Fumigation Basics

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Module Outline

I. Fumigation
II. Keys to a Successful Fumigation
III. Application Methods
IV. Product Responsibility
V. Planning a Fumigation
VI. Managing a Fumigation
VII. Conclusion

I. FUMIGATION

Soil Fumigation

- Soil fumigants are hazardous materials and must be handled with care only by those individuals experienced with their proper use.
- Handlers and certified applicators must have received the proper training before any fumigation activity takes place.
- Always read and follow the label!!!

Why Fumigate?

Pink Root in onions (Phoma)

- Fumigation objectives: Manage targeted pathogens to help growers meet cropping objectives
- Cropping objectives
  - Uniform crop
  - Healthy plants
  - Optimal growth
  - Superior crop quality
  - Increase production
  - **Maximize economic return**

Chloropicrin and Disease Management

Chloropicrin is a multipurpose fumigant used to manage soil borne diseases and pests including:

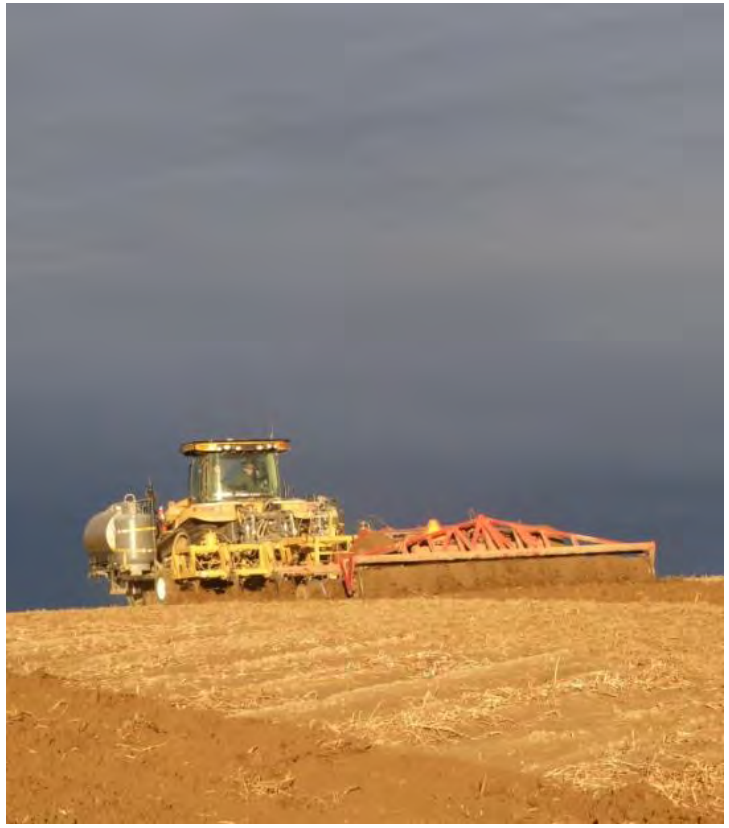
- Fusarium
- Phytopthora
- Verticillium Wilt
- Collototricum Streptomyces
- Phoma (Pink Root)
- Pythium
- Rhizoctonia
- Wire Worms

Chloropicrin Formulations

- Chloropicrin can be formulated with other fumigants to optimize desired disease/ nematode management.
- Most common is Telone II and Methyl Bromide.

- PicClor 80 – 80% Pic/ 20% Telone II
- PicClor 60: 60% Pic/ 40% TeloneII
- Telone C-35: 35% Pic/ 65% Telone II
- Strike 85/Pic Plus: 85% Pic/ 15% solvent
- Tri-Con 50/50: 50% MB/ 50% pic

**there are many ratios consult local sales managers for specifics*



Examples of Crops that use Fumigants Worldwide

- Tomato
- Potato
- Sweet Potato
- Yam
- Peppers
- Onion
- Celery
- Cucumber
- Tobacco
- Peanuts
- Strawberry
- Raspberry
- Blueberry
- Grapes
- Melons
- Stone Fruits
- Pome Fruits
- Tree Nuts
- Ginseng
- Ginger



