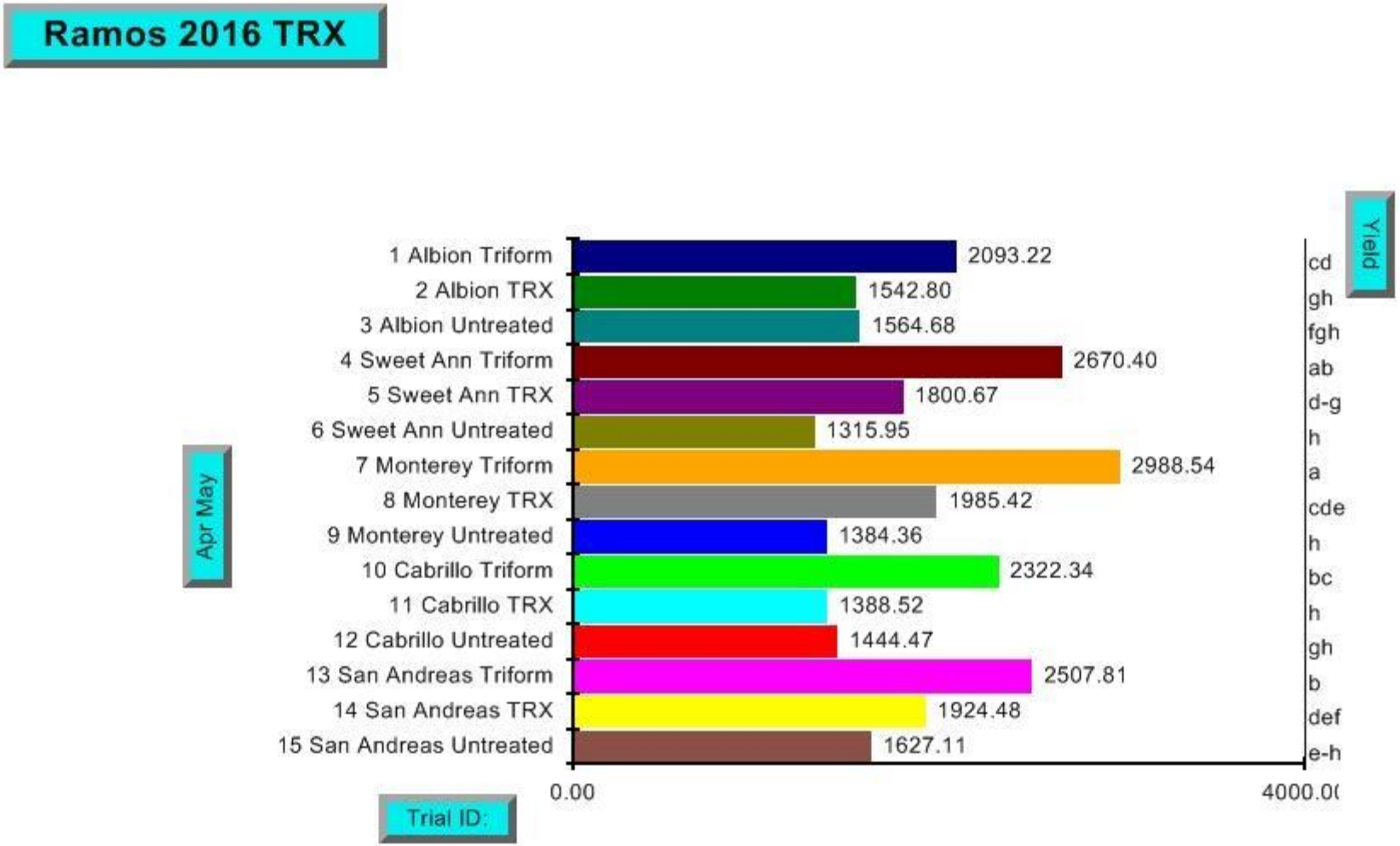
Exploring alternative fumigants

TRX58

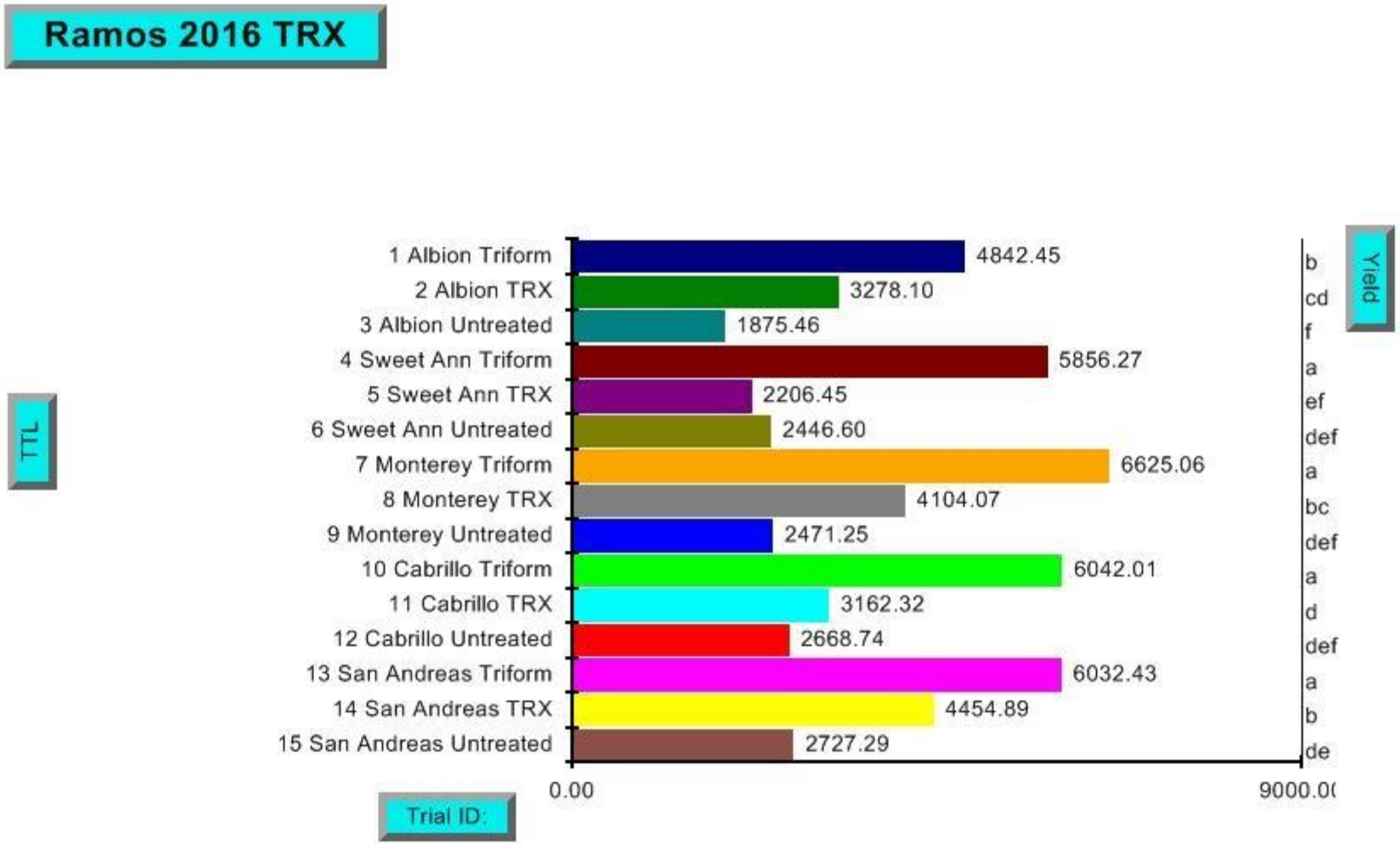
TRX58 trial

- Test material TRX58 (550 #/A) compared to Triform 80 (34 gal/A) and untreated check done in field heavily infested with *Fusarium*.
- Flat fumigation, followed by planting of 5 varieties (Cabrillo, Albion, Monterey, Sweet Ann and San Andreas).

April & May


Ramos 2016 TRX
Apr May
1 Albion Triform
2 Albion TRX
3 Albion Untreated
4 Sweet Ann Triform
5 Sweet Ann TRX
6 Sweet Ann Untreated
7 Monterey Triform
8 Monterey TRX
9 Monterey Untreated
10 Cabrillo Triform
11 Cabrillo TRX
12 Cabrillo Untreated
13 San Andreas Triform
14 San Andreas TRX
15 San Andreas Untreated
2093.22
1542.80
1564.68
2670.40
1800.67
1315.95
2988.54
1985.42
1384.36
2322.34
1388.52
1444.47
2507.81
1924.48
1627.11
Yield
cd
gh
fgh
ab
d-g
h
a
cde
h
bc
h
gh
b
def
e-h
0.00
4000.0(
Trial ID:

Yield totals



Conclusion

- Fumigation with weak fumigant is better than doing nothing.
- Variety tolerance DOES NOT maintain full yield, and performance IS enhanced by the use of a fumigant.

