New Equipment and Improved Formulations of 1,3-Dichloropropene and Chloropicrin

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Dow AgroSciences

The Montreal Protocol
A Catalyst for Innovation

- Where will “alternatives” come from?
  - Non-chemical, non-fumigant alternatives
  - Cultural changes in production
  - Existing and “New” fumigants
  - Using existing tools more effectively
    - enhanced formulations
    - improved equipment

Existing and “New” Fumigants

Existing Fumigants

- Methyl bromide
- 1,3-dichloropropene
- Chloropicrin
- MITC generators

“New” Fumigants

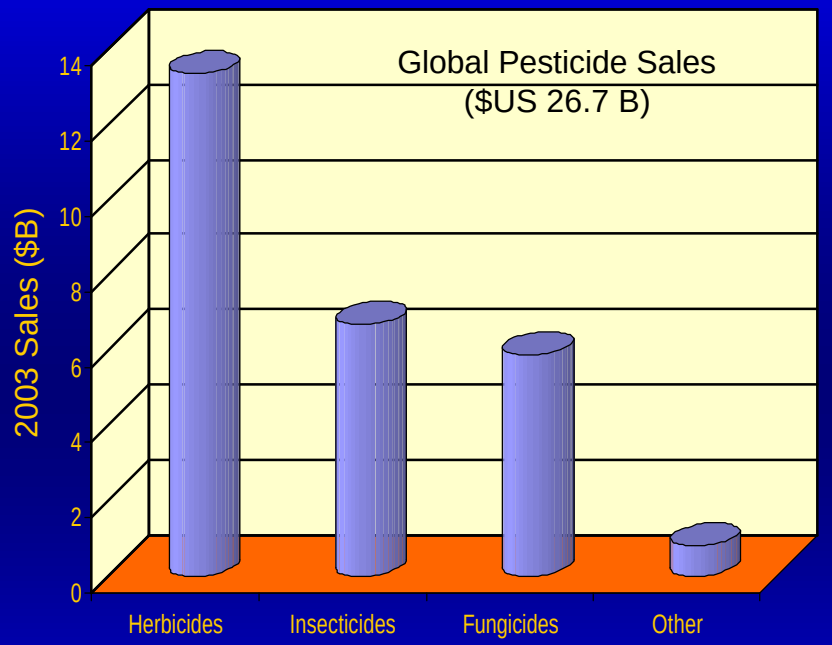
- Methyl iodide
- Propargyl bromide
- Sodium azide
- Discovery research?

Discovery Research

Challenges to the development of new fumigants:

- Economics - limited opportunity
- Regulatory – anachronisms --

+ No residues
+ Extensive registration
+ Robust efficacy
+ Strong stewardship



Source: Phillips McDougall

Balancing the pros and cons, it makes sense to optimize the value o existing fumigants

Optimize the Value of Existing Fumigants

1. Enhanced Formulations
2. Improved Application Methods
3. New Application Equipment

Enhanced Formulations

- The goal of formulation enhancement is to increase the value of the product to the customer

1. Improve product performance
   - efficacy
   - pest spectrum
2. Improve product utility
   - easier to use
   - application flexibility
   - lower use rate

