Efficacy trials with new fumigants

Dominus®, Allyl 33, EDN®, and Paladin®

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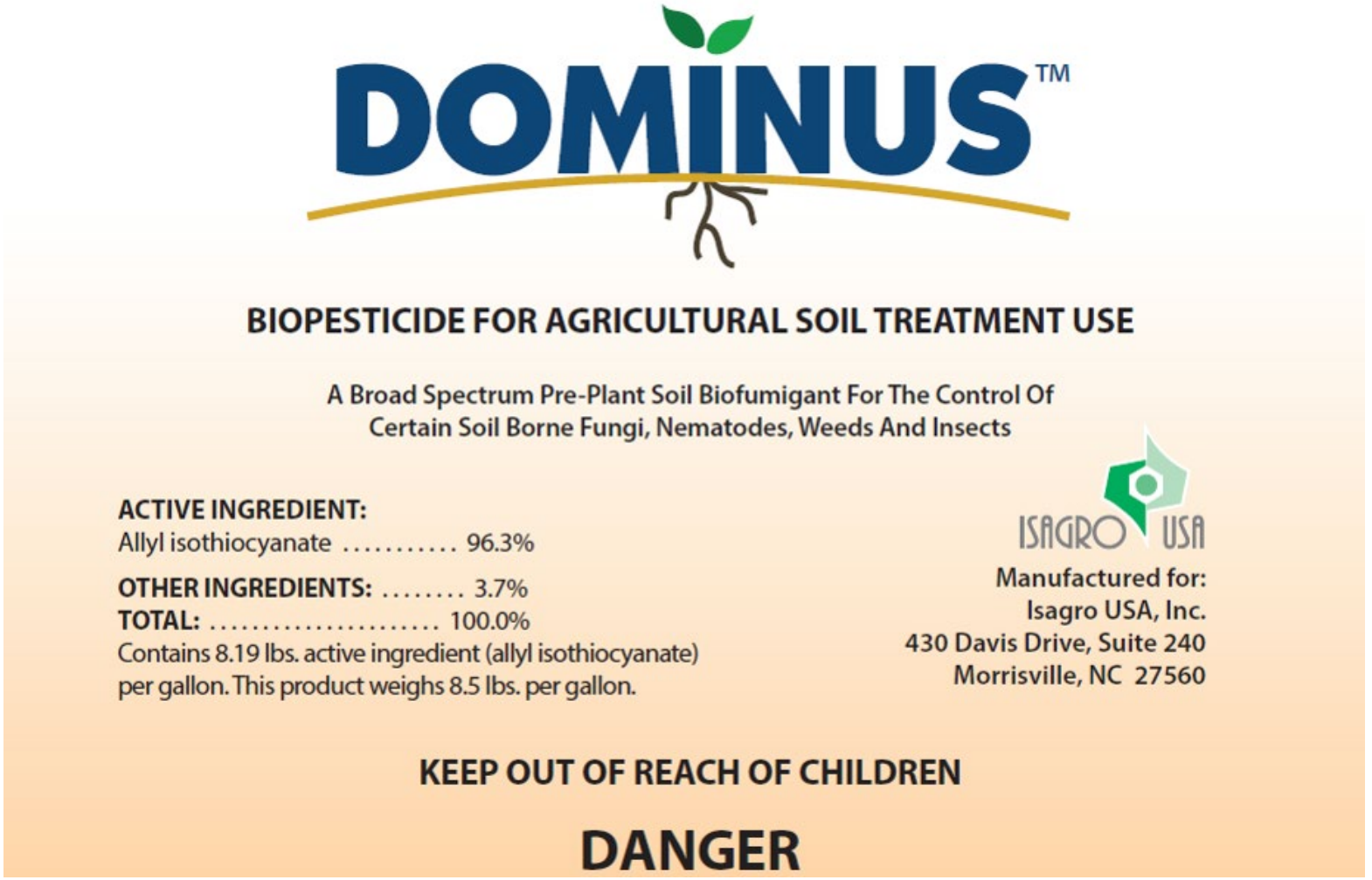


- New Chemistry (Oil of Mustard Seed) AITC Active ingredient
- Low vapor pressure and high boiling point

