Cultural and physical weed management & Seed management

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Ideal weed characteristics

- **Non specialized germination**
- **Seed dormancy**
- Rapid seedling growth
- **Fast reproduction**
- **Long seed production interval**
- No pollinators
- **High seed production**
- **Always produces seed**
- **Seed dispersal**
- Vigorous perennial
- Brittle perennial
- Vegetative reproduction
- Able to compete with other plants

Baker 1974

Weed seed

- Why are weed seed so important?
  - Seeds survive for years in the soil
  - Weeds excel a making lots of seed
  - Weeds generally “invade” new sites as seed
  - Strategies to reduce weed seedbanks

Weed seedbanks:

- “Weed seed in field soils produced during several previous seasons.”

Importance of weed seedbanks

- High weed seedbanks = high weed pressure
- Seedbank status influences herbicide selection
- Prevention of seedbank infestation requires constant effort

Life of a seedbank

Seed fall

Tillage

Dormant

Non-dormant

Germination & emergence

Fumigants

solarization

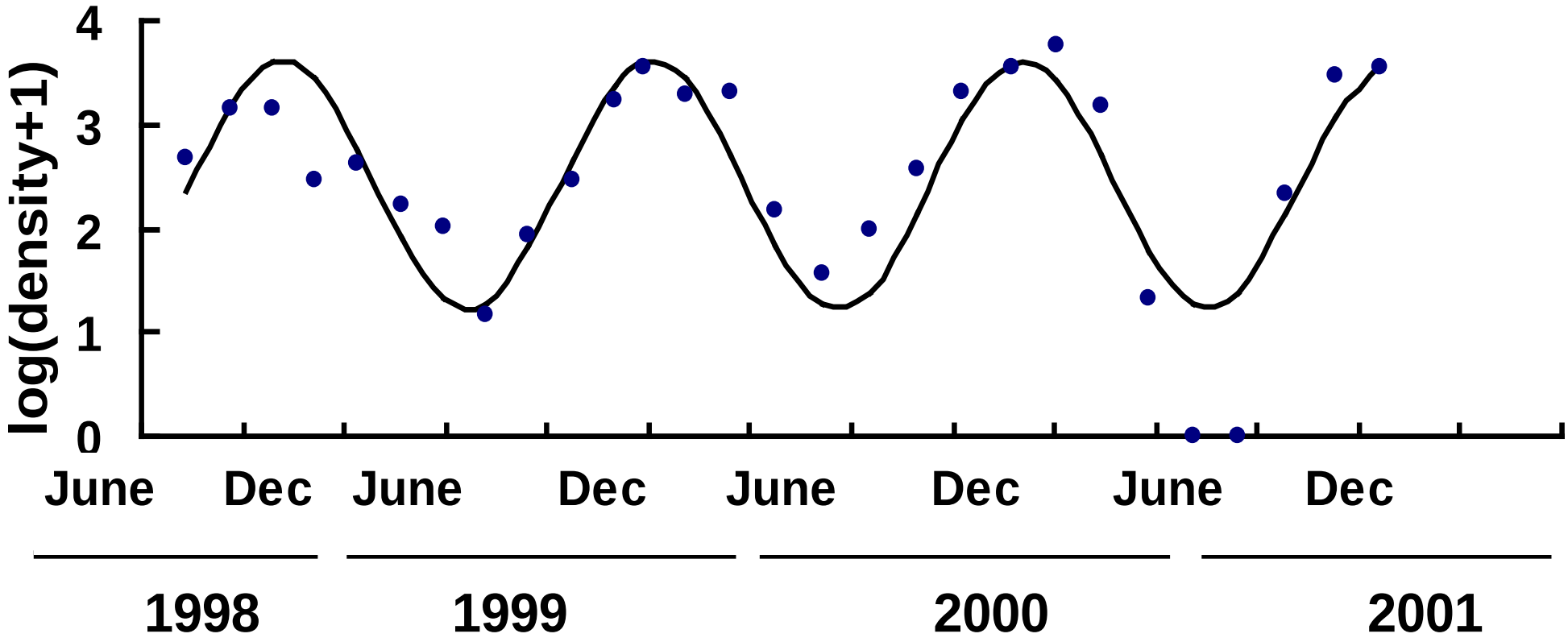
Death

Harper 1977

Weed seedbanks in California fields

- In the Sacramento Valley, seedbank densities ranged from 7.9 to 60.9 million seeds /A. (Battista 1998).
- In the Salinas Valley, seedbank densities ranged from 6.3 to 140.2 million seeds /A. (Fennimore, unpublished results).