Enhanced Formulations

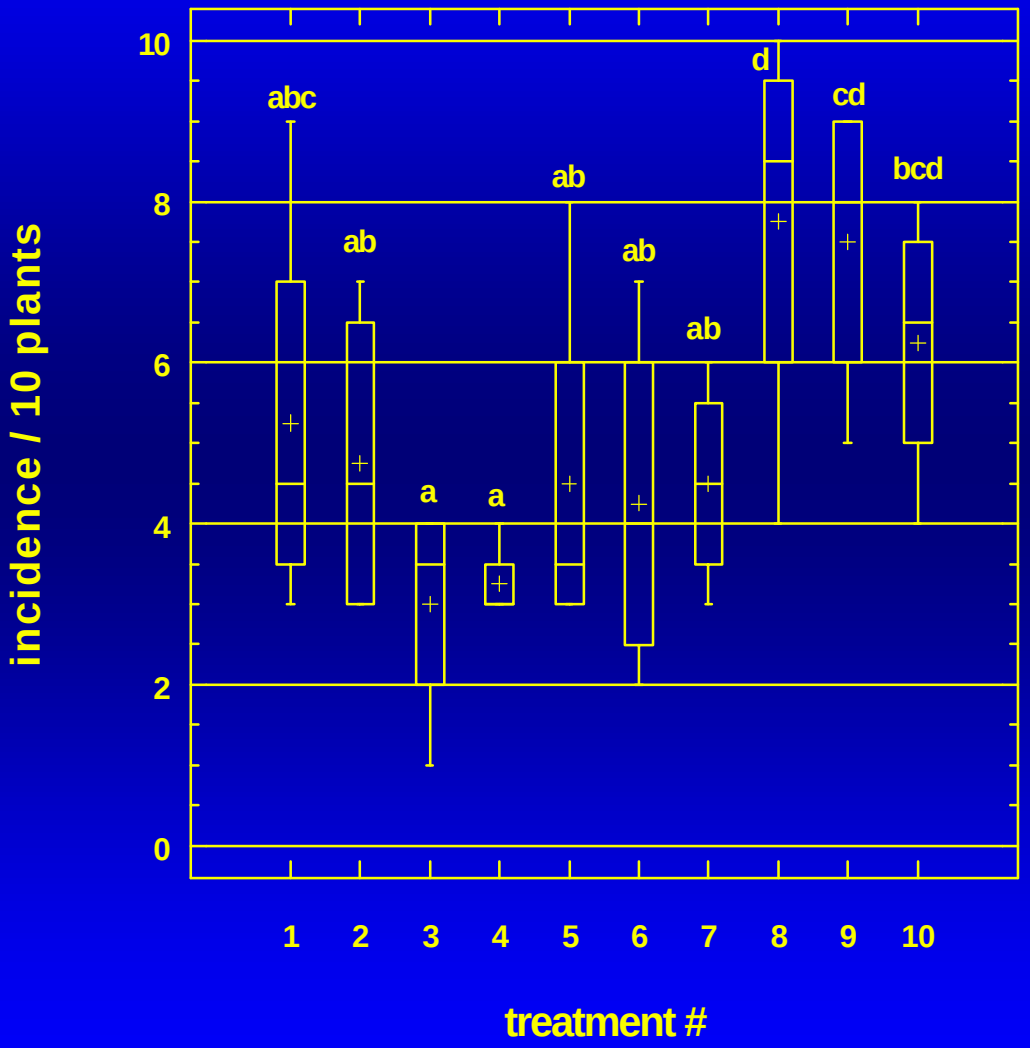
Formulation Changes and Benefits

- Additional chloropicrin in 1,3-D formulations
  - control of nematodes plus enhanced control of soil-borne diseases
  - used in shank injection or drip irrigation formulations
- Emulsifiers
  - ensure uniform distribution of fumigant in irrigation water
  - enhance solubility in water
  - allows direct injection into drip irrigation tubes

Verticillium Wilt of Cauliflower

Arroyo Grande, CA

Disease Incidence at Harvest



#	treatment	gal/ac
1	Telone EC	12
2	Telone C15 EC	14.5
3	Telone C25 EC	16
4	Telone C35 EC	18.5
5	chloropicrin EC	4
6	metam drip, fenamiphos G	75
7	TELONE II injection	12
8	ABB9017 drip, fenamiphos G	2
9	ABB9017 drip, fenamiphos G	4
10	untreated	

JPM9514

Enhanced Formulations

Initial Formulations

Product(s)	1,3-D		Chloropicrin		Total Gm/L	Shank or Drip
	Gm/L	%	Gm/L	%		
Telone* Dorlone*	1188	97.5	-	-	1188	Shank
Telone* EC Condor*	1127	94.0	-	-	1127	Drip
Telone* C-17	1034	81.2	210	16.5	1244	Shank

* Trademark of Dow AgroSciences LLC

Enhanced Formulations

Current Formulations

Product(s)	1,3-D		Chloropicrin		Total Gm/L	Shank or Drip
	Gm/ L	%	Gm/L	%		
Telone* Dorlone*	1188	97.5	-	-	1188	Shank
Telone* EC Condor*	1127	94.0	-	-	1127	Drip
Telone* C-17	1034	81.2	210	16.5	1244	Shank
Telone* C-35 Telopic* Doublestopper*	866	61.1	474	34.7	1340	Shank
InLine* Telopic* EC	808	60.8	442	33.3	1250	Drip