Dominus®

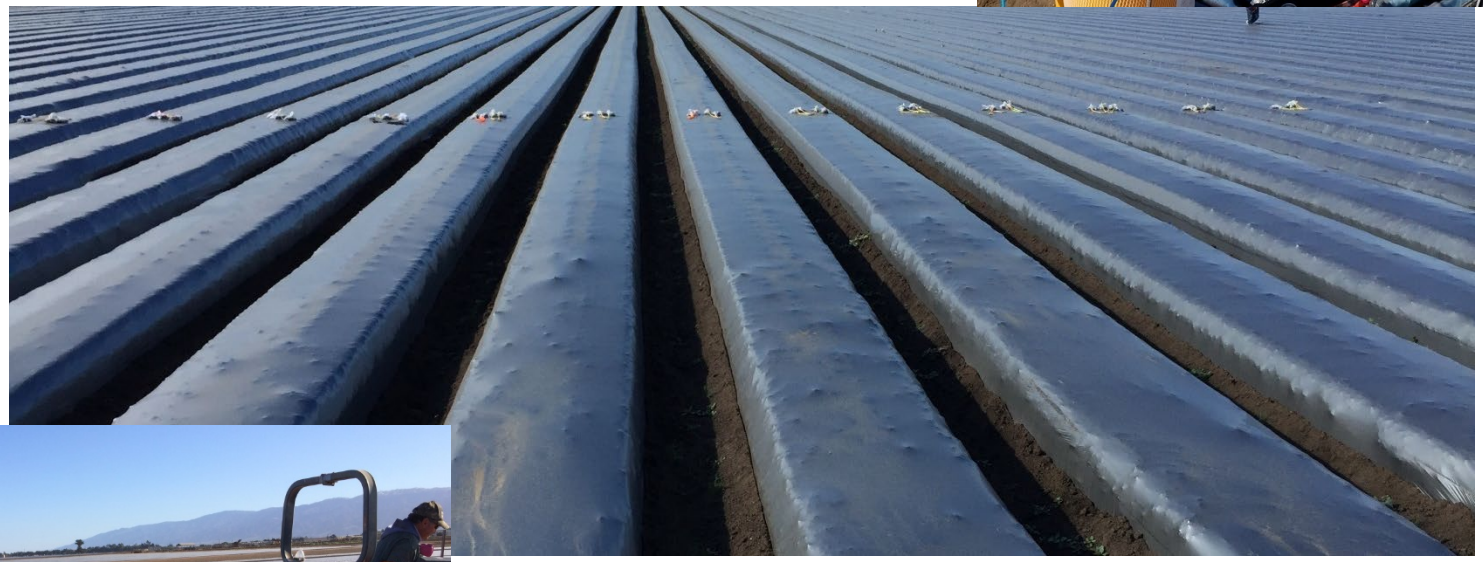
Allyl isothiocyanate (AITC)

- **EPA Registration was granted Sept 2013 (Isagro USA)**
- **Synthetically produced biopesticide that is found in brassica**
- **Pre-plant Application rate: 200 – 350 lbs/a**
- **Small buffer zones, no FMP**

Selected properties of Dominus

CAS #	57-06-7
Boiling point	151°C
Vapor pressure	3.5 – 4 mm Hg
Vapor density (water = 1.0)	3.4
Density	1.0126 g/cm^3 @ 20˚C
Solubility in water	Slight, 2 g/L water @ 25˚C
Solubility in alcohol	Very soluble (1:8) in 80% ethanol
Henry's Law Constant	0.0002752 atm-m^3/mole
Molecular formula	C_4H_5NS
Molecular weight	99.1542 g/mol
Soil half-life, DT50)	Aerobic DT50 of less than 3 days

The objective of this research was to evaluate optimum amount of irrigation water for drip fumigation of a new emulsifiable concentrate formulation of Dominus for strawberry production in California



Pathogen Bags installation @ 6” & 12”

