

Frost Fighting in Peaches

Cascade Wind Machine Service

Dave Harmening



Dave Harmening

Cascade Wind Machine Service

- 36 Years in Sales, Installation & Service
- Last 9 years Dealer Support and New Market Development World Wide
- Starting coming to the Southeast in 2009



Orchard-Rite Yakima Washington



Live Near Wenatchee, WA.





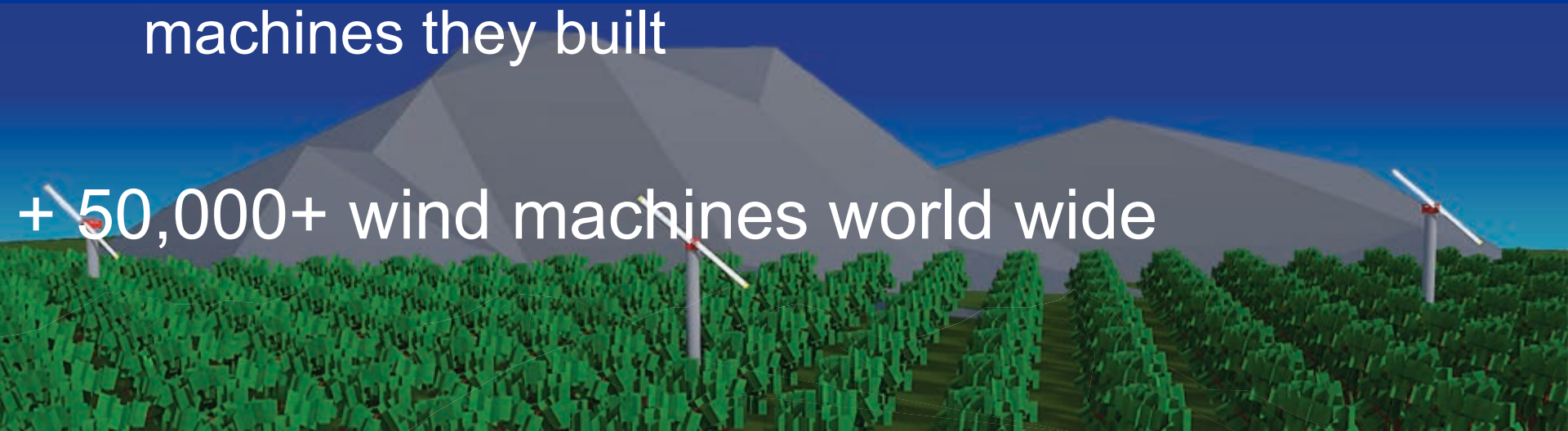


100M from bedroom window

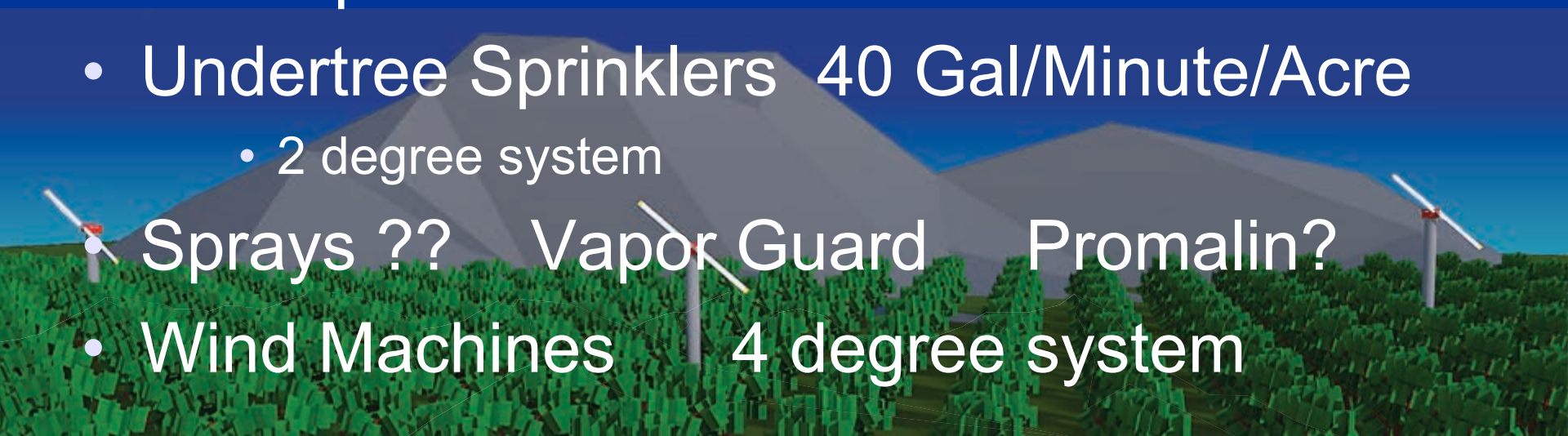


Orchard-Rite Inc.

- Manufacturing wind machines since 1974
 - * 28,000+ units sold world wide
- Purchased Tropic Breeze in 1984
 - + provide parts and service for the 23,000+ machines they built
- + 50,000+ wind machines world wide

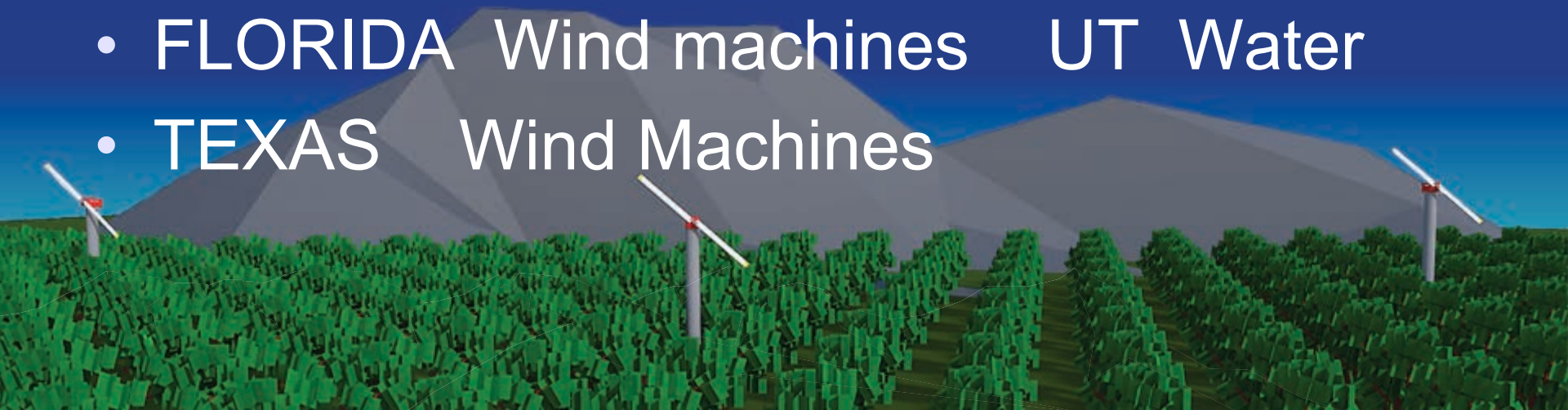


Frost Protection Options

- Good Orchard Site Best Option
 - Overhead Sprinklers- Good system can protect during severe conditions 8 degrees
 - Heaters 6 degree systems possible
 - Helicopters
 - Undertree Sprinklers 40 Gal/Minute/Acre
 - 2 degree system
 - Sprays ?? Vapor Guard Promalin?
 - Wind Machines 4 degree system
- 

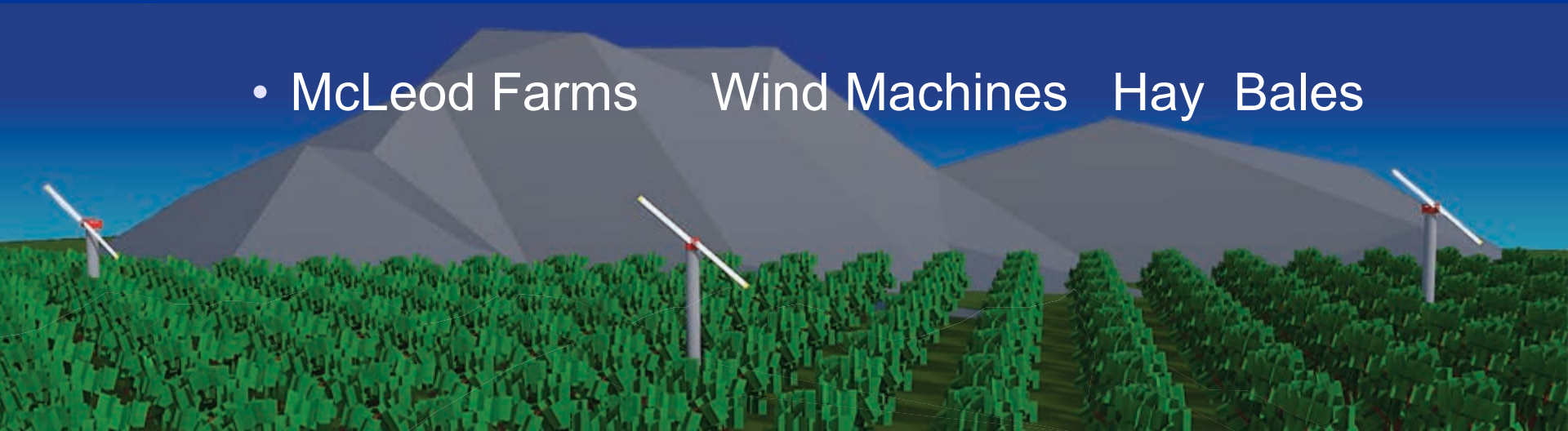
FROST PROTECTION IN PEACHES

- CALIFORNIA Little Protection Needed
- WASHINGTON Utilized fans & heat
- ALABAMA Good Sites and Wind Machines
- GEORGIA Very little protection utilized.
- FLORIDA Wind machines UT Water
- TEXAS Wind Machines



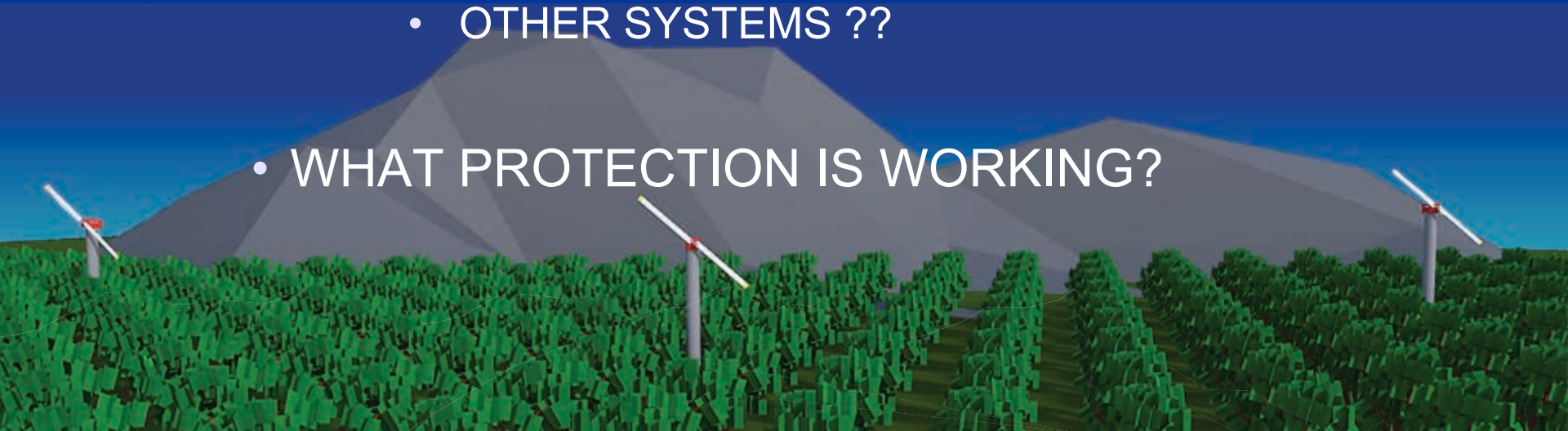
FROST PROTECTION IN PEACHES

- SOUTH CAROLINA
 - MANY RELY ON CROP INSURANCE
 - Watson Wind Machines
 - Need supplemental heat
 - Better overlap
 - McLeod Farms Wind Machines Hay Bales



FROST PROTECTION IN PEACHES

- NORTH CAROLINA
 - RADIATIONAL FROST or ADVECTIVE FREEZE
 - WHAT IS BEING USED CURRENTLY?
 - WIND MACHINES Johnson Peaches
 - OTHER SYSTEMS ??
 - WHAT PROTECTION IS WORKING?