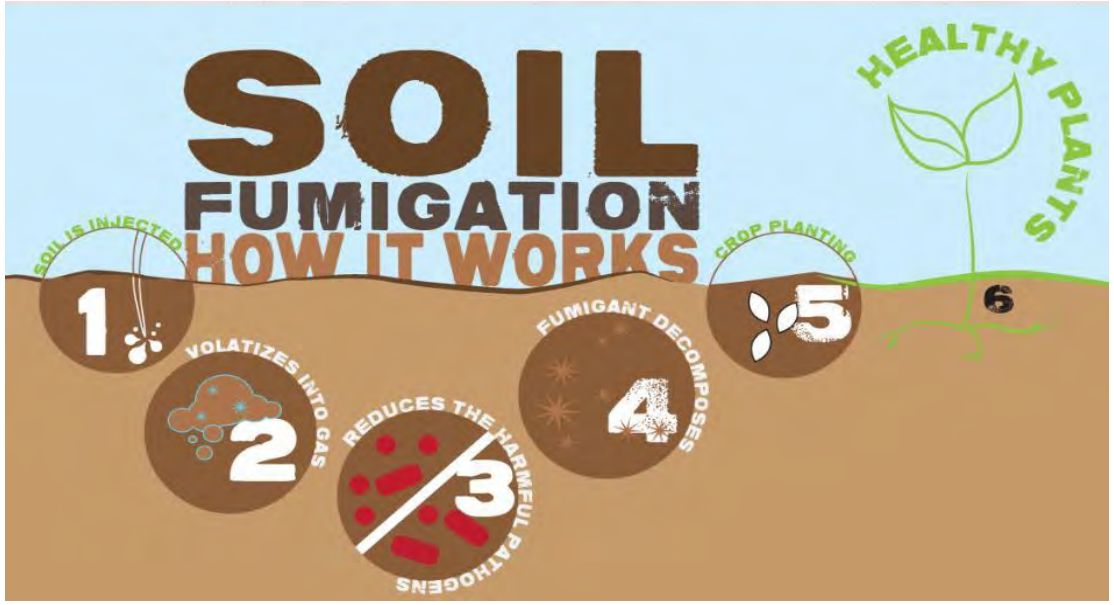


Soil Fumigation: *How it works*

1. Fumigants are injected as liquids into the soil

2.The fumigant volatizes into gas diffusing through the soil air space , radiating out from the points of injection

3.The treatment significantly reduces harmful pathogens, rebalancing the native beneficial soil microbe population, conditioning it for planting.



4.Fumigant decomposes rapidly in the soil *(Chloropicrin actually biodegrades into plant nutrients)*

5.Crop planting takes place in newly condition soil

6.Healthy plants are able to maximize their water and nutrient use and grow full yield potential with no uptake into the root or residue on the plant

Soil Fumigation: *Impact on Land Utilization*

- Pre-plant soil fumigation with allows the grower to plant the same crop year after year on the same land with no spread of disease and no impact to yield or quality of production.
- Reduces or eliminates the need for crop rotation.
- Where crop rotation is utilized, subsequent crops planted on fumigated land reap the benefits from fumigation of primary crop, increasing the quality and yield of all crops.
- **Examples**
- Rotation of onions, tomatoes and sugar beets with pepper crops
- Rotation of lettuce with strawberry crops

Soil Fumigation: *Impact on Land Utilization*

Soil fumigation results in higher yields per acre, reducing the total land required as compared to organic crop production.

Examples:

- Lettuce in California
  - 232,842 total acres grown
  - 18,012 organic acres (8% of total)
  - Organic production has a 69% yield efficiency of conventional
  - To convert all lettuce to organic, 169% of the current conventional acreage would be required (393,503 acres)
  - To convert all lettuce to organic, an additional 160,660 acres of cropland would be required
- Grapes in California
  - 772,238 total harvested acres
  - 27,762 organic harvested acres
  - Organic grapes account for 64% of current non-organic acreage harvested
  - Would need 136% of current non-organic acreage
  - If all acres in CA turned organic, we would need 1,050,243 acres
  - Increase of 278,005 additional acres of cropland

Soil Fumigation: *Effect on Water Use Efficiency*

The practice of soil fumigation improves root growth leading to larger, healthier root systems with more secondary root growth, increasing water use efficiency as compared to organic crop production.

Examples:

- Lettuce in California
  - To convert all lettuce to organic, an additional 160,660 acres of cropland would be required
  - 2.5 ft/acre of water are needed for lettuce
  - 131 billion additional gallons of water required per year if converted to organic crop production
- Grapes in California
  - To convert all grapes to organic, an additional 278,005 additional acres of cropland would be required
  - 0.33 ft/ acre of water needed for grapes
  - 30.2 billion additional gallons of water required per year if converted to organic crop production

(One US Survey acre foot = 325,853 gallons of water)

Soil Fumigation: *Effect on Pesticide & Fertilizer Use*

- By eliminating soil-borne diseases and pests, pre-plant fumigation with Chloropicrin allows for healthy, expanded root systems and a more vigorous foliar structure.
- Frail plants and underdeveloped root systems are more vulnerable to foliar pests and disease.
- Weak crops are prone to build-ups of:
  - Cyclamen spider mites
  - Leaf spot
  - Powdery mildew
  - Root weevils
  - Other root diseases
- Pre-plant fumigation with Chloropicrin grows strong roots and plants, decreasing the susceptibility of crops to these foliar pests and diseases and reducing the need for use of foliar miticides and fungicides.

II. Keys to Successful Fumigation

PROMOTING GOOD MOVEMENT OF THE PRODUCT THROUGH THE SOIL

Keys to Successful Fumigation:

Promote Good Movement

- Soil Preparation
- Soil Temperature
- Soil Moisture
- Fumigant
- Injection Depth
- Sealing
- Waiting Period
- Timing

Application

- Product placement
  - Current label say 10 inches from sealed or packed surface
  - New label will say 12 inches !!!!
- Proper equipment to seal surface.
  - Broadcast: Disk followed by ring roller
  - Bed: Ring roller, bed press or chisel disruption
- Forecast warns of stagnant air conditions