Crop Termination

Fumigation and Crop Termination 2019-2020 Fumigation Efficacy Trial

Peter Henry, USDA Salinas

Mark Bolda, UCCE Santa Cruz County

Introduction

1- Is it worth it to fumigate when using resistant plants?

2- What's the general efficacy of crop termination with KPAM or Dominus?

3- How about if we combine a crop termination with chloropicrin?

Treatments, Dates and Rates

- KPAM (CT) 9/28/19 20 gal per acre
- Dominus 9/28/19 20 gal per acre
- Tri Clor 80 10/12/19 350# per acre
- KPAM (drip) 10/19/19 47 gal per acre

- CT = crop termination

Applications

- Dominus CT
- KPAM CT then KPAM drip
- KPAM CT then Tri Clor 80
- KPAM CT
- Tri Clor 80
- Untreated

Varieties Included

- San Andreas (Fusarium resistant)
- Monterey (Fusarium susceptible)
- Fronteras (Fusarium resistant)

Fronteras

in 8 lb boxes per acre

Treatment	April	First Half	Second Half	Ttl thru Aug
Dominus CT	478 a	5208 a	1534 a	7413 a
KPAM CT then KPAM drip	478 a	4848 a	1609 a	6456 a
KPAM CT then Tri Clor 80	491 a	5548 a	1878 a	7423 a
KPAM CT	459 a	5096 a	1758 a	6852 a
Tri Clor 80	551 a	5314 a	1526 a	6840 a
Untreated	363 a	2841 b	696 b	3538 b

Means followed by the same letter do not significantly differ P = 0.05, LSD

Monterey

in 8 lb boxes per acre

Treatment	April	First Half	Second Half	Ttl thru Aug
Dominus CT	486 a	3689 a	271 b	4011 b
KPAM CT then KPAM drip	595 a	3759 a	193 b	3968 b
KPAM CT then Tri Clor 80	388 a	4715 a	3261 a	7988 a
KPAM CT	529 a	3674 a	176 b	3874 b
Tri Clor 80	479 a	4511 a	1741 a	6479 a
Untreated	474 a	2744 c	129 b	3095 b

Tri Clor 80

CT then Tri Clor

San Andreas

in 8 lb boxes per acre

Treatment	April	First Half	Second Half	Ttl thru Aug
Dominus CT	280 ab	4418 a	3269 a	7686 a
KPAM CT then KPAM drip	322 a	4529 a	3261 a	7791 a
KPAM CT then Tri Clor 80	154 c	4271 a	3835 a	8106 a
KPAM CT	273 ab	4413 a	3188 a	7601 a
Tri Clor 80	179 bc	4238 a	3105 a	7343 a
Untreated	334 a	3416 b	1168 b	4585 b

Conclusion- Fumigation

- **Yes**, it is worth it to fumigate even when using plants resistant to *Fusarium oxysporum* f. sp. *fragaria*.
- Crop termination works to improve yields in resistant varieties through the season, and in the first half of the season in susceptible varieties.
- Crop termination very much look like it enhances chloropicrin efficacy in susceptible varieties.

Fumigant comparison including mustard seed meal (MSM)