* Trademark of Dow AgroSciences LLC

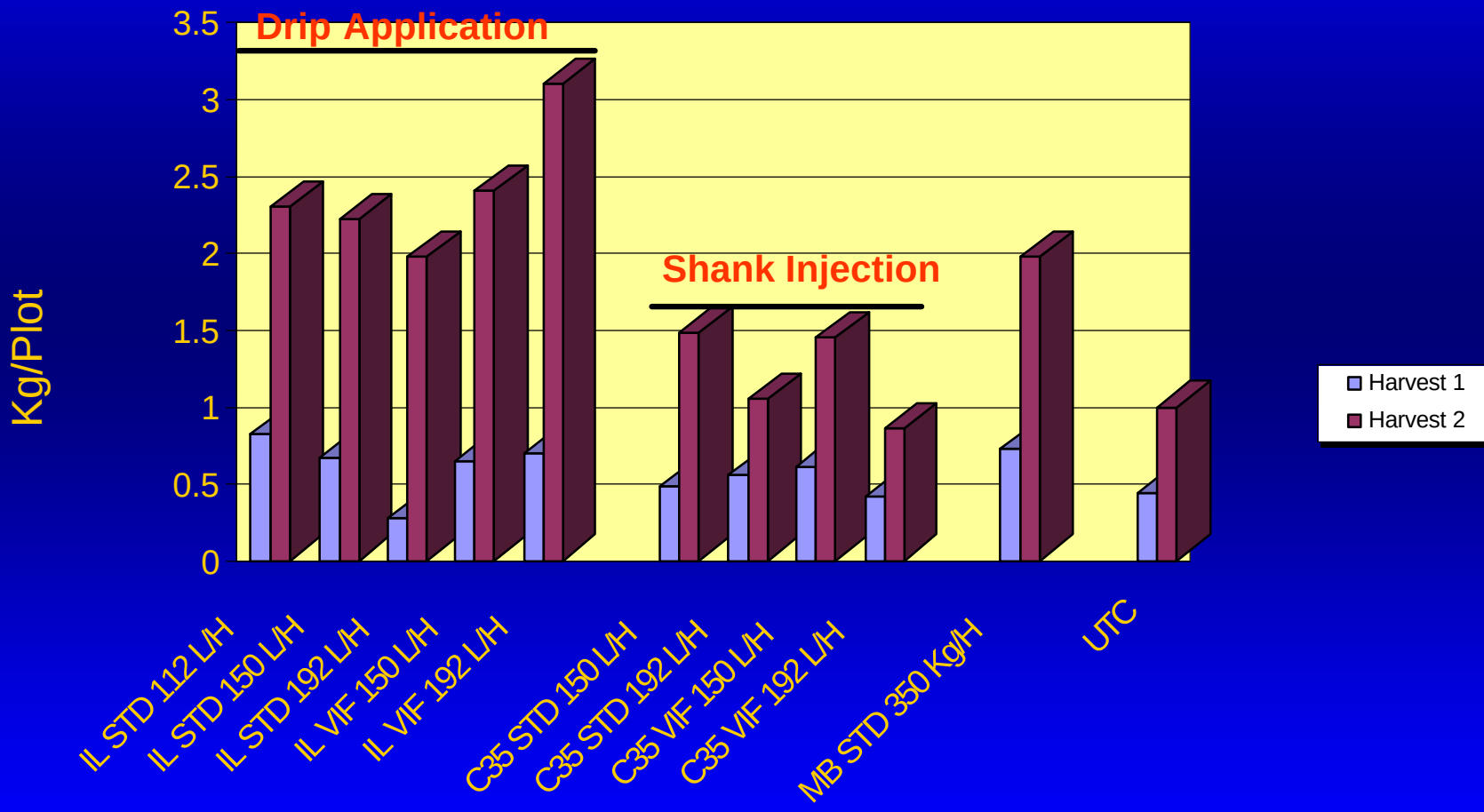
‘New’ Application Methods

Application via Drip Irrigation Tubes

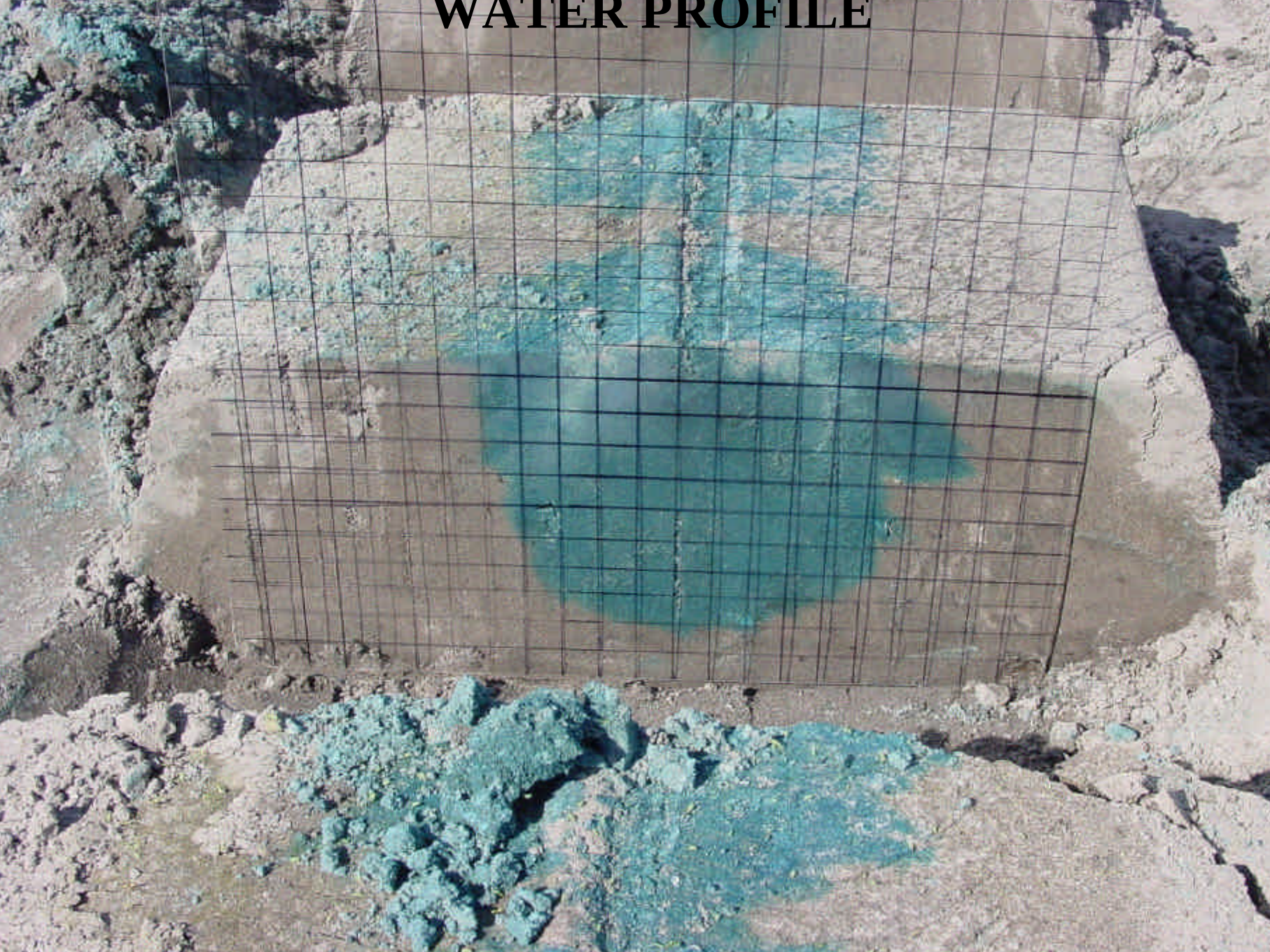
- Better distribution in the soil
- Lower use rates
- Better efficacy in most soils
- Better retention of fumigant in the soil
- Lower cost of fumigation
- More consistent performance
- Reduced exposure of workers to fumigant
- Utilizes existing drip tubes