Bluegrass emergence patterns



The bottom line–bluegrass is dormant in spring, nondormant in fall

Weed seed production

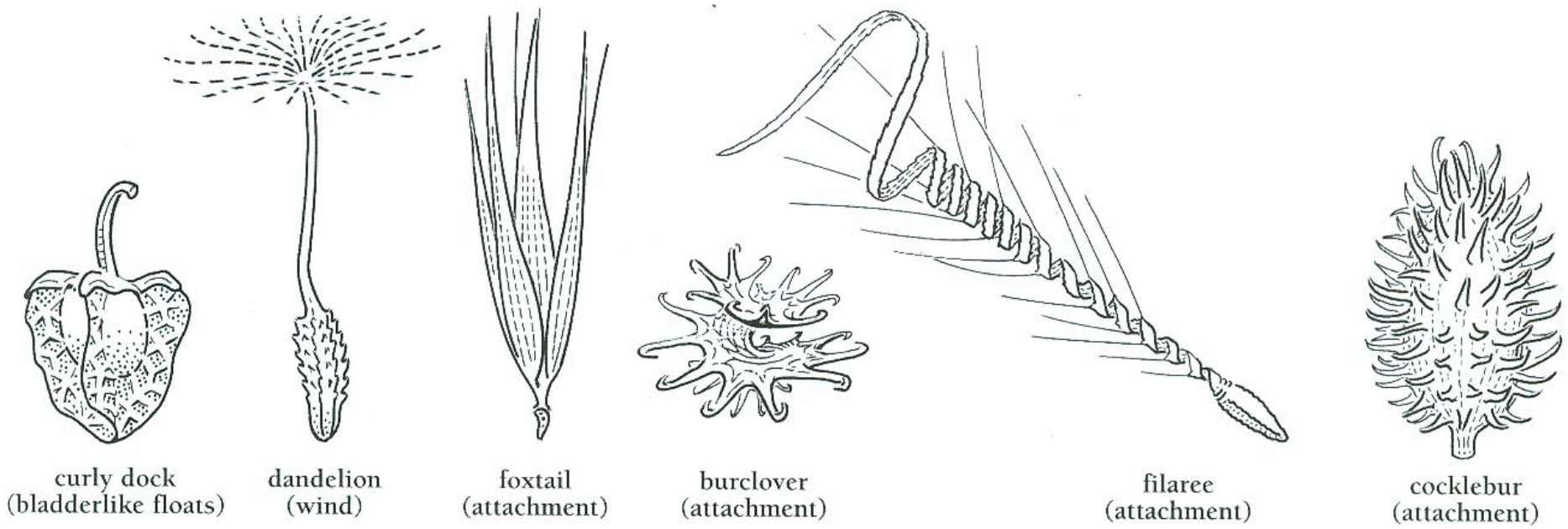
Weed species	No. seed/plant
C. lambsquarters	72,450
C. purslane	52,300
C. ragweed	3,380
P. smartweed	19,300
Prickly lettuce	27,900
RR pigweed	117,400
Shepherdspurse	38,500
Wild oat	250
Yellow foxtail	6,420

Stevens 1954, 1957

Weed seed dispersal

- Dispersal agents are: animals, wind, water and humans.
- The biggest threat to dispersal is the introduction of new weed species.
- The introduction of more weed seeds of existing species is bad, but less of a threat.
  - If you have 10 million pigweed seed/A in your field, adding 100,000 pigweed seed/A is bad but not a tragedy.
  - If you have no field bindweed, adding 10 field bindweed seed/A **IS A TRAGEDY**.