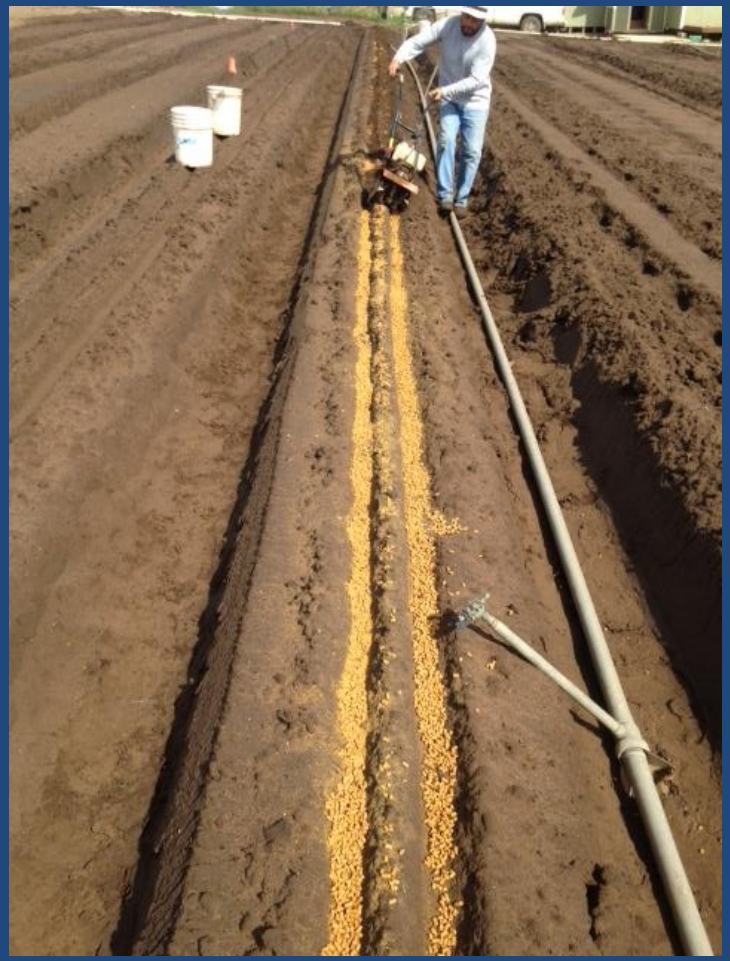
- Is mustard seed beneficial to strawberry when used in combination with alternative fumigants?

Treatment Plan

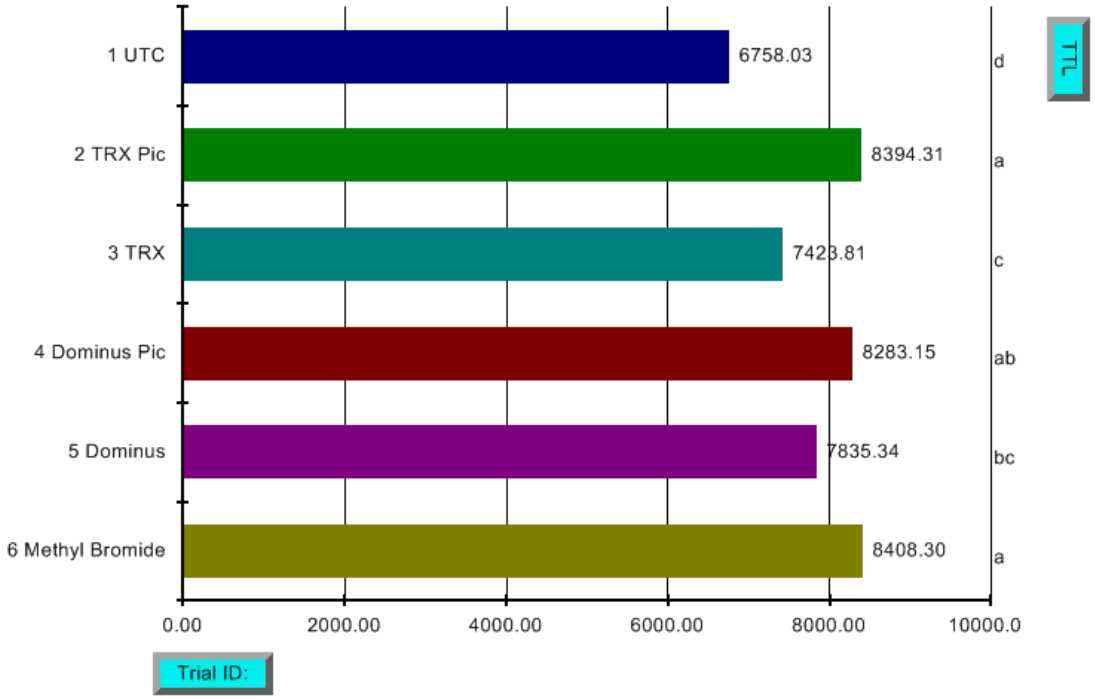
- 6 fumigation treatments (including untreated control).

