AMVAC™
An American Vanguard Company

K-Pam and Vapam Fumigation Training

M. Herrington
June 18, 2020

Topics for Discussion

I. Chemistry
II. Regulations
III. GAPs Good Agricultural Practices
IV. Rates and Calculations
V. Safety and Handling
VI. Application Technology

VAPAM HL

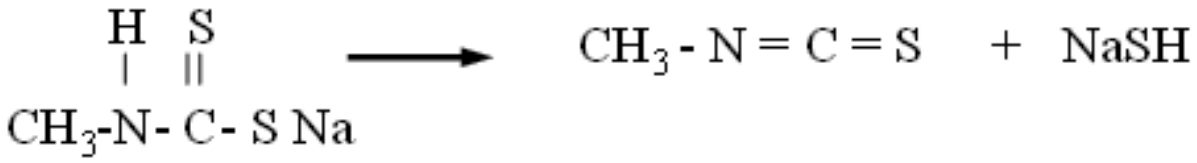
Sodium N-methyldithiocarbamate

42% A.I.

Max use rate is 75 gal/treated acre

VAPAM Soil Fumigant

METAM CONVERTS TO MITC WHEN APPLIED TO SOIL



Metam	**MITC**
•Liquid	•Gas
•Moves in Soil Water	•Moves in Soil Air
•Low Biological Activity	•Primary Biological Activity

Conversion Rate Depends on Soil and Environmental Factors

K-PAM HL

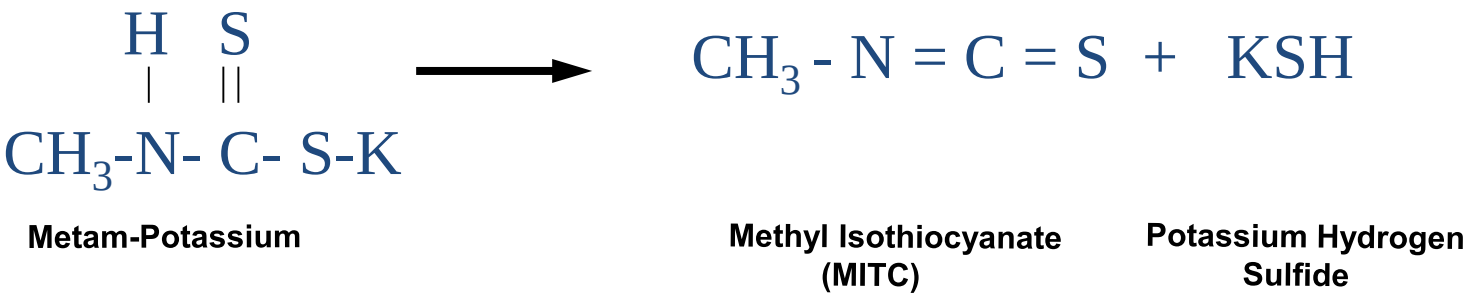
Potassium N-methyldithiocarbamate

54% A.I.

Max use rate is 62 gal/ treated acre

K-Pam® HL™ Soil Fumigant

Conversion of K-Pam HL in the Soil



MITC is the primary biologically active ingredient.

MITC is a strong eye and respiratory irritant

In soil, MITC binds on soil surfaces, dissolves in water and mixes with air

Soil microbial activity breaks it down to nitrogen, sulfur and hydrogen

VAPAM vs. K-PAM

VAPAM @ 37 gpa

- Hydrogen: 19.73 lbs
- Carbon: 29.60 lbs
- Nitrogen: 17.26 lbs
- Sulfur: 78.93 lbs
- Sodium: 28.36 lbs

K-PAM @ 31 gpa

- Hydrogen: 20.04 lbs
- Carbon: 30.06 lbs
- Nitrogen: 17.54 lbs
- Sulfur: 80.20 lbs
- **Potassium (K_2O): 55.80 lbs**

K-Pam provides potassium

Concentration of Potassium in soil and leaf tissue in Peppers in treated plots

	Soil		Leaf Tissue	
Location	MB:PIC	K-Pam	MB:PIC	K-Pam
1	44 PPM	94 PPM	4.40%	4.20%
2	40 PPM	126 PPM	4.14%	3.97%
3	26 PPM	112 PPM	4.08%	3.96%
4	60 PPM	133 PPM	3.56%	4.28%

Dr. Dan Chellemi

VAPAM & K-PAM Regulations

- ❑ PPE Requirements
- ❑ VAPAM and K-PAM are “Restricted Use”
- ❑ Re-entry Interval in the treated area is 5 days
- ❑ Buffer zone period is 48 hours
- ❑ Treated area can be planted after 14-21 days
- ❑ Required Fumigation Management Plan (FMP)
- ❑ Required Fumigation Certification and Handler/Applicator Training
- ❑ Mandatory Good Agricultural Practices (GAP)
- ❑ Posting Requirements and On-Site Monitoring
- ❑ Emergency Preparedness

There are 3 Sources of Information!

1. **The VAPAM & K-PAM Labels**
   - www.amvac.com
2. **The EPA Fumigant Tool Box**
3. **AMVAC's "Fumigants Simplified" booklet**

Signal Word Is “Danger”

- ✓ Corrosive.
- ✓ Causes skin damage.
- ✓ Do not get on skin or clothing.
- ✓ Prolonged or frequent repeated skin contact may cause allergic reactions in some individuals.
- ✓ Harmful if inhaled.
- ✓ Irritating to nose and throat. Avoid breathing vapor or spray mist.
- ✓ Irritating to eyes. Do not get in eyes.

Applicator Certification Required

- ❑ All certified applicators supervising a soil fumigation must have successfully completed a fumigation training and passed the test
- ❑ On line training at;