BASIC ENERGY EXCHANGE

DAY

NIGHT

INCOMING RADIATION

HEAT ENERGY
LOST TO SPACE

HEAT ENERGY
LOST TO SPACE

TOP OF ATMOSPHERE

HEAT ENERGY
REFLECTED
AND ABSORBED

HEAT ENERGY
REFLECTED
AND ABSORBED

HEAT
ENERGY
INTO SOIL

LOWER
ATMOSPHERE
HEATED BY
CONVECTION

LOWER
ATMOSPHERE
COOLED BY
CONDUCTION

OUTGOING
RADIATION

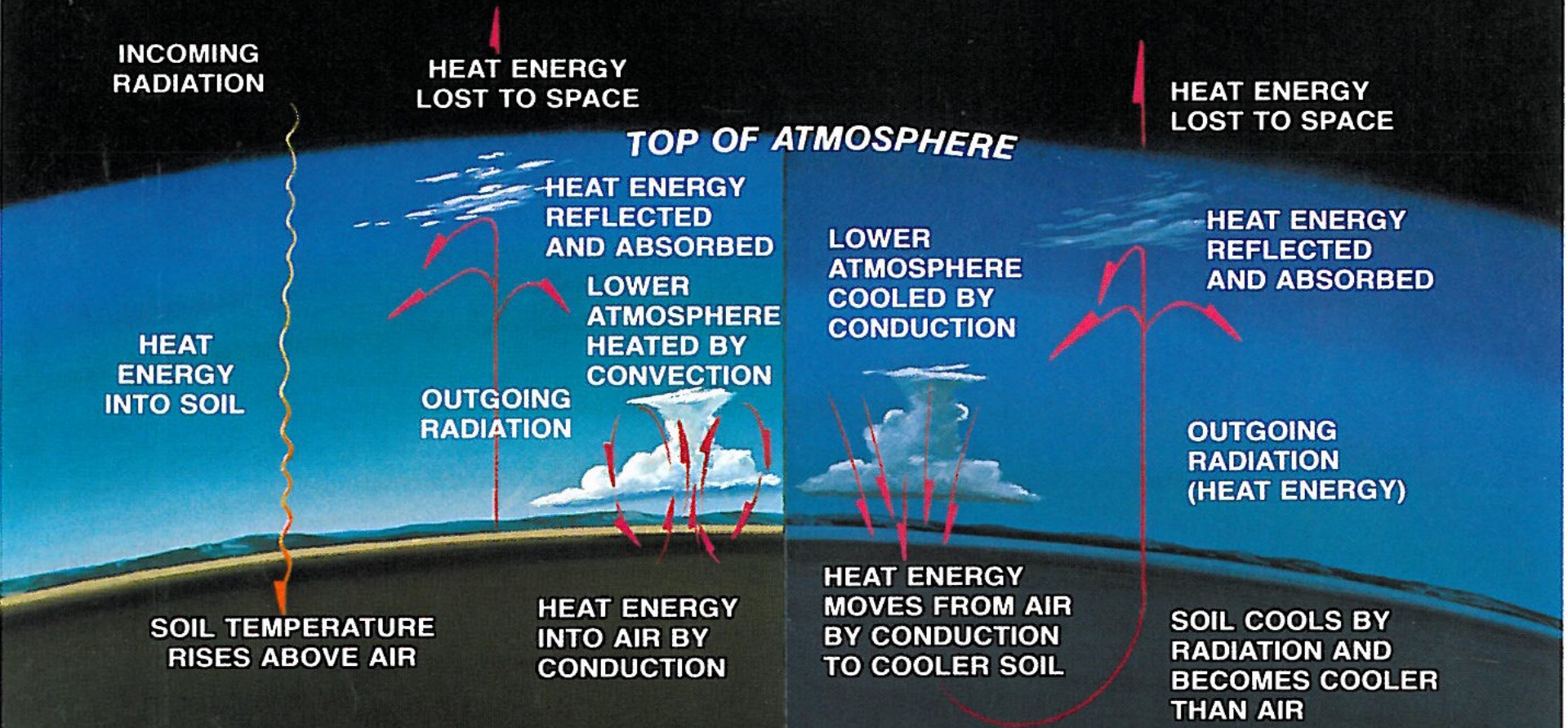
OUTGOING
RADIATION
(HEAT ENERGY)

SOIL TEMPERATURE
RISES ABOVE AIR

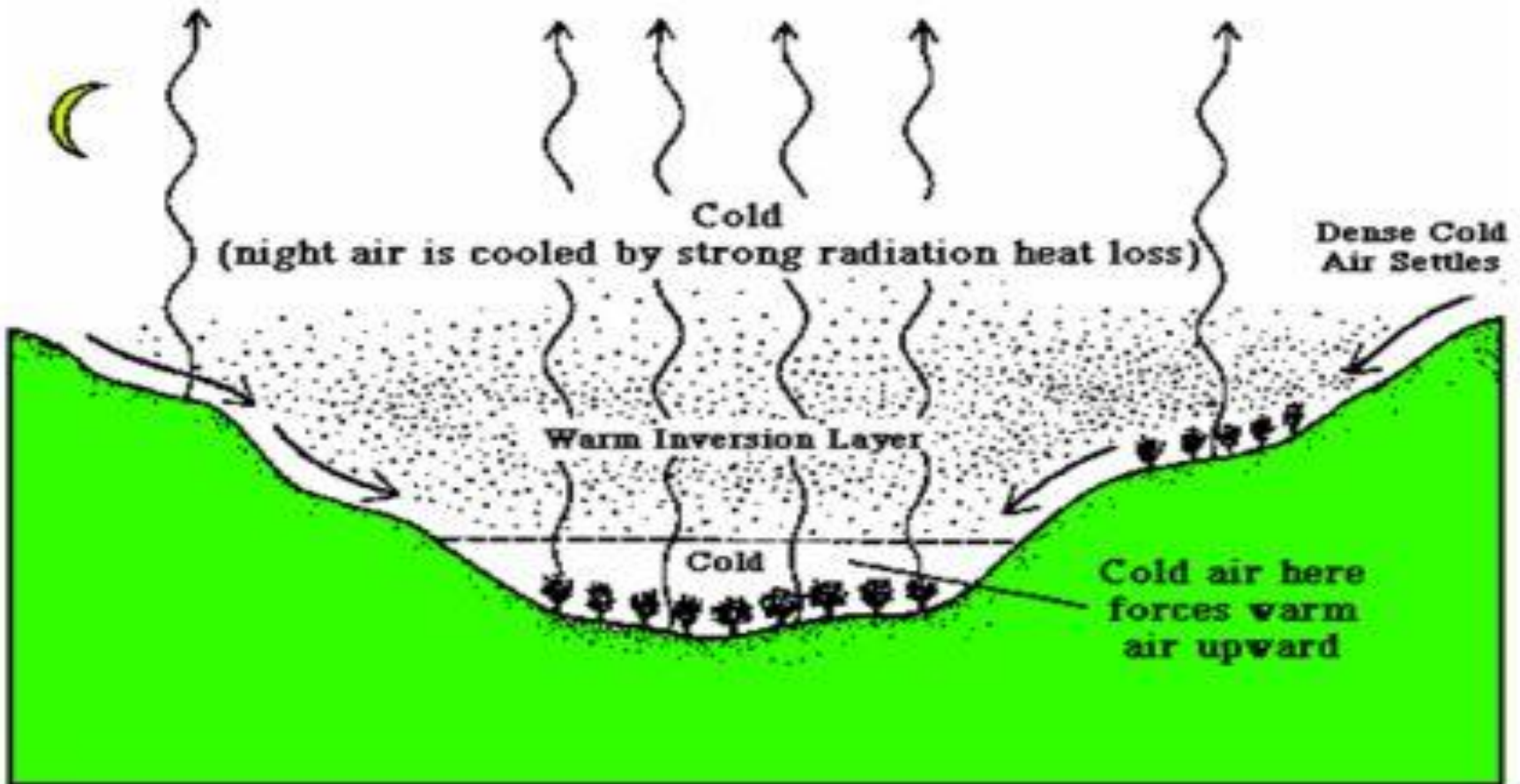
HEAT ENERGY
INTO AIR BY
CONDUCTION

HEAT ENERGY
MOVES FROM AIR
BY CONDUCTION
TO COOLER SOIL

SOIL COOLS BY
RADIATION AND
BECOMES COOLER
THAN AIR



Radiation Frost



VERTICAL TEMPERATURE IN ORCHARD UNDER INVERSION

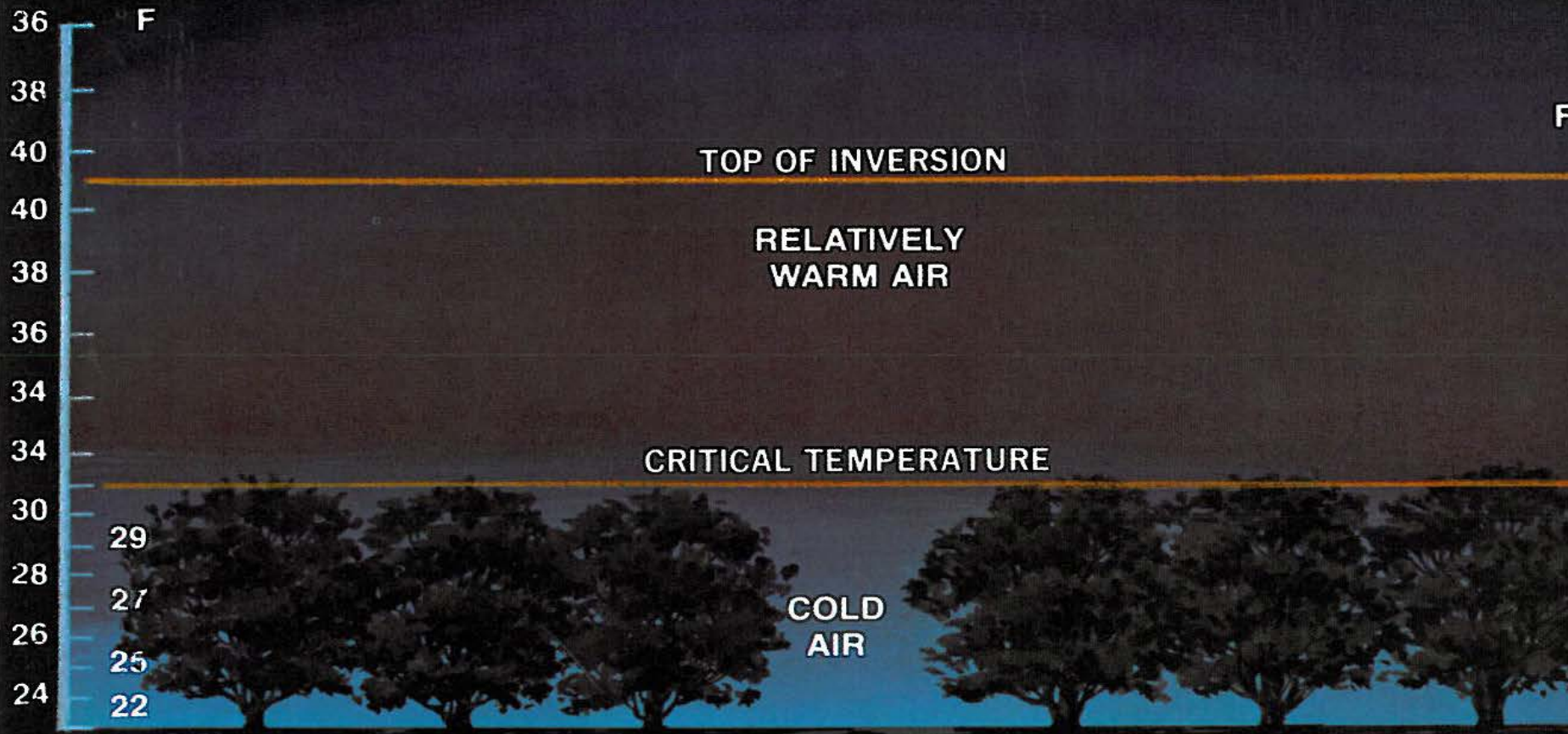
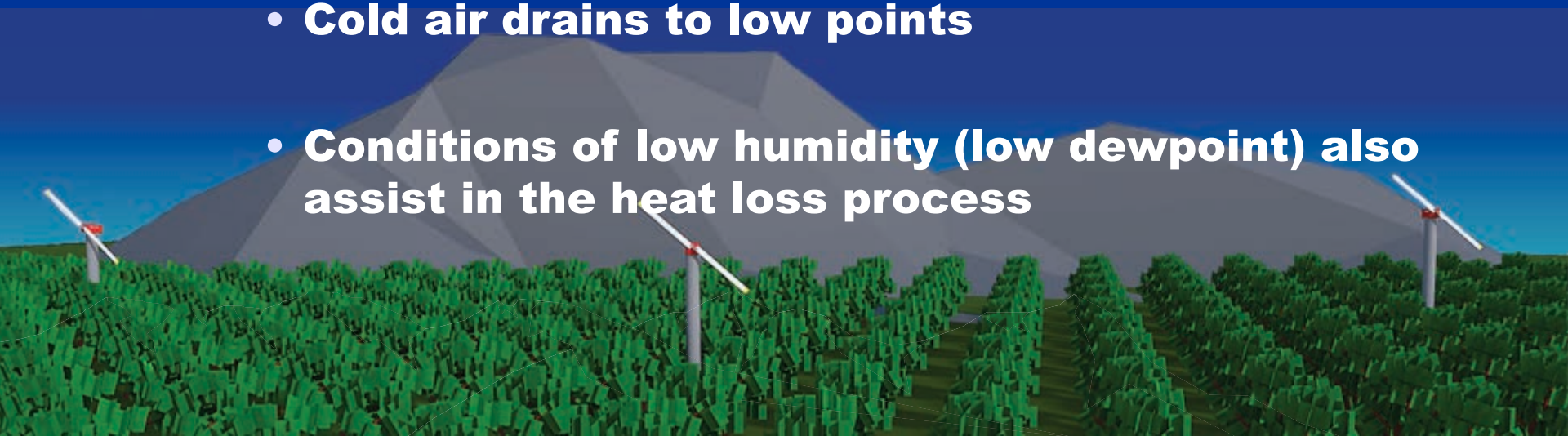


Figure 10

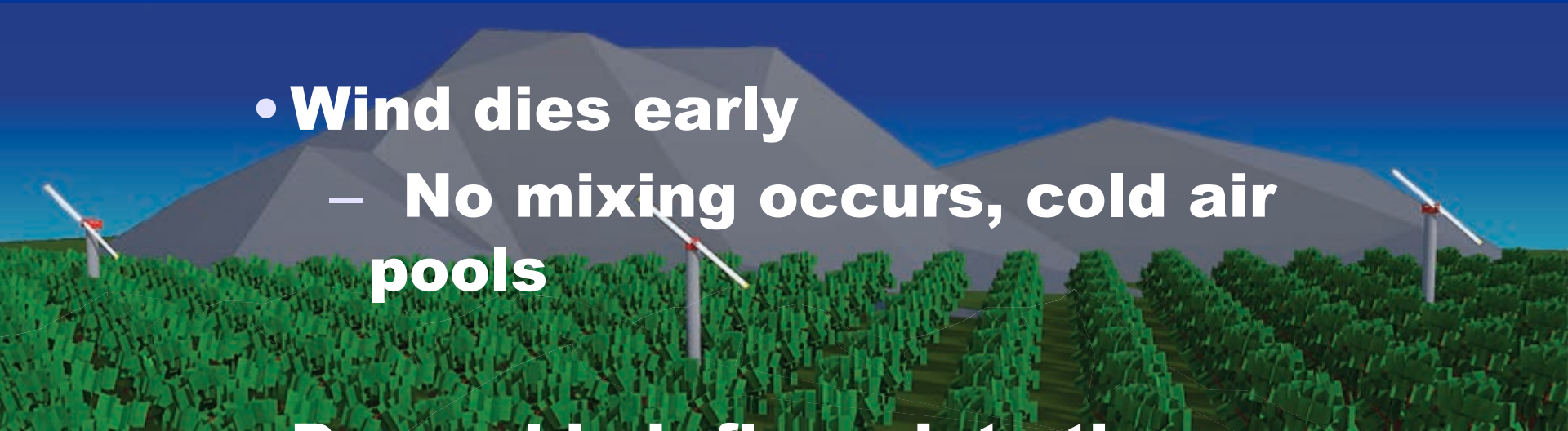
Radiation Frost

- **Radiation frost is the most common frost occurrence**
 - **Occurs under cloudless skies without mixing winds**
 - - a temperature inversion is created - warm air above cold air
 - **Cold air drains to low points**
 - **Conditions of low humidity (low dewpoint) also assist in the heat loss process**