Mustard Seed Meal

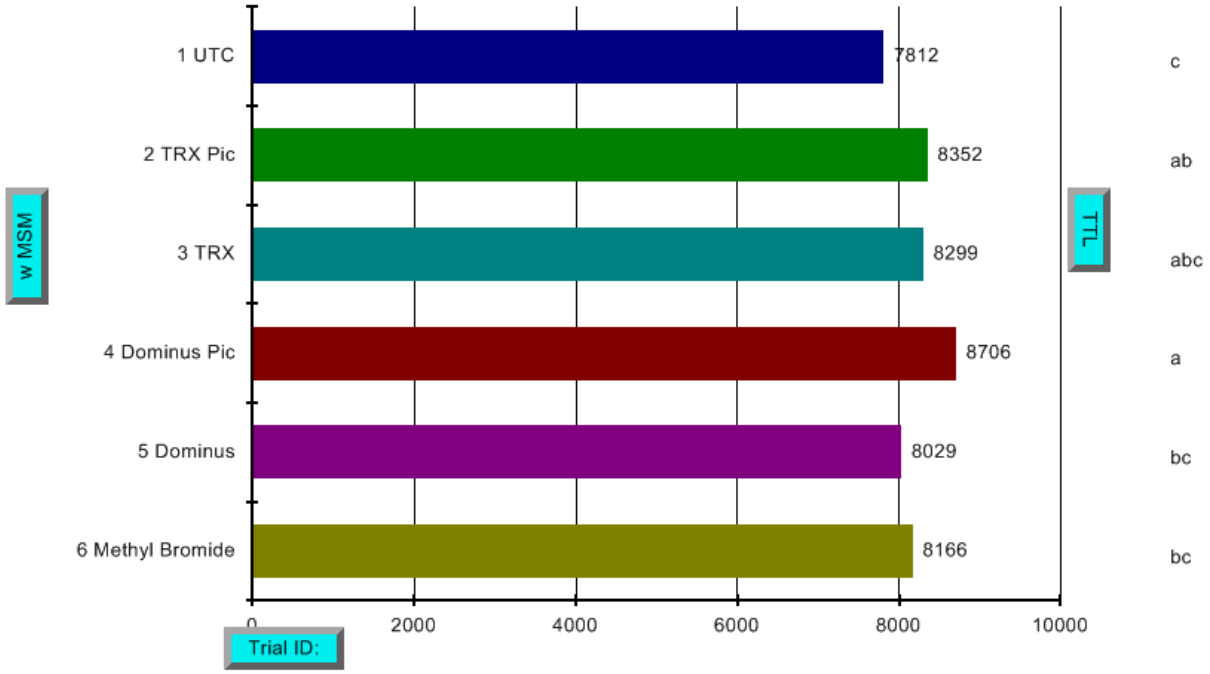
- 1 ton per acre



Straight comparison of fumigants without MSM