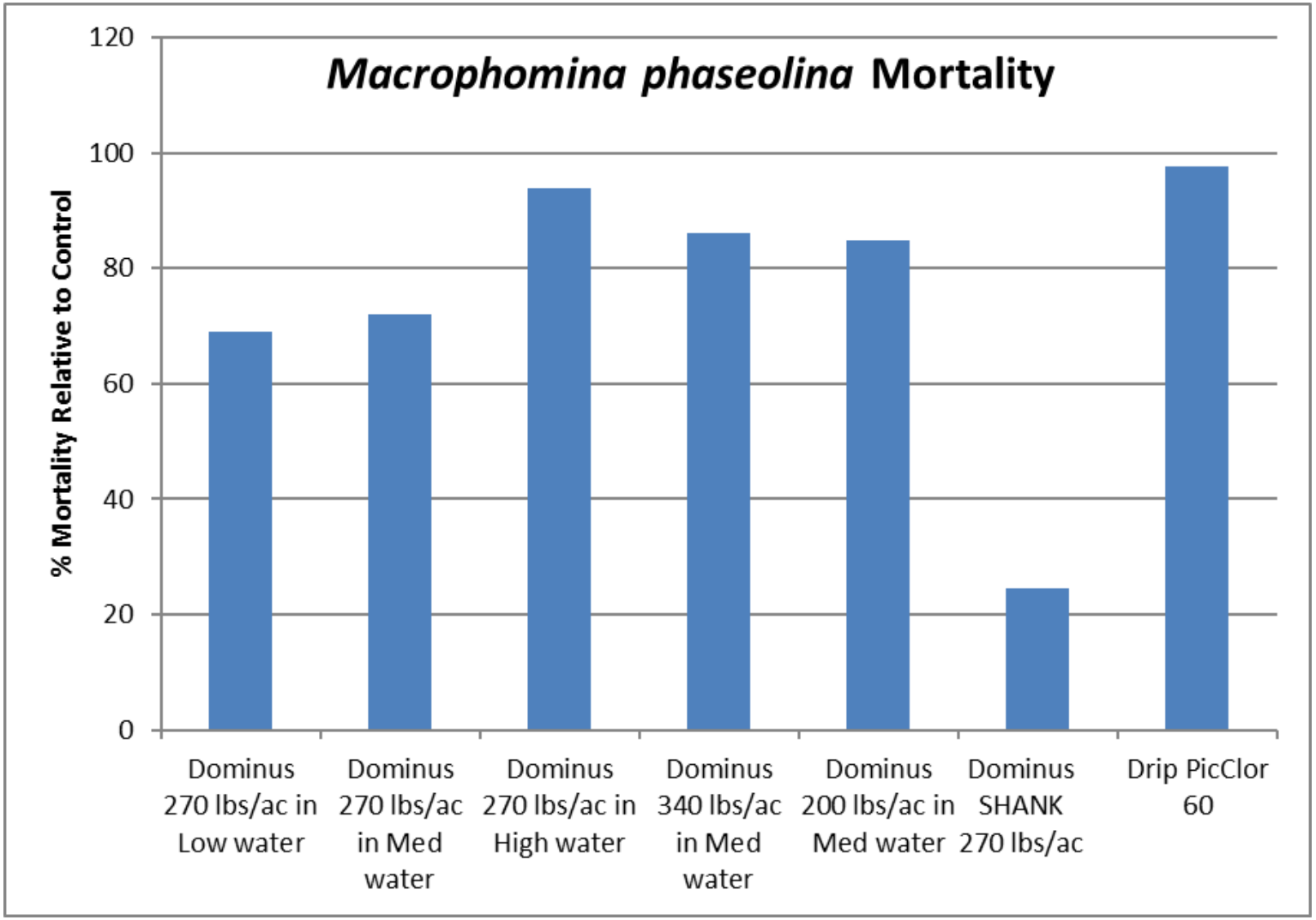
Materials &Methods

Treatment	Application Method	Rate lbs/ac	Application Time
Control	----	----	----
Dominus in Low water	Drip	270	94 min
Dominus in Med water	Drip	270	156 min
Dominus in High water	Drip	270	218 min
Dominus in Med water	Drip	340	156 min
Dominus in Med water	Drip	200	156 min
Dominus shank injection	Shank	270	----
Drip PicClor 60	Drip	350	156 min