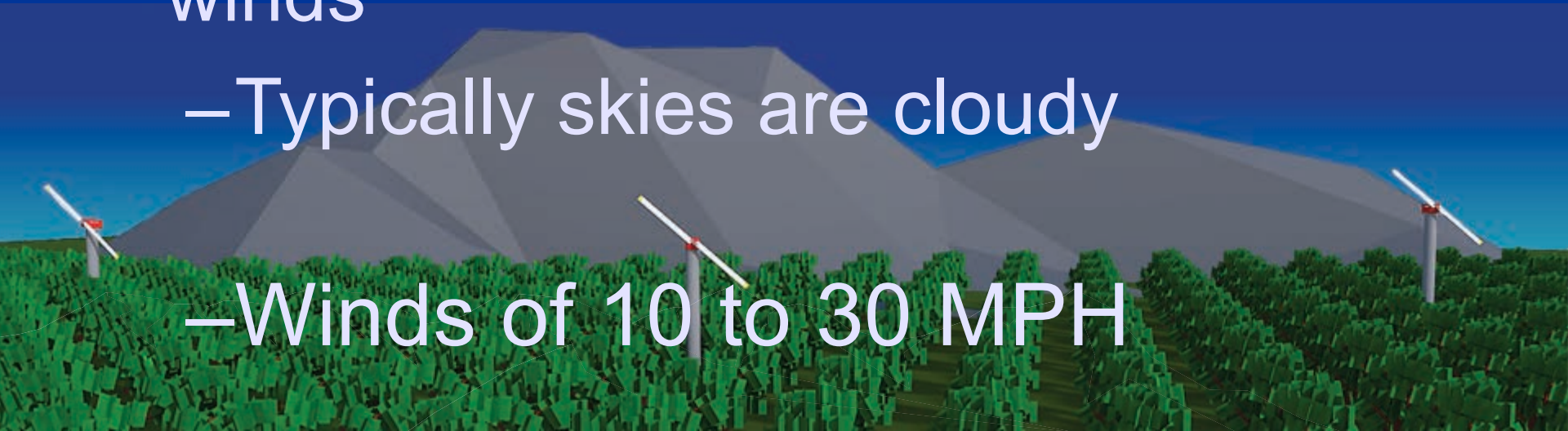
Set Up for Severe Night

- **Cool, cloudy day**
 - **No solar heat transfer to ground**
- **Clouds clear soon after sunset**
 - **heat escapes into the atmosphere**
- **Wind dies early**
 - **No mixing occurs, cold air pools**



Advective Freeze Winter Heating

- Occurs when a large mass of dry, cold air moves into the area
- Very difficult and expensive to combat especially if associated with strong winds
 - Typically skies are cloudy
 - Winds of 10 to 30 MPH



Protection During Advective Freezes

- **Only heaters can be of help but difficult**
 - **Winds take heat out of the orchard**
 - **Expensive to operate**
 - **40 Pots/acre 1 gal/hour**



Protection During Advective Freezes

– WATER SYSTEMS ARE RISKY

- Water not available**
- Freezing of lines & sprinklers**
- Ice breaks down limbs**



OVERHEAD SPRINKLERS BREAK DOWN PEACH TREES



- **Protection with wind machines**

- **Not possible while wind is blowing over 5 MPH**

- **First 2 nights, cloudy & windy**

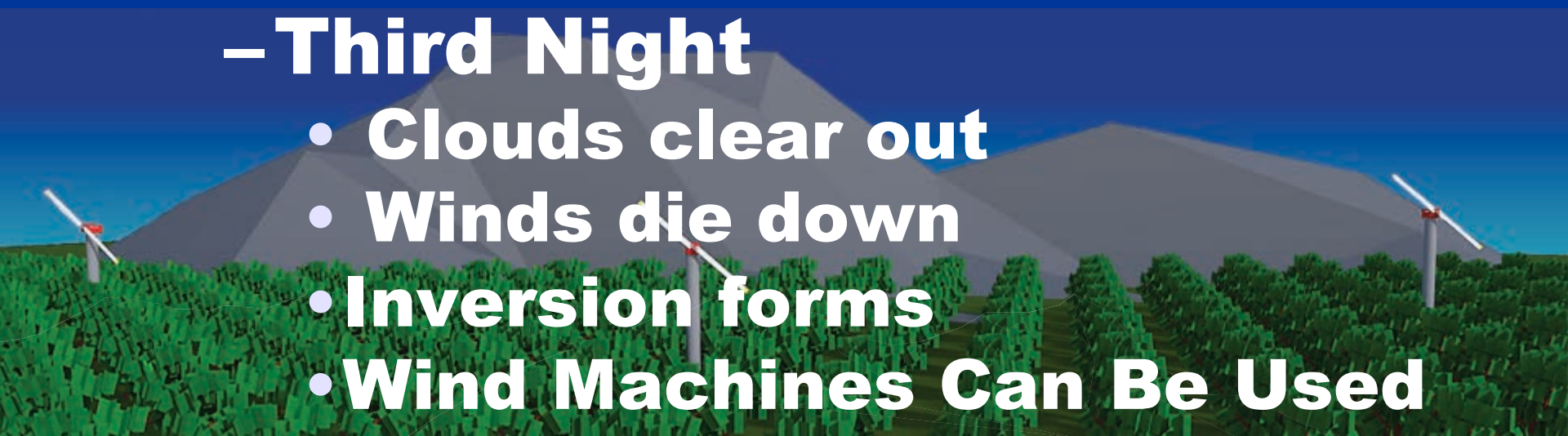
- **Third Night**

- **Clouds clear out**

- **Winds die down**

- **Inversion forms**

- **Wind Machines Can Be Used**



VERTICAL TEMPERATURE IN ORCHARD UNDER INVERSION

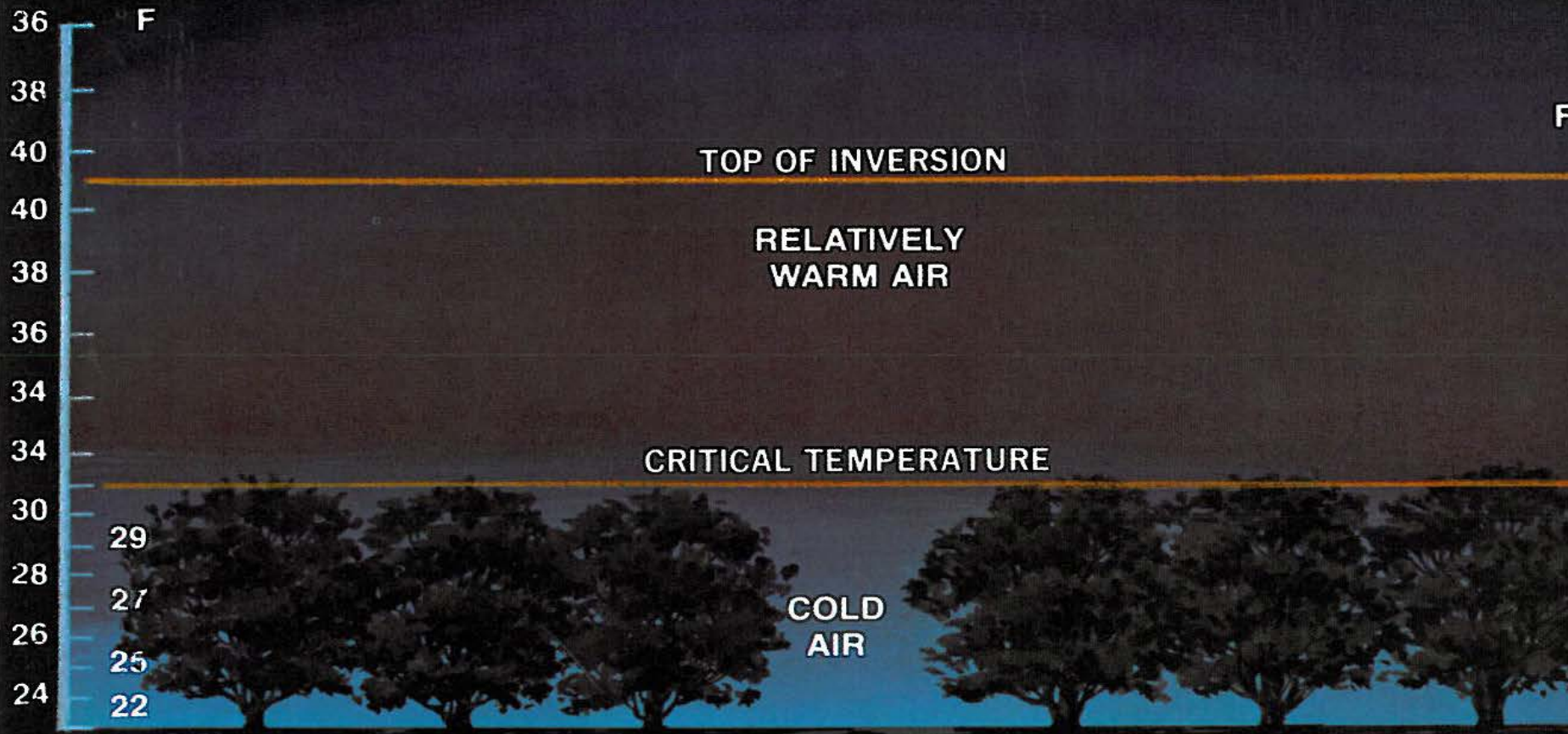
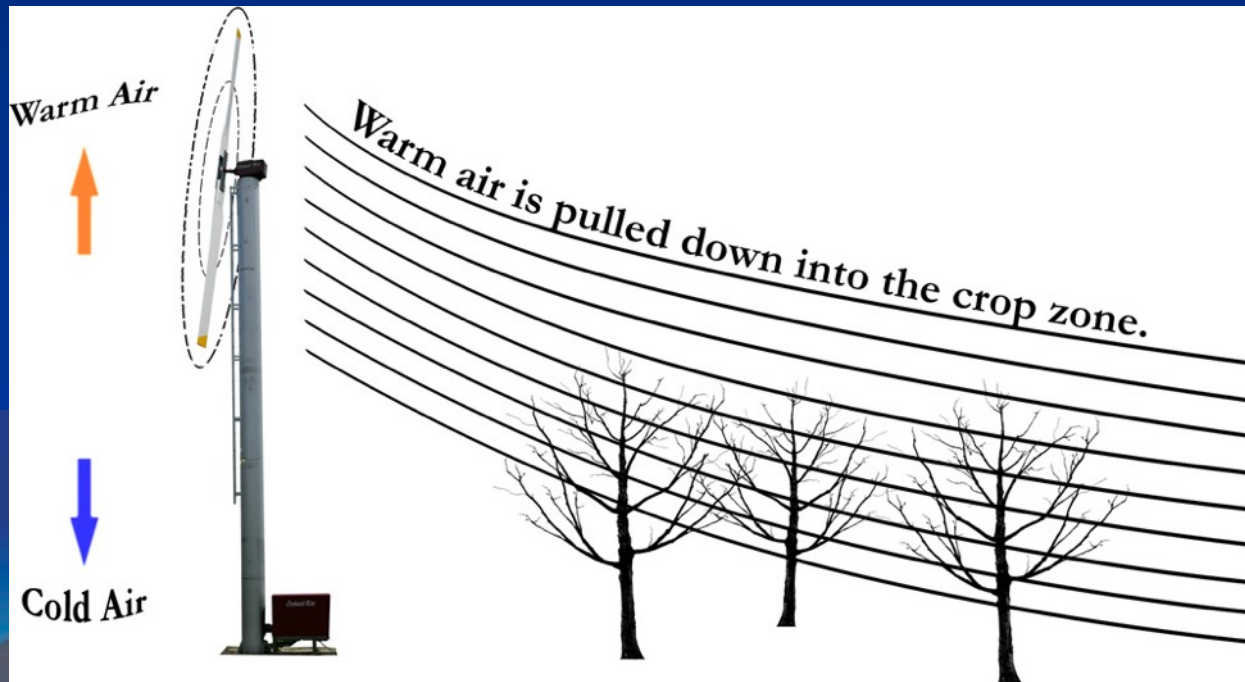


Figure 10

Theory of Wind Machines

How do fans protect?

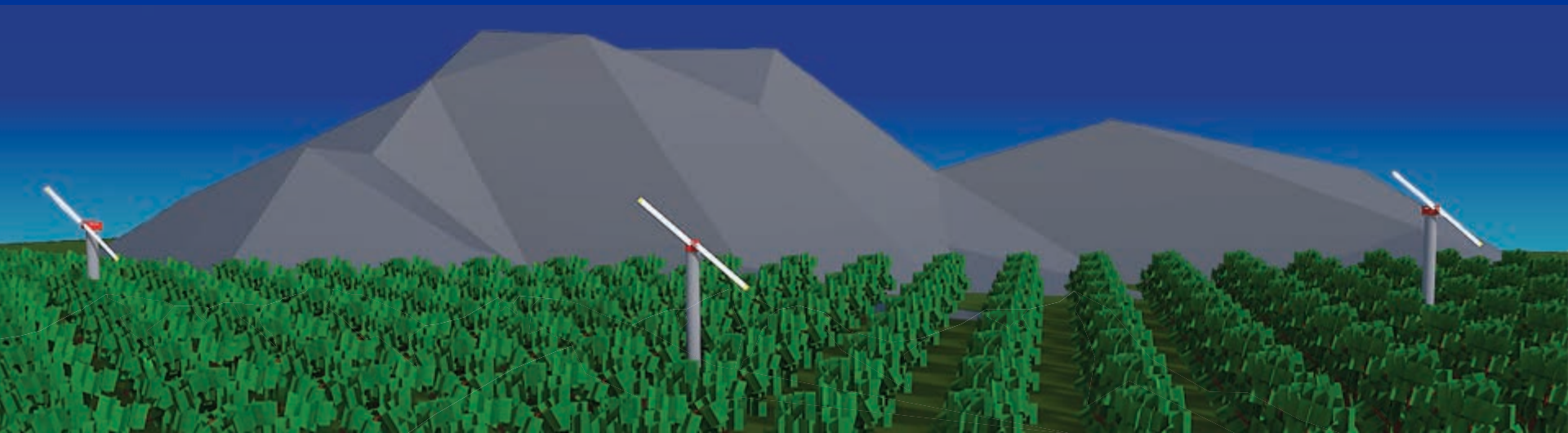
1. MIXING Use warm air inversion



How do fans protect?