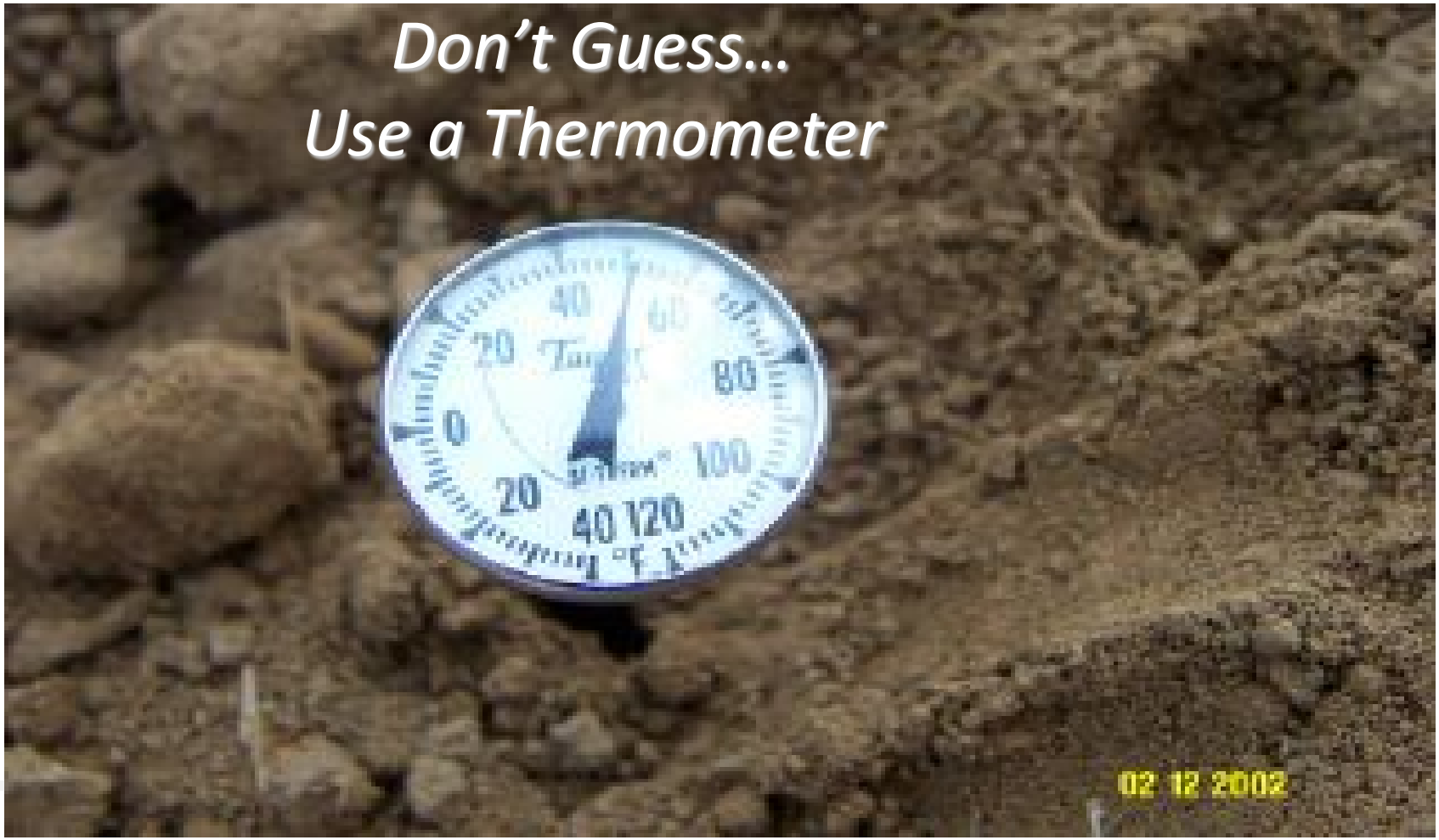
  www.epa.gov/fumiganttraining

  or
- ❑ In-Person Training by AMVAC
- ❑ Must be recertified every 3 years.

VAPAM & K-PAM
Good Agricultural Practices
(GAP's)

Soil Moisture Must Be Right.

Soil Temperature Must Be Right.



Soil Must Be Prepared
No Clods or Litter

Weather? Whether to apply or not

- Confirm no dramatic weather for the day
- Winds must be 2 mph and increasing to 5 mph
- No air inversions
- No excessive rain right after application

K-Pam and Vapam Fumigation

After making the decision to fumigate, the 3 most important factors required to ensure efficacy and return on your investment are:

APPLICATION

APPLICATION

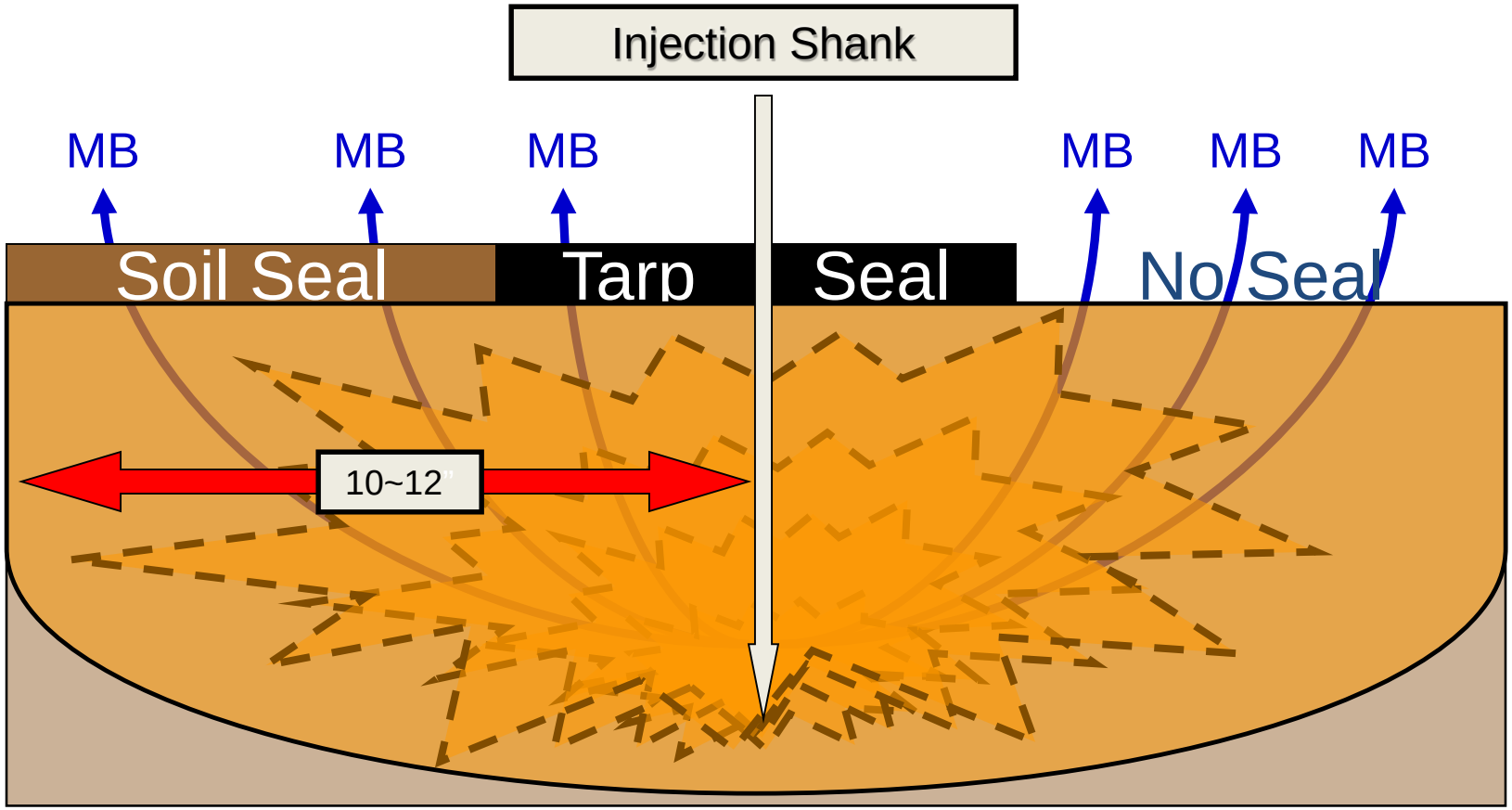
APPLICATION

Application Principles

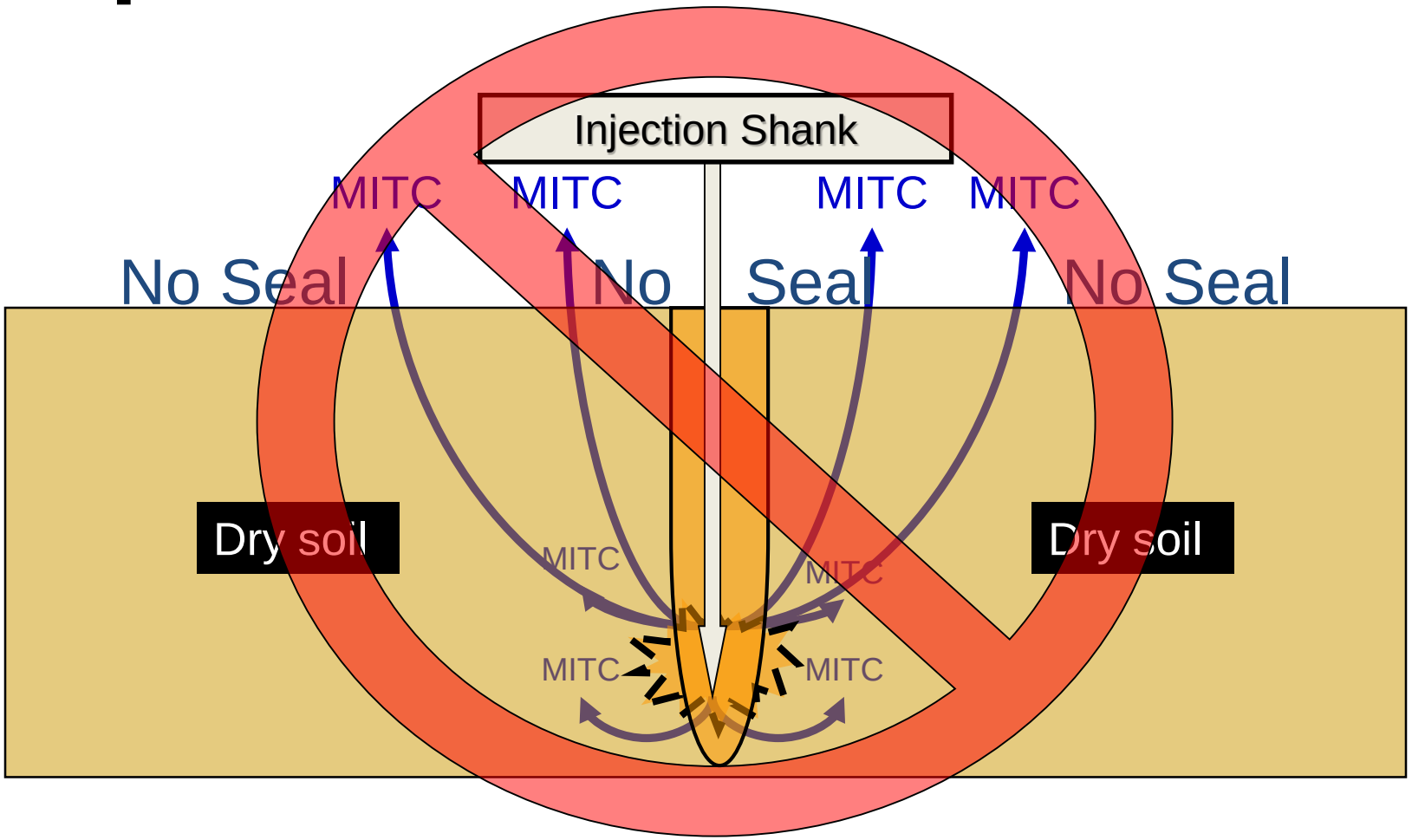
- Due to limited lateral movement Vapam and K-Pam must be placed close to the target pests during the application process
- Soil must be sealed by some means to keep MITC gas from escaping too quickly before it has had time to work