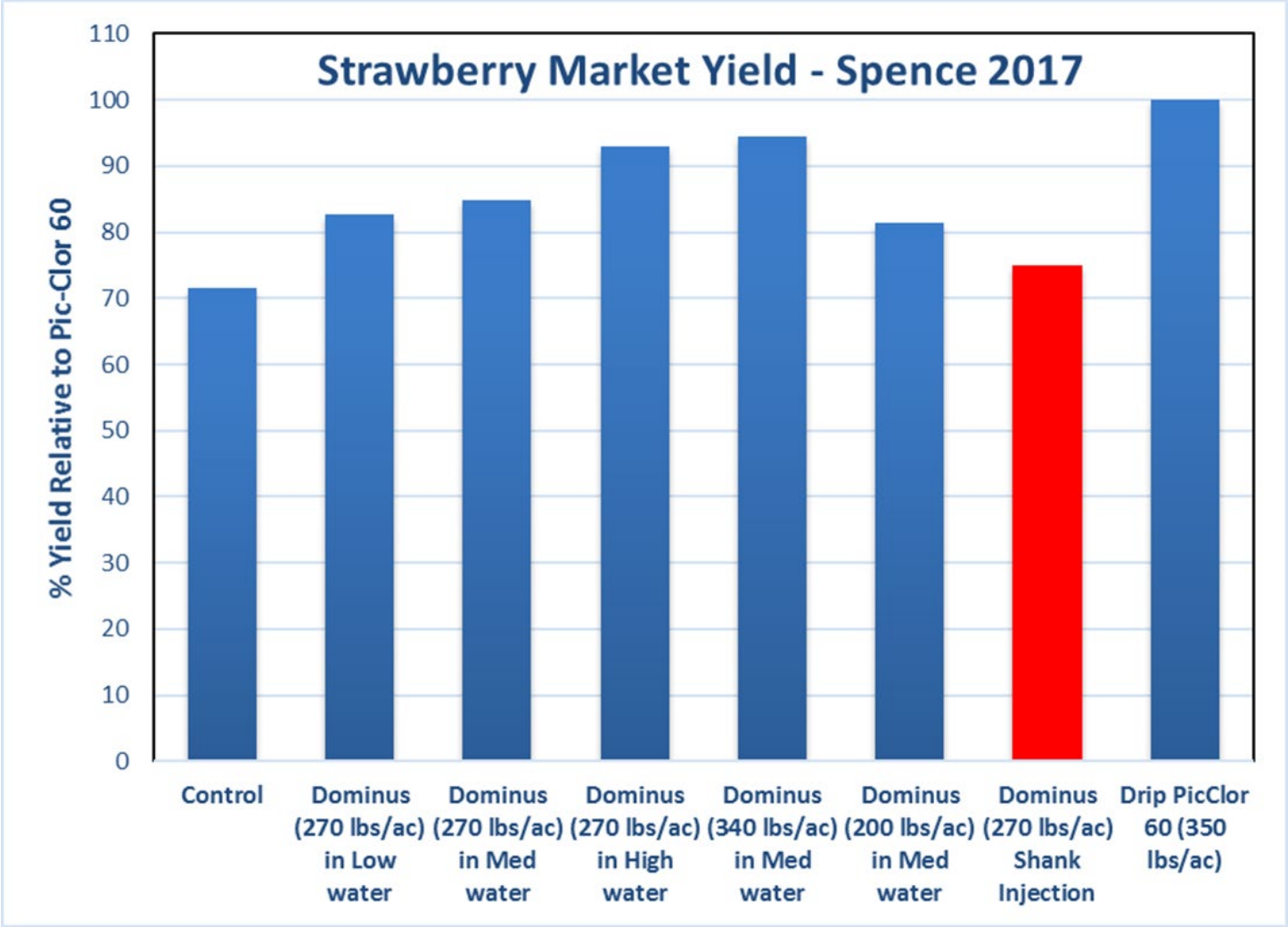
Methods

- Yield data were taken twice per week throughout the production season (March through mid September) and were graded into marketable and nonmarketable yields.