1. MIXING PULL DOWN WARM INVERSION AIR

2. VENTILATE PREVENT AIR STAGNATION

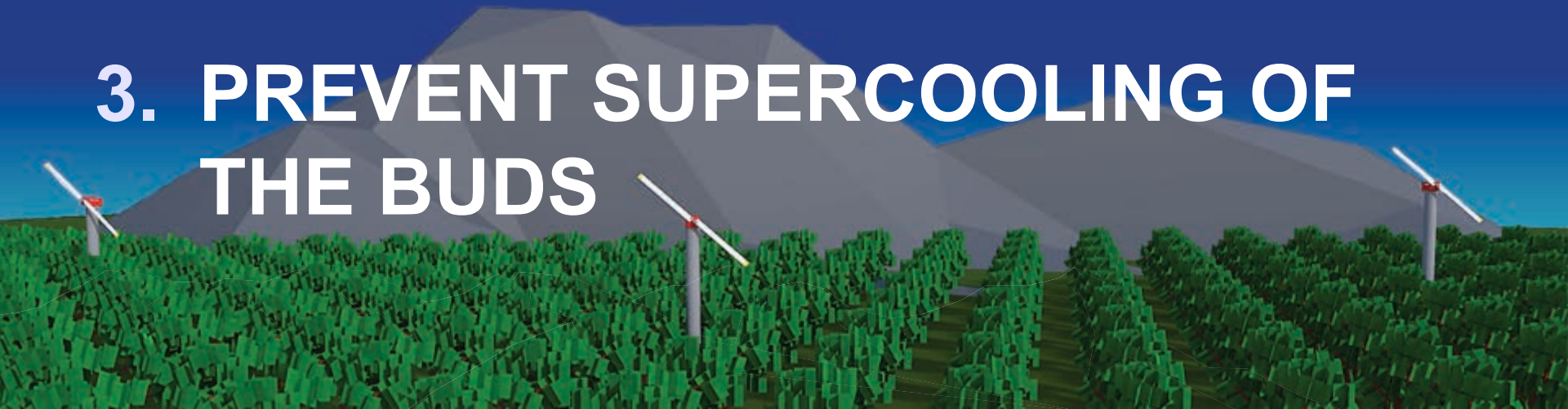


How do fans protect?

1. **MIXING** PULL DOWN WARM INVERSION AIR

2. **VENTILATE** PREVENT AIR STAGNATION

3. **PREVENT SUPERCOOLING OF THE BUDS**

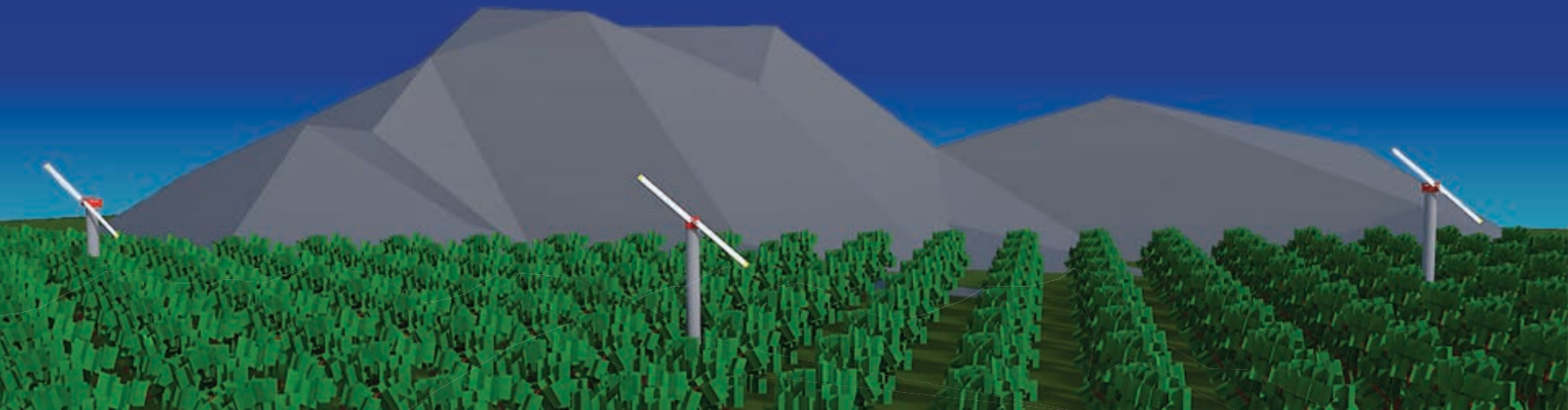




Thermometer must be covered
or they read 2°F. colder

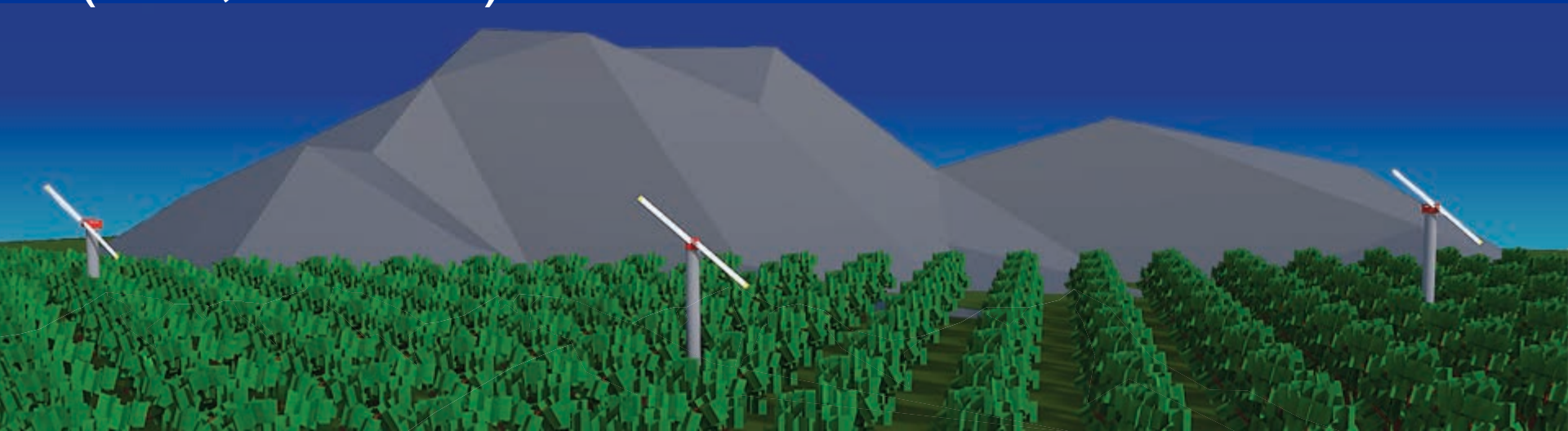


WHY USE WIND MACHINES?



Why Consider Wind Machines?

- Wind machines are a proven system for 60+ years and around the world in a variety of crops
- Wind machines are environmentally benign (well, almost)



Demand for Wind Machines Increasing Worldwide

- WIND MACHINES SALES HAVE DOUBLED IN LAST 10 YEARS
- 500 units being added in Western USA this year alone
- New crop areas being protected every year all over the world



Frost Control World Wide

Citrus, Wine Grapes, Tree Fruit, Berries, Nurseries, Nuts

➤ Germany

➤ France

➤ Italy

➤ Spain

➤ Poland

➤ Turkey

➤ Morocco

➤ Saudi Arabia

• Australia

• New Zealand

• South Korea

• Japan

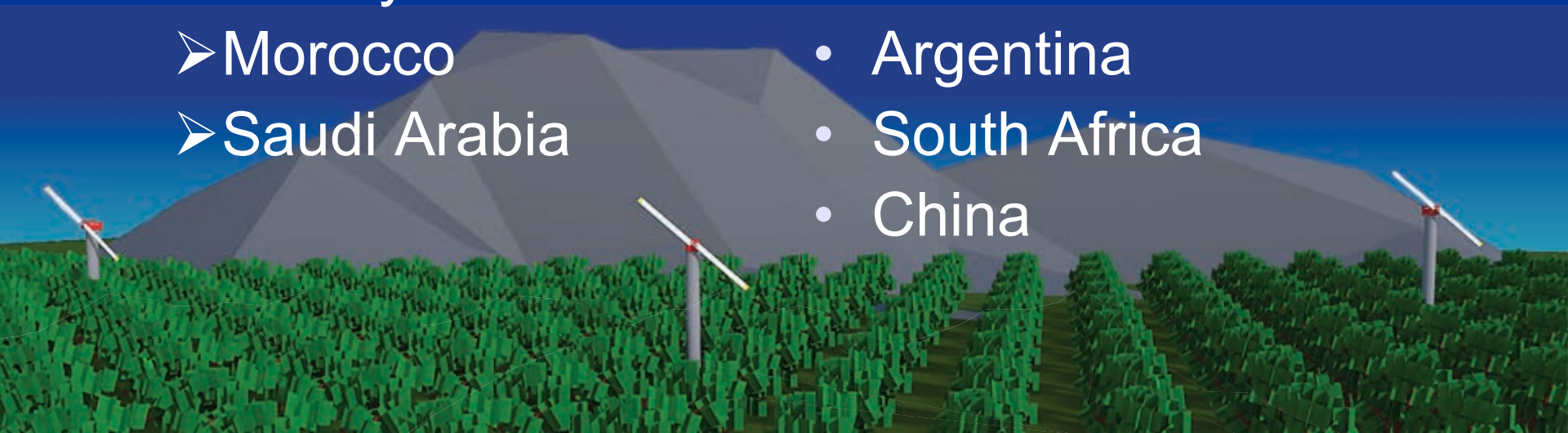
• Mexico

• Chile

• Argentina

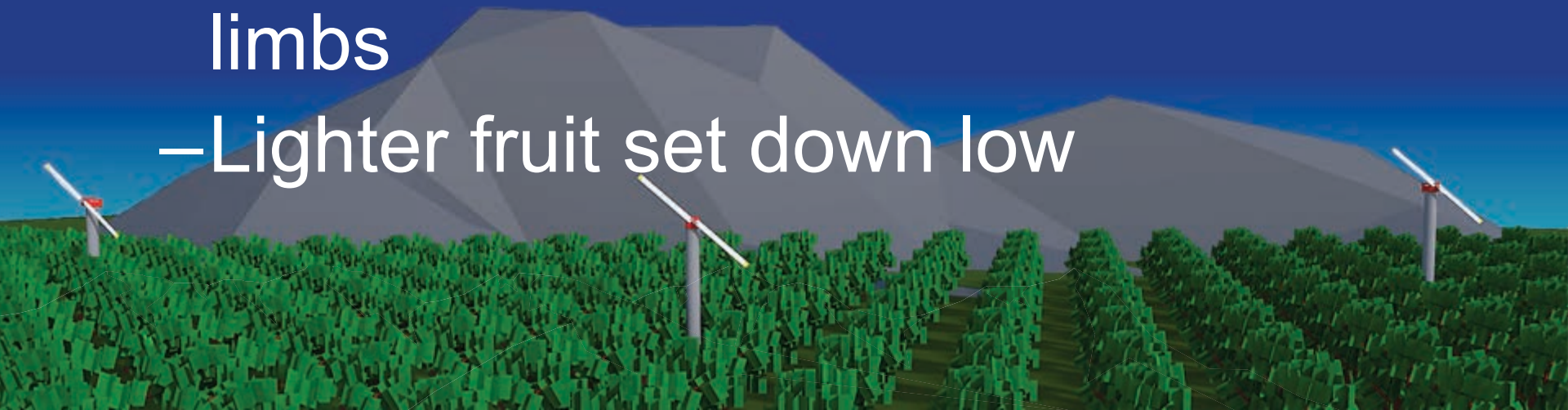
• South Africa

• China



Will Wind Machines Work Here?

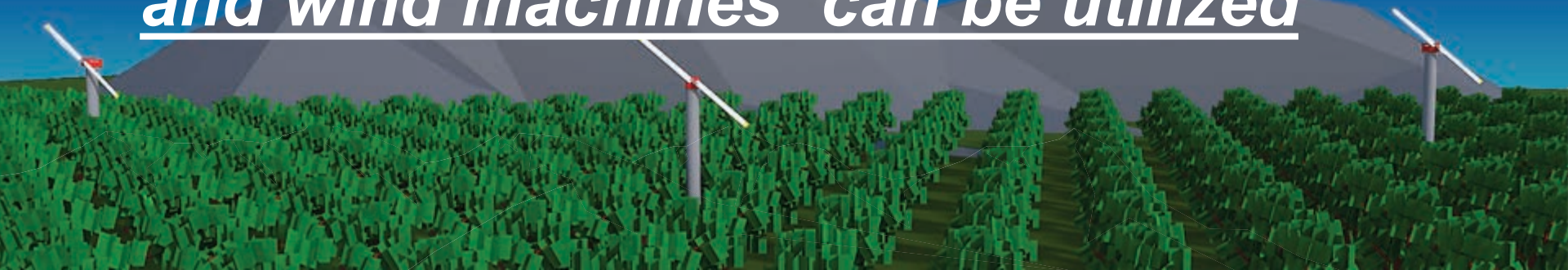
- Are you seeing damaged flower parts?
- Are you seeing damage only at lower levels?
 - Dead blossoms low, no damage higher in tree
 - Misshapen or smaller fruit on lower limbs
 - Lighter fruit set down low



Will Wind Machines Work Here?

- Is there fruit on the slopes but not in low spots?
- Damage next to obstructions or in air drainages?

