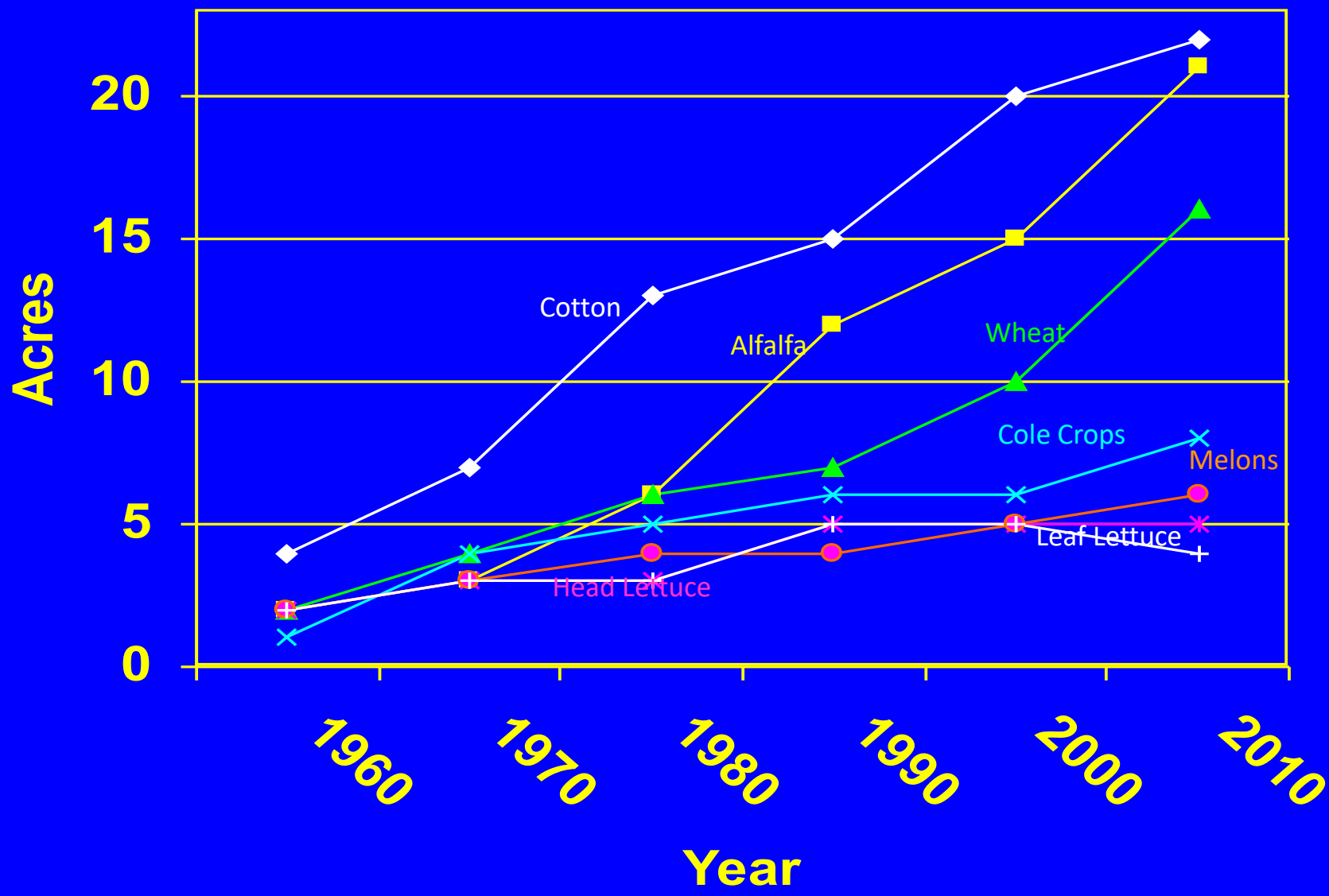
# The Affect of Changing Production Practices on Herbicides

B.Tickes

U of Arizona Cooperative Extension

# Herbicide Registrations



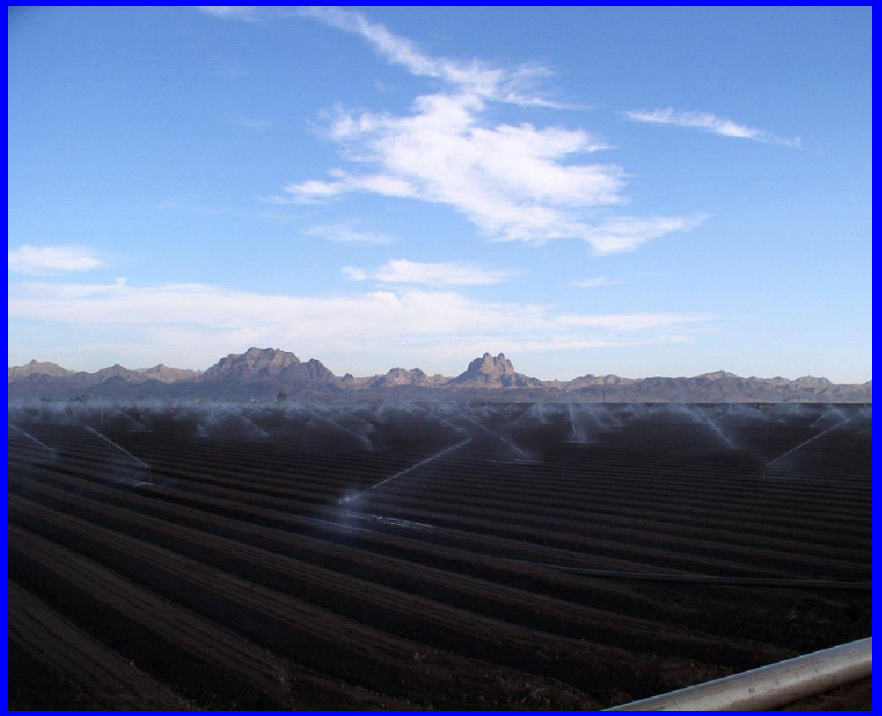
# Vegetable Herbicides

**No Change**

- Active Ingredients

**Change**

- Formulations
- Production Practices(irrigation)
- Technology



Alfalfa grown on beds

Subsurface Drip Irrigation

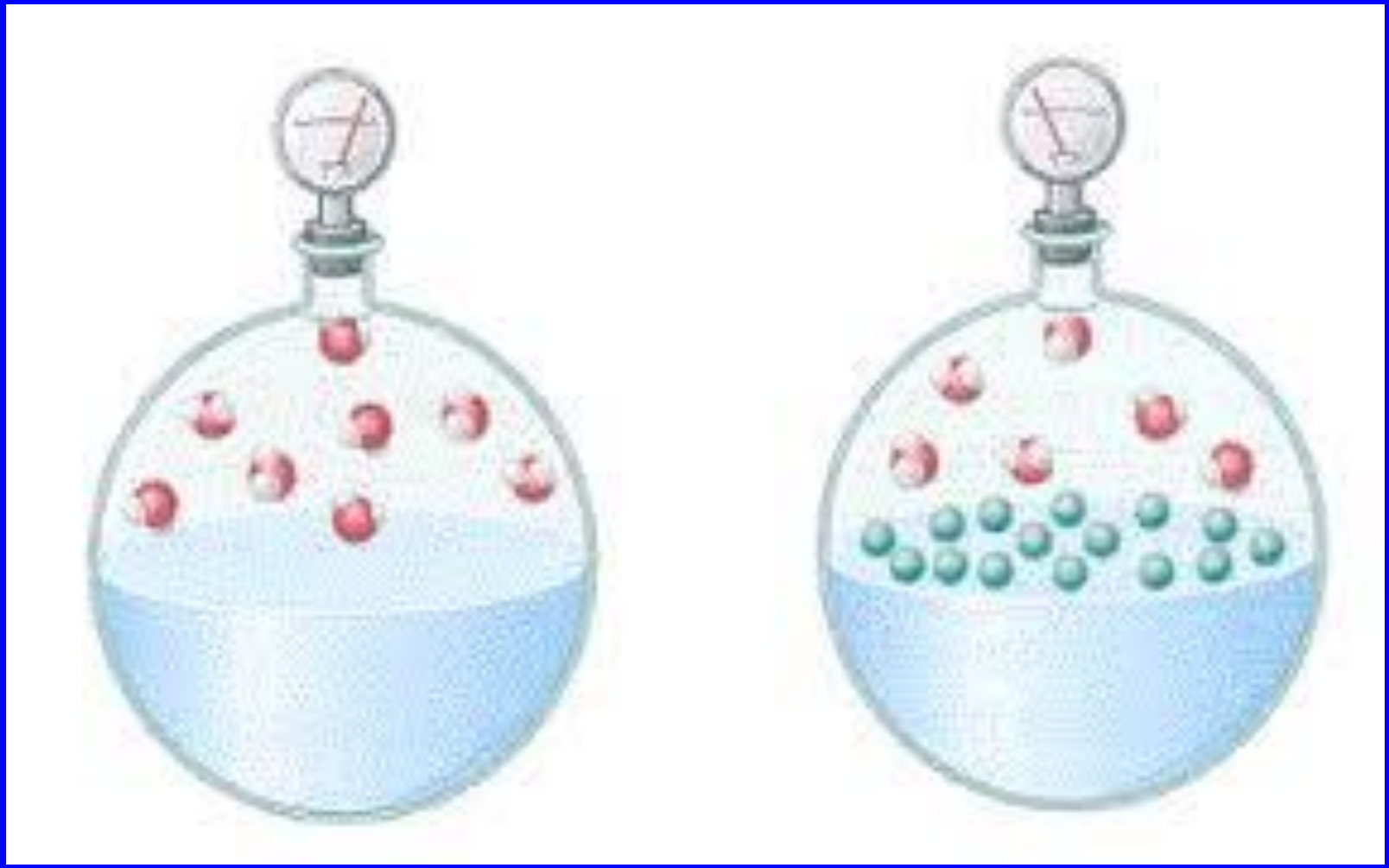
# Two factors that have major impact on how irrigation affects herbicides are:

- **Vaporization**
- **Adsorption to soil**

# Vapor Pressure

# Vapor Pressure

- The tendency of a substance to volatilize is expressed by it's vapor pressure. This is usually expressed in mmHg at 77 F



# Vapor Pressure is affected by:

- Temperature
- Moisture
- Climate
- Soil type
- Adsorption
- Water solubility
- How applied

# Vapor Pressure of Herbicides

| Herbicide | Vapor Pressure(mm Hg) |
|---|---|
| Eptam | 0.034 |
| Trifluralin | 0.00014 |
| Kerb | 0.000085 |
| Balan | 0.000085 |
| Prowl | 0.0000094 |
| Dacthal | 0.0000025 |
| Goal | 0.0000020 |
| Prefar | 0.00000080 |

Vapor Pressure above 0.00001 is considered volatile

# Vapor Pressure References can be misleading because:

- Active ingredients can react with water to change volatility.
- Other ingredients can be contained in the formulation
- Different formulations can have different volatility


**Kerb 50W**

**Rates: 1-2 lbs.**

**Kerb 3.3**

**Rates: 1.2 - 2.4 pts.**


KERB 50-W
SELECTIVE HERBICIDE IN WATER-SOLUBLE POUCHES
KEEP OUT OF REACH OF CHILDREN
CAUTION
Restricted Use Pesticide
Dow AgroSciences
Kerb
50-W
Keep Out of Reach of Children
CAUTION
Dow AgroSciences
Kerb 50WP
KERB FLO

Prowl $H_2O$

Prowl 3.3


Stauffer
Prefar
4-E
KEEP OUT OF REACH OF CHILDREN
CAUTION
STATEMENT OF PRACTICAL TREATMENT
5 GAL. NET 18.9 L
Prefar
4-E
emulsifiable liquid for
control of annual grasses
and broadleaf weeds
Keep Out of Reach of Children
CAUTION
5 GAL. NET 18.9L
Prefar 4-E
Selective Herbicide
Emulsifiable Liquid for Control of Annual Grasses and Broadleaf Weeds
KEEP OUT OF REACH OF CHILDREN
CAUTION
Gowan
Prefar 6-E
Selective Herbicide
Emulsifiable Liquid for Control of Annual Grasses and Broadleaf Weeds
KEEP OUT OF REACH OF CHILDREN
CAUTION
Gowan

# Dacthal

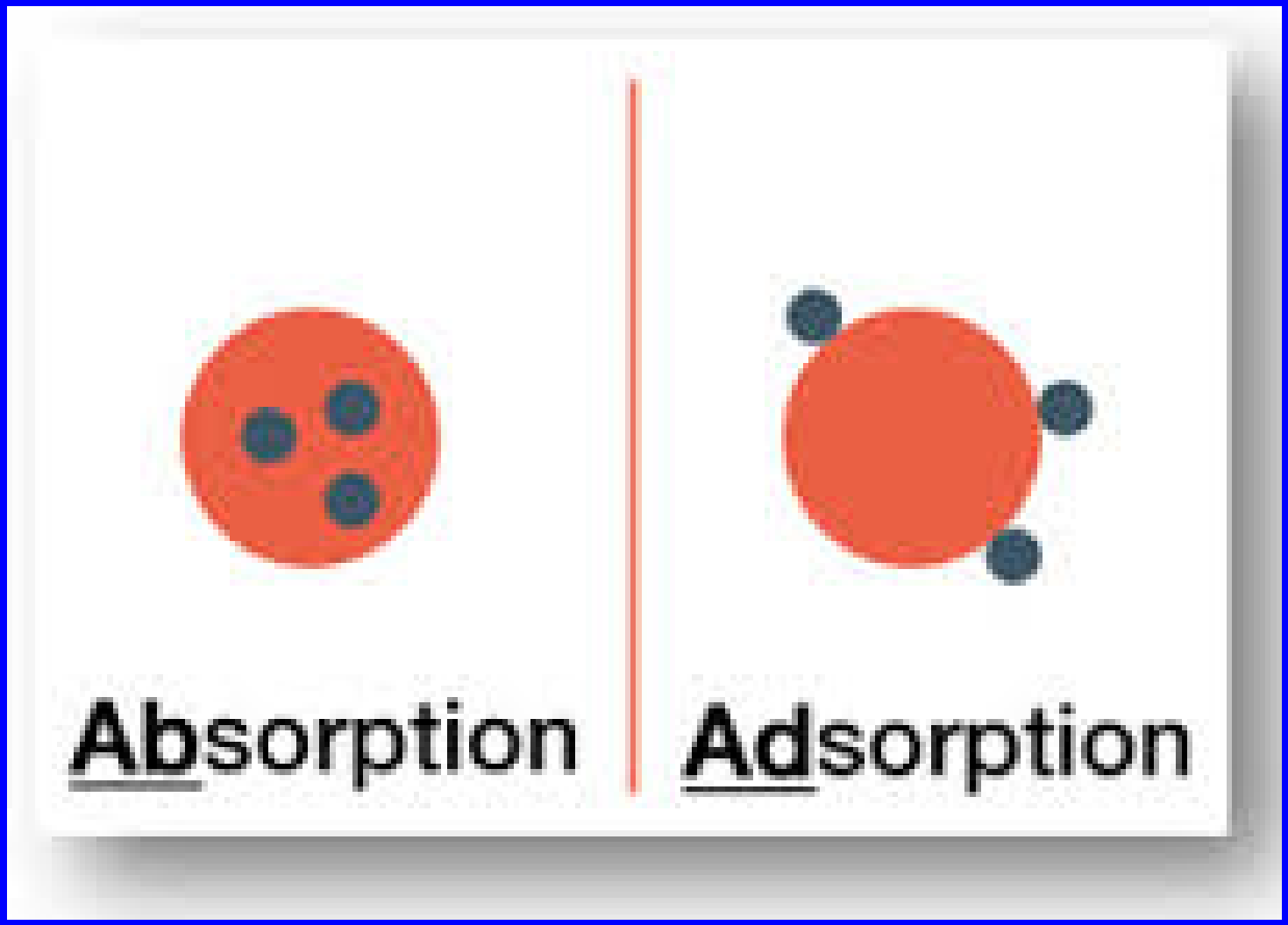

DACTHAL FLOWABLE

Dacthal W 75

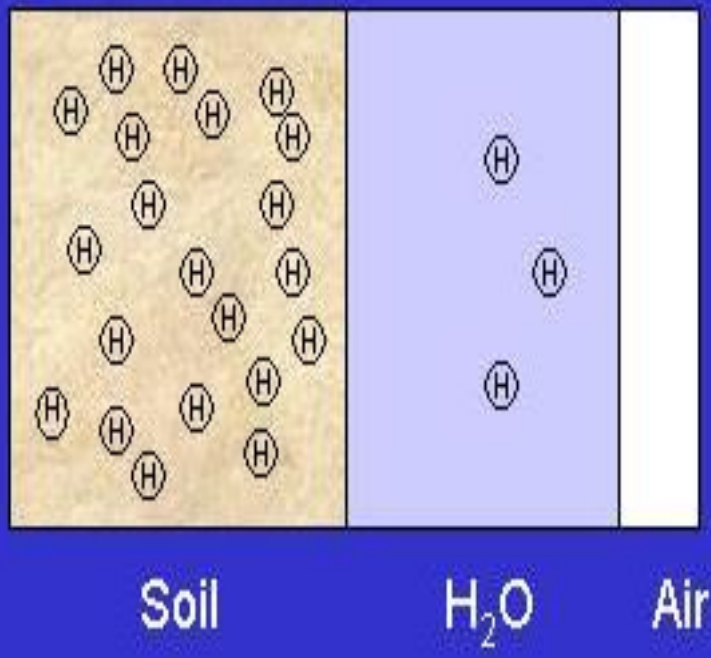

1lb
Acre
ELANCO
Balan

# Adsorption

- Physical
- Chemical

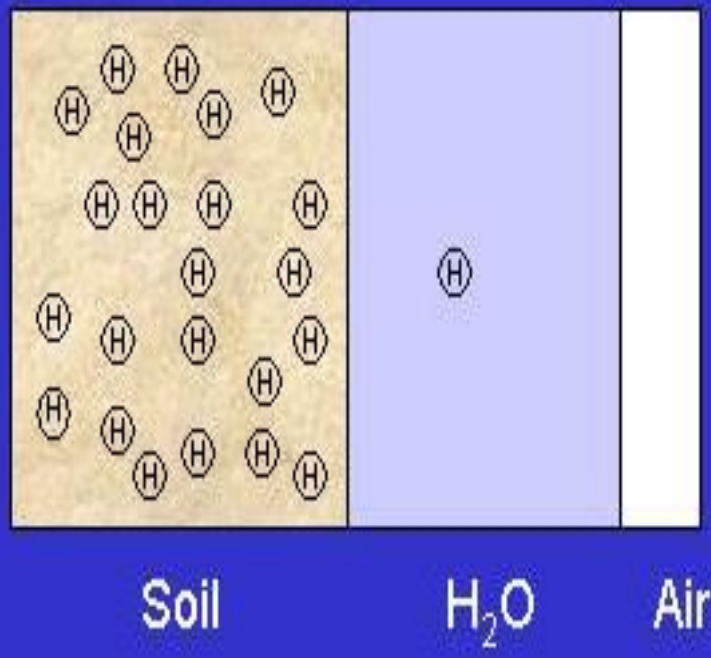

Absorption
Adsorption

# $K_{oc}$ = Amount on soil / Amount in water




$K_{oc} = 7$

21 molecules bound / 3 free




$K_{oc} = 24$

24 molecules bound / 1 free

# Adsorption Coefficient(Koc)

| Herbicide | K(oc) |
|---|---|
| Paraquat | 1,000,000 |
| Goal | 100,000 |
| Glyphosate | 24,000 |
| Balan | 9000 |
| Trifluralin | 7000 |
| Prowl | 5000 |
| Dacthal | 5000 |
| Prefar | 1000 |
| Kerb | 800 |
| Eptam | 200 |

Eptam

# Volatilization of *S*-Ethyl *N*,*N*-Dipropylthiocarbamate from Water and Wet Soil during and after Flood Irrigation of an Alfalfa Field

Mark M. Cliath,* William F. Spencer, Walter J. Farmer, Thomas D. Shoup, and Raj Grover

The herbicide *S*-ethyl *N*,*N*-dipropylthiocarbamate (EPTC) was applied to alfalfa in irrigation water. The actual vapor loss rate was assessed using an aerodynamic technique to estimate the EPTC vapor flux from the field during and after 2.19 ppm EPTC was applied by flood irrigation. The EPTC vapor flux 59.5 cm above the field varied from 37 to 259 g $ha^{-1}$ $h^{-1}$ while surface water was present. The EPTC vapor flux values measured over wet soil after irrigation ranged from 2 to 103 g $ha^{-1}$ $h^{-1}$ and was highest at night. Of the 3.04 kg $ha^{-1}$ EPTC applied, 7.0% was removed in tailwater runoff and 73.6% volatilized during the 52 hours of observation. This indicates that using surface irrigation water to apply EPTC to alfalfa is an inefficient method.