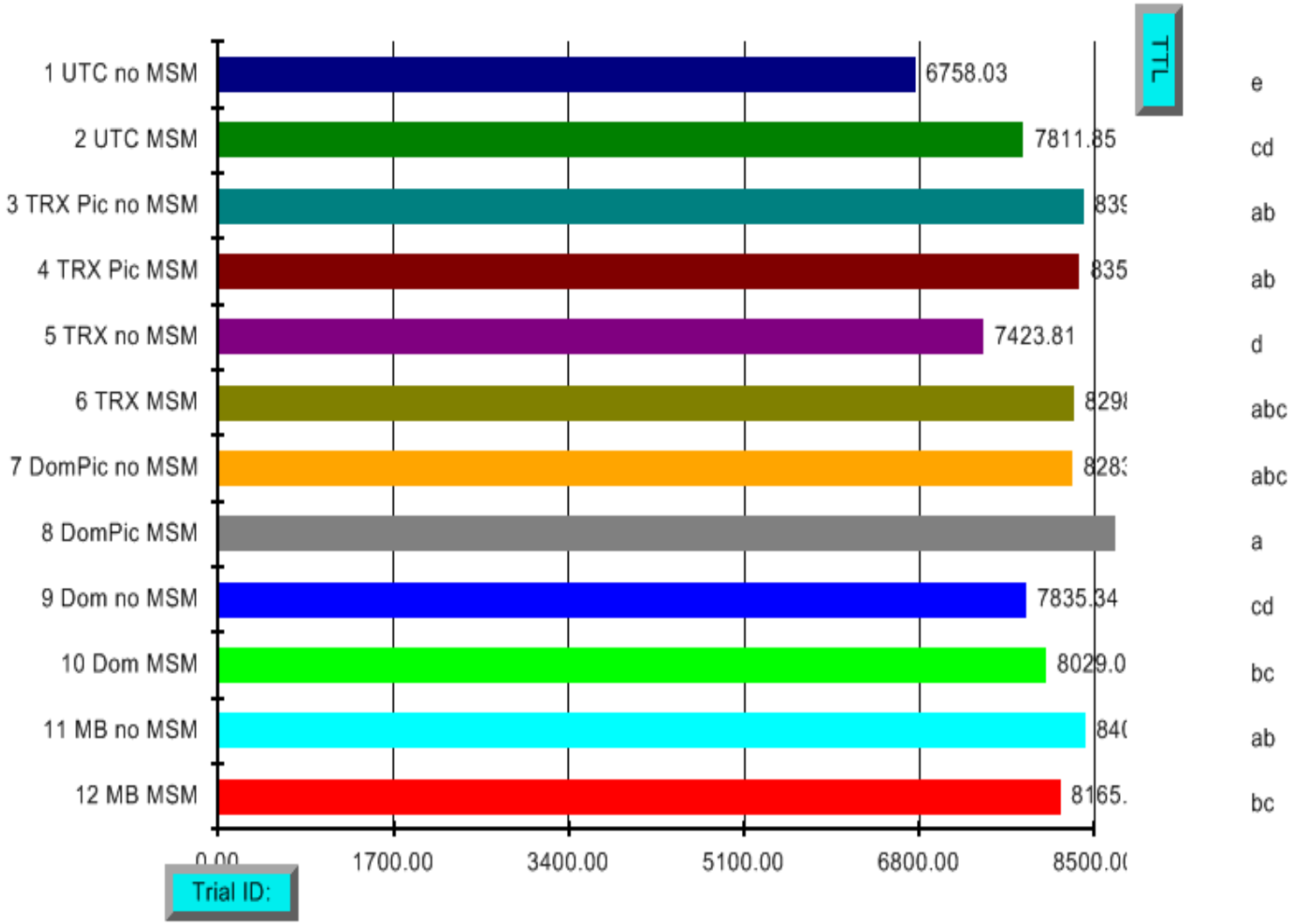


Straight comparison of fumigants with MSM



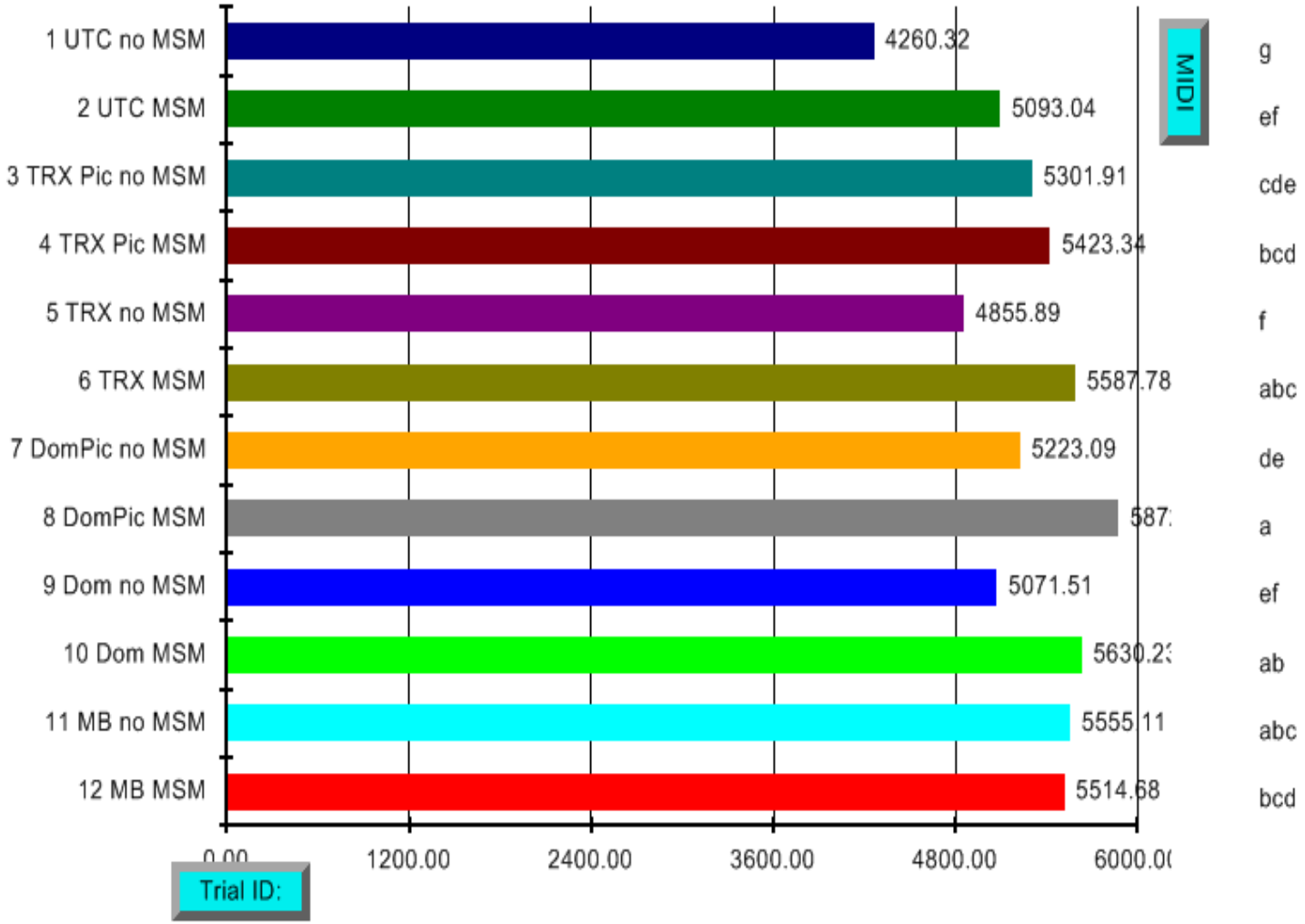
MSM - no MSM 2015 CBC