Concentration x Duration = Fumigation Effect

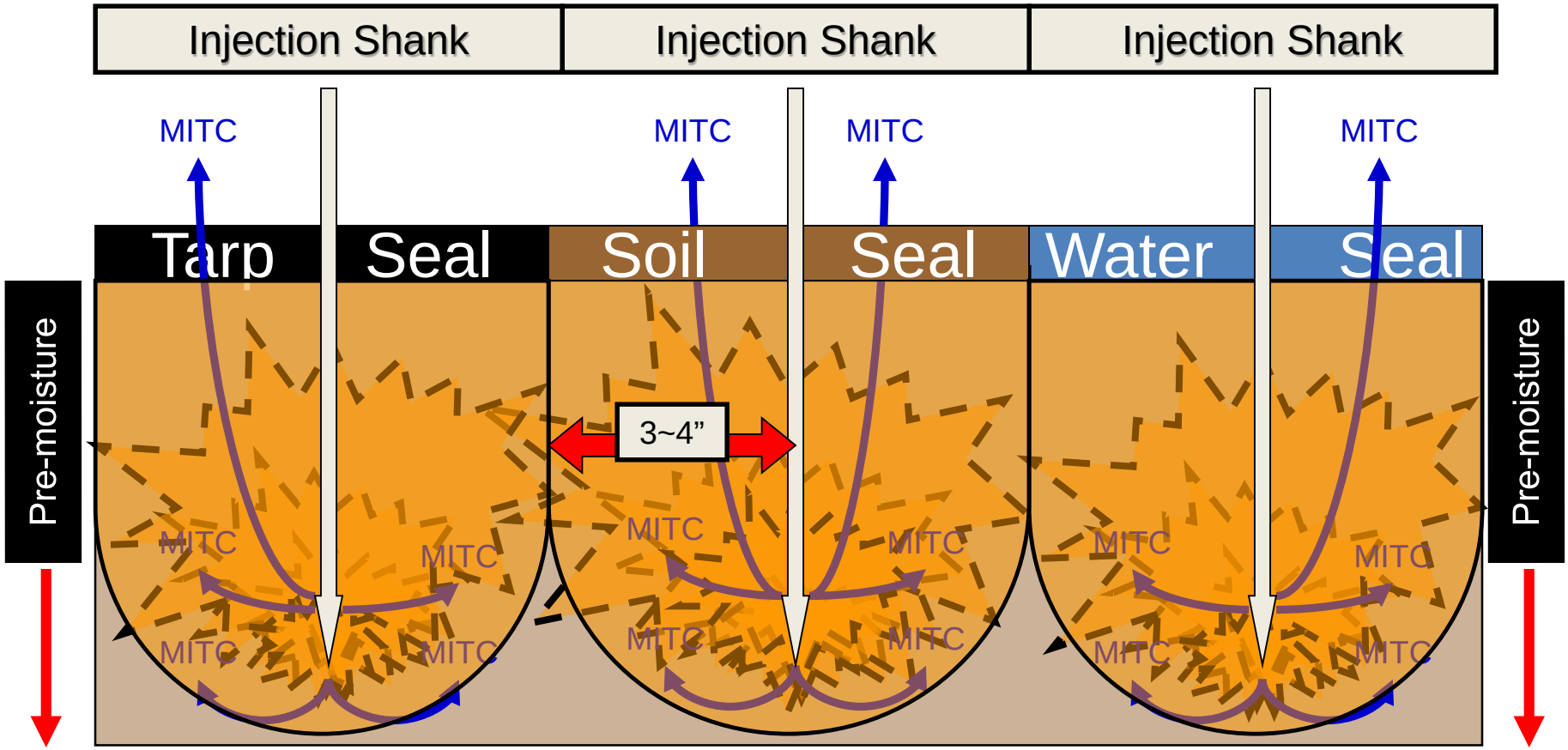
Methyl Bromide Movement



Vapam/K-Pam Movement



Vapam/K-Pam Movement



LABEL RATES

Treated area application rate refers to the rate of product applied to the portion of the field (e.g. rate within the bed of strip) that is fumigated
Broadcast equivalent application rate refers to the rate of fumigant applied within the entire perimeter of the treatment block (including areas between treated strips, roadways, etc.)

	Label rate (gal per treated acre)
Vapam HL	***30 - 75***
K-Pam HL	***30 - 62***

OPTIMAL RATE OF METAM DEPENDS ON

- **Application method**
  - Broadcast vs. banded
  - Shank vs. drip irrigation
- **Application time**
  - Spring vs. Fall
- **Target pest**
  - High rate required for hard-to-control weeds such as nutsedge
  - High rate required for hard-to-control soil borne pathogens such as *Fusarium*
  - High rate required for nematodes deeper in the soil profile
- **Soil type**
  - Soil texture will influence rate use
  - High soil organic matter increases the required rate

Broadcast equivalent rate

CALCULATING THE BROADCAST EQUIVALENT APPLICATION RATE

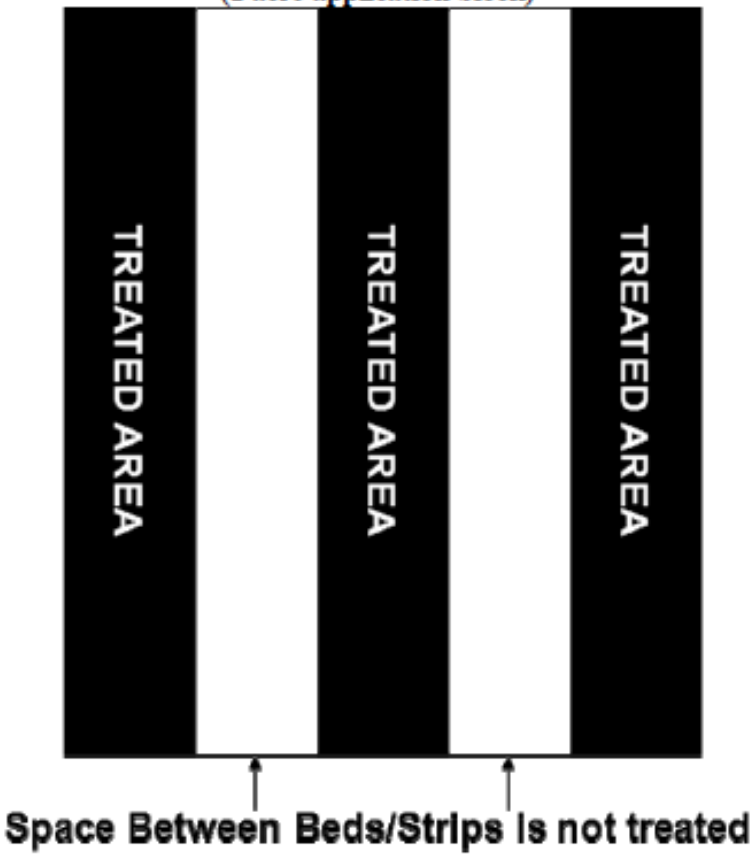
To calculate the broadcast equivalent rate for bedded or strip applications the following information is needed:

- gallons of product per treated acre
- strip or bed bottom width (inches)
- center-to-center row spacing (inches)
- application block size (acres)

Gallons of product **per treated acre** is the ratio of total amount of product applied to the size of the **total area treated** (e.g., the rate of product applied in the bed). For bedded or strip applications, the **total area treated** is the summation of the area (i.e., length x width) of each treated bed bottom or strip that is located within the application block as shown by the black areas in Figure 1 (e.g., black areas are 0.6A or 60% of the area within the application block). The area of the space between the beds/strips is not factored in the total area treated.

The **application block size** is the acreage within the perimeter of the fumigated portion of a field (including furrows, irrigation ditches, roadways). The perimeter of the application block is the border that connects the outermost edges of total area treated with the fumigant product.

Figure 1. Bedded/Strip Application (1 acre application block)



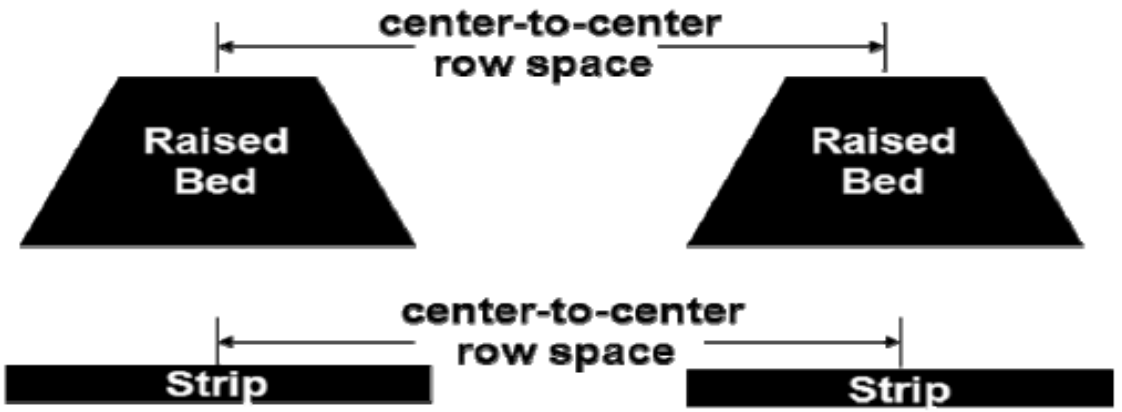
Broadcast equivalent rate in raised-bed applications

The "broadcast equivalent rate" must be calculated with the following formula:

$$\text{Broadcast equivalent rate (gallons product/acre)} = \frac{\text{strip or bed bottom width (inches)}}{\text{center-to-center row spacing (inches)}} \times \text{gallons of product/ treated acre applied in the strip or bed}$$