Average Pepper Yield (Kg) per Plot

Oxnard, CA - 2002

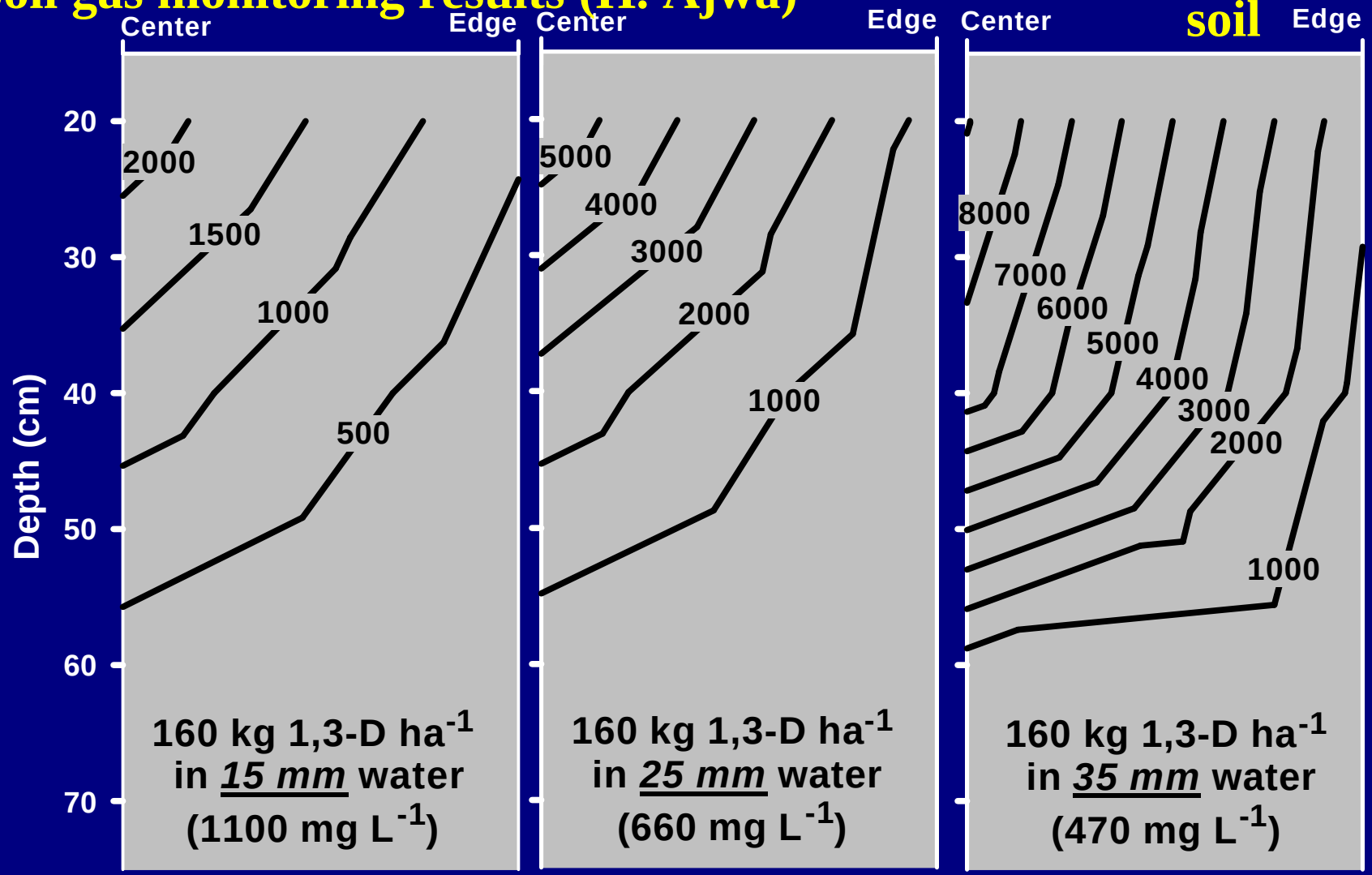


WATER PROFILE



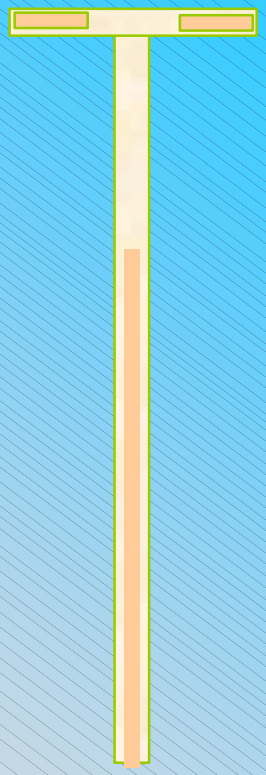
Soil gas monitoring results (H. Ajwa)