Results


Macrophomina phaseolina Mortality
% Mortality Relative to Control
120
100
80
60
40
20
0
Dominus 270 lbs/ac in Low water
Dominus 270 lbs/ac in Med water
Dominus 270 lbs/ac in High water
Dominus 340 lbs/ac in Med water
Dominus 200 lbs/ac in Med water
Dominus SHANK 270 lbs/ac
Drip PicClor 60

Results


Strawberry Market Yield - Spence 2017
% Yield Relative to Pic-Clor 60
110
100
90
80
70
60
50
40
30
20
10
0
Control
Dominus (270 lbs/ac) in Low water
Dominus (270 lbs/ac) in Med water
Dominus (270 lbs/ac) in High water
Dominus (340 lbs/ac) in Med water
Dominus (200 lbs/ac) in Med water
Dominus (270 lbs/ac) Shank Injection
Drip PicClor 60 (350 lbs/ac)

Summary Dominus

- **Strawberry yields increased with increasing the amount of water used to apply Dominus.**
- **The movement and diffusion of shank injected Dominus is limited. Adding more shanks or increasing the number of outlets on the shanks may improve the distribution in soil.**

EDN (ETHANEDINITRILE, C_2N_2

→ EDN™ FUMIGAS manual for fumigation

THE LINDE GROUP

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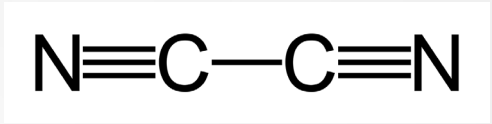
EDN™ FUMIGAS fumigant.

Manual for fumigation.

Selected Properties of Ethanedinitrile



Product Brand Name:	EDN (ETHANEDINITRILE, C_2N_2)
USEPA Reg. No.:	62719-321
% Active Ingredient:	99.58%
Chemical Family:	DiCyanogen
Color, Odor.	Colorless gas, almond-like odor.
Molecular Formula:	C_2N_2
Molecular Weight:	52
CAS No.:	460-19-5
Density:	Gas: 2.189 mg/cm^3 @ 20^{o}C Liquid: 989 mg/cm^3 @ -40^{o}C
Boiling Point:	-20°C
Vapor Pressure:	5.16 bar @ 21.1^{O}C
Solubility in water @101.325kPa@20°C	450 cm^3/100 cm^3 water

Properties of EDN

- It diffuses through soils quickly.
- Threshold Limit Value (TLV Human) = 10 ppm or 21 mg/m^3.
- LC_{50} (inhalation) 350 ppm/1 hour (rat).
- LDL_o (subcutaneous) 13 mg/kg (rabbit).
- **It is effective in controlling soil-borne fungal pathogens, nematodes, and many weeds.**