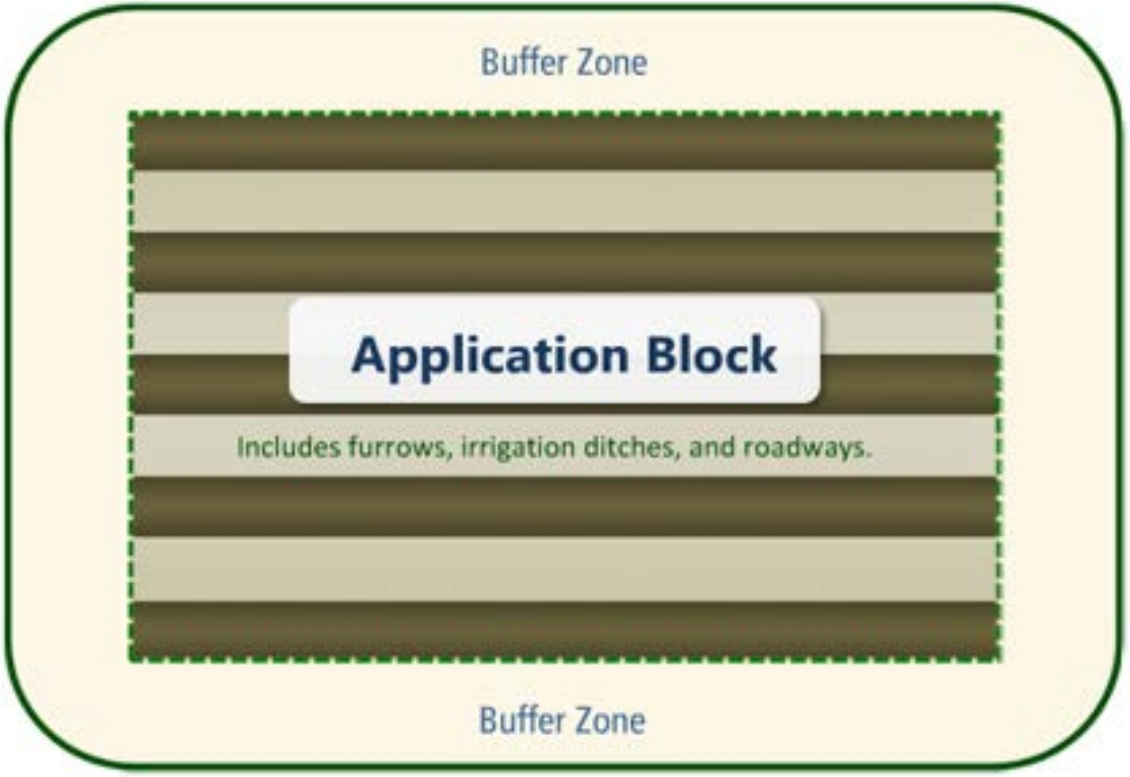
- The bed width must be measured from the bottom of the bed.
- The center-to-center row spacing must be calculated as shown in Figure 2.
- If there are any ditches, waterways, drive rows and other areas that are not fumigated that are in the application block, multiply the above broadcast equivalent equation by **(total area of strips or beds + row spacing)/(application block size).** A sample calculation is provided below.

Figure 2. Center Row Spacing



Buffer zones

Buffer zone is an untreated area around the application block



The distance of a buffer zone from the edge of the treated area depends on the application method and application block size – see the label for details

Table 3. Shank Injection Application - Bedded Buffer Zone Distances in Feet

	Application Block Size (acres)																									
Gal / A	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80	90	100	110	120	140	160
1	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
2	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
4	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
5	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
6	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
7	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
8	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
9	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
11	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
12	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
13	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
14	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
15	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
16	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
18	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
19	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
20	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	40
21	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	40	55
22	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	44	63	83
23	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	44	63	83	102
25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	28	30	55	80	105	130
26	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	46	65	78	95	118	140	163	186
27	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	28	30	68	105	133	160	180	200	220	240
28	25	25	25	25	25	25	25	25	25	25	25	25	25	25	31	34	43	51	86	120	150	179	199	219	239	259
29	25	25	25	25	25	25	25	25	25	25	25	25	25	25	36	43	58	72	104	136	167	198	218	238	258	278
31	25	25	25	25	25	25	25	25	25	25	25	25	25	25	42	52	73	94	122	151	184	218	238	258	278	298
32	25	25	25	25	25	25	25	25	25	25	25	25	25	25	48	61	88	115	141	166	202	237	257	277	297	317
33	25	25	25	25	25	25	25	25	25	25	25	25	25	25	53	70	103	136	159	182	219	256	276	296	316	336
34	25	25	25	25	25	25	25	25	25	25	25	25	25	25	59	79	118	157	177	197	236	275	295	315	335	355
35	25	25	25	25	25	25	25	25	25	25	25	31	41	47	80	101	138	177	200	223	259	295	318	341	364	388
36	25	25	25	25	25	25	25	25	25	25	25	36	56	69	100	122	157	196	223	249	282	315	341	367	394	420

Buffer Zone Credits

Buffer zone distance may be reduced by these percentages listed below. All credits may be added but cannot exceed 80% and minimum buffer zone is 25 feet..

- **Clay Content**. ≥27% = 10% reduction in buffers
- **Soil Temperature**. A 10% reduction if the soil temperature is ≤ 50°F at depth of application
- **Organic Matter Content**. ≥ 1% = 10%, ≥2% = 20%, ≥3% = 30% reductions.
- **Plastic Tarps** (tarpcredits.epa.gov) depending on the level of barrier you can reduce buffers by 10%, 20%, and 30%.

EPA now requires a buffer zone with proper posting

Application Flexibility
What is Working in Florida?

- Applications through water
  - Drip fumigation
- Applications mechanically in soil
  - Rototiller
  - Shank injection
  - Mini-Coulter application
- VAPAM & K-PAM as a base treatment
  - Combination with chloropicrin
  - Combination with Telone

Application Checklist

- ❑ Determine target pests and location.
- ❑ Soil preparation, (seed bed ready) and determine soil type
- ❑ Soil moisture, (60-80% field capacity)
- ❑ Avoid skips in the treatment zone
- ❑ Obtain a good seal
- ❑ Post application rainfall can diminish efficacy near the soil surface

How to Handle K-pam and Vapam

Metam Storage and Handling

AMVAC
An American Vanguard Company

Mini-Bulks can be easily mounted on tractor.

Field Transfer Procedures

- Field bulk tanks should be placed down slope and at least 100 feet from wells, and distanced from other water sources, (streams and ponds).
- Transfer in a well ventilated area away from buildings and other equipment.
- A closed transfer system (interlocking transfer) is mandatory!
- Always vent the receiving tank!
- Use Personal Protective Equipment.
- Eye Wash and Shower.