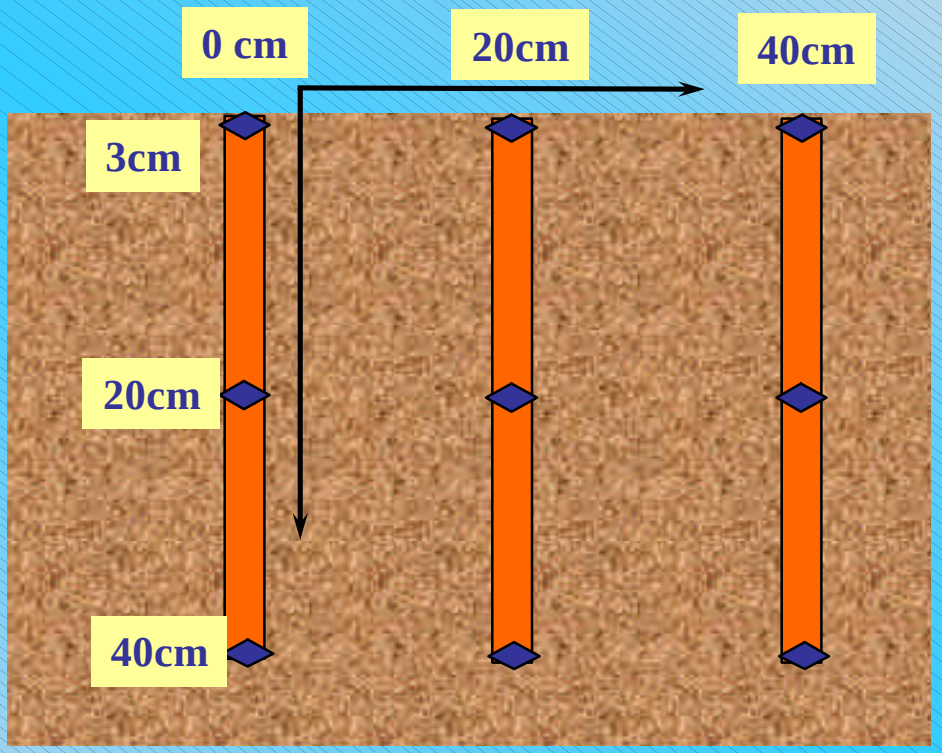
fine sandy loam soil

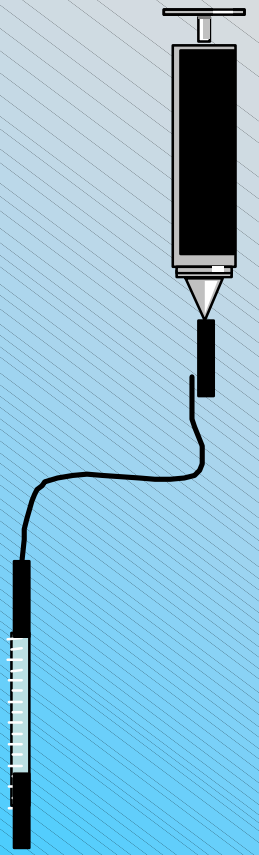


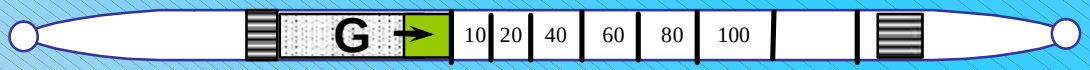
1,3-D concentration (mg L^{-1} air) in the gaseous phase of Watsonville soil 24 hrs after drip application