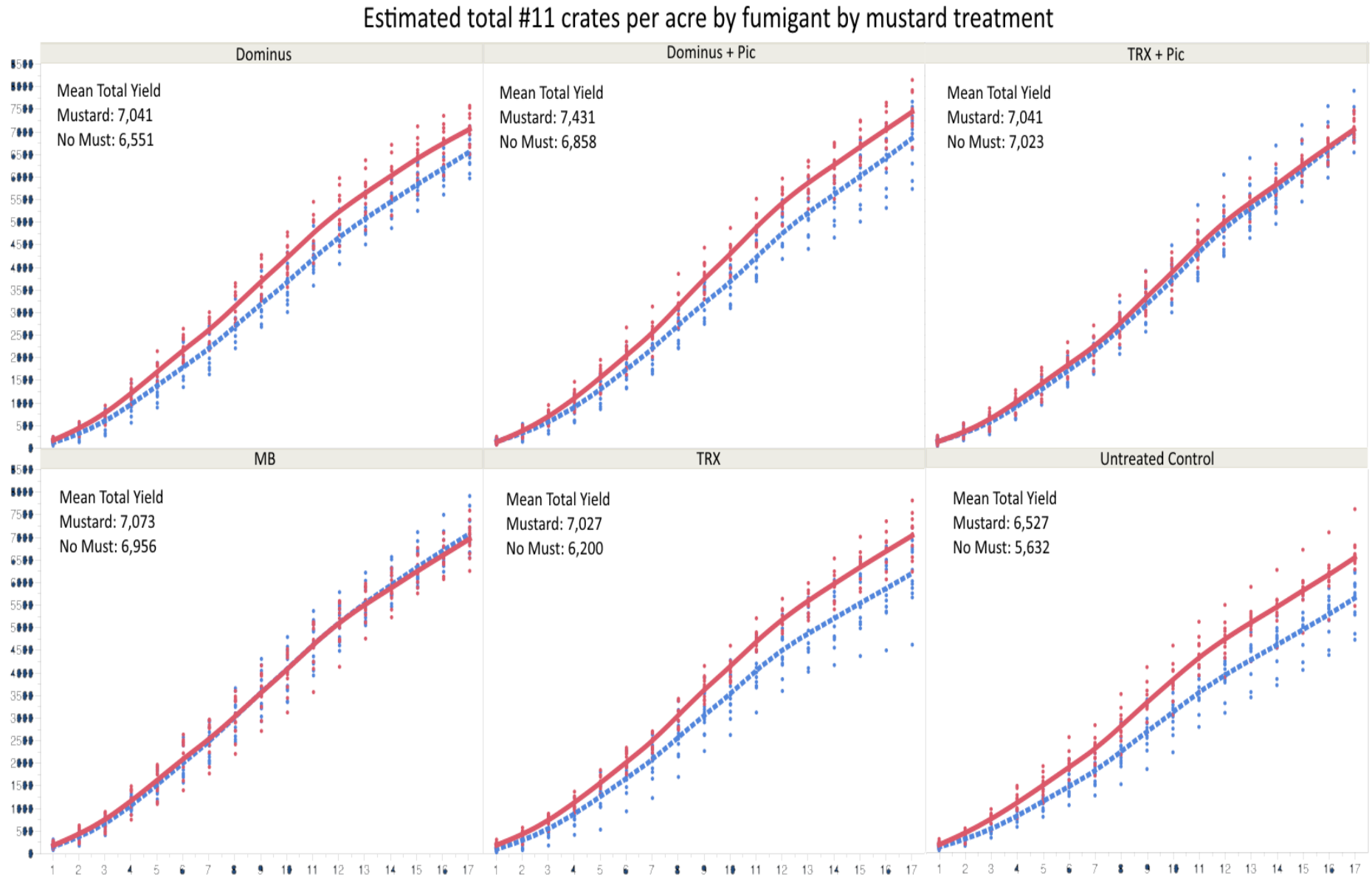
MSM is additive to weaker treatments, note DomPic + MSM is SIG higher than MB