Research Presented at the MBAO in 2016

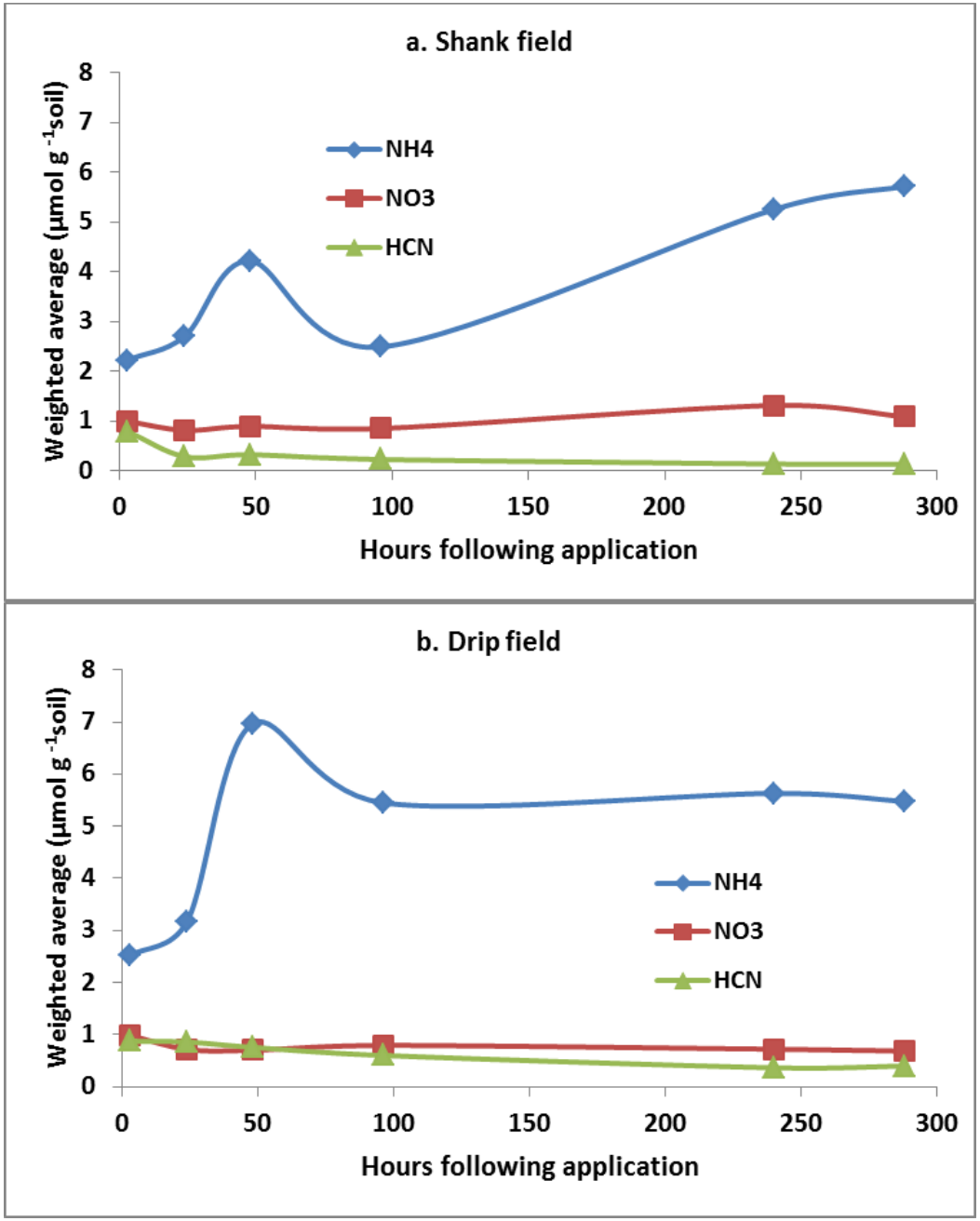
EDN (Ethanedinitrile) 