1 - 7 DAA SAMPLING

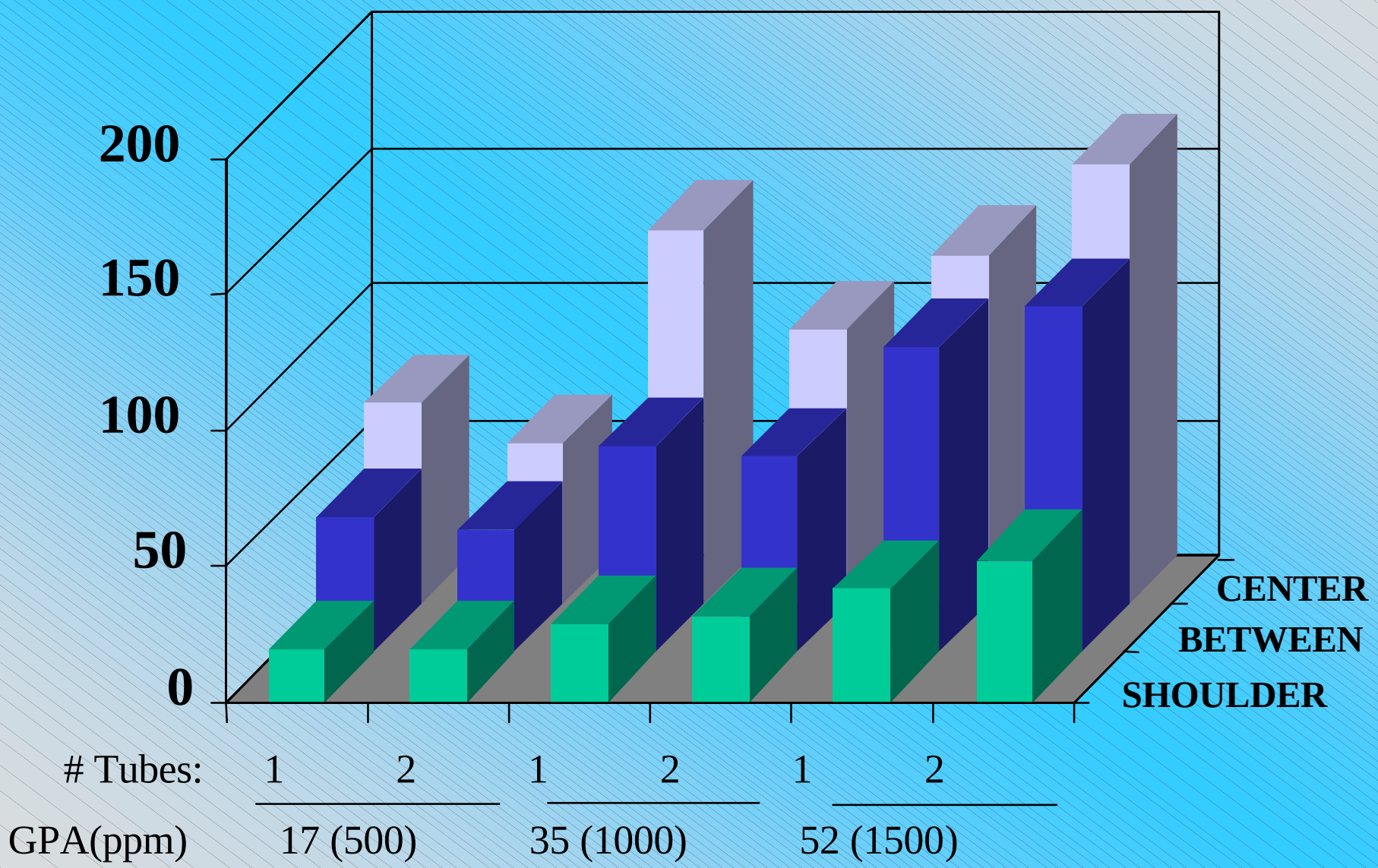




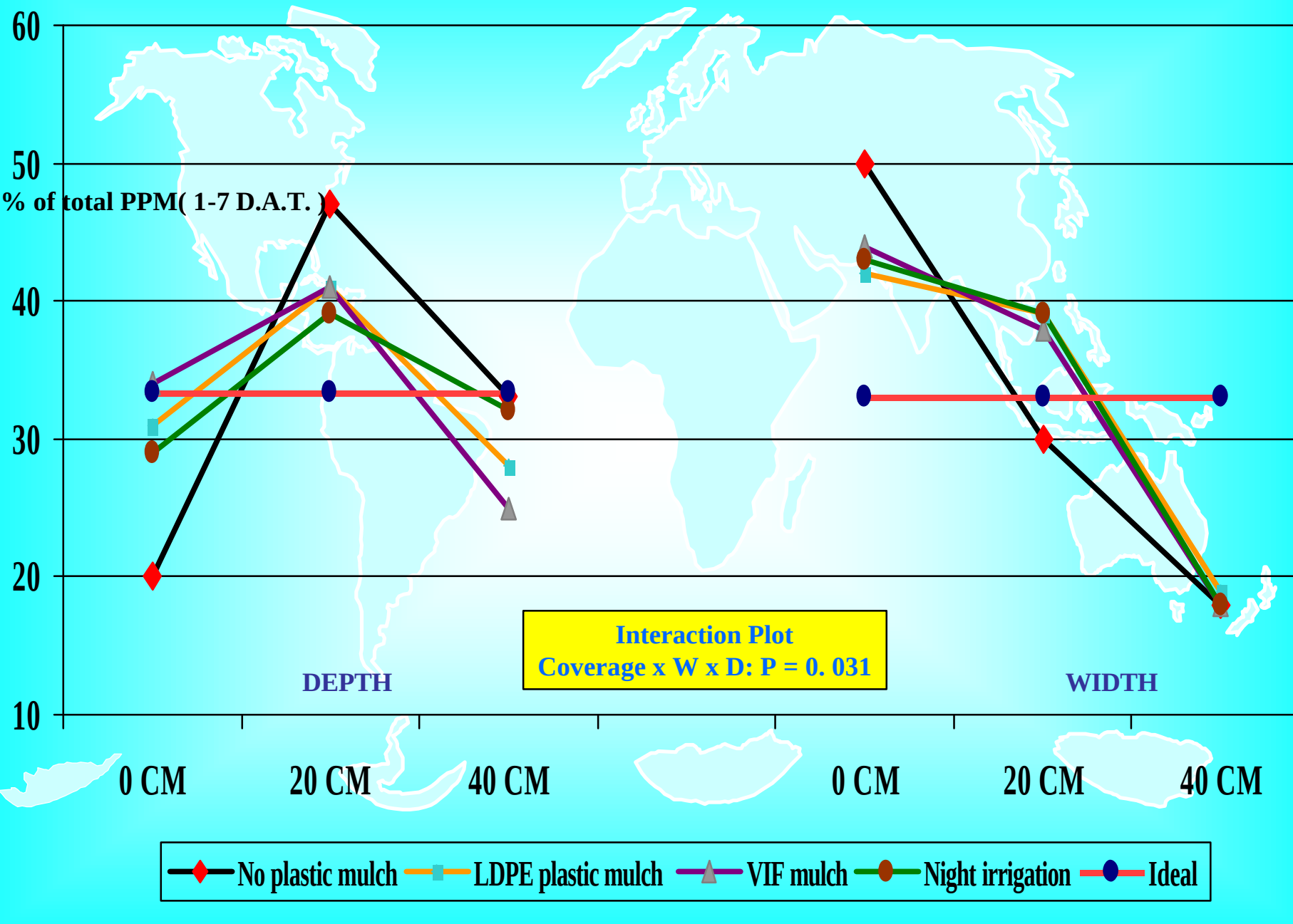




EFFECT OF GALLONS PER ACRE AND CONCENTRATION (PPM) C
GASTEC READINGS 1 DAY AFTER APPLICATION



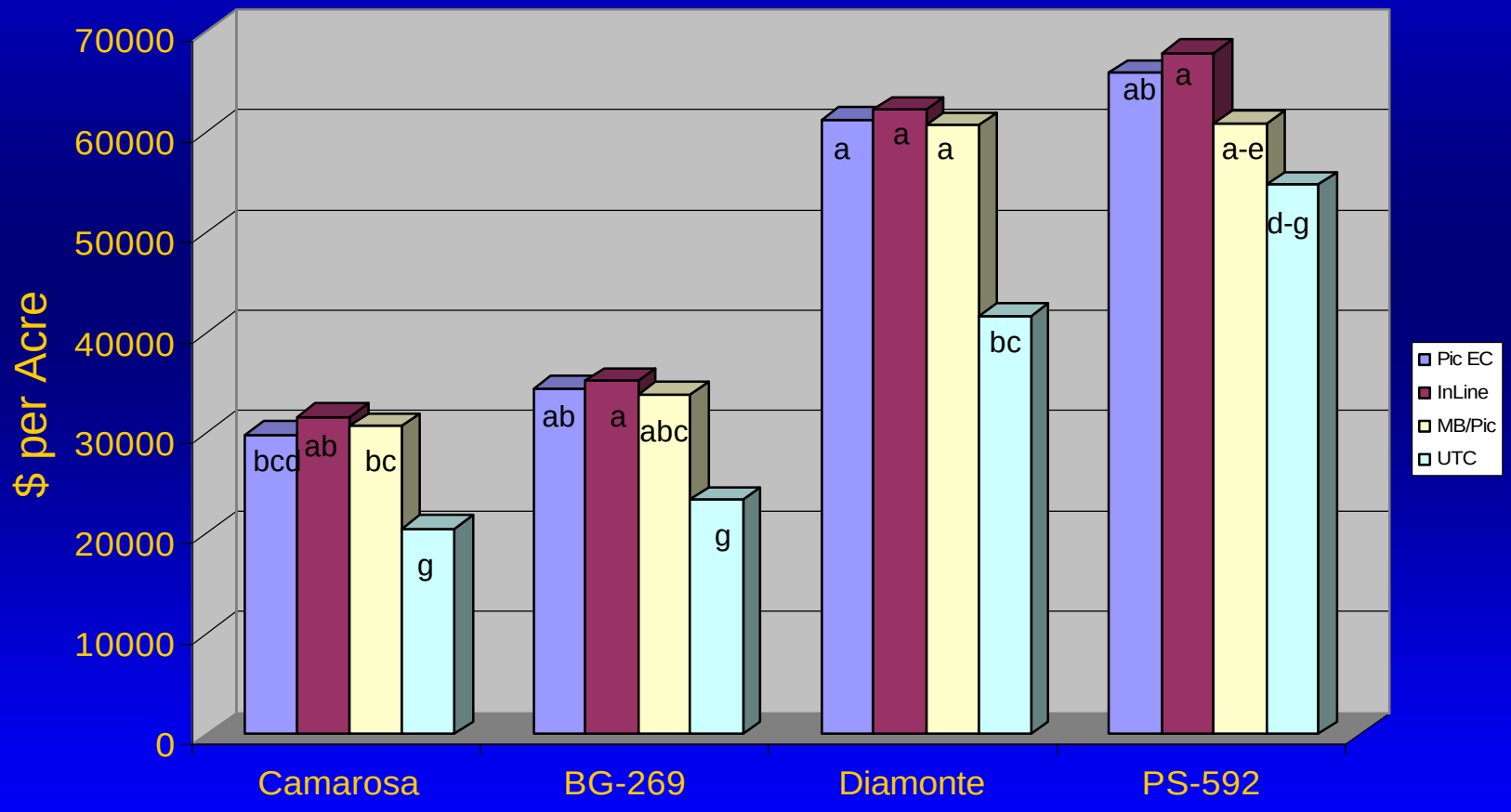
SOIL COVERAGE



Strawberry Marketable Berry Value

IR-4 2001-2002

California



Values followed by the same letter are not significantly different (DMRT P=0.05)

New Application Equipment
Yetter Coulter


TeloneTube
Beaver Tail for sealing and dispersion
Coulter and Knife

Press Wheels in Action

New Equipment

Advantages of Yetter Coulter

- Better soil sealing
  - Beaver tail
  - Press wheels
- Deeper placement of fumigant for better soil distribution