Seed dispersal mechanisms



Intact & scarified burclover seeds: coat imposed dormancy

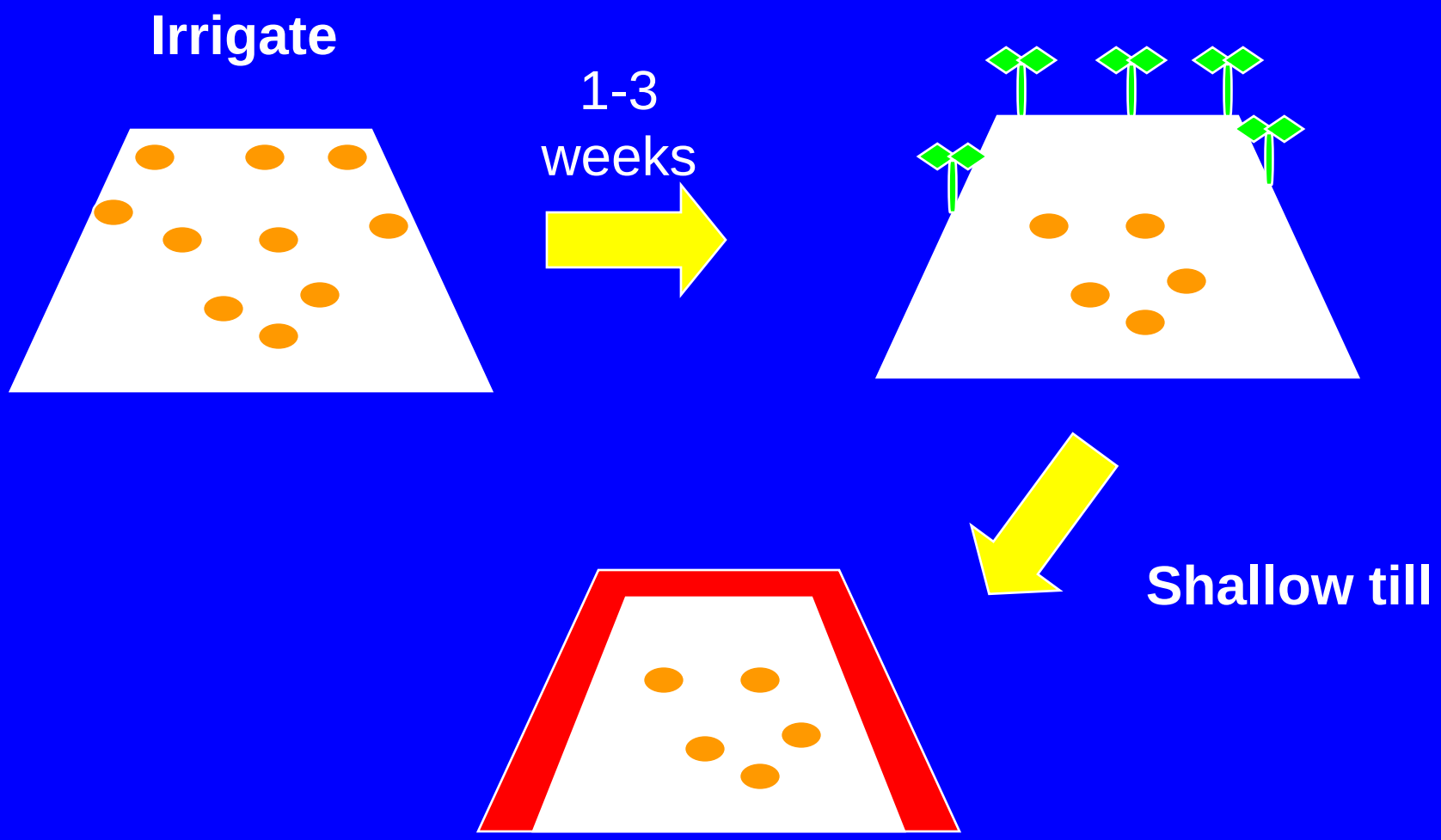
Depth of weed emergence

Species	Optimum depth (in)	Maximum depth (in)
Cm. chickweed	0.4	0.8
Lambsquarters	0.2	2.0
Lg. crabgrass	0.4	1.6
Shepherd’s-purse	0.2	0.8
Wild mustard	0.4	2.3
Wild oat	1.0	7.0