Precautions

Most spills are caused by improper, inadequate or poorly maintained equipment

Spills

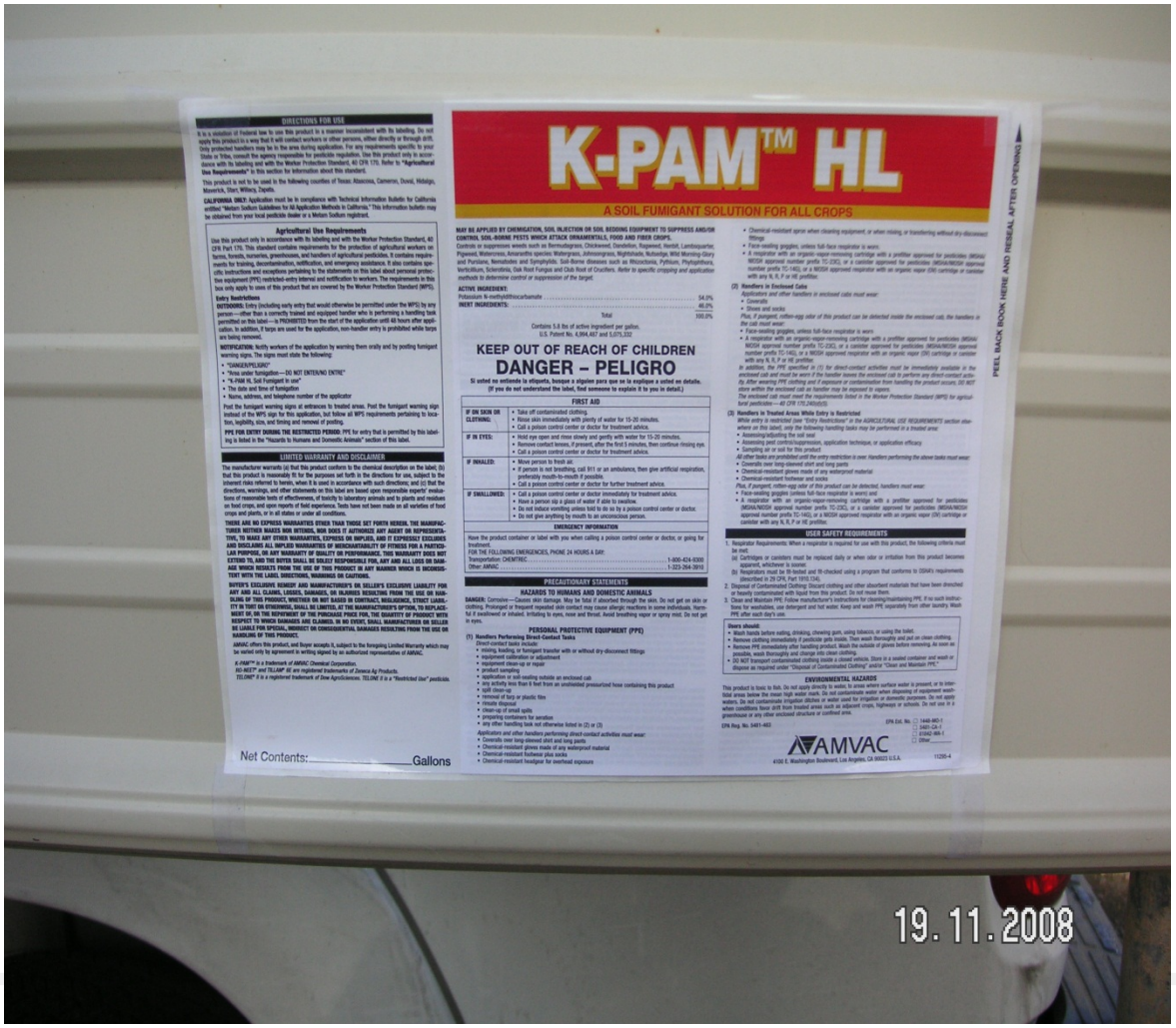
Improper Tank Security

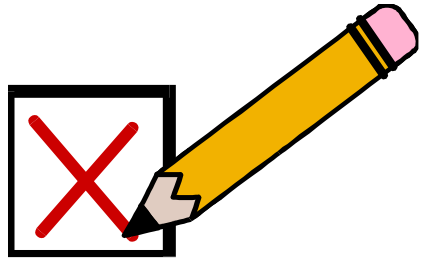
Unsecured Discharge Valve

Tanks must be locked-CCR T3 6672

Proper Tank Security

Metam Proper Tank Labeling



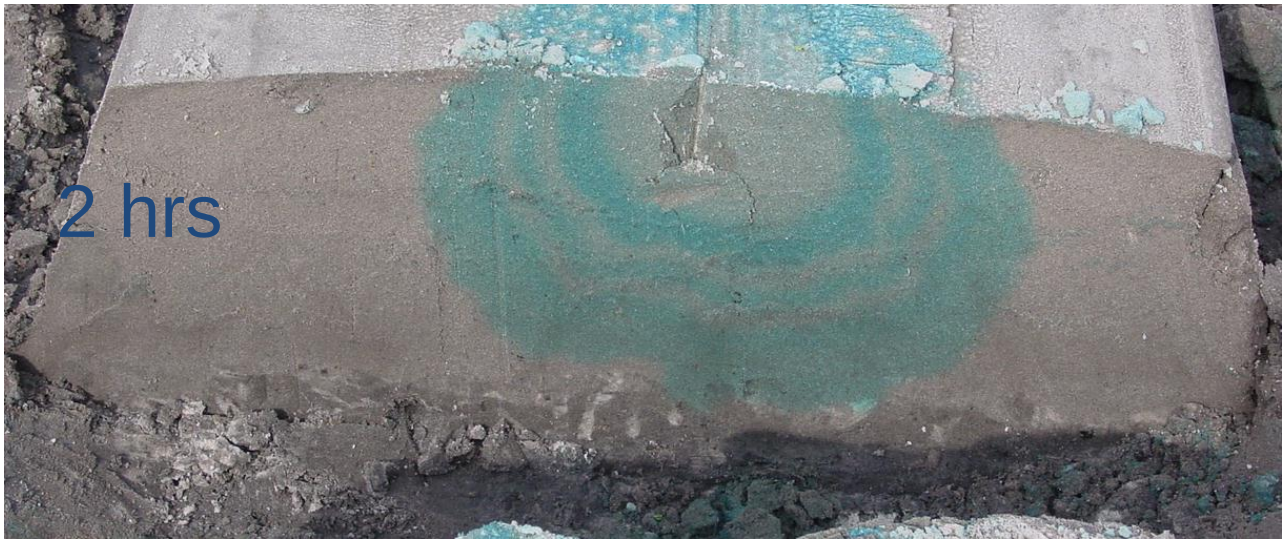


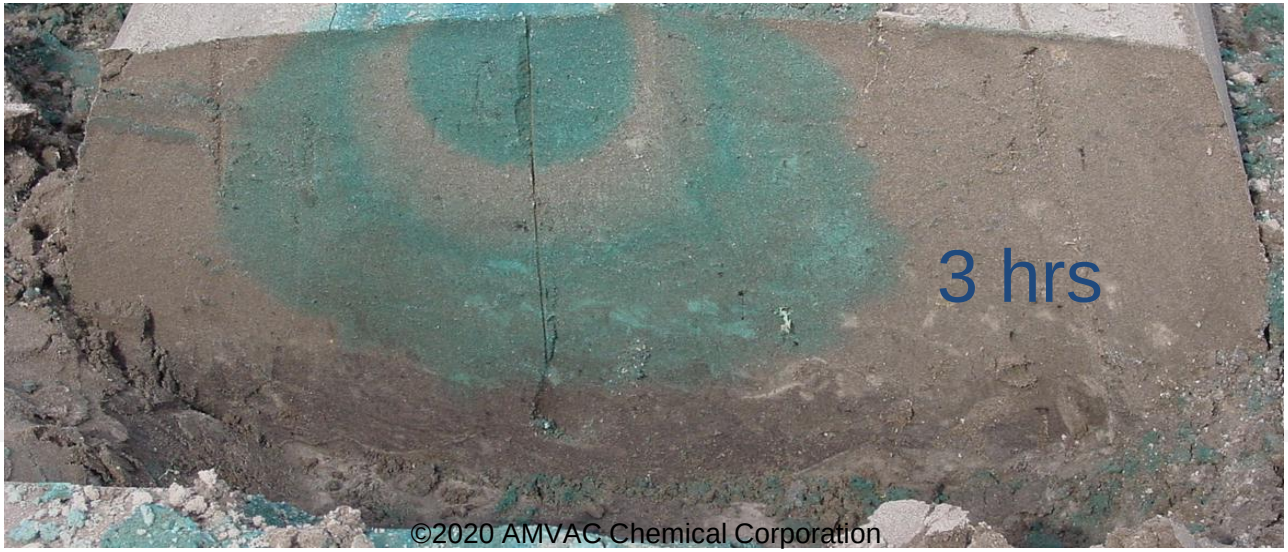
Metam Drip Application under Plastic

Drip Application Recommendations

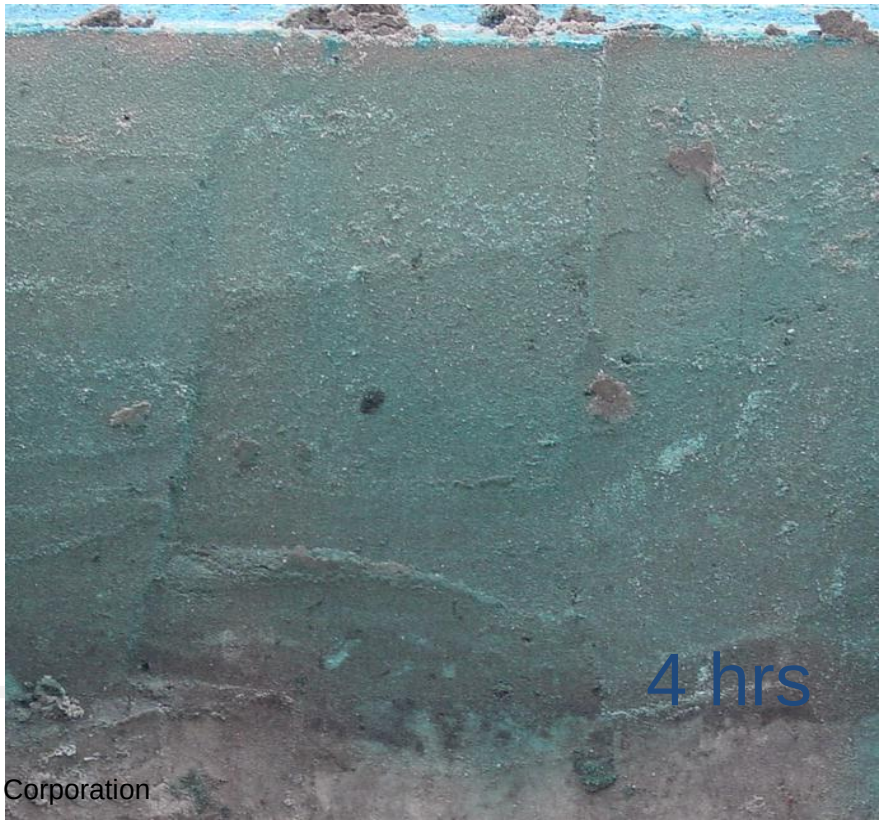
- Begin With Good Soil Moisture
- Firm Bed Compaction
- Thoroughly Pre-Wet the Bed
  - Usually one day prior to application
- Determine length of time required to thoroughly “re-wet” the bed
- Determine rate per treated acre
  - Apply K-Pam at a uniform rate throughout the duration of the anticipated run time.
- Purge (thoroughly flush) the drip lines
- Wait 14-21 days for MITC to dissipate
- No Worker Exposure!

EFFECT OF RUN TIME ON WATER DISTRIBUTION ACROSS THE BED ON THE EMITTER-Dr. Joe Noling





EFFECT OF RUN TIME ON WATER DISTRIBUTION ALONG THE BED ON THE DRIP TAPE



Single tape with limited run time

Dr. Nathan Boyd
GCREC

Double Drip tape application

Mechanical Application

Ground Equipment and Application Considerations

- Read the current label as equipment requirements have changed over the years.
- Check valves on shanks to not allow fumigant to drain or drip on the soil surface.
- All tanks, hoses, fitting, valves and connections must be serviceable and not leaking.
- Dry connect fittings must be installed on all tanks and transfer hoses.
- Sight and pressure gauges must be working.