- Can be used for in-bed, pre-bed and broadcast applications of fumigants

FFVA Commercial Demonstration Trials

- Designed to demonstrate value of methyl bromide alternative treatments on tomato and pepper in Florida
- Trials conducted 2002 - 2004
- Funded by an FFVA grant (USDA source)
- UFL and USDA researchers conducted all trials on commercial production farms
- Standard protocol at 10 locations
- Interim and final reports submitted to FFVA

FFVA Commercial Demonstration Trials

Standard Protocol

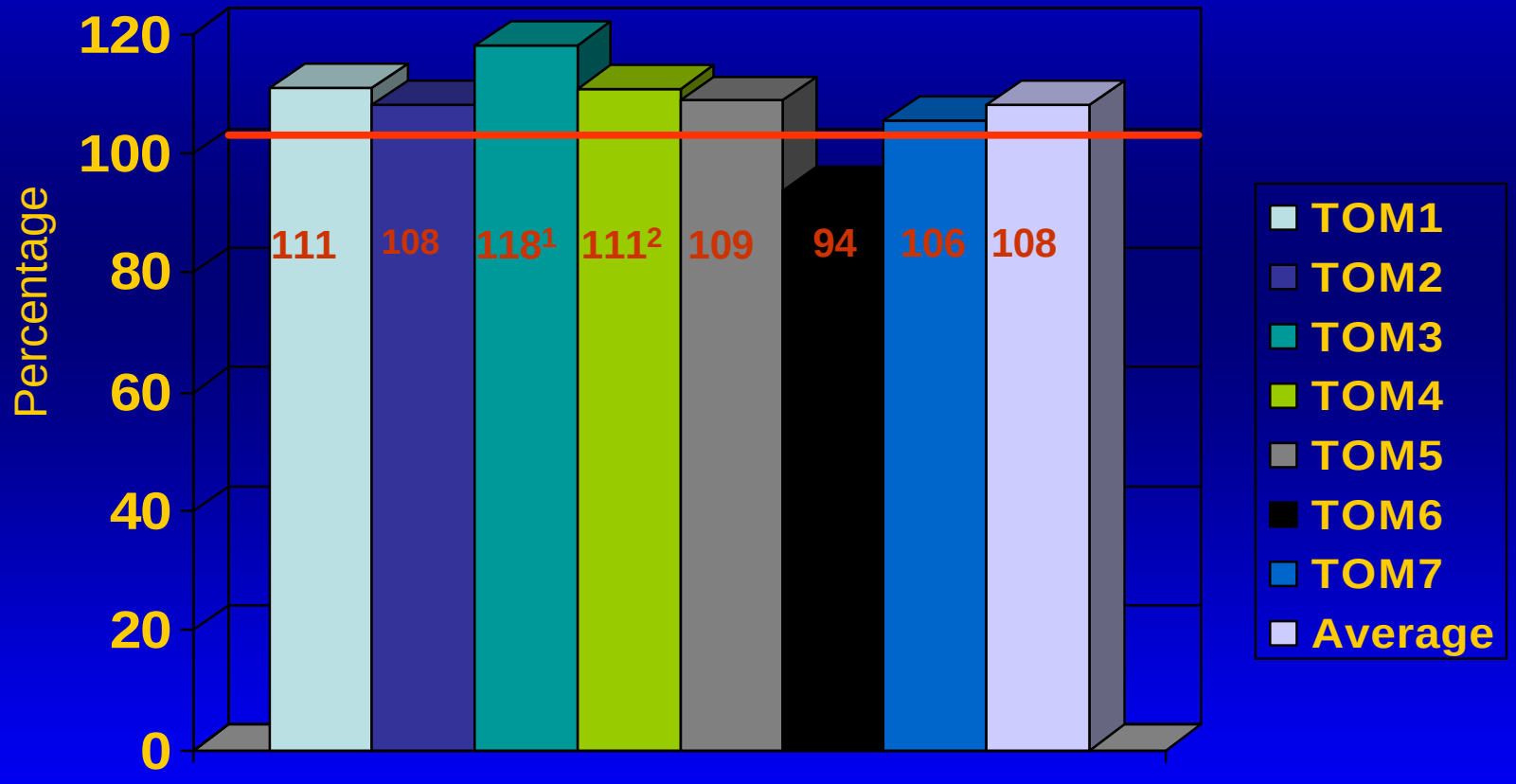
1. Telone C-35 @ 26 gpa applied broadcast with Yetter coulter plus herbicide plus chloropicrin @ 150 lbs pta applied in bed
2. Methyl bromide/ chloropicrin (67/33) @ 350 lb/a