! If you answer yes to these, your damage is occurring during radiational conditions and wind machines can be utilized



OTHER QUESTIONS

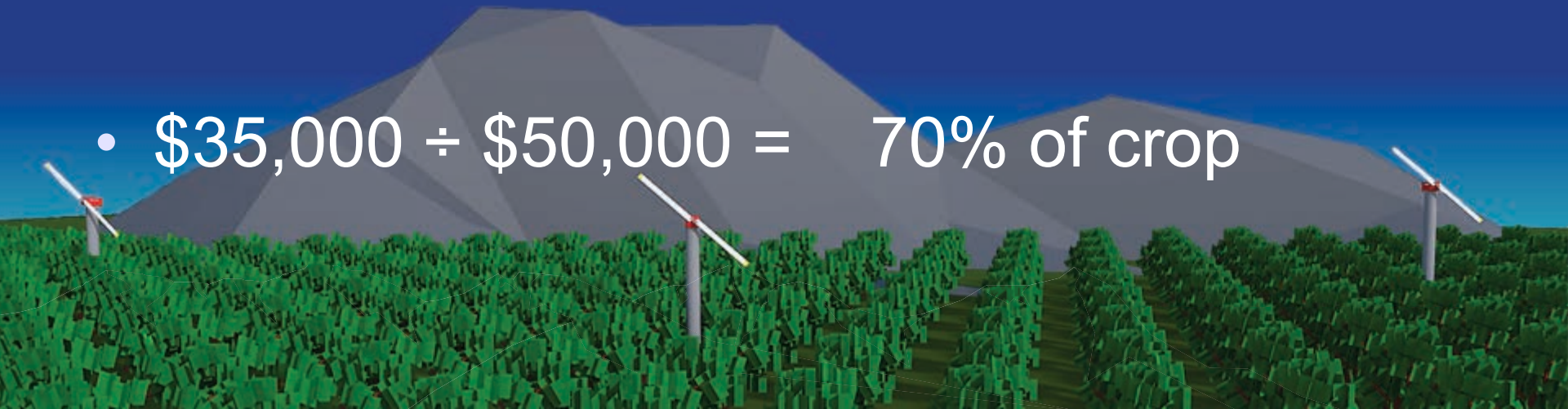
- HOW MUCH TEMPERATURE LIFT NEEDED?
 - FANS = 4 Degree System
- ARE THE ORCHARD BLOCKS LARGE ENOUGH TO JUSTIFY FANS?



Economics of Wind Machines

ONE YEAR PAYBACK

- \$35,000 Installation & Fuel
- 10 Acres \$5000/Acre = \$50,000
- $\$35,000 \div \$50,000 = 70\%$ of crop



Economics of Wind Machine

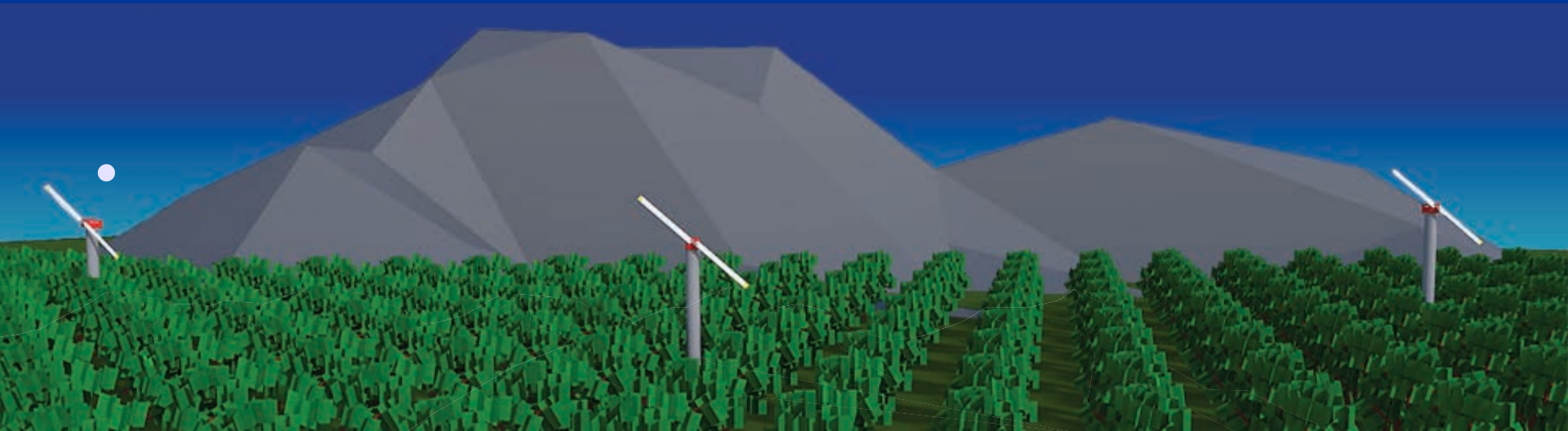
5 YEAR PAYBACK

- \$8000+/- Annual cost to finance, operate, & maintain wind machine over 5 years
TOTAL 5 YEAR COSTS = \$40,000

- 10 Acres of fruit worth \$50,000

- $\$8000 \times 5 = \$40,000$ \ $\$50,000 = 16\%$ Over 5 years
Justifies the wind machine

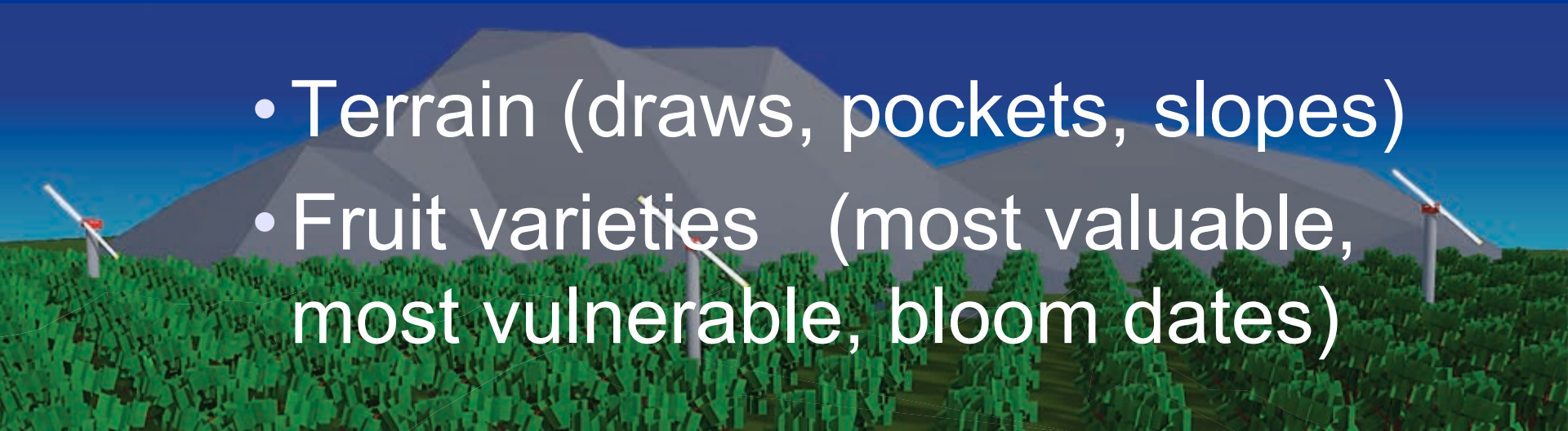
WHERE TO PLACE FANS



Proper Siting of Wind Machines

NUMEROUS CONSIDERATIONS

- Orchard dimensions
- Cold air drifts
- Terrain (draws, pockets, slopes)
- Fruit varieties (most valuable, most vulnerable, bloom dates)



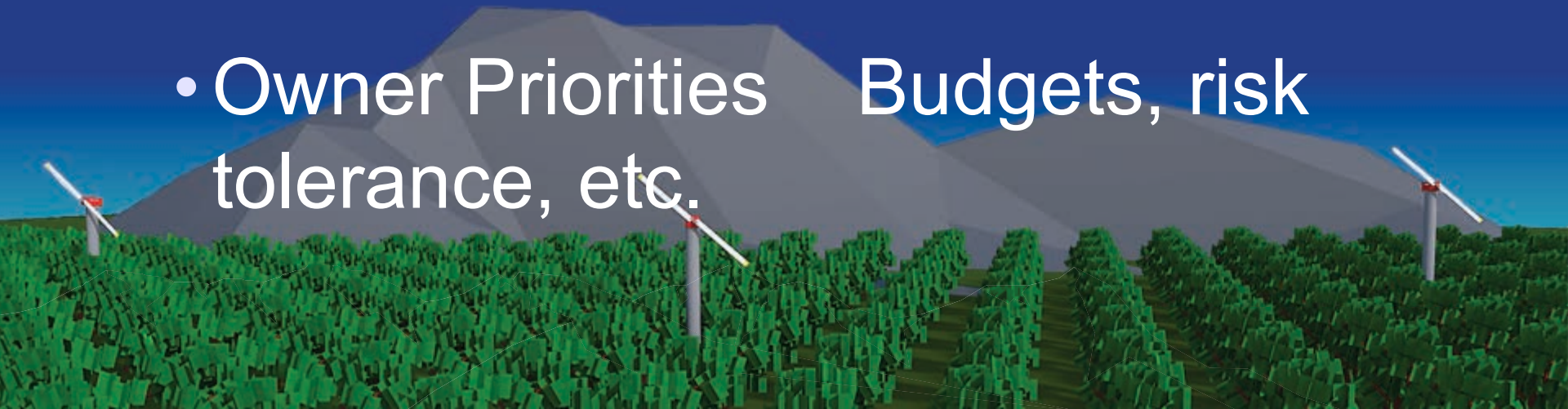
Proper Siting of Wind Machines

–NUMEROUS CONSIDERATIONS

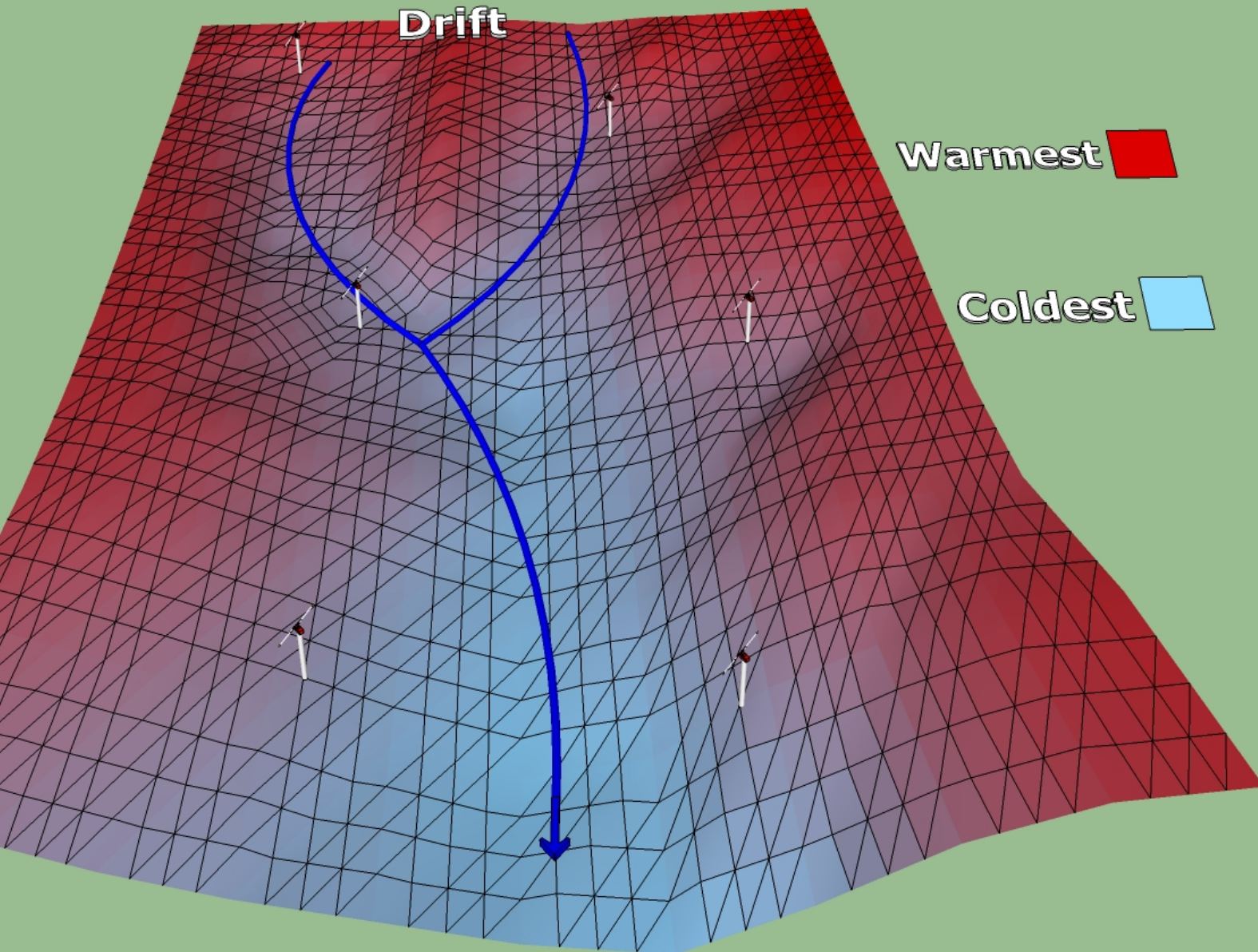
- Frost damage history

- Temperature Data

- Owner Priorities Budgets, risk tolerance, etc.