Measurement of loss of field applied pesticides by volatilization into the atmosphere has been an active area of agricultural research since Willis et al. (1971, 1972) first measured concentrations of pesticides in the air above treated soil plots. Actual vapor flux densities were measured above plots and fields of bare soil and corn (Caro et al., 1971; Parmele et al., 1972; Taylor et al., 1976), soybeans (Harper et al., 1976; White et al., 1977), and orchard grass (Taylor et al., 1977). These studies were recently summarized and evaluated by Taylor (1978).

In 1977, Soderquist et al. reported finding the thiolcarbamate herbicide molinate in the air above a flooded rice field and speculated that loss by volatilization from field water was "the major route of dissipation".

Applying *S*-ethyl *N*,*N*-dipropylthiocarbamate (EPTC) to alfalfa in flood-irrigation water (called herbigation) is often the preferred application method in California's Imperial Valley. Alfalfa is irrigated about 25 times annually and as many as six cuttings are removed each year. The soil is often treated with a preemergent herbicide, like EPTC, after each second or third cutting, by adding the herbicide to the irrigation water. EPTC is considered a volatile thiolcarbamate herbicide, moderately soluble in water [320 mg $L^{-1}$ at 30 °C, Freed et al. (1967)] with a saturation vapor pressure of $2.97 \times 10^{-2}$ mmHg at 30 °C (Hamaker, 1972). EPTC vapor flux densities in the atmosphere above an alfalfa field during flood herbigation were reported by Cliath in 1978. This report presents information on total volatilization losses during and after EPTC was applied.

## METHODS AND MATERIALS

**Experimental Site and Treatment.** The experimental site was located at Brawley, CA, at the USDA Imperial Valley Conservation Research Center. The site was about 162 m long (N-S) and 126 m wide (E-W) and included a 2.04-ha area planted to alfalfa, as shown in Figure 1. Outside the west edge of the field, 24 12-$m^2$ basins with borders spaced 3.3 m apart were also planted to alfalfa and provided additional fetch from the windward direction. The soil was Holtville clay loam (Typic Torrifluvents). The field contained a poor-to-medium stand of alfalfa that had not been irrigated for 10–14 days. EPTC was applied to the alfalfa field by herbigation 7 days after cutting when the plants were approximately 15–25 cm high.

U.S. Department of Agriculture, Science and Education Administration, University of California, Riverside, California 92521.

A weighing lysimeter was located about 100 m W and 75 m S of the NE corner as shown in Figure 1. The meteorological equipment, which included radiometers, wind run anemometers, soil heat flux plates, air temperature and relative humidity sensors, and a wind direction indicator, were located near the lysimeter.

To measure irrigation water runoff from the field, two 10.2-cm Parshall flumes were installed 23 and 80 m W and 10 m S of the NE corner of the field.

A pesticide collection mast assembly was positioned on the expected downwind side of the field 85 m S and 25 m W of the NE corner of the field. The pesticide collection mast assembly was a modification of the setup reported by Turner and Glotfelty (1977). A detailed description was reported by Cliath (1978). Basically, the pesticide collection mast consisted of six polyurethane foam plug collectors attached to a vacuum source and positioned at 10, 18, 30, 45, 70, and 100 cm above the soil surface. The collectors positioned at 10 and 18 cm were within the crop canopy. Air was drawn through each of these collectors at 2 L $min^{-1}$.

Beginning at 0730 h on May 25, 1977, 3.04 kg/ha EPTC was applied at an average concentration of 2.17 ppm by adding about 14 mL $min^{-1}$ of a 0.84 kg $L^{-1}$ (7 lb $gal^{-1}$) EC formulation through a Dripolator to irrigation water in the head ditch flowing at 0.056 $m^3$ $s^{-1}$ (2 cfs). The herbigation of the alfalfa progressed from west to east across the field until the equivalent of 13 cm (5.2 in.) of irrigation water was applied to the field surface. Herbigation ceased when the head flume was closed at 1630 h.

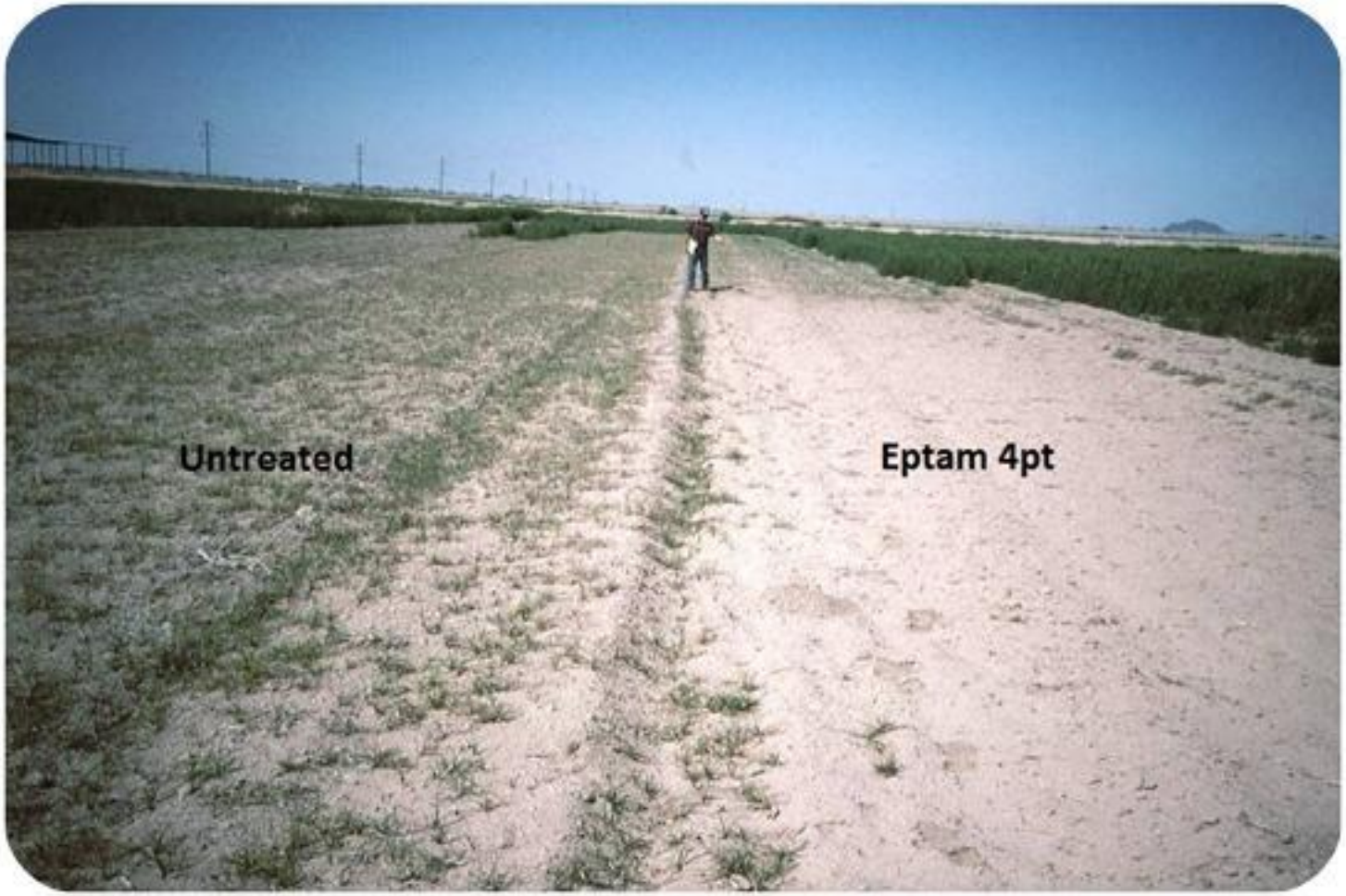
Beginning at 0930 h on May 25, 1977, we measured wind speed ($\bar{u}$), temperature ($\bar{T}$), and atmospheric temperature lapse rate ($\overline{\Delta T}$) every 30 min until 1900 h on May 27. The wind speed was measured with six calibrated Casella rotating cup anemometers located at 40, 60, 80, 100, 130, and 200 cm above the soil surface. Temperatures were measured with Bowen temperature sensors spaced 35 cm apart and located 45 and 80 cm above the soil surface. Details of the meteorological instrumentation were reported by Cliath (1978).

Runoff from irrigation water began at 1300 h and continued until about 0100 h the next day. We obtained 3.8-L grab samples of runoff each hour until 1504 h and every 2 h afterward until 0144 h on May 26 when runoff ceased. Staff gauge records were made at each sampling to calculate total pesticide runoff from flow volumes and herbicide concentrations in the irrigation tailwater.