Note: Standard herbicide treatment was Devrinol plus Treflan

FFVA Commercial Demonstration Trials - Tomato

2002 - 2004

Telone C-35 + Herbicide Yield as a Percentage of MB/pic



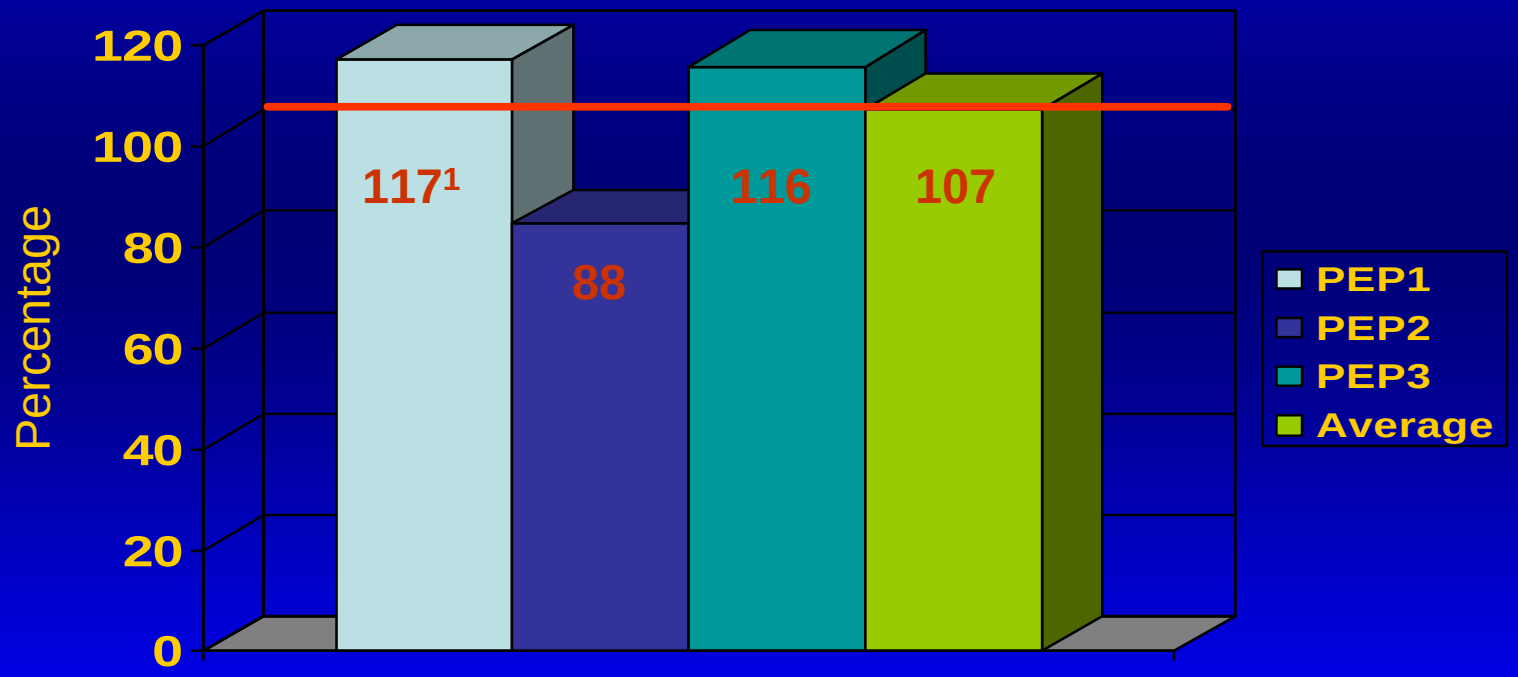
[1]Third consecutive year of a Telone C-35 alternative program

[2]Forth consecutive year of a Telone C-35 alternative program

FFVA Commercial Demonstration Trials - Pepper

2002 - 2004

Telone C-35 + Herbicide Yield as a Percentage of MB/pic



[1]Third consecutive year of a Telone C-35 alternative program

Application Methods, Equipment and Costs

Telone Application Methods In-bed

Advantages:

- Same application as MB/pic
- 7 years of data that demonstrates that it works

Cost:

Telone C-35 @ 35 gpta = $350
+ Herb $50
$400

400 lbs MeBr @ 2.80/lb = $560

Telone Application Methods
Prebed

Yetter Prebedder

Apply Telone with prebedder and then “turf” or “false bed” over the applied area

Places the Telone only where the bed will be placed.

Telone Application Methods Prebed

- Advantages
  - Economical as In-bed
  - PPE - Wear long sleeve shirt and long pants, shoes & socks
- Cost

C-35 @ 35 gpta	$350
+ pic in-bed @ 175 lbs pta	$150
+ Herbicide	$50
	$550

MeBr @ 2.65/lb @ 400 lbs pta = $530

Telone Application Methods Broadcast

Advantages

- Fewer people needed in field
- Highly effective in the high disease markets

Cost

C-35 @ 20 gpta	$400
+ pic in-bed @ 175 lbs pta	$150
+ Herb	$50
	$600

MeBr @ 2.80/lb @ 400 lbs pta = $560

Summary

- The Montreal Protocol has been a catalyst for fumigation research
- Enhanced formulations, improved application combined with monitoring methods and new equipment can add value to existing fumigants
- These enhancements result in additional viable alternatives for growers as methyl bromide is phased out

Telone®

Everything grows better

A Pre-Plant Soil Fumigant to Manage Soil Borne Pests in High Value Crops