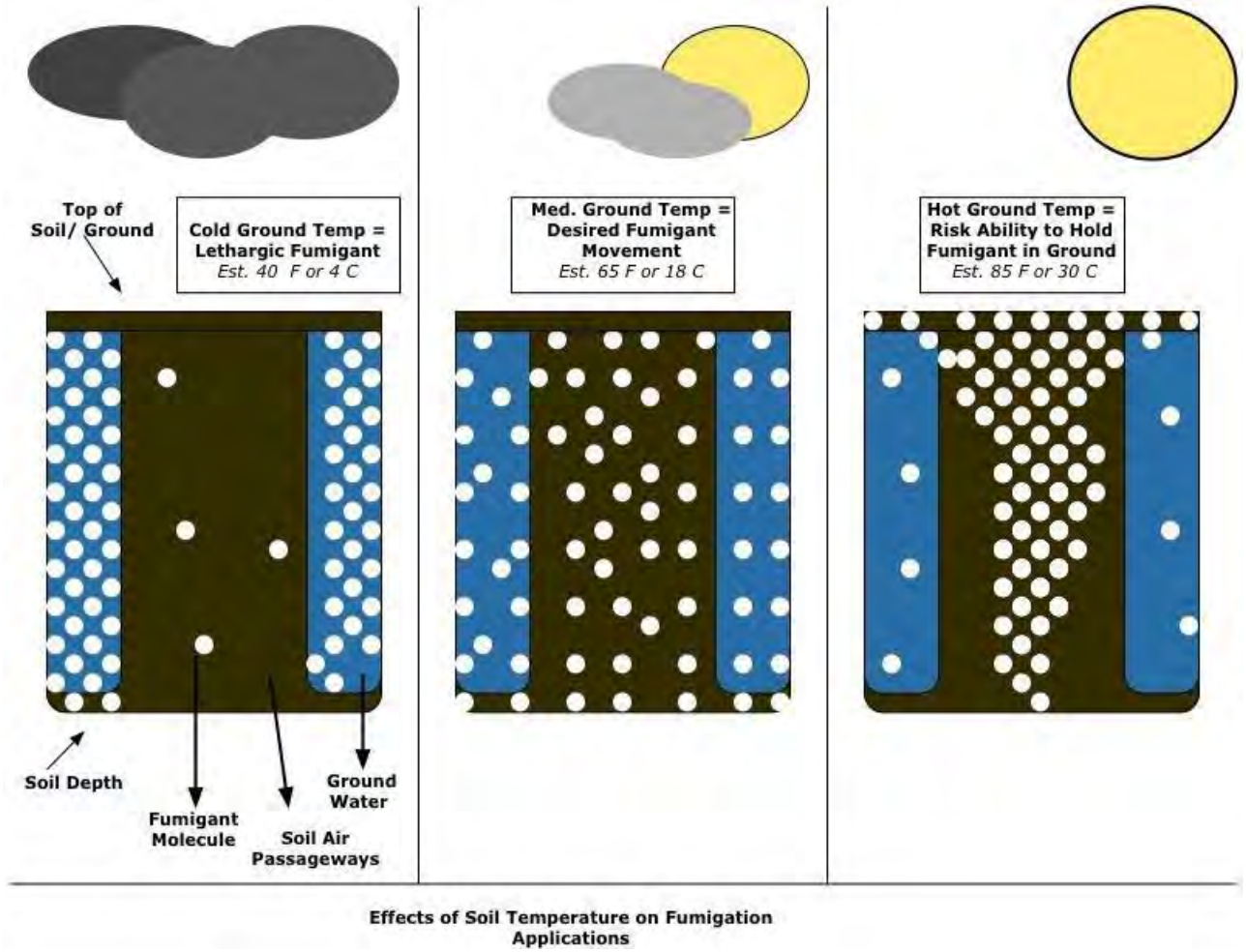
• If you cannot apply the product 12 inches deep, properly seal the soil, or soil moisture is inadequate there is potential for an off gassing.

• Do not fumigate!