Vaporized EPTC was sampled beginning at 1445 h on May 25, when the irrigation water passed the sampling

# Eptam Losses in "water run" Flood Irrigated Alfalfa

- **Volatilized from water** **28.4%**
- **Volatilized from wet soil** **45.2%**
- **Runoff in tailwater** **7.0 %**
- **Total Lost** **<u>80.6%</u>**

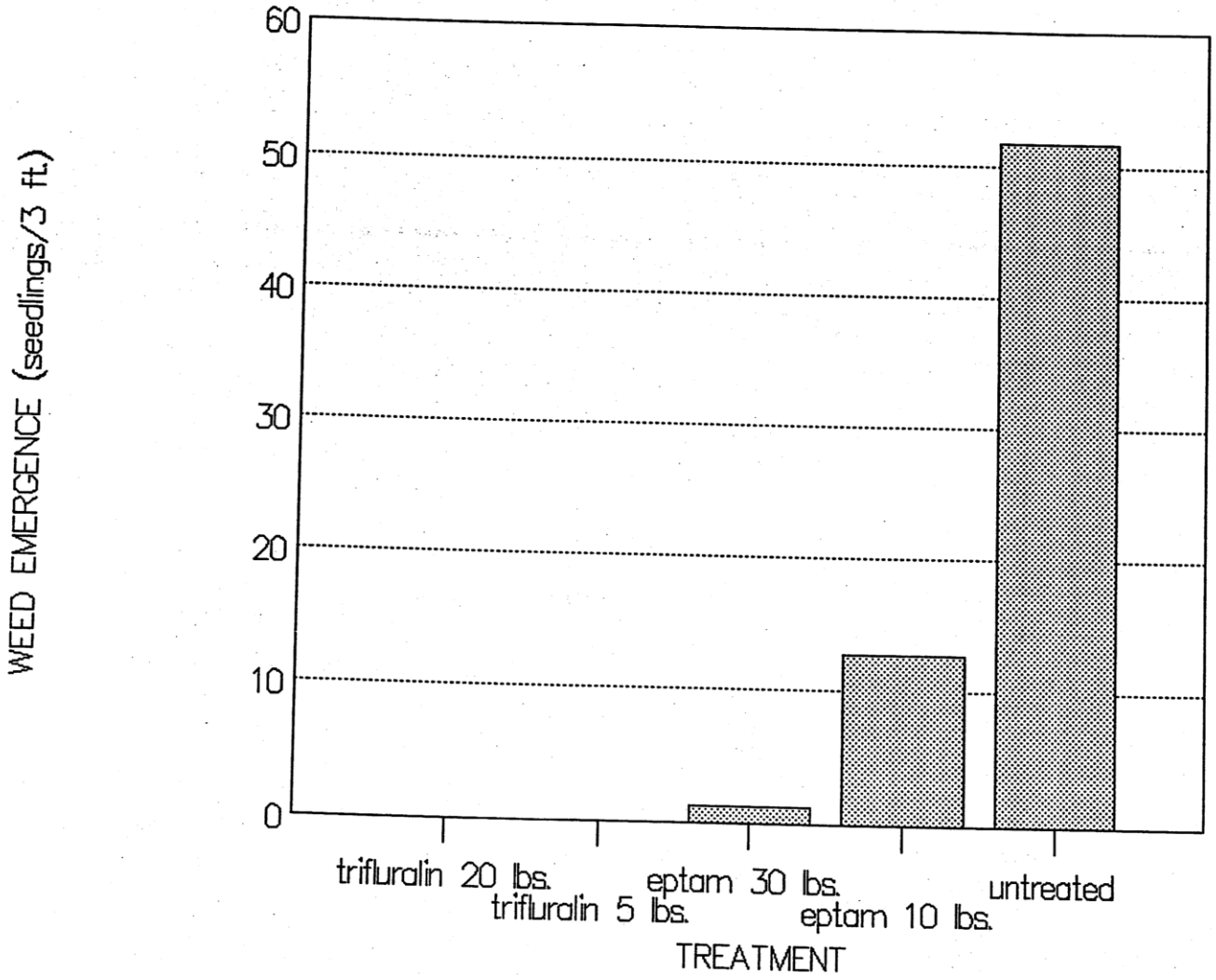

Untreated
Eptam 4pt


Carrots
Carro
Untreated
Eptam 3.5 pt. (3X)

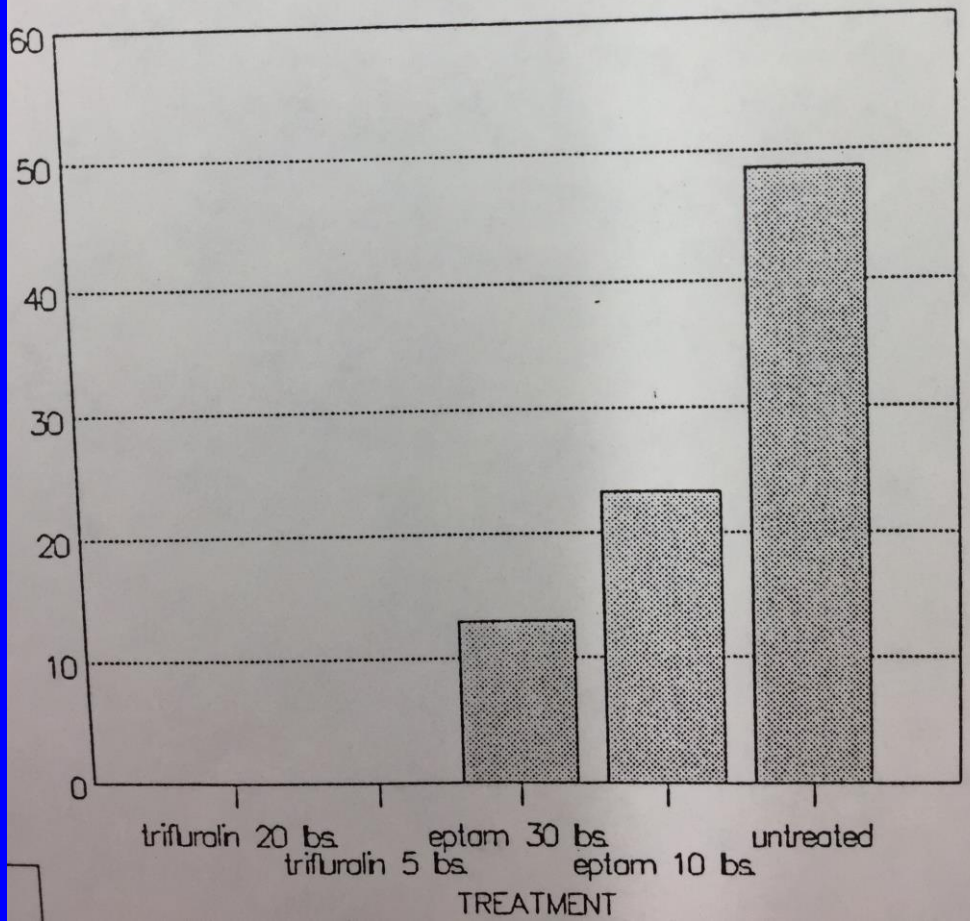
# Treflan


UTC - 12 hrs.

# 12 hours

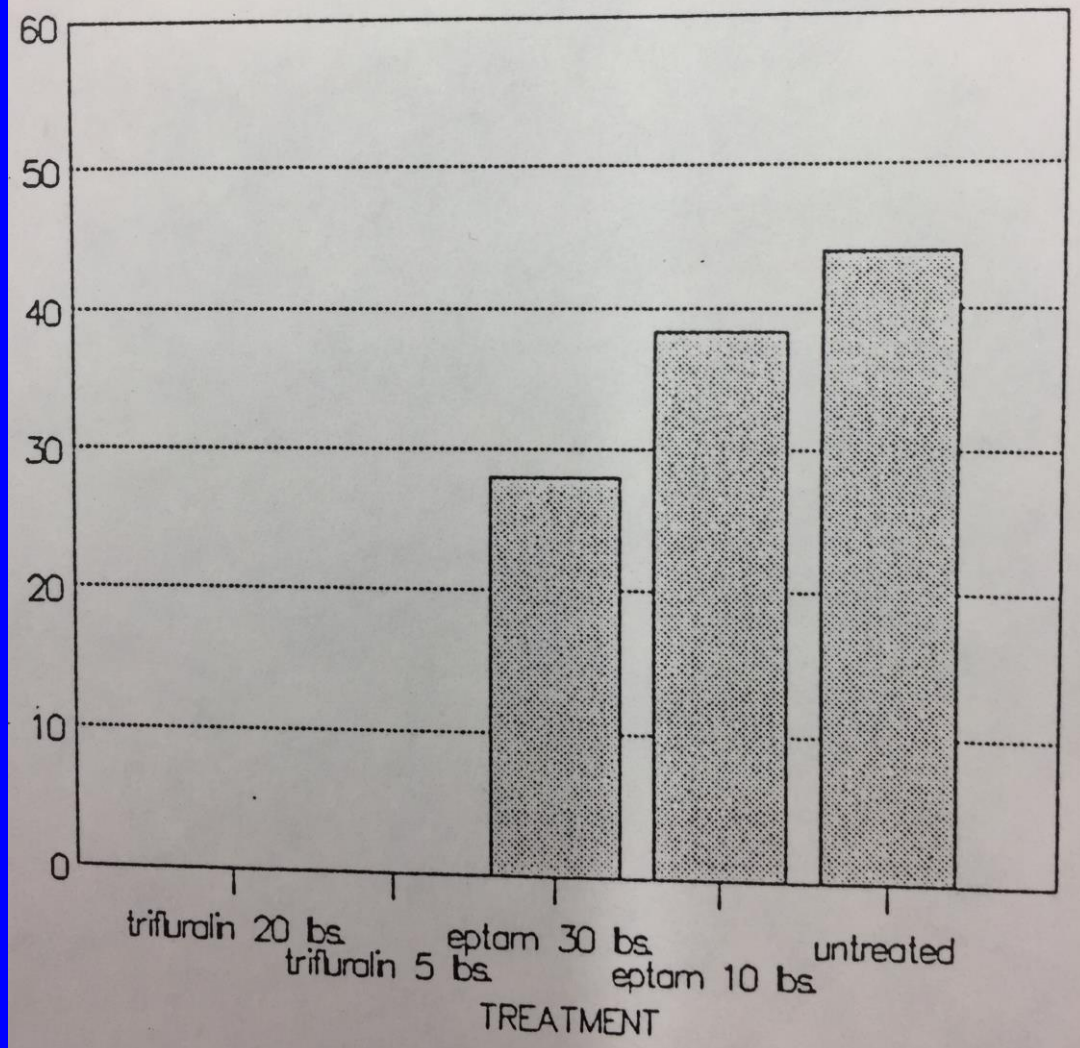

WEED EMERGENCE (seedlings/3 ft.)
60
50
40
30
20
10
0
trifluralin 20 lbs.
trifluralin 5 lbs.
eptam 30 lbs.
eptam 10 lbs.
untreated
TREATMENT