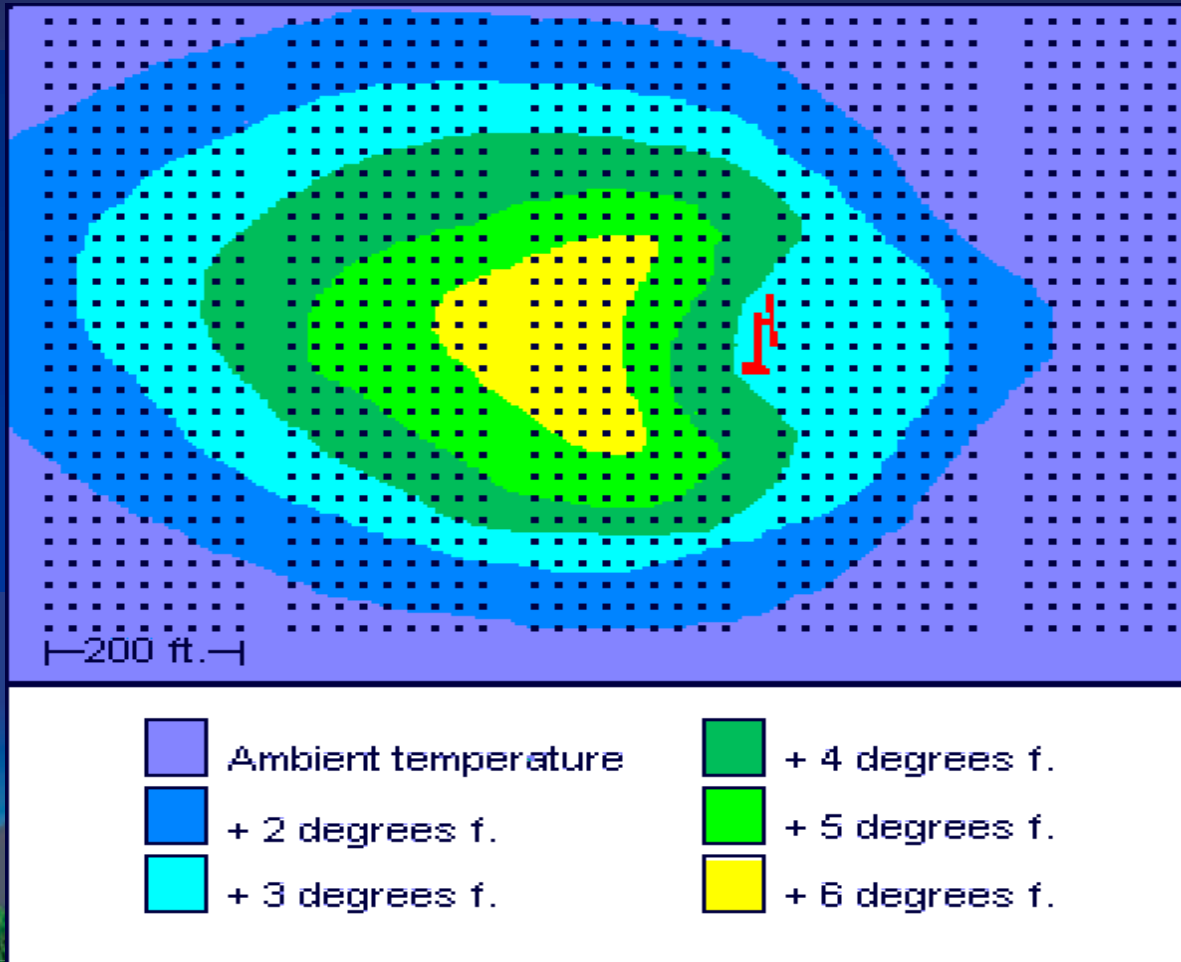


TOPOGRAPHY, DRIFTS, & COLD AREAS

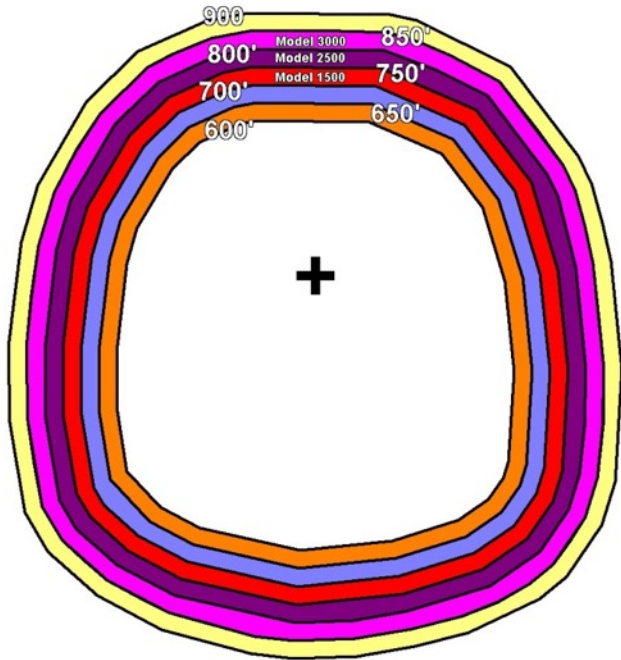


Drift affects fan coverage

125 HP Aluminum 1984



Single Machine Protection Area



OVAL ACREAGE

600'	=	6.43
650'	+1.14	= 7.57
700'	+ 1.24	= 8.81
750'	+1.32	= 10.13
800'	+1.44	= 11.57
850'	+1.55	= 13.12
900'		

183M = 2.6 Ha

198M = 3.0 Ha

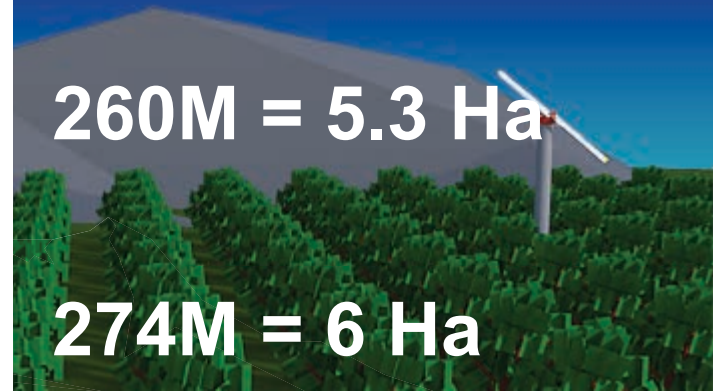
213M = 3.6 Ha

228M = 4.1 Ha

244M = 4.7 Ha

260M = 5.3 Ha

274M = 6 Ha



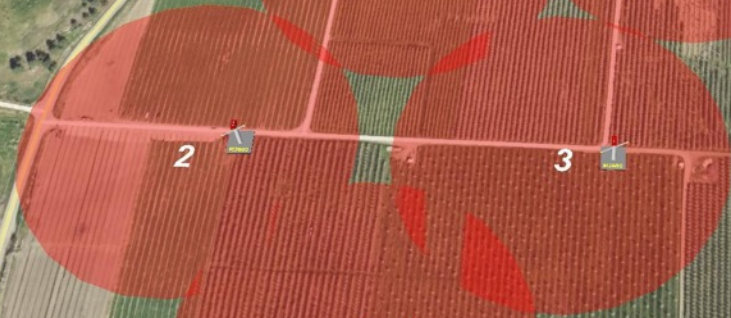
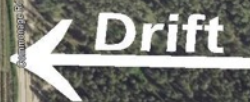
**Coral Beach Farms
Home Orchard
Wind Machine Map**

**8 O-R M2600
6-5-10**



Contour TGB

**Move #4 to the East and install # 8
on driveway above the house**



Carrs

Winey Cr. Rd



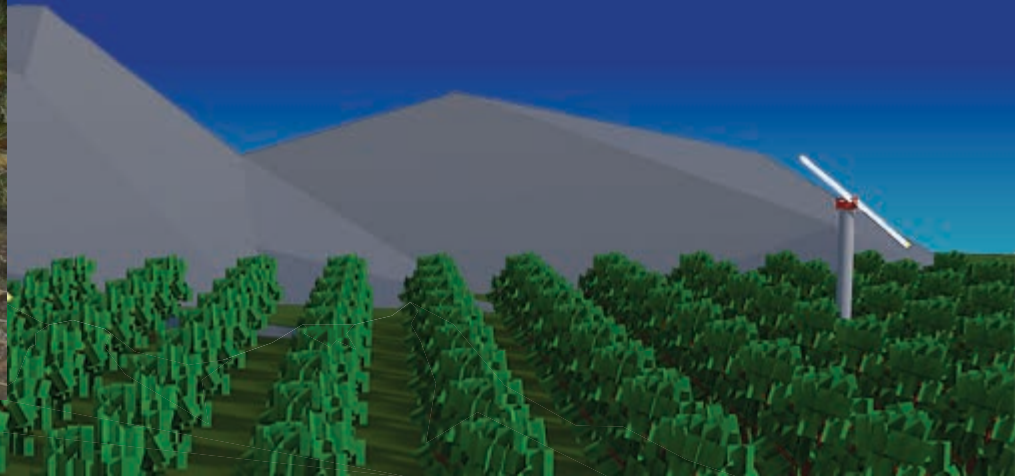
Check Drift

Use ribbons or smoke

No Drift



- After sundown or before sun up
- Clear Conditions
- No Wind



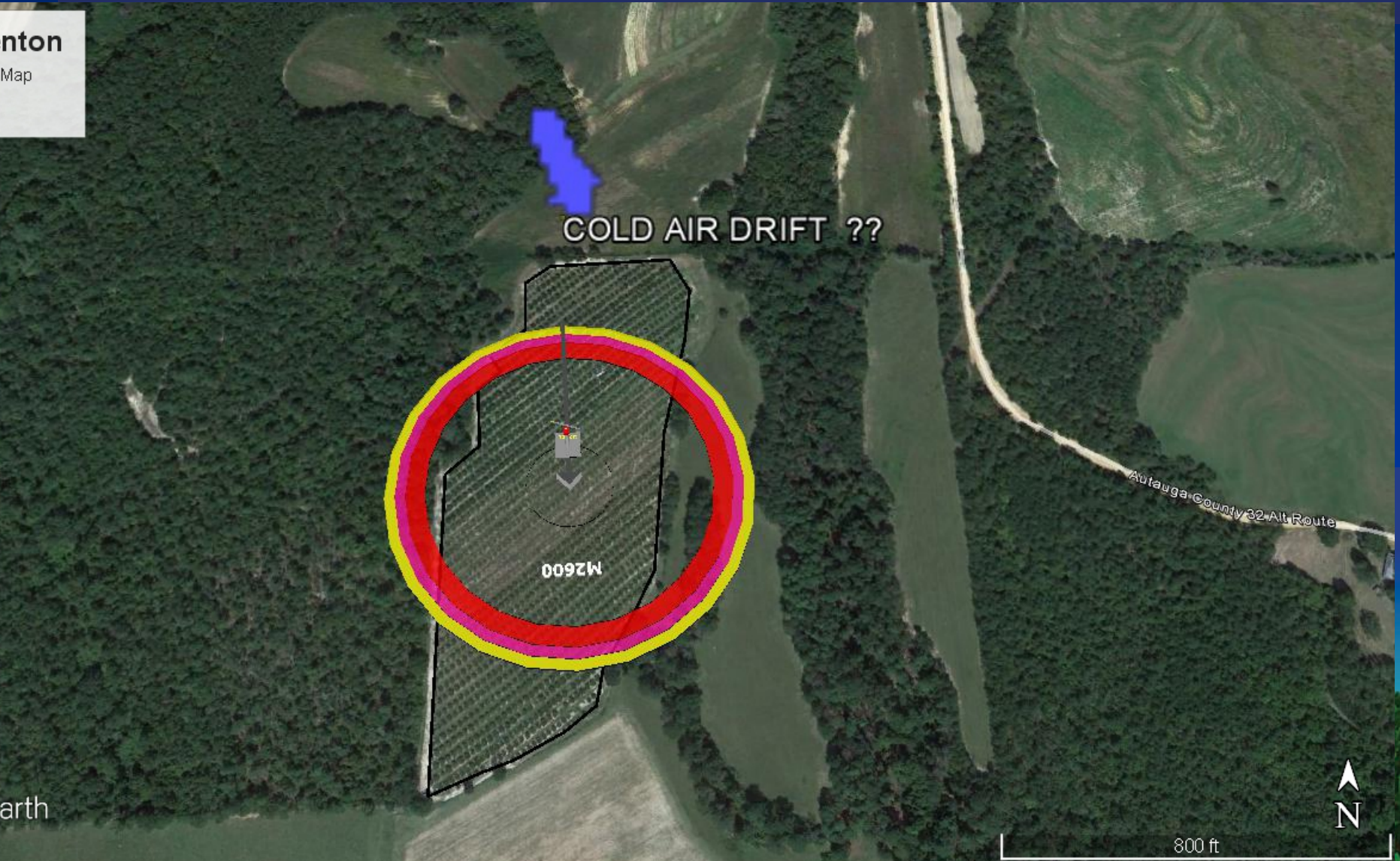
Light Drift



Medium Drift



Spot Protect or Full Coverage?