Keys to Successful Fumigation: *Ex. Soil Preparation*

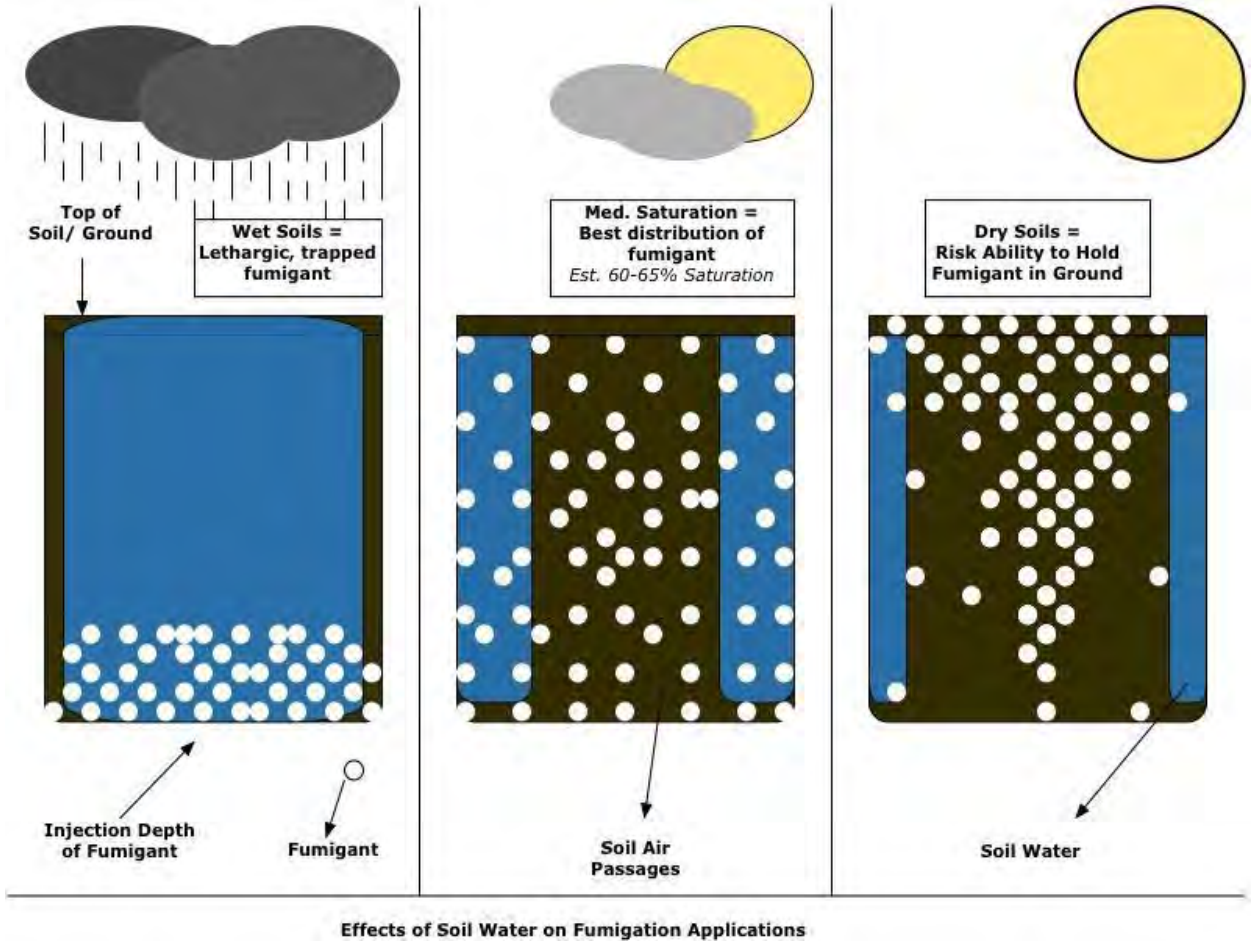
- Soil should be in good seedbed condition prior to fumigation
- Break up clods and loosen soil by
- cultivation one week before application.
- Work soil deeper than intended fumigation.
- Soil should be free of trash to reduce fumigant “tie up” in organic matter.

Keys to Successful Fumigation: *Ex. Soil Temperature*



Effects of Soil Temperature on Fumigation Applications

Keys to Successful Fumigation: *Ex. Soil Moisture*



Effects of Soil Water on Fumigation Applications

Keys to Successful Fumigation:
Testing for Soil Moisture

TRIEST AG GROUP RECOMMENDS…

- Soil should be moist from a minimum of 2” below soil surface
- Apply at a depth of at least 8”
- Use the USDA Soil Moisture “Feel Test” to determine moisture
- Obtain soil sample
- Squeeze firmly in hand to form “ball” shape
- Form a ribbon by squeezing soil between thumb and forefinger
- Observe Soil texture, firmness, water, staining on fingers, and color
- Dry soils will crumble in hand, while wet soils will stain hand and leave water residue

THE USDA “FEEL TEST”

- (Examples at 50-75% available)

Fine Sandy/Loam Soils

Sandy Loam Soils

Sandy Clay Soils

Clay Soils

III. APPLICATION METHODS

Methods of Application:

Determine what is best for you

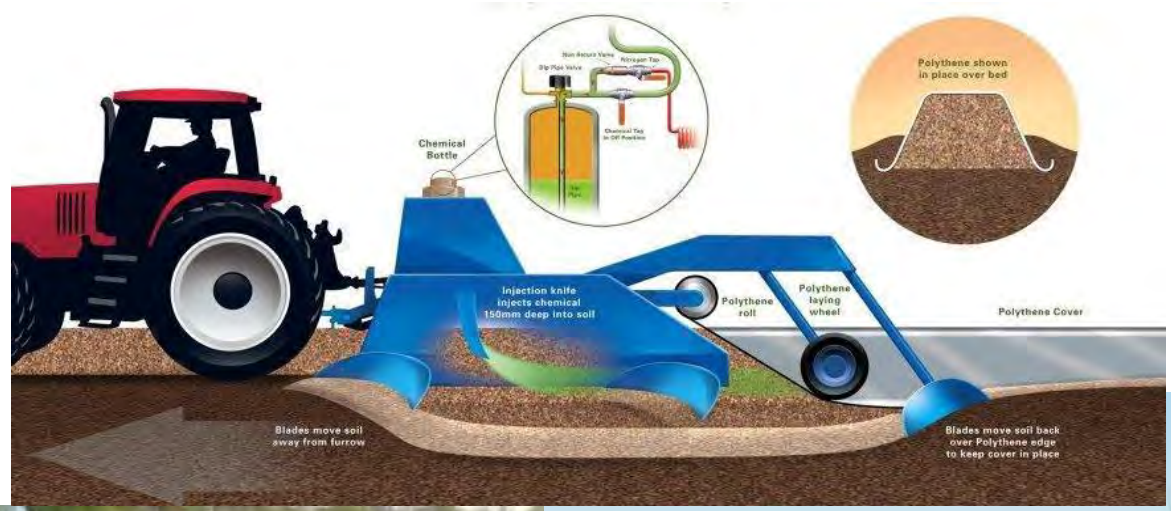
<u>OPTIONS</u>

- Tarp, Broadcast Fumigation
- Tarp, Bed Row Fumigation
- Non Tarp Applications
- Drip Injection
- Spot Injection