# 3 DAYS

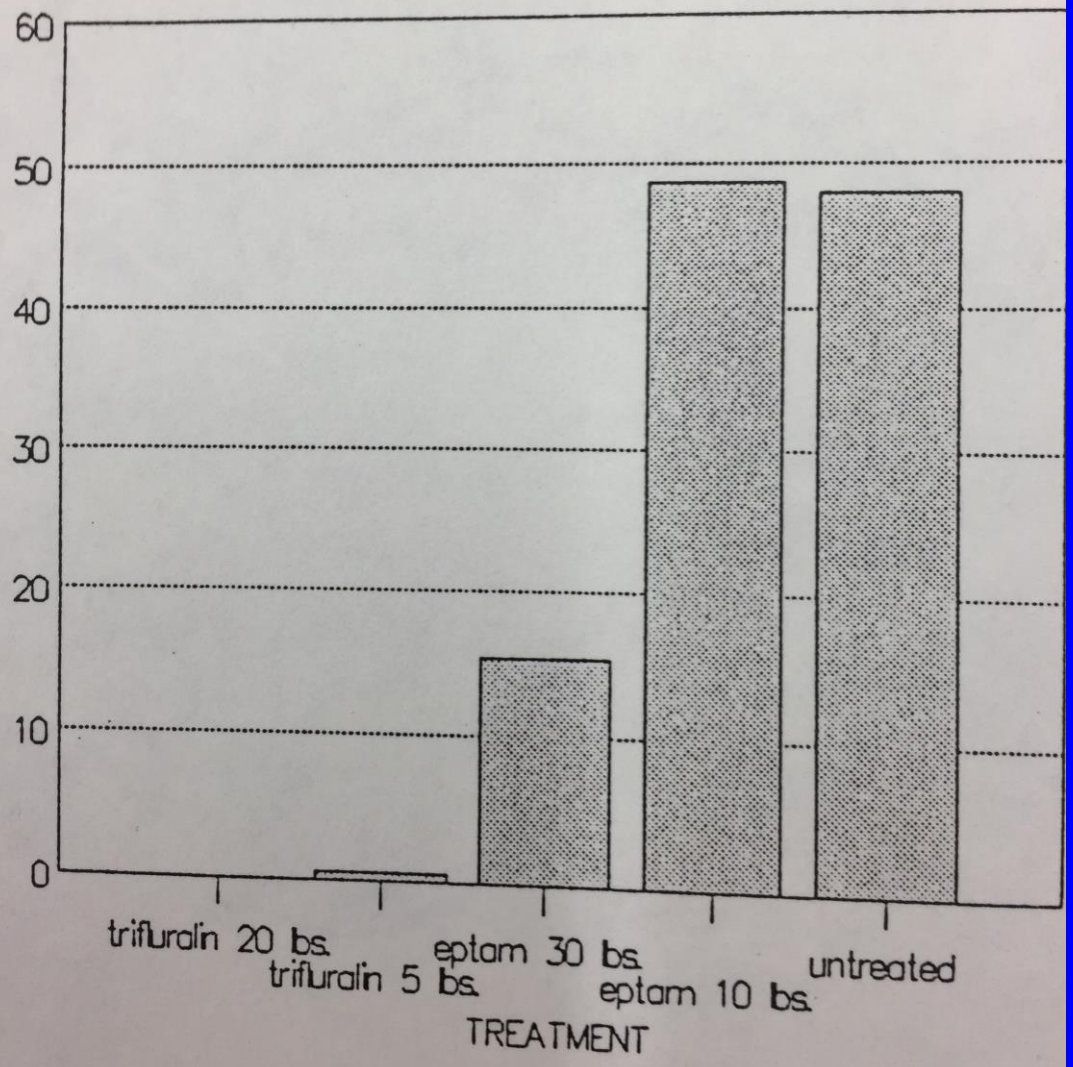

60
50
40
30
20
10
0
trifluralin 20 lbs.
trifluralin 5 lbs.
eptam 30 lbs.
eptam 10 lbs.
untreated
TREATMENT

WEED B

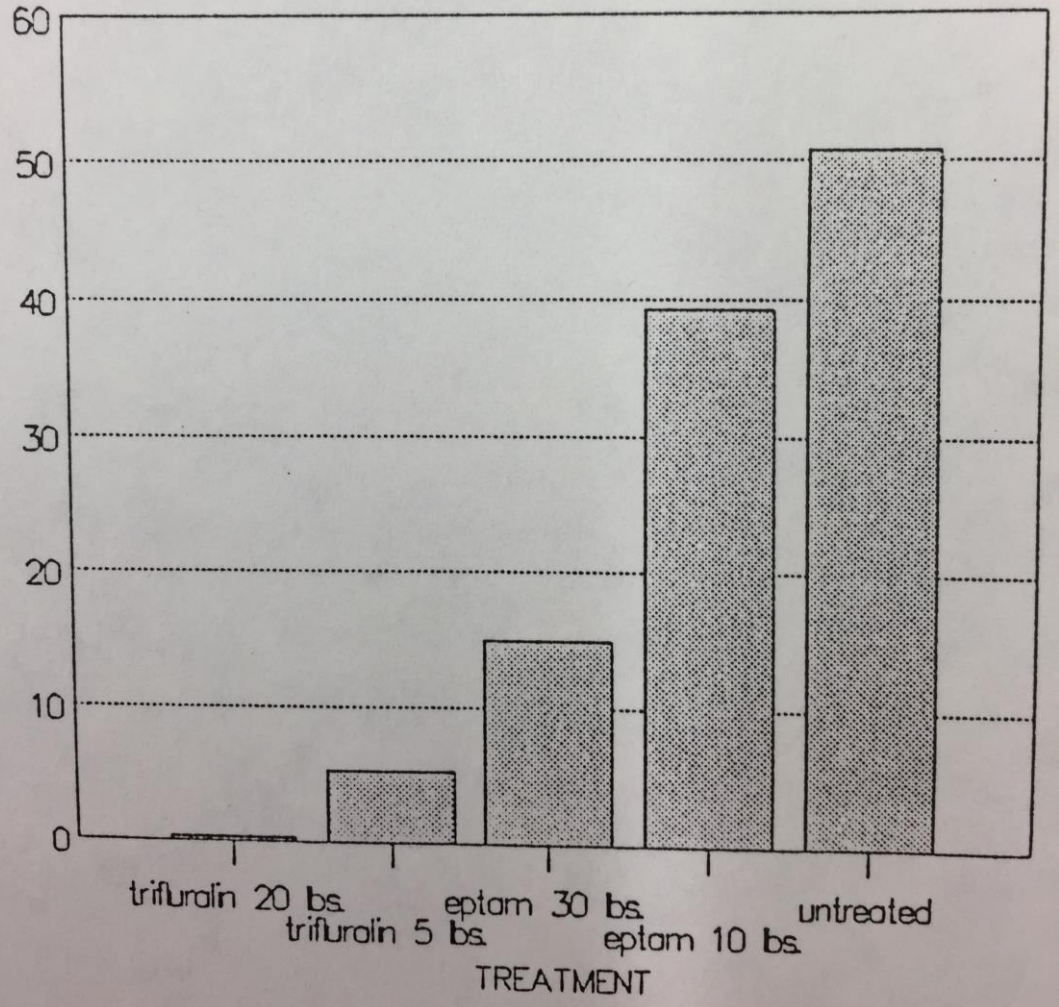
# 5 DAYS


60
50
40
30
20
10
0
trifuralin 20 bs.
trifuralin 5 bs.
eptam 30 bs.
eptam 10 bs.
untreated
TREATMENT