Full Coverage Map

Penton Farms

Wind Machine Map B 2 Units 11-8-14

Scott Penton
Peach Orchard

#2

#1

M2600

M2690

Google earth

1000 ft



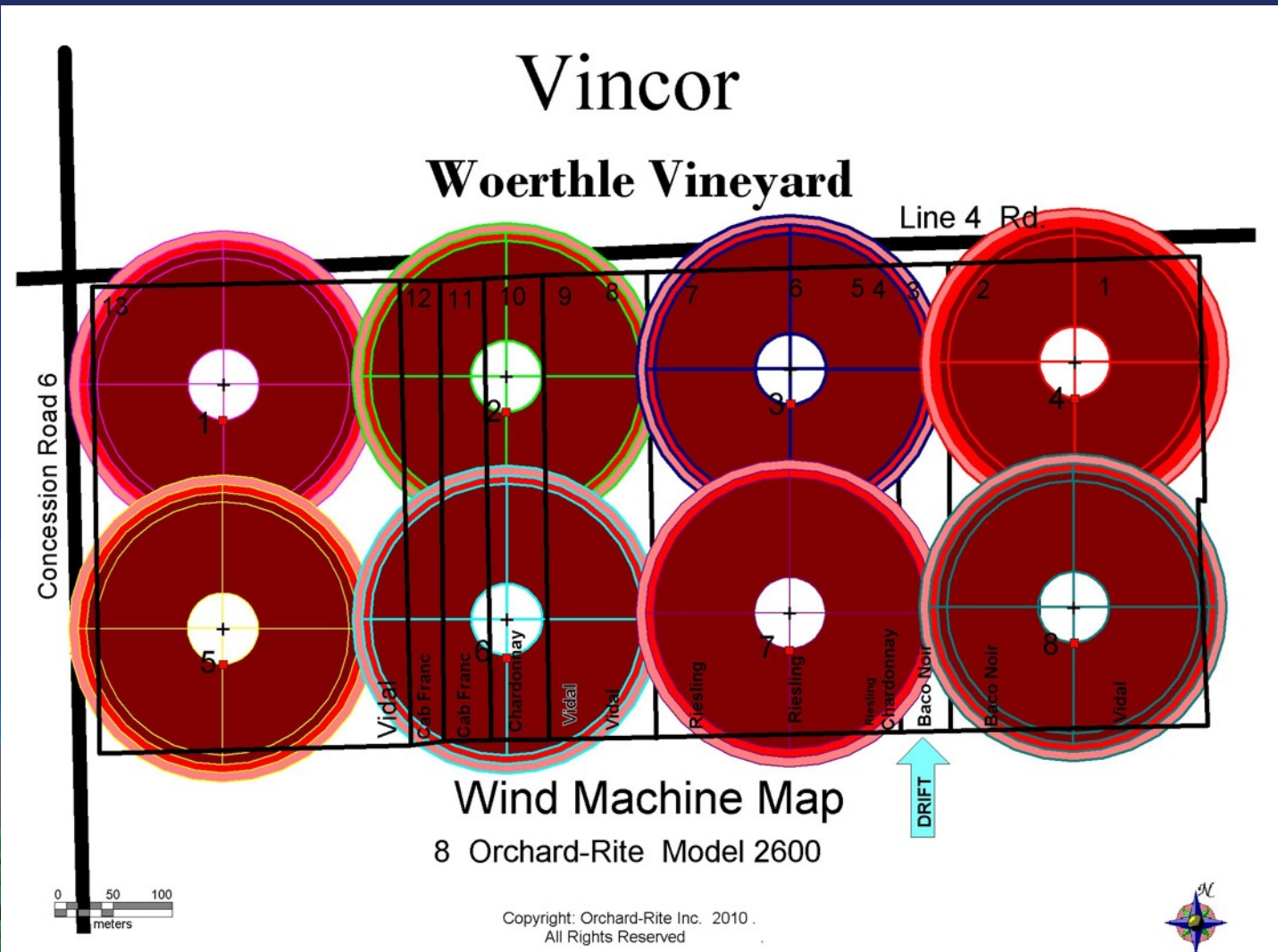
county 32

Autauga County 32 Alt Route

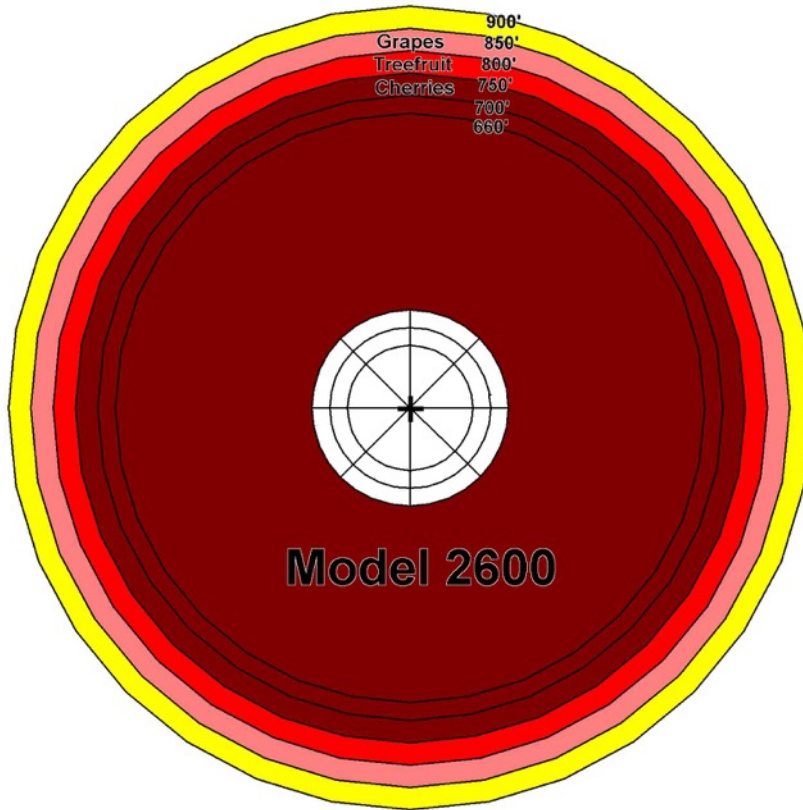
Autauga County 123



Fans work best in combination



DIFFERENT SPACING FOR VARIOUS CROPS

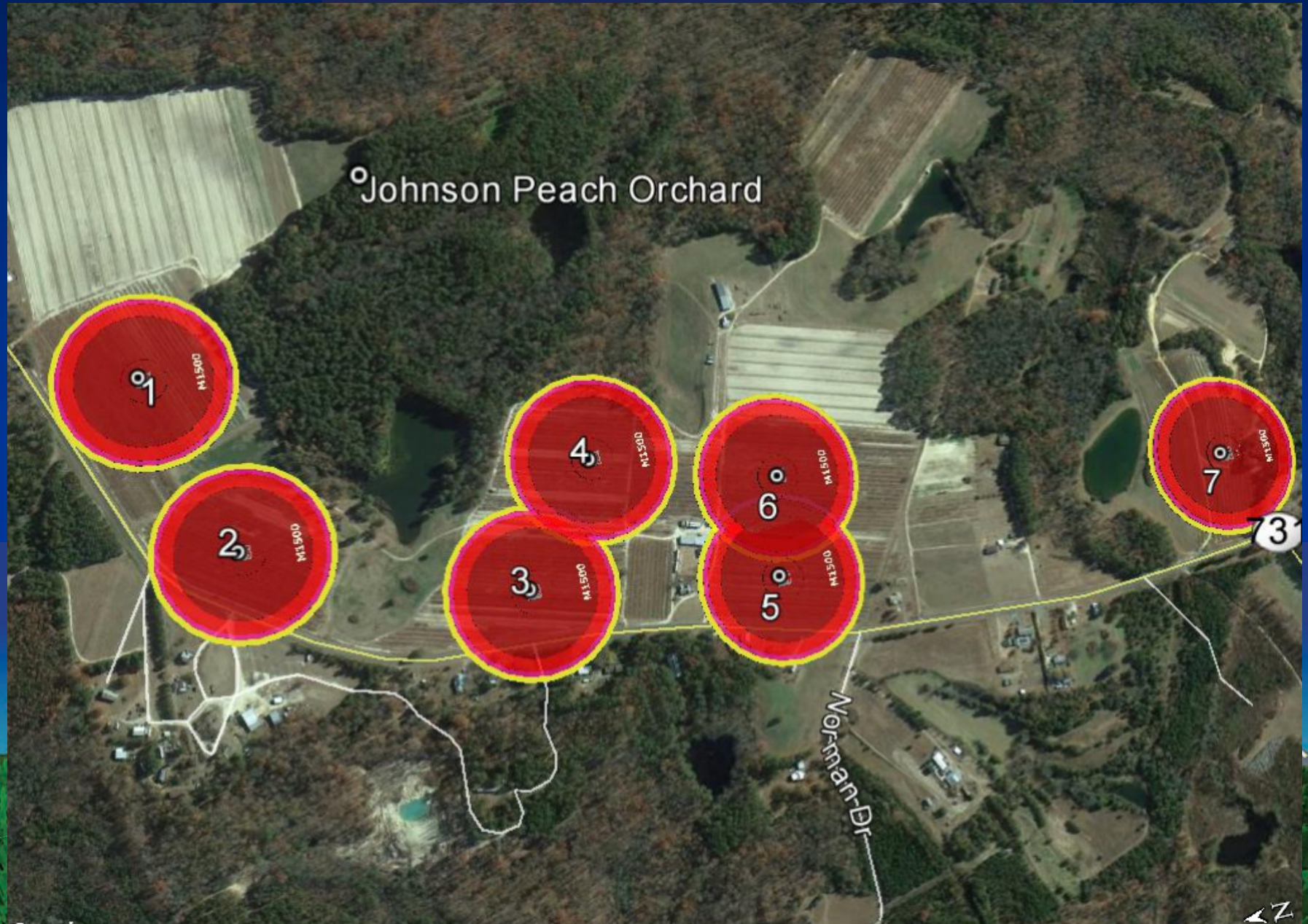


- GRAPES & CITRUS
- TREE FRUIT
- SOFT FRUIT

Use Aerial Photos & Maps to design an overlapping system

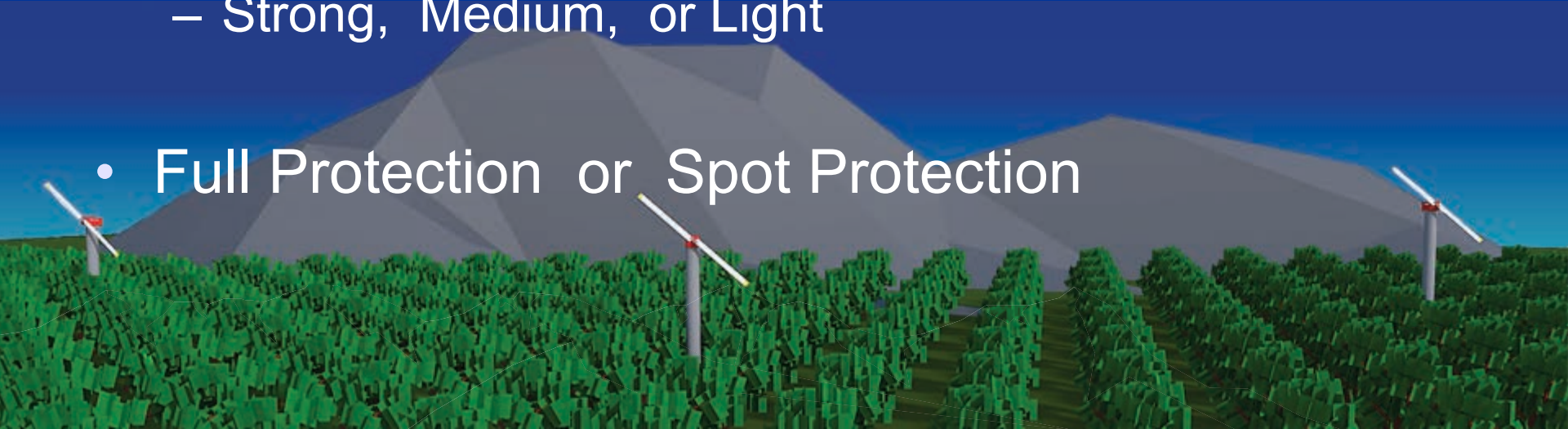


Johnson Peaches

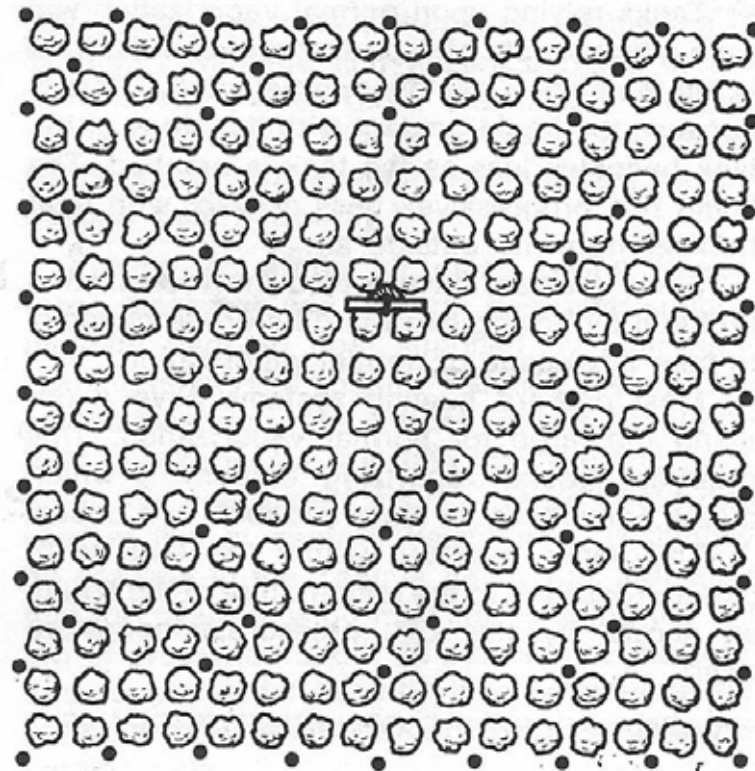
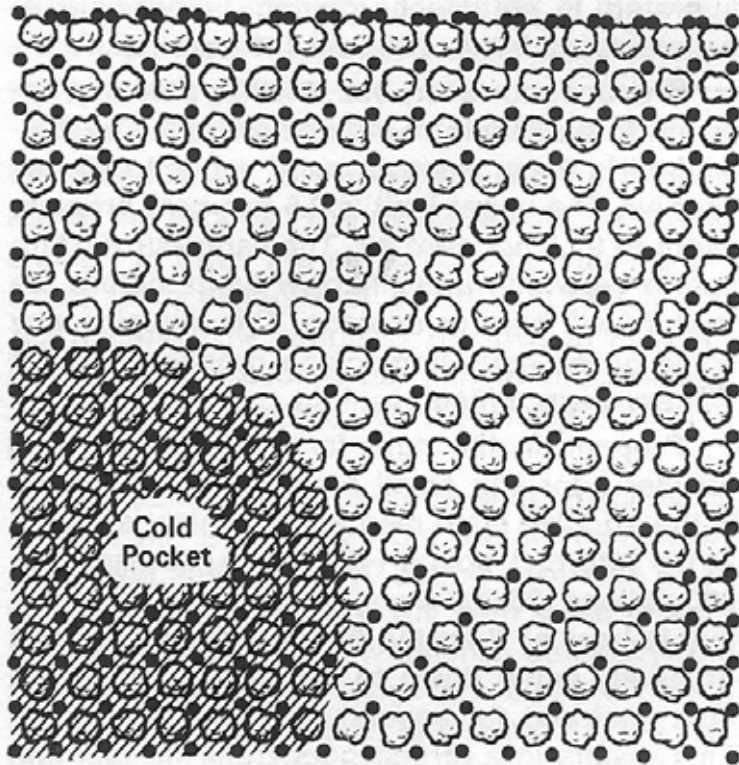


Points To Consider

- IDENTIFY PAST DAMAGE, CROP VALUE, TEMPERATURES, ETC.
-
- DRIFT What is the direction and speed
- PROTECTION STRENGTH
 - Strong, Medium, or Light
- Full Protection or Spot Protection