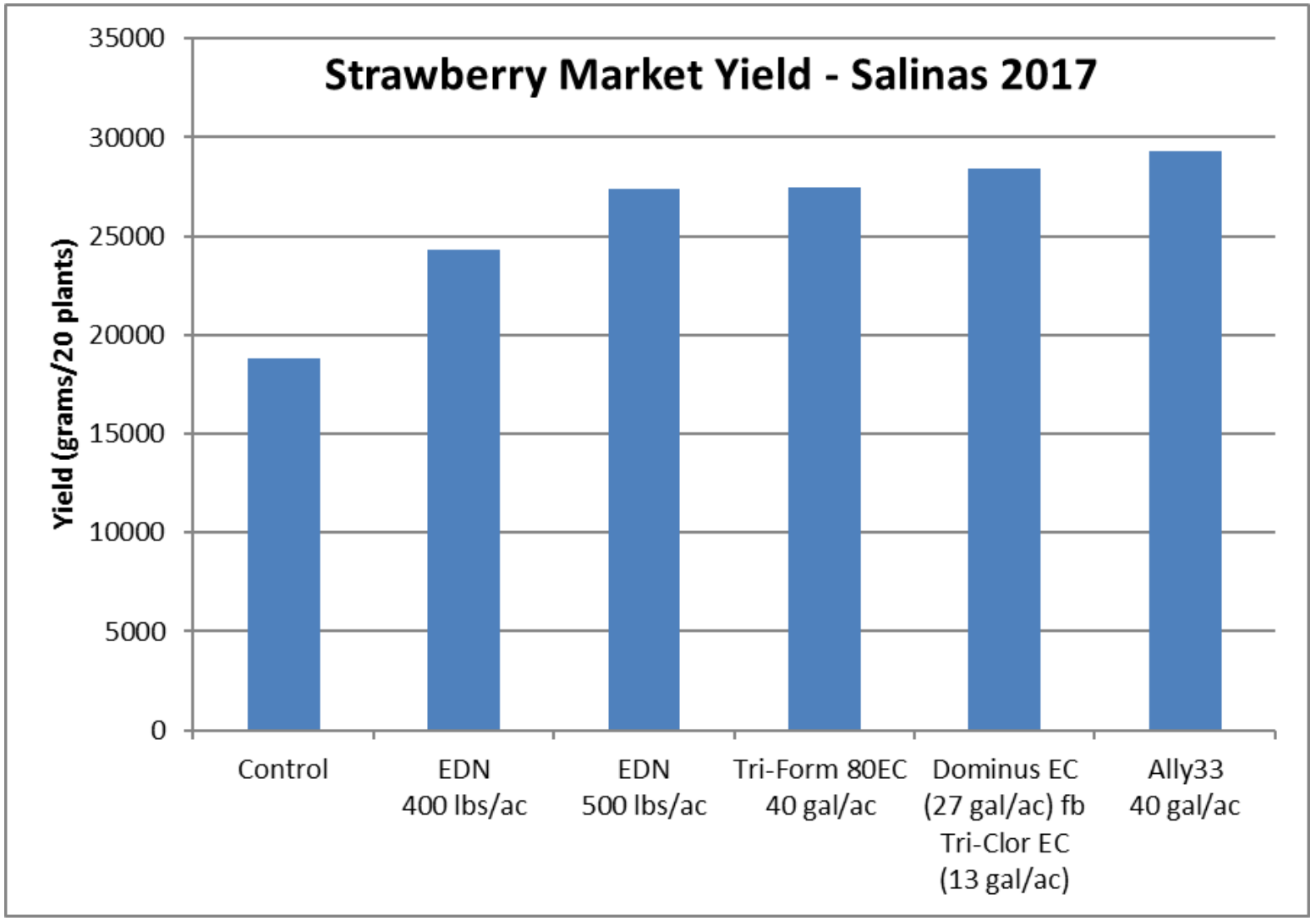
- **Possible degradation products:**
  - **$NCCN + 2H_2O \rightarrow HCN + HOCN$**
  - **$HOCN + H_2O \rightarrow NH_3 + CO_2$**
  - **$HCN + H_2O \rightarrow HC(O)NH_2 + H_2O \rightarrow HCO_2^- + NH_4^+$**

- **HCN converts into thiocyanate (SCN) and eventually into $SO_4 + NH_3 + CO_2$ <u>or</u> HCN forms precipitates with metals (eg., Fe)**

Average concentrations of HCN, NH_4, & NO_3 in the soil liquid phase in the shank field (top) and drip field (bottom) over 280 hours after EDN application.

Average over 55 cm depth.




Strawberry Market Yield - Salinas 2017
Yield (grams/20 plants)
35000
30000
25000
20000
15000
10000
5000
0
Control
EDN 400 lbs/ac
EDN 500 lbs/ac
Tri-Form 80EC 40 gal/ac
Dominus EC (27 gal/ac) fb Tri-Clor EC (13 gal/ac)
Ally33 40 gal/ac

Paladin

Dimethyl disulfide (DMDS)

- **EPA Registration was granted in 2010 (Arkema)**
  Applied only under TIF

- **Used as a flavoring for an onion or garlic taste in processed cheese and meat (0.02-10 ppm)**

- **Efficacy (Rates: 400 – 600 lbs/a)**

General conclusion

- AITC was effective in controlling multiple pathogens, Nematode and weed seeds at the labeled rate
- AITC efficacy relies heavily on soil movement and distribution. Higher water volumes and the addition of surfactants helped increase AITC efficiency
- Efficacy improved when AITC is applied in combination with chloropicrin

- EDN (ethanedinitrile) is effective in controlling soilborne pathogens weeds. Several efficacy studies are being conducted in California and Florida

- Paladin registration was withdrawn from California and no further efficacy research is being conducted on strawberry

Thank you very much

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