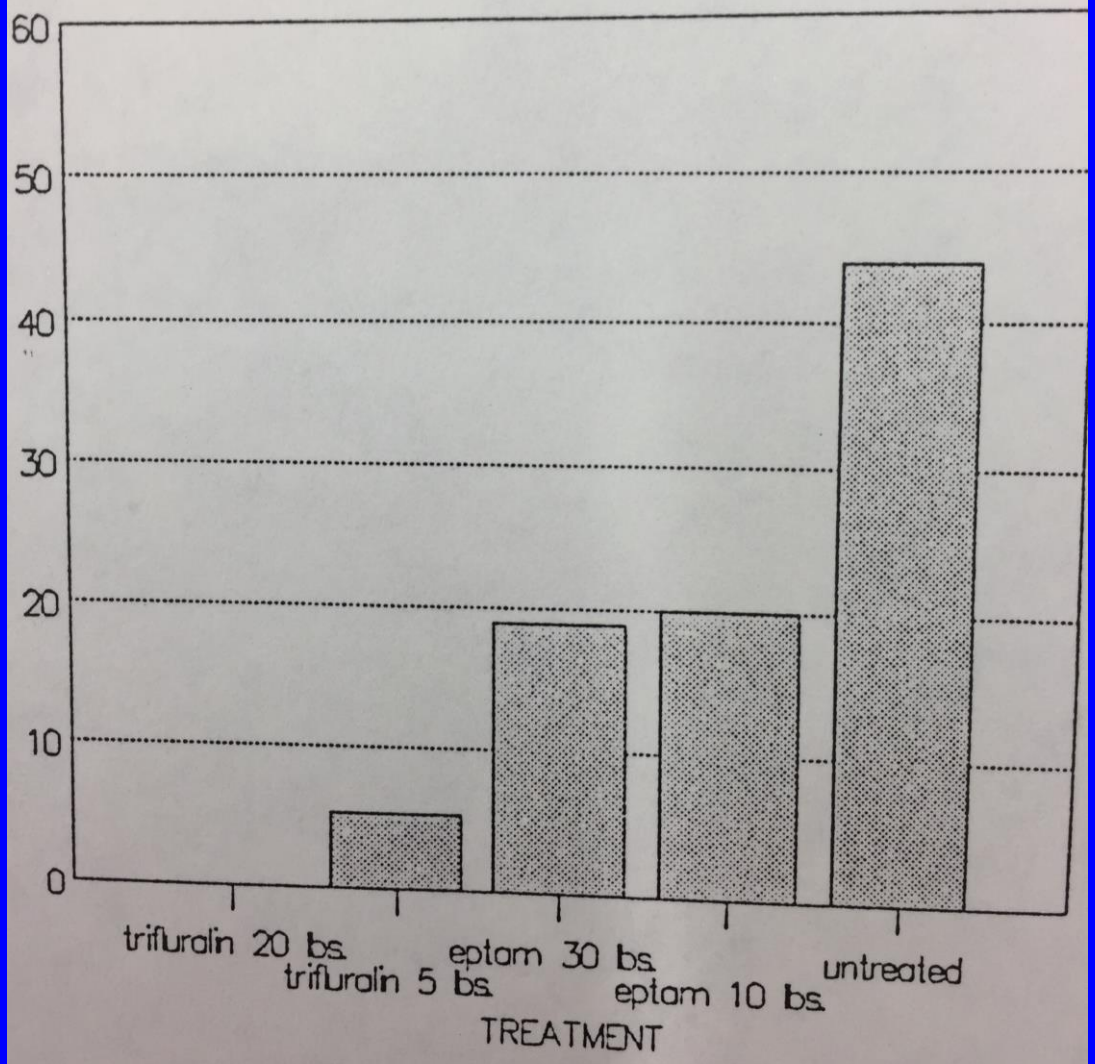
# 7DAYS


60
50
40
30
20
10
0
trifluralin 20 lbs.
trifluralin 5 lbs.
eptam 30 lbs.
eptam 10 lbs.
untreated
TREATMENT

# 10 DAYS


60
50
40
30
20
10
0
trifuralin 20 bs.
trifuralin 5 bs.
eptam 30 bs.
eptam 10 bs.
untreated
TREATMENT

# 14 DAYS


60
50
40
30
20
10
0
trifluralin 20 lbs.
trifluralin 5 lbs.
eptam 30 lbs.
eptam 10 lbs.
untreated
TREATMENT

ARIZONA AGROCHEMICAL COMPANY
Growing thru Chemical Progress
P.O. BOX 21537 PHOENIX, ARIZ. 85036 PHONE 602 243-2711

EPA REG. NO. 1471-120
EPA EST. NO. 1471-IN-2
EPA SLN NO. AZ-

TREFLAN(R) PRO-5(TM)
WATER RUN APPLICATION

FOR CONTROL OF WEEDS IN ESTABLISHED ALFALFA, ESTABLISHED BERMUDA GRASS FOR SEED, AND CITRUS IN MARICOPA AND YUMA
FLYING IN THE IRRIGATION WATER. SEE MAIN LABELS FOR WEEDS CONTROLLED.

TREFLAN(R) PRO-5(TM) is to be metered into the irrigation water with an even flow device at or near a head gate o
in close approximation to the field in order that there be sufficient mixing before passing into the furrows or b
of 0.8 to 1.6 pints per acre in established Alfalfa and at a rate of 1.6 to 3.2 pints per acre in Citrus and esta
Grass for seed on light to medium textured soils. TREFLAN PRO-5 should be applied by this method to established
seed in the first irrigation after being burned off and in established Alfalfa after the first or second cutting
mination of summer annuals. For better weed control in Citrus grown in soil that cracks after drying, apply anot
per acre of TREFLAN PRO-5 the next irrigation after the initial application. For continued weed control in Citru
4 to 6 months. Established Alfalfa and established Bermuda Grass for seed which is being grown in heavier soils
drying should not be treated with water run TREFLAN PRO-5.

THE IRRIGATION RUN SHOULD NOT BE ANY LONGER THAN 660 FEET, otherwise optimum weed control may not be achieved us
application. The fields to be treated should be nearly dead level, there should be no run off or tail water, the
to medium textured and the crops must be established in order to prevent injury to them. In order to get rapid
of the TREFLAN PRO-5 throughout the field, a minimum head of 10 cubic feet per second of water should be used.

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
All applicable directions, restrictions and precautions of the EPA registered label are to be followed.
This label must be in the possession of the user at the time of application.
The refuse and seed cleaning of TREFLAN PRO-5 treated Bermuda Grass being grown for seed cannot be used for past
forage or bedding purposes. The crop refuse (threshings and straws) and seed cleaning should be destroyed accor
local practices that will not contaminate the environment or any other crops, food, fiber and livestock. Seed c
establishment of pasture, turf, and for propagation purposes.

* TREFLAN(R) PRO-5(TM) - the registered trademark for Elanco Products trifluralin.

# Balan Injury to lettuce

# Goal

Imported Chemigation Rig with Manual Agitation

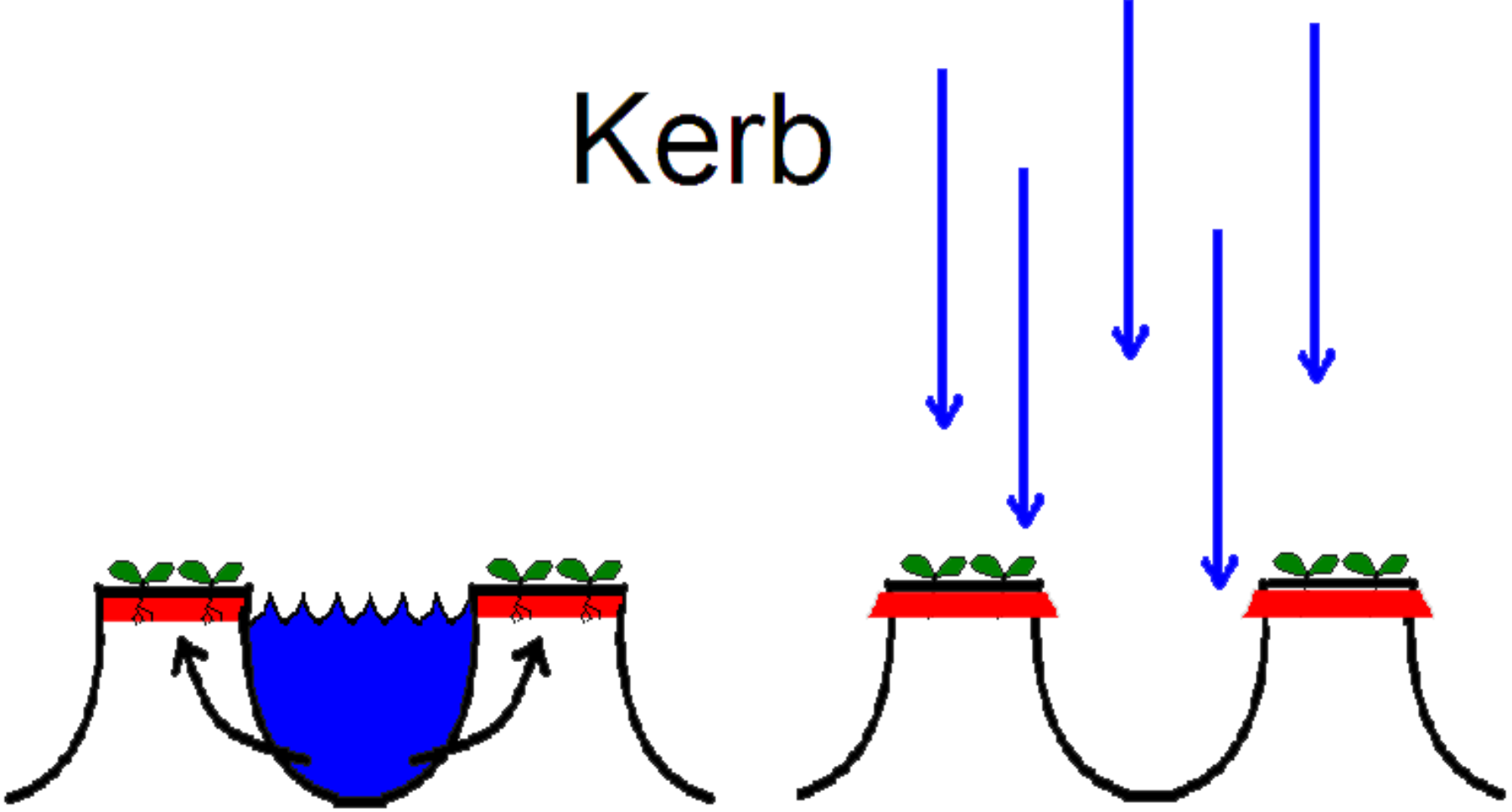

GoalTender 6oz.
Untreated

Onions/Bard, Ca. 2009. Goal 2XL 16oz.


Movement
Goal 2 XL 1.0 lb/a.i.