Wind Machine & Supplemental Heat



SUPPLEMENTAL HEAT

- Hay/Straw Coal Wood

- Diesel or Propane Heaters

- 6 degree system

- Undertree Sprinklers

- 6 degree system



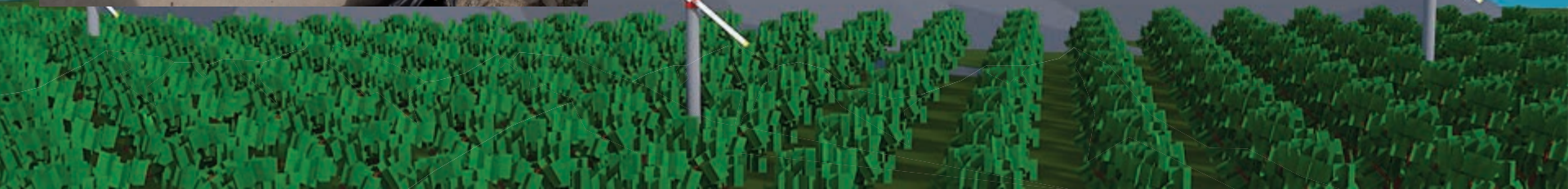
Straw Bales and Fans



Hay Burner



Coal Heaters

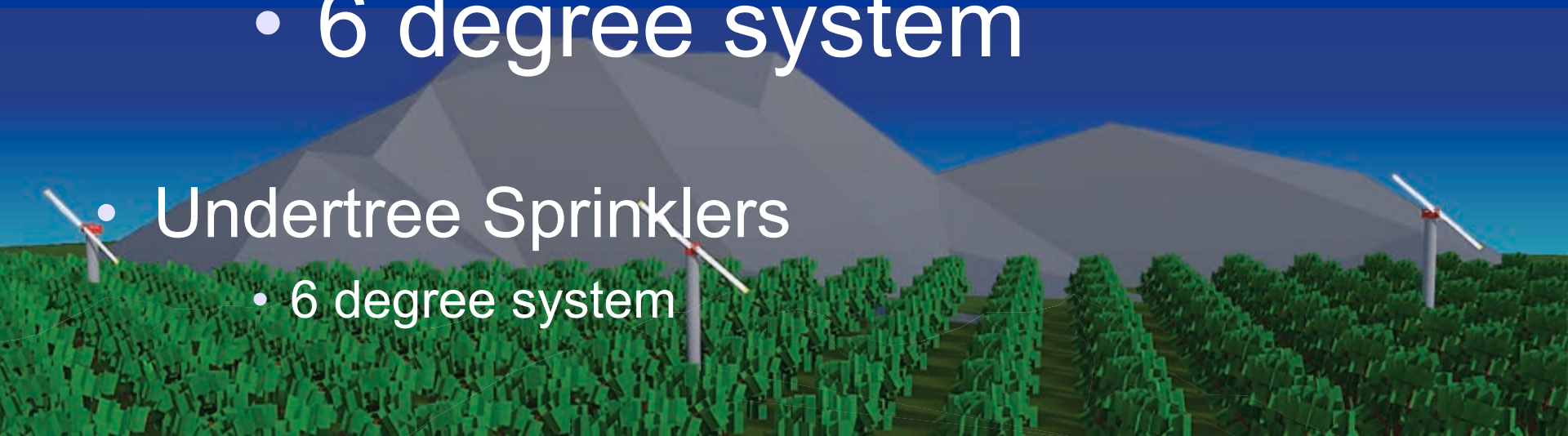


Wood Heaters



SUPPLEMENTAL HEAT

- Hay/Straw Bales
 -
- Diesel or Propane Heaters
 - 6 degree system
- Undertree Sprinklers
 - 6 degree system



Wind Machine & Heater Placement

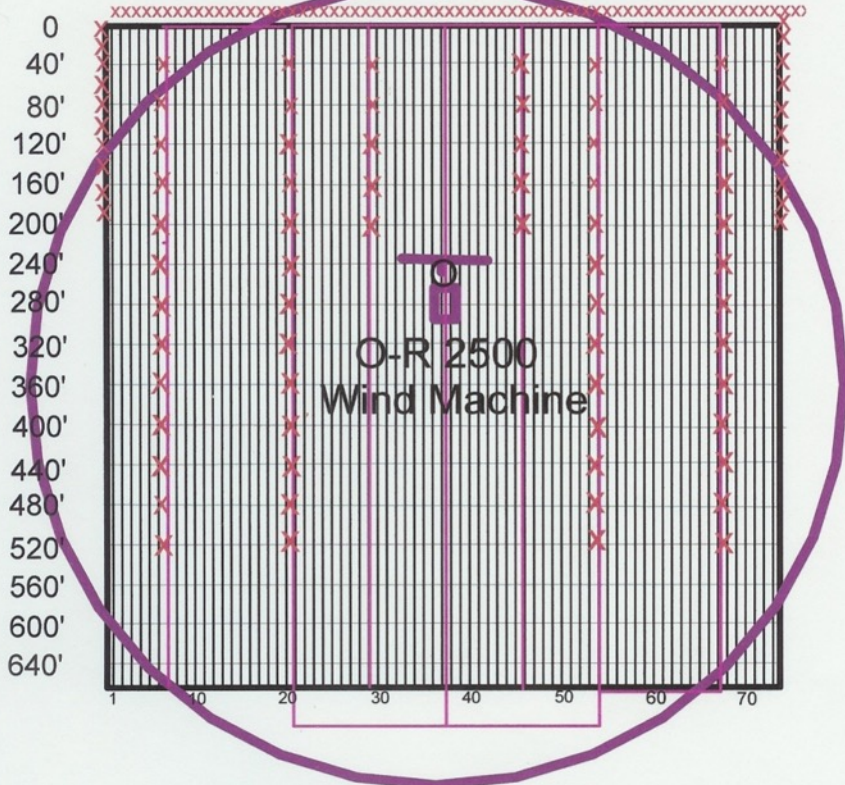
Moderate Heating System

155 Pot Total

Grapes 9' rows

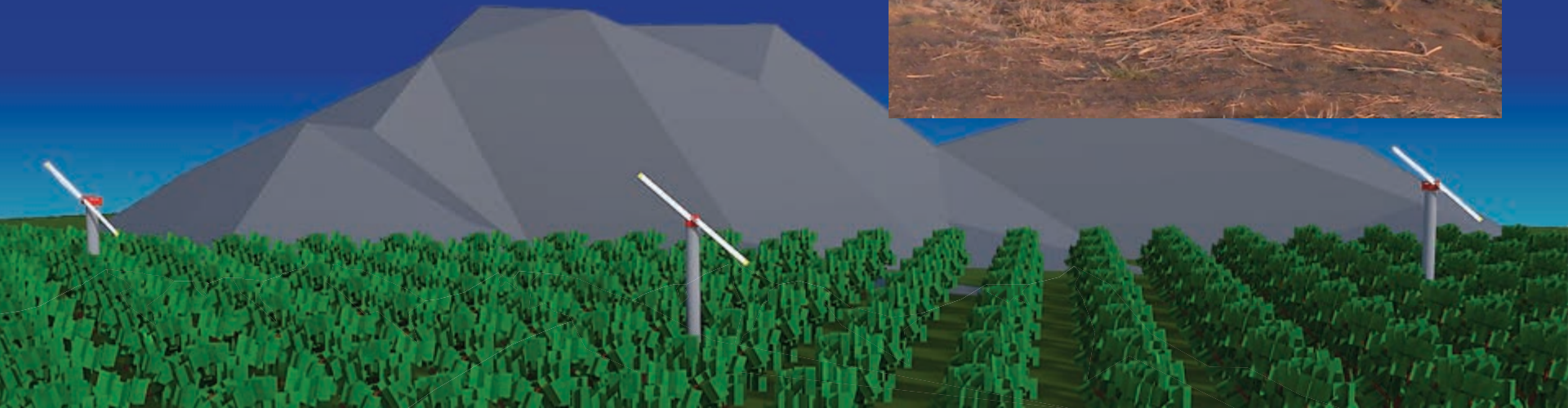
Cold Air Drift

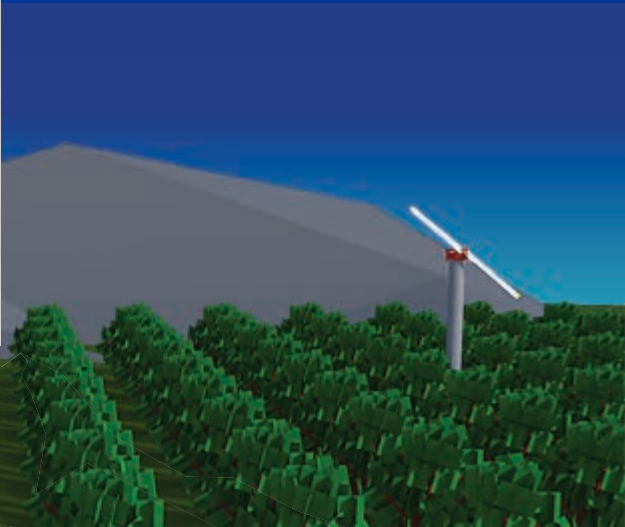
73 Pot border



660' x 660'
10 acres
155 pots
Model 2500 Fan

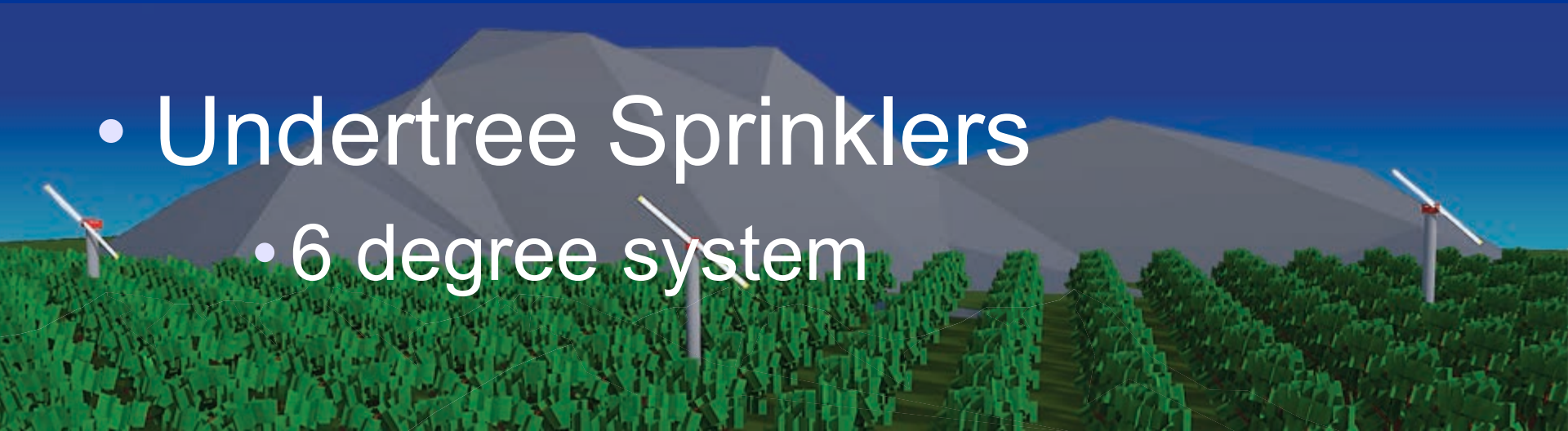
PROPANE HEATERS





SUPPLEMENTAL HEAT

- Hay/Straw Bales
 -
- Diesel or Propane Heaters
 - 6 degree system
- Undertree Sprinklers
 - 6 degree system



Florida Peaches



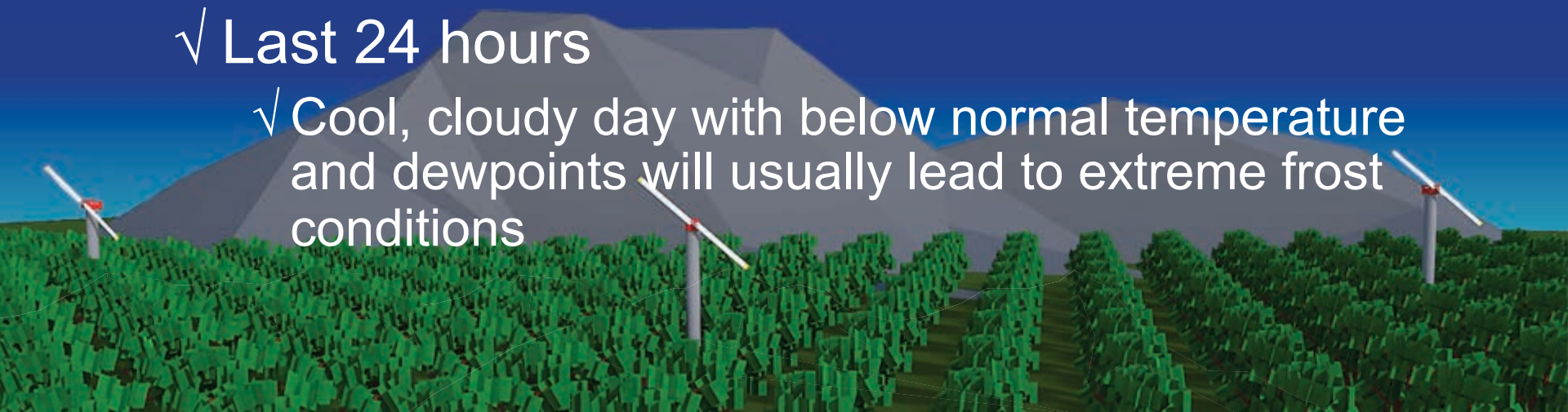
Wind Machine Operation

- Low dewpoints will result in
 - Faster temperature drops
 - Weaker inversions
 - Lower Temperatures
 - Need to start sooner
 - Normal 3° – 4° F. above critical
- With dewpoints below 20°F (-7° C)
start 3 - 5° F above critical temperature
or as soon as the wind goes calm



Wind Machine Operation

- Bud Stage or Fruit Maturity
- Dewpoint
- Weather Conditions
 - √ Previous 7 days
 - ✓ Very warm weather weakens buds, start earlier
 - ✓ Progressively cooler nights will harden the buds
 - √ Last 24 hours
 - ✓ Cool, cloudy day with below normal temperature and dewpoints will usually lead to extreme frost conditions



FROST PROTECTION REQUIREMENTS

- Good system with enough temperature lift for your site
- Proper Management of the System
- DILIGENCE & PERSEVERENCE!!!