<u>CONSIDERATIONS</u>

- Land/ terrain
- Disease pressure
- Drainage/irrigation issues
- Cultural practices

Methods of Application: *Ex. Tarp, Bed-row fumigation*



Fumigant Application – Berry Bed Fumigation

Methods of Application: *Ex. Non Tarp Applications*

Applying Fumigant: *Non-Tarp*

Bed Applications

- Tobacco
- Potatoes
- Melons
- Onions

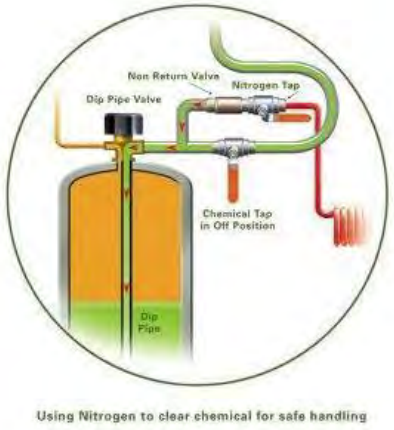
Broadcast

- Apples, cherries
- Potatoes
- Raspberries
- Ornamentals

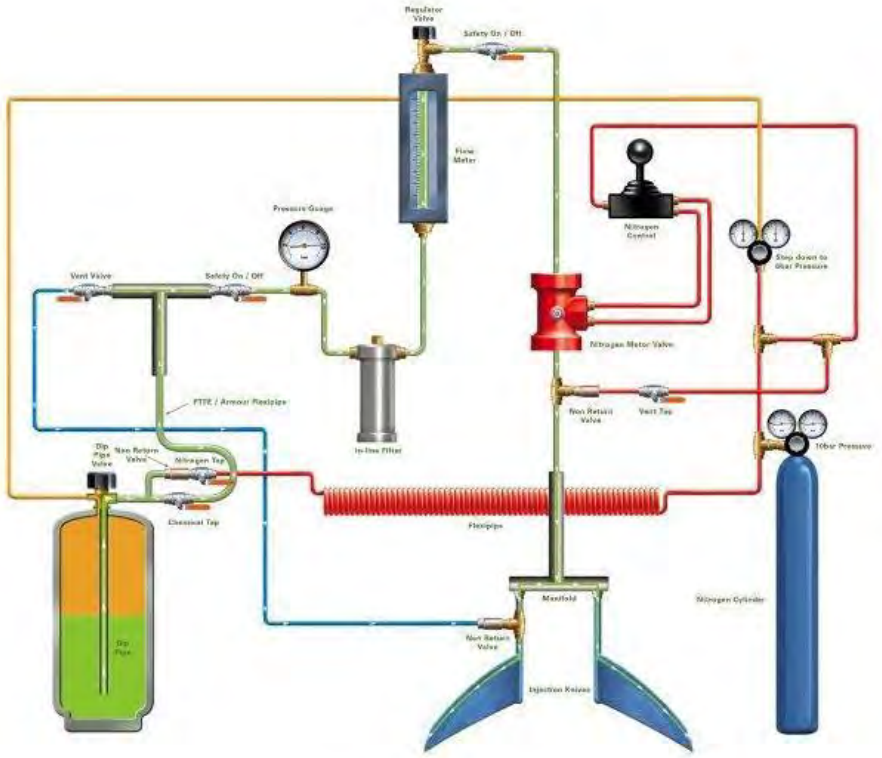
Chloropicrin Application – Flex Fume Potato

Methods of Application: *Ex. Drip Fumigation*

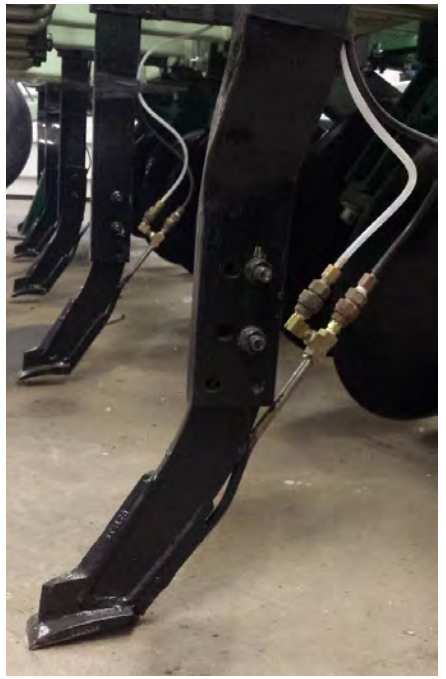
Methods of Application: *Ex. Fumigation Equipment*