Rototill and Roll

Shank Broadcast

Broadcast Applicator Newer Shank Designs

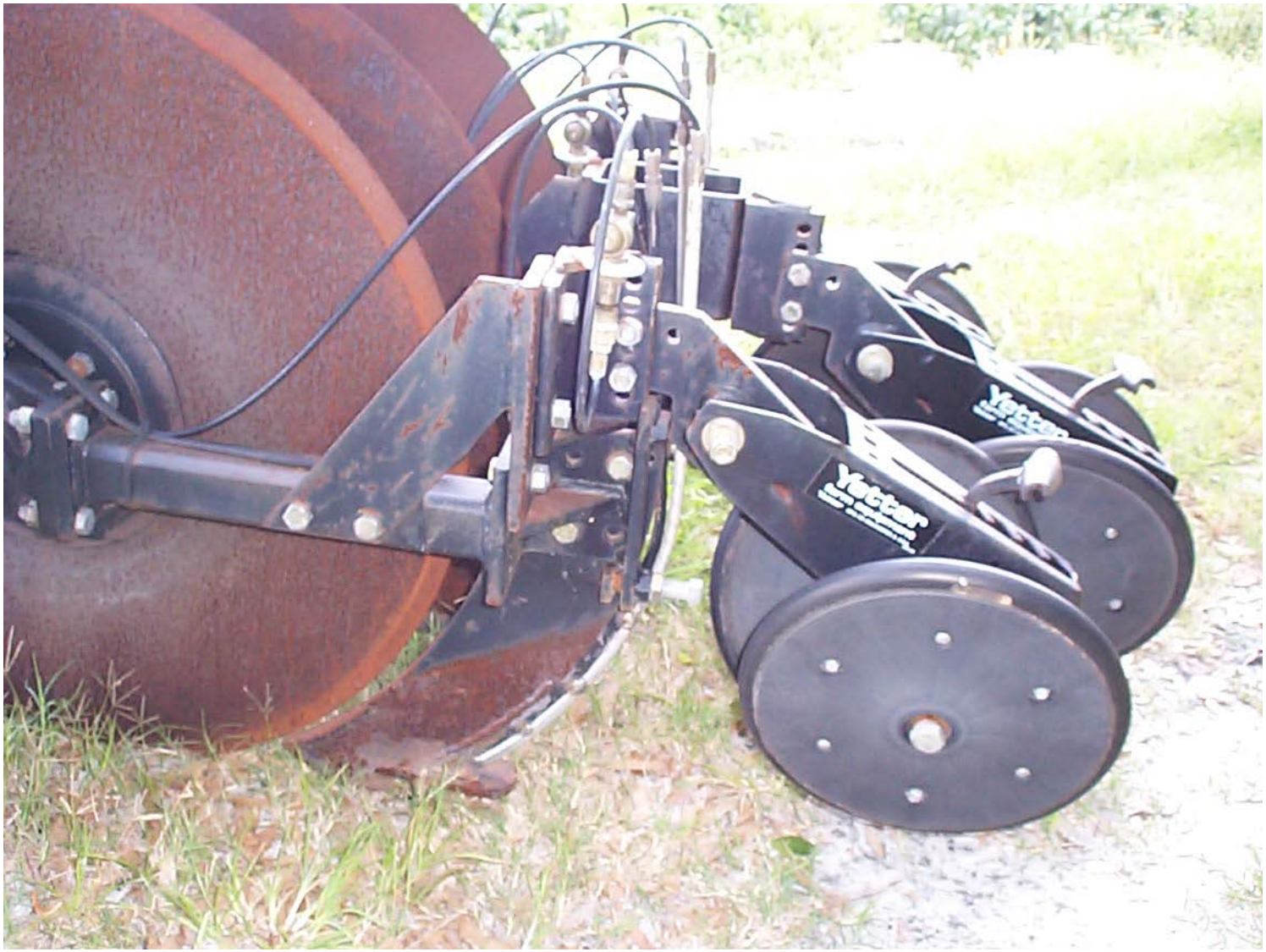
In-Bedder Applicators

Super Bedder

AMVAC
An American Vanguard Company

Deep Shank Applications-Dr. Joe Noling

Large Coulter Applicators – Yetter Rig



AMVAC
An American Vanguard Company

Mini-Coulter Applicator by John Mirusso

Mirusso Vapam® / K-Pam® Applicator

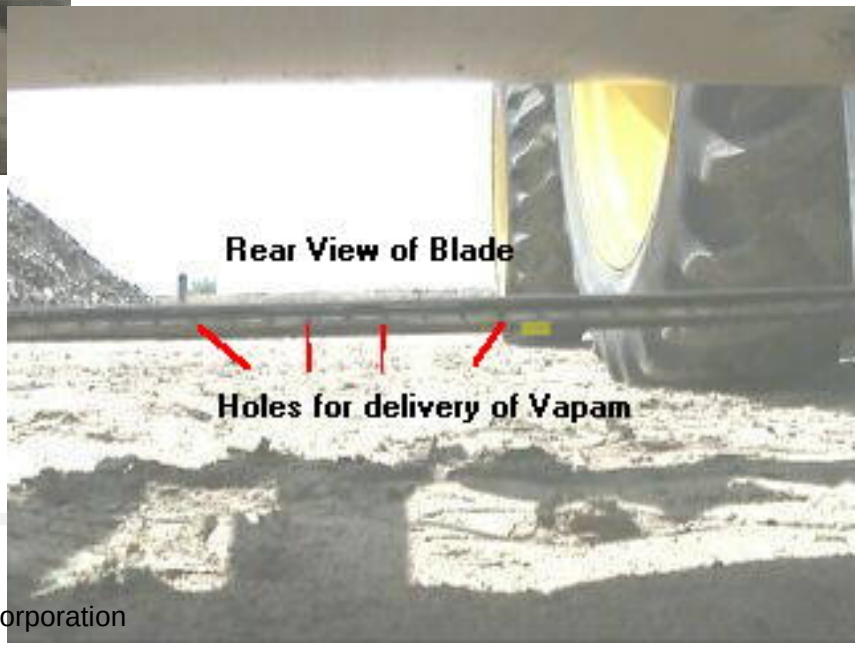
- This equipment support the 3-way Program of K-Pam, Telone, and Chloropicrin
- Telone and Chloropicrin are applied in bed with standard gas rig followed by ***K-Pam*** through the Mirusson K-Pam Applicator.
- This program relies upon ***K-Pam*** for the weed control since Telone and chloropicrin are not reliable weed control products.
- **John Mirusso, Mirusso Fumigation & Equipment,**
- **Delray Beach, FL**
- **561-251-5187**

Dr. Jim Gilreath GCREC

Lettuce Coulter Rig

3 Shank Potato Rig

Spray Blade



Center Pivot Application

K-Pam/Vapam Sprinkler Application

What about Mulch Films –

- Remember, you get credits for higher barrier films!

Effective Sealing is Critical to:

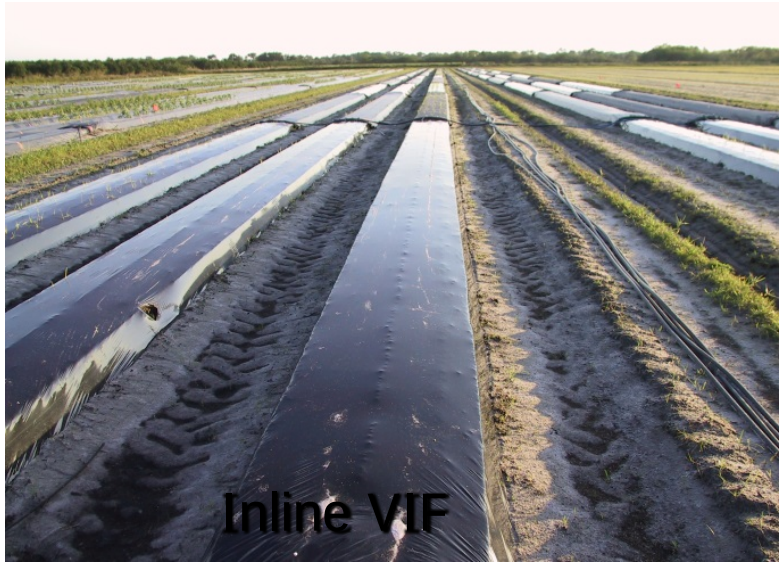
- Maximize fumigation effect
  - Concentration X Duration = Fumigation Effect
  - Greater potential dose to target organisms
- Minimize off-gassing problems
  - Reduces Buffer Zones especially with VIF and TIF
  - Avoid fume concerns with public
  - Help insure long-term product viability

Which Mulch Film is Right?

Dr. Jim Gilreath

Inline, Inline + K-Pam with VIF

Dr. Jim Gilreath



Thank you for your time and attention

Mike Herrington
SE High Value Crop Specialist
MikeH@Amvac.com

K-Pam and Vapam are restricted use pesticides. Important: Always read and follow label instructions. See label for listed weeds and pests. Some products may not be registered for sale or use in all states or counties. Please check with your state agency responsible for pesticide registration to ensure registration status. All products are EPA registered.