MSM - no MSM 2015 CBC

Trend to earliness





Look at it another way

November 18, 2014 soil sample

	No MSM	MSM
NO-3-N	6.6*	32.7*
Olsen P	51	56
X-K	145	168
pH	7.0**	6.7**

* = Averages are significantly different at the 0.05 level (p=0.03)
**= Averages are very significantly different at 0.05 level (p=0.004)

Trianum- Rootshield comparison

- APN brand fertilizer (7-2-4 with micronutrients)
- Trianum (T22 *Trichoderma harzianum*)
- Rootshield (*T. harzianum and T. virens*)

Treatment	Rate	Timing/Type
Transplant APN -Dip only	1% dilute + ~ 1 part/400 for drip	Dip only
Untreated check	-	-
Trianum dip + drip in season	30 g/1000 plants + 300 g/A drip	Every six weeks after dip
Transplant APN dip + Rootshield drip in season	1 lb /6.67 + 5 oz/100 gal drip	Every six weeks after dip

Trianum study
Plant Diameter

Treatment	Dec 14, 2017	Jan 12, 2018	Feb 15, 2018
Transplant APN - Dip only	12.6 a	19.5 a	26.2 a
Untreated check	12.1 a	17.3 b	25.0 a
Trianum dip + drip in season	13.4 a	19.6 a	25.0 a
Transplant APN dip + Rootshield drip in season	12.1 a	17.6 b	25.4 a

Yields by month

Treatment	April yield	April size	May yield	May size	Jun yield	Jun size	July yield	July size	Aug yield	Aug size
Transplant APN -Dip only	744.9 b	38.4 b	2657.0 a	32.9 a	2983.3 a	28.6 a	1977.3 a	24.9 a	673.0 a	22.4 a
Untreated check	689.2 b	40.6 ab	2684.5 a	35.2 a	2914.5 a	27.3 a	1946.3 a	24.8 a	603.5 a	24.6 a
Trianum dip + drip in season	950.0 a	43.7 a	2924.0 a	35.5 a	3083.8 a	28.0 a	2337.8 a	24.8 a	832.0 a	24.8 a
Transplant APN dip + Rootshield drip in season	839.4 ab	44.6 a	2790.5 a	32.9 a	2974.3 a	27.2 a	2058.5 a	25.0 a	681.3 a	25.5 a

Total Yields

Treatment	Season yield	Season average size
Transplant APN -Dip only	9037.8 a	29.4 a
Untreated check	8838.8 a	30.5 a
Trianum dip + drip in season	10139.3 a	31.3 a
Transplant APN dip + Rootshield drip in season	9355.3 a	31.0 a

Genetic resistance

Resistant Varieties

- San Andreas
- Fronteras
- Moxie
- Royal Royce
- Many proprietary varieties

Conclusion

- Integrated management of soil pathogens will be the essential mindset of success going forward.
- Continuing research MUST include all aspects of soil pathogen management – fumigation, plant resistance, and non-fumigant alternatives.