# Kerb

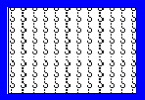
# Kerb



Furrow

Sprinkler


**Sprinklers**



**Furrow**


Applied 5 days
after
sprinklers started

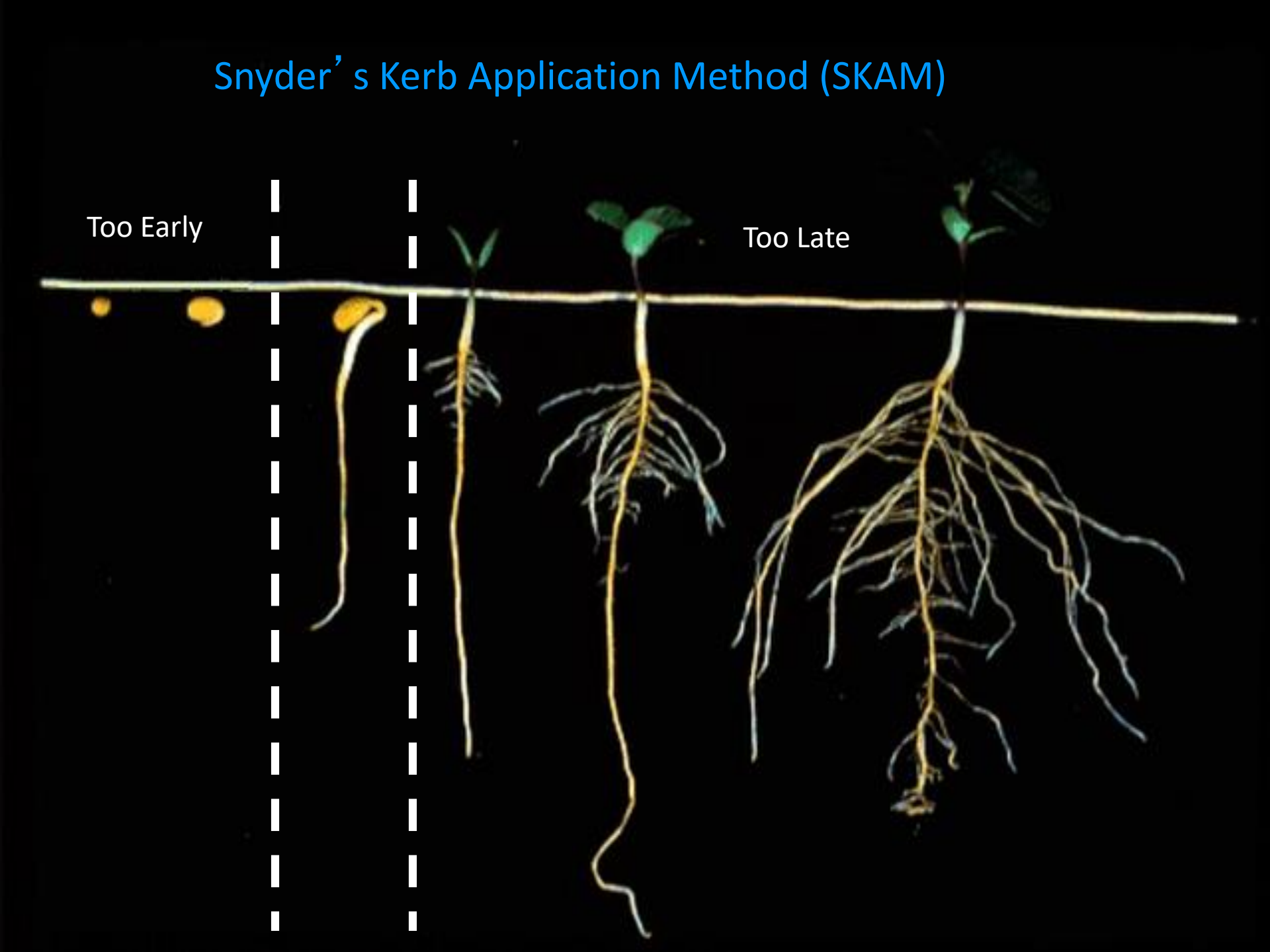
# Chemigation Equipment





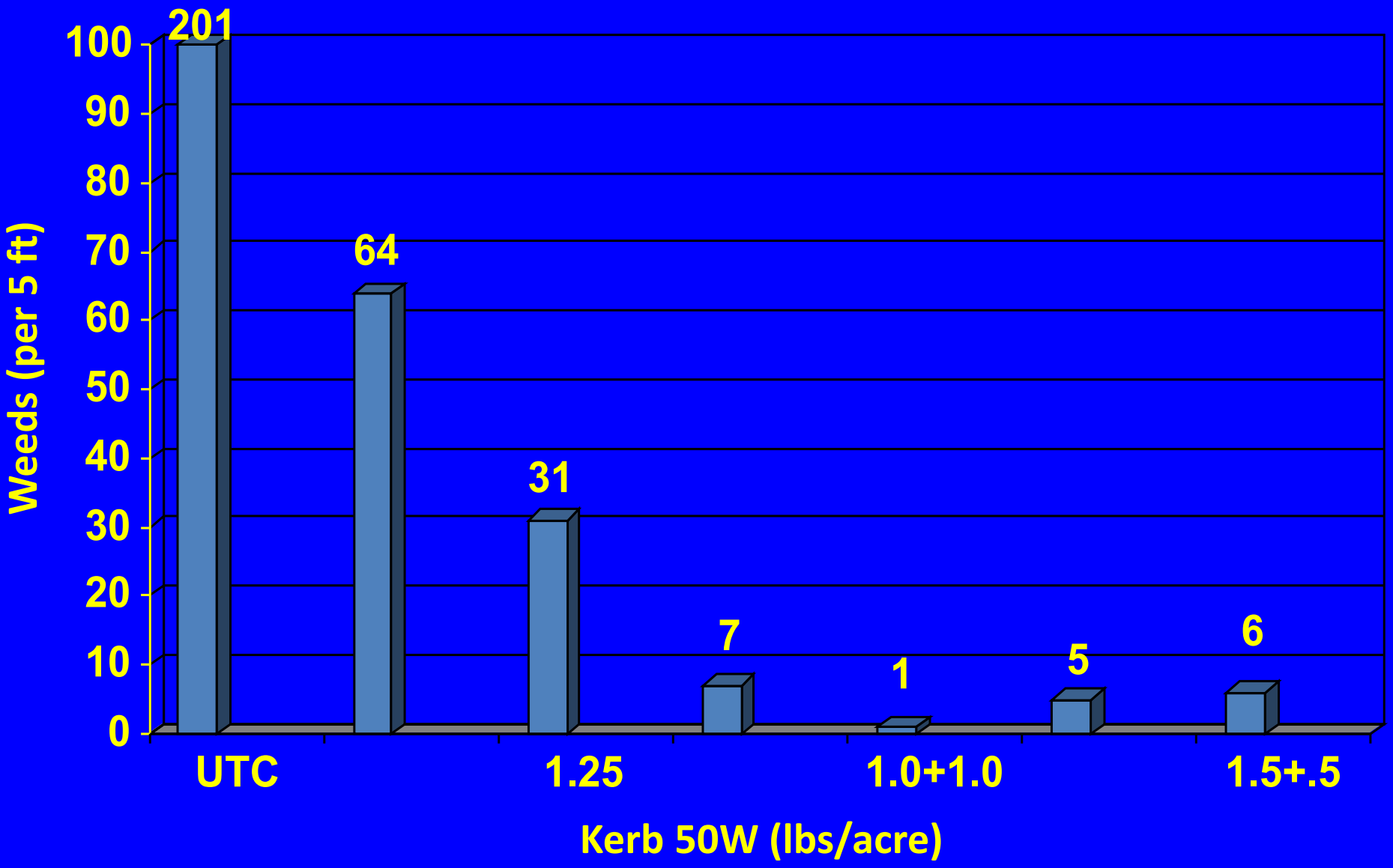



# Snyder's Kerb Application Method (SKAM)




Untreated
1.0 + 1.0

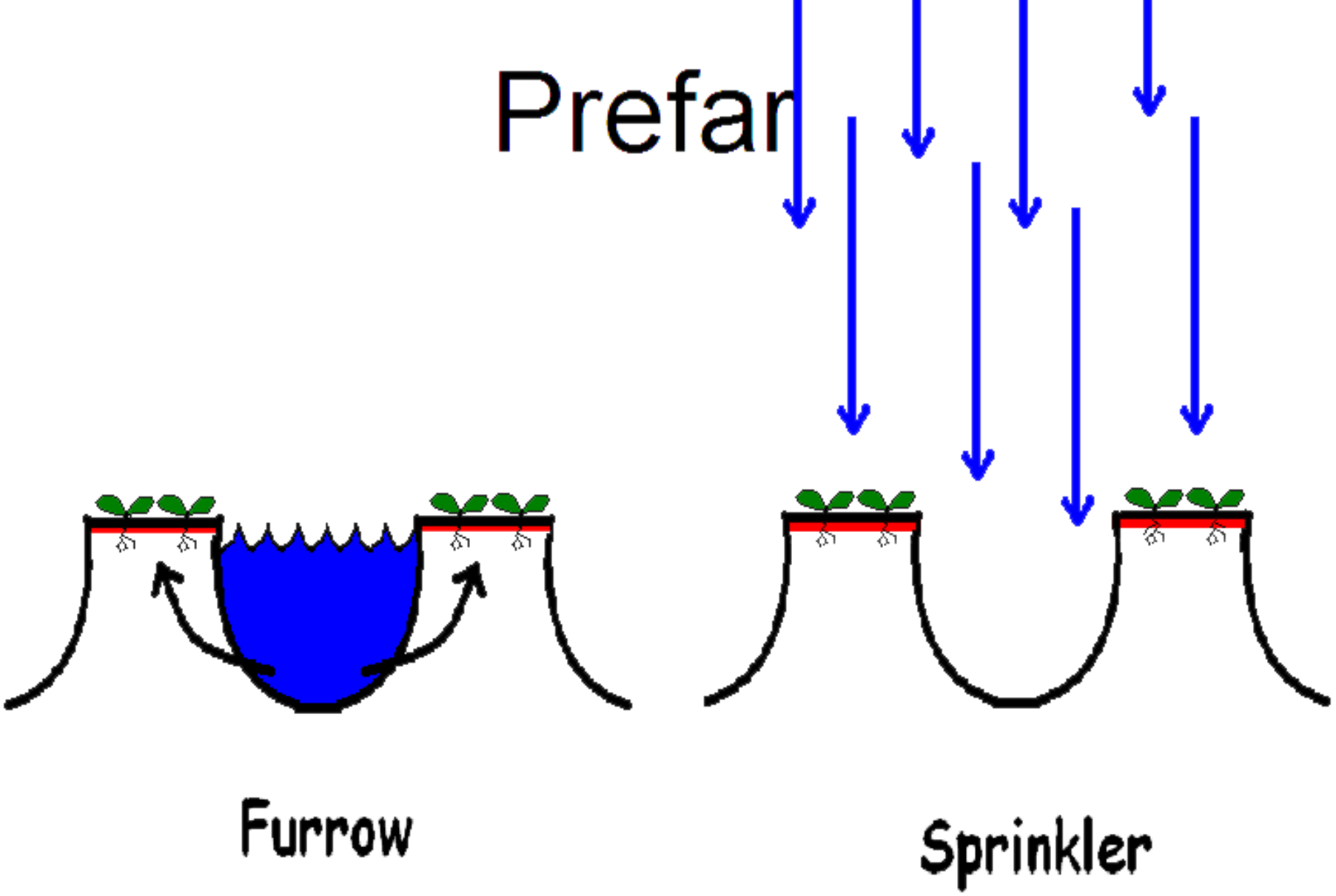
# Kerb Split Application Trial Summary



Prefar

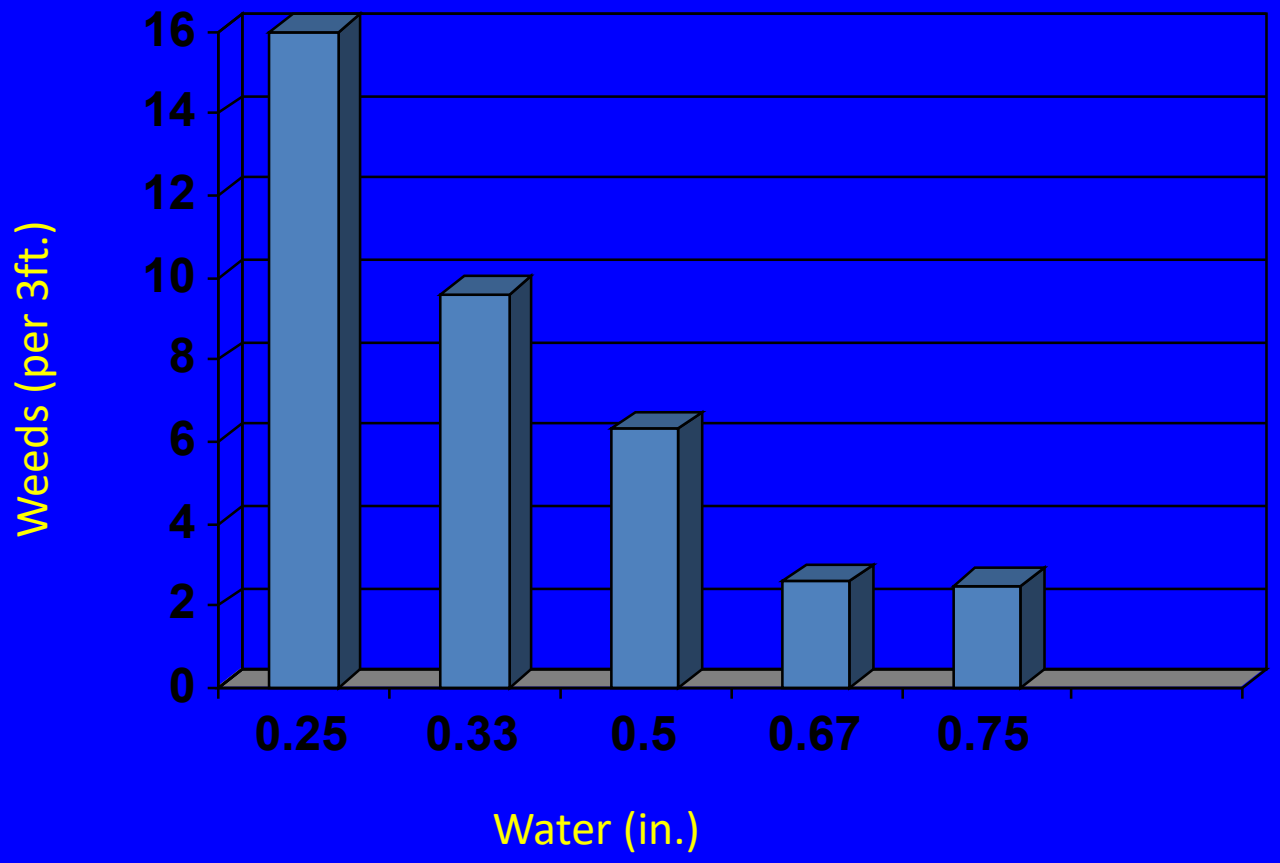

Prefar
6 qts.

Prefar

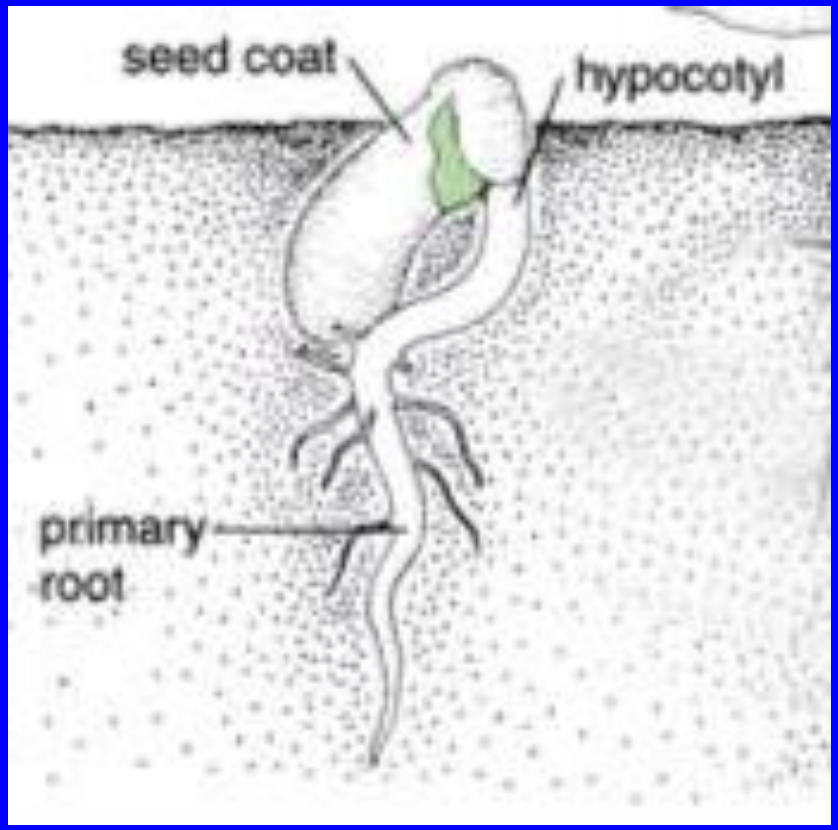



ZIMMATIC
LINDSAY MFG. CO.

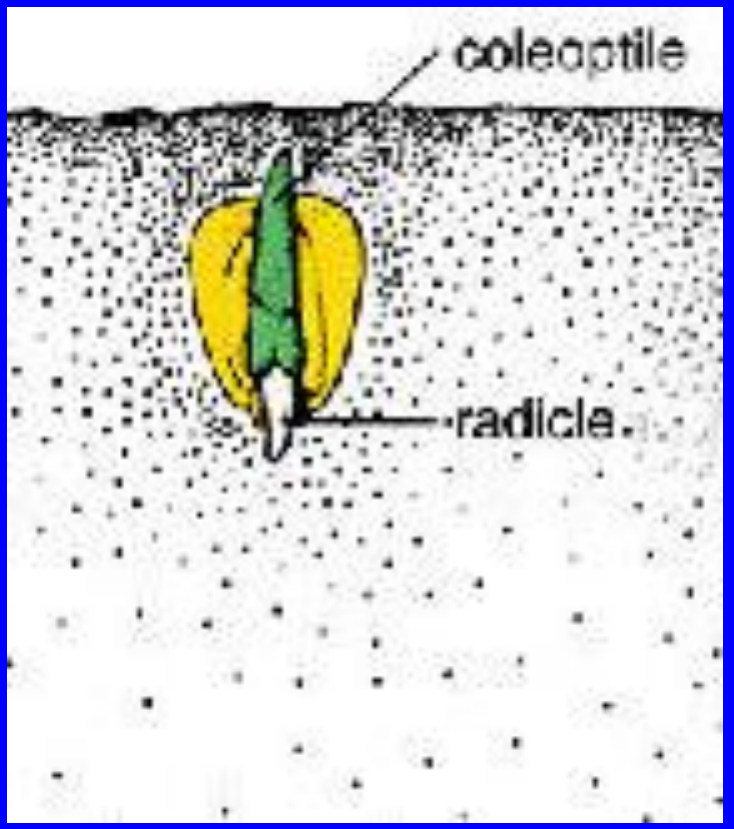
# Prefar- Water interaction



# Dacthal




Broadleaf




Grass

Furrow Irrigated

Sprinkler Irrigated

Dacthal/ Lettuce

Aim® EC

HERBICIDE

EPA Reg. No. 279-3241 SLN # AZ-130003

**This label expires and must not be distributed or used in accordance with this SLN registration after 12/31/2018.**

- It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
- This state-specific Section 24(c) labeling must be in the possession of the user at the time of application.
- Follow all applicable directions, restrictions, and precautions on the EPA registered label for Aim EC Herbicide (EPA Reg. No. 279-3241) and this label.

**For Agricultural Use Only**

| CROP | DO NOT APPLY MORE Aim EC Herbicide THAN INDICATED BELOW | SPRAY VOLUM |
|---|---|---|
| **Lettuce – For use in lettuce thinning machines** | **1.0 fl oz (0.016 lb ai) per broadcast acre.** | **Minimum of 1 gallons / acre** |

**Directions For Use**

Use Aim EC Herbicide to remove unwanted lettuce plants. Applications must be made with a sprayer de for thinning lettuce. The machine must accurately spray unwanted plants without injuring desirable lettuce p

# Vapor Pressure of Carfentrazone is 1.2 X 10 -7

Above 1.0 X 10 5 is considered volatile

END