Using Nitrogen to clear chemical for safe handling



Generic Pressurized Fumigation Rig



Self Sealing Knife

IV. Product Responsibility:

DEALER AND END-USER RESPONSIBILITIES

Product Responsibility: Dealer Responsibility

- Comply with applicable laws and regulations
- Verify that application equipment is maintained and meets label requirements
- Follow safe storage, handling, and transportation practices
- Return Cylinders in Good Condition
- Ensure they are labeled and have correct placards
- Ensure employees are qualified and receive appropriate training
- Maintain true and accurate records of sales
- Make copies of licenses held by end users
- Document and be able to track serial numbers of containers sold to end users
- Ensure End-Users :
    - Are provided instructional materials
    - Holds a valid grower pesticide number or
    - Holds a valid exterminator license

Product Responsibility: End User Responsibility

- Comply with applicable laws and regulations
- Verify that application equipment is maintained and meets label requirements
- Follow safe storage, handling, and transportation practices
- Return cylinders in good condition!
- Ensure handlers are receive appropriate training and PPE
- Ensure you have a valid license to buy and apply Fumigants
- Ensure bystanders and unequipped persons do not enter the buffer zone
- Complete an FMP and Post Application Summary
- Maintain a copy each for two years

V. Planning a Fumigation

CREATING, UPDATING, AND USING THE FUMIGANT MANAGEMENT PLAN

Planning an Application: *Fumigation Management Plan*

- **Create a "FMP" (Fumigant Management Plan)**
- What is a FMP?
- A safety measure. Meant to mitigate risk to bystanders, handlers, and workers…
- An essential tool for the fumigator on site to manage the application…
- Safety = Proper Application…
- Proper Application = The best results…
- FMPs can be downloaded directly from the US EPA website or you can create your own generic FMP so long as all required information is on it.

Planning an Application:

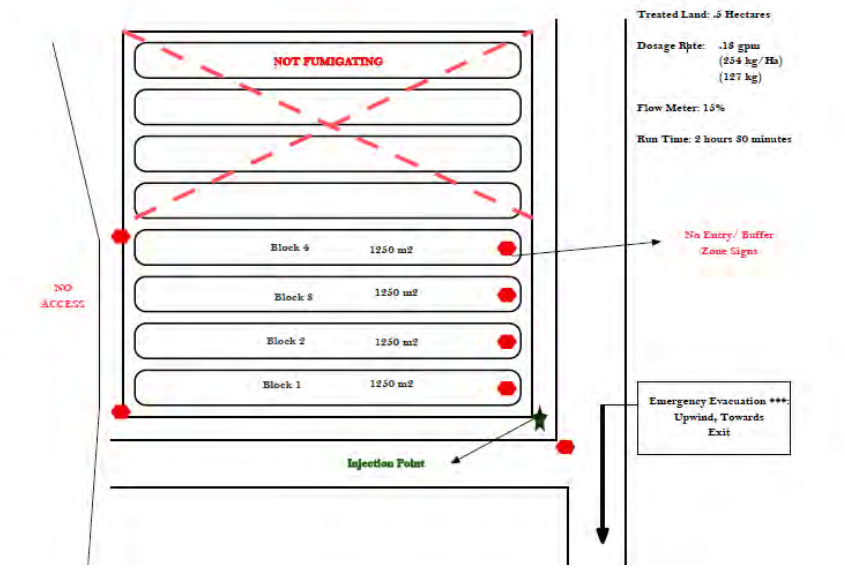
What is on a FMP? (specifics also found on label !)

- Certified Applicator Information
- General Site information
- Customer/owner information
- Record keeping requirements
- Application details (ie: rate)
- Buffer Zone details
- Emergency Response Plan
- Communication Plan
- Handler Information
- Enclosed Cabs (If Applicable)
- Tarp Plan (cutting/removal dates)
- Soil Conditions
- Posting Signs
- Applicable Emergency Measures (ie: close to hospitals)
- Advance Notification Requirements (if applicable)
- Air Monitoring Plan
- Good Agricultural Practices (checklist)
- Site Map illustrating block specific info

Planning an Application:

Ex. Fumigation Site Maps

MAP 1: HAND DRAWN



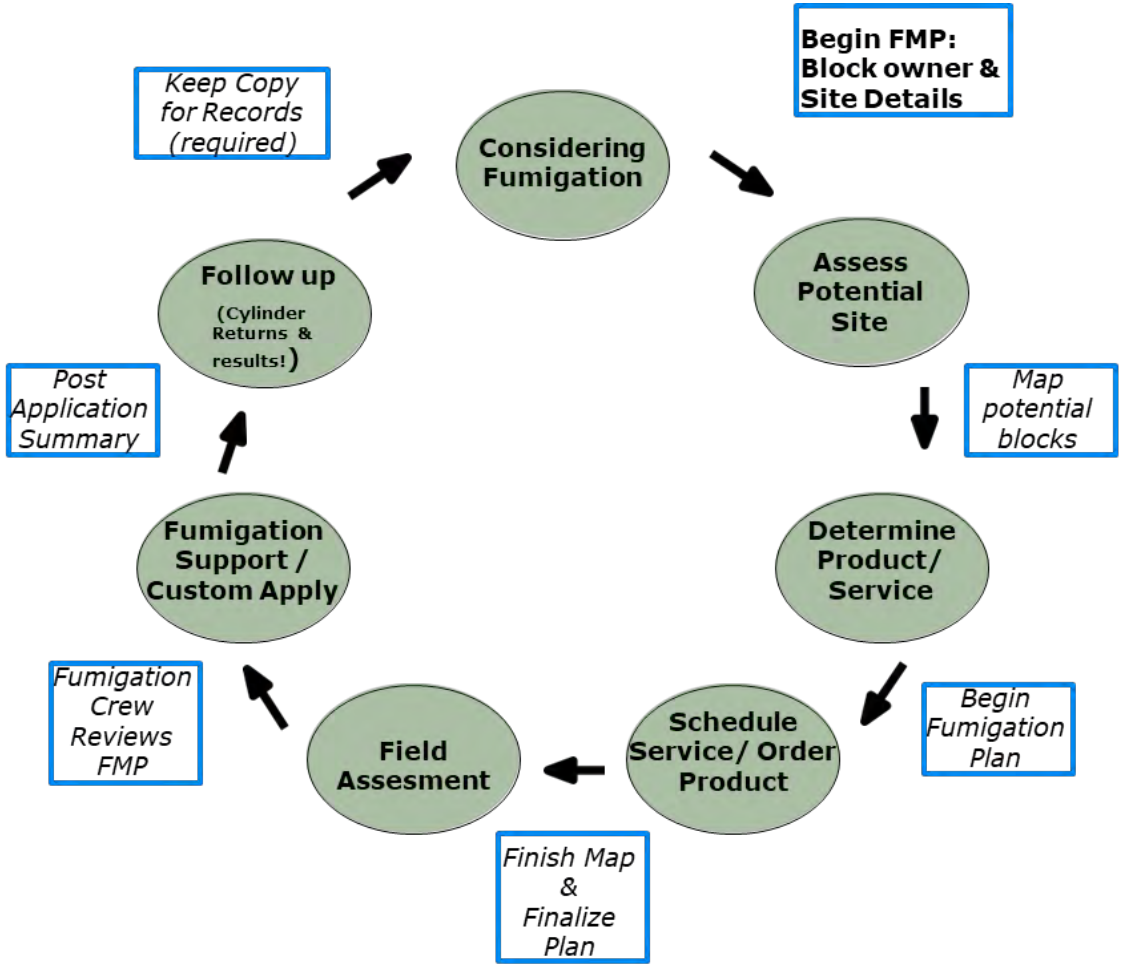
MAP 2: GOOGLE EARTH

MAPS CONTAIN:

» Plot Outline » Product Used » Entry/Exit and Buffer Zone Signs

» Dose Rate » Application Size » Emergency Evacuation Route

Planning an Application: *Use the FMP as a tool…*



VI. Managing the Application

ARRIVAL, RISK MANAGEMENT, BUFFER ZONES, INVERSIONS, AND POST APPLICATION

Managing an Application: *Arriving On Site*

- Review FMP before arrival on the field
  - Confirm and print out weather forecast and wind conditions
- Assess the field conditions: Ground temperature, moisture, organic matter, soil texture
- Verify that all provided handlers are on FMP, have been trained, and have proper PPE
- Fill out and post proper Buffer Zone and NO Entry Signs
- Licensed applicator verifies and Signs FMP
- Dawn appropriate PPE to prep/ connect fumigation equipment
  - Remove bonnets and attach lines to fumigant
  - Attach Nitrogen lines to fumigant cylinders
- For a tarp, broadcast fumigation use tractor to mark a header on either end of the field where film is buried
- Begin Fumigation

***** DOCUMENT ANY changes to the fumigation plan to be used for the Post Application Summary**

Managing an Application:

Mitigating the risk of vapor drift

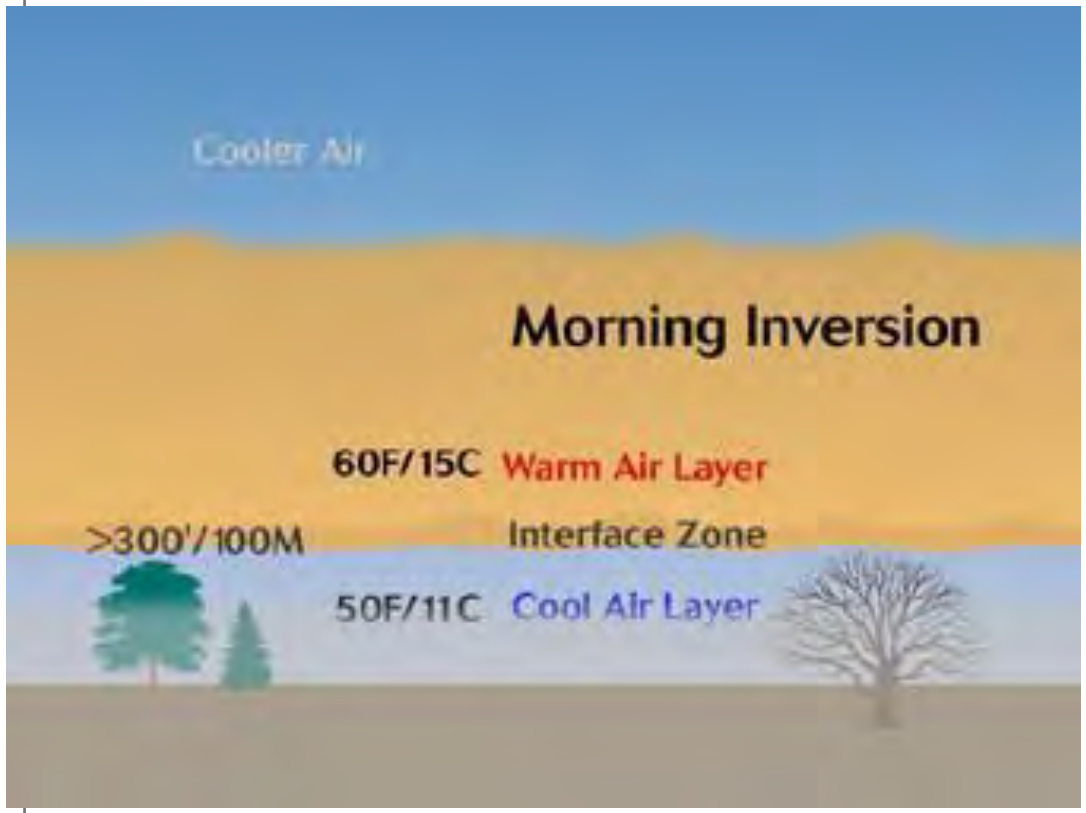
- Vapor drift is when the fumigant travels to unintended areas that can potentially affect by-standers.

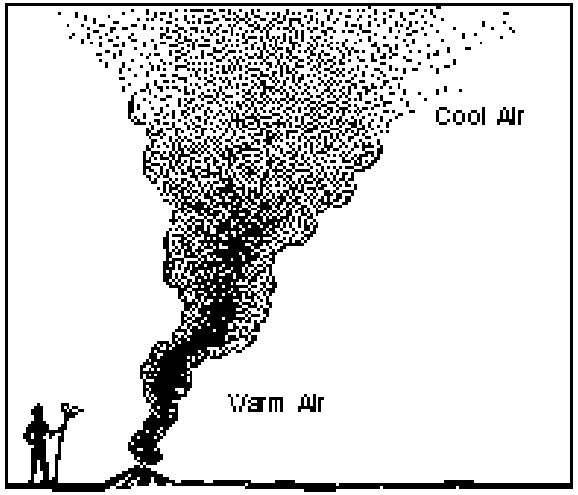
- The risk of incident from drift can be greatly diminished by:
    - Following your FMP
    - Checking weather (not fumigating in high winds and adverse weather)
    - Limit application to target area
    - Focus on odor mitigation
    - Bigger hills and beds
    - Smaller beds increase risk
    - Having proper buffer zones
    - Looking out for temperature inversions

Managing an Application: *What is a buffer zone?*

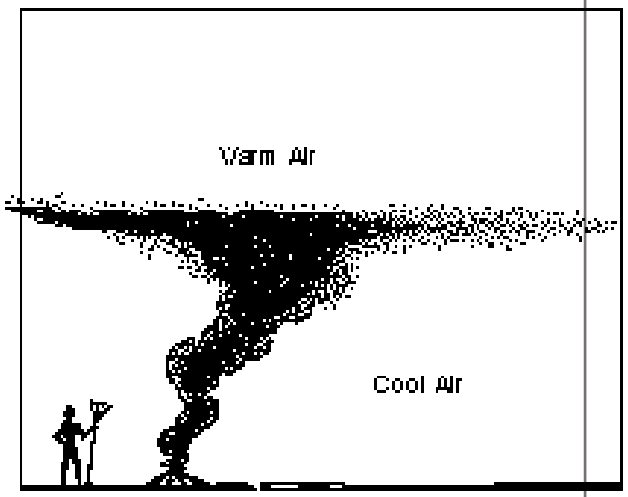
- The buffer zone is a restricted area surrounding the location where a fumigation has taken place
- Meant to warn bystanders that the
- fumigation has been used
- Means to prevent accidental entry into a treated area.
- Check the label for the specific size
- buffer zone required.
- Buffer zones are based on the rate used and the size of the application
- Buffer Zone Signs should be posted as a warning at all entryways to a fumigation site

Managing an Application: *Temperature Inversion*





Normal conditions –
Smoke rises and disperses



Inversion condition
Smoke concentrates

Managing an Application: *Post Application*

- Soil must be left 10-14 days after application
- DO NOT “DRESS UP” THE ENDS!
- Unprotected persons do not re-enter the buffer zone within 48 hrs after application.
- At end of fumigation period, prior to planting, ensure no chloropicrin present.
- Perform a lettuce seed test, or place transplants in field to test for residual fumigant.

Managing an Application:
Post Application Summary

- Deviations from FMP
  - E.g., date of application, procedures, personnel, etc.
- Summary of weather, site conditions
- Description of problems or complaints
- Actual dates of tarp activities, sign removal, etc.
- In the USA - Must complete within 30 days of application
- TriEst Ag Group recommends completing Post App directly after fumigation

VII. Conclusion: Fumigation

In Closing

- Soil fumigation economically and effectively helps manage many types of nematodes, viruses, bacteria, soil insects, fungi and certain weeds and diseases.

- When properly applied pre-plant soil fumigant treatments
- protect valuable crops including a variety of vegetables, field crops, nursery crops, and nut and fruit trees worldwide.

THANK YOU!

Questions or Comments ?

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