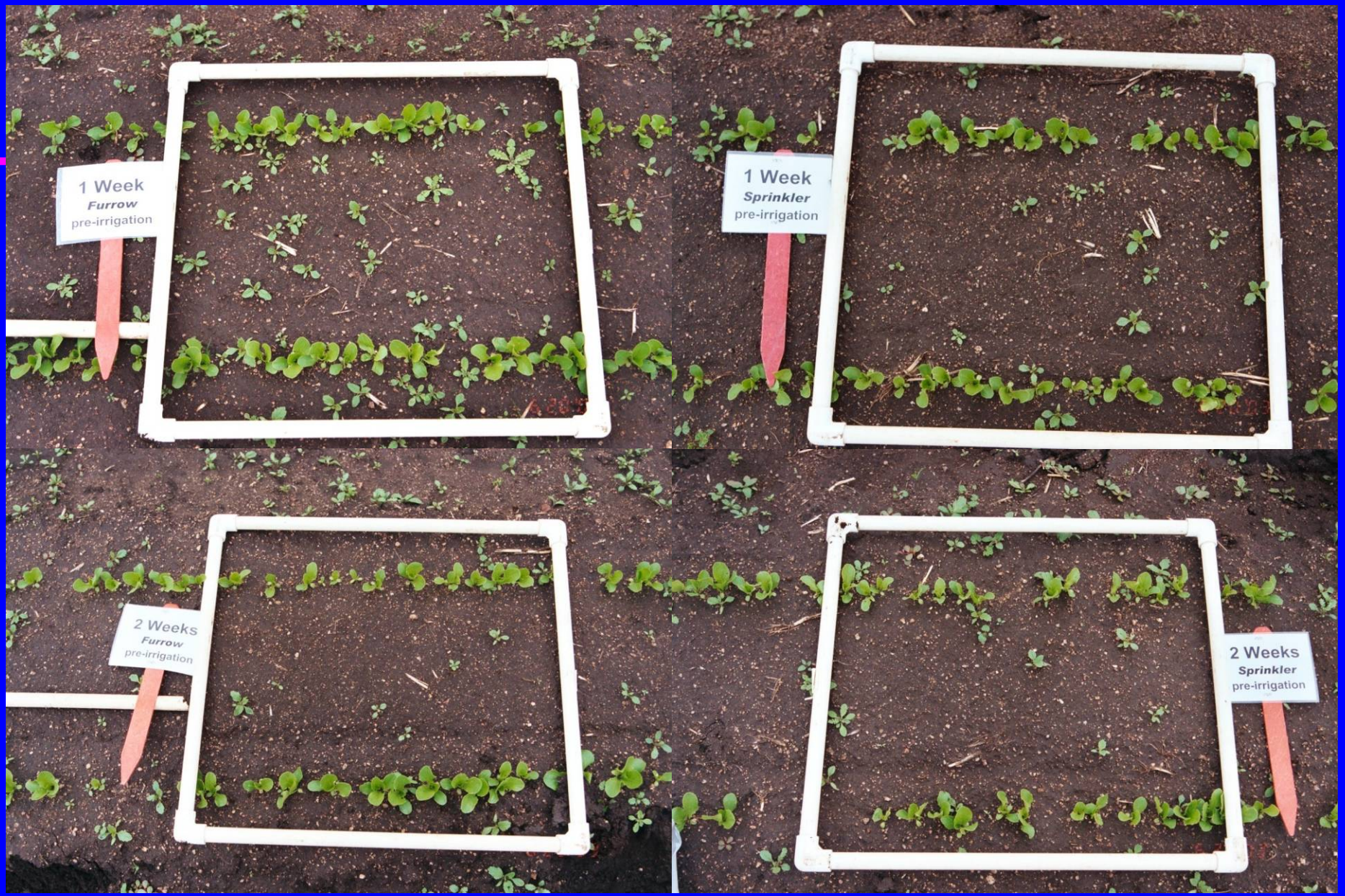
Role of preirrigation in weed management

- In the dry months of the year, fields are preirrigated to allow proper tillage.
- The primary objective is to prepare a fine seedbed for planting.
- Performed properly, preirrigation followed by shallow tillage can remove many weeds and improve weed control.

Preirrigation to control weeds




No
pre-
irrigation


1 Week
Furrow
pre-irrigation
1 Week
Sprinkler
pre-irrigation
2 Weeks
Furrow
pre-irrigation
2 Weeks
Sprinkler
pre-irrigation

Conclusions—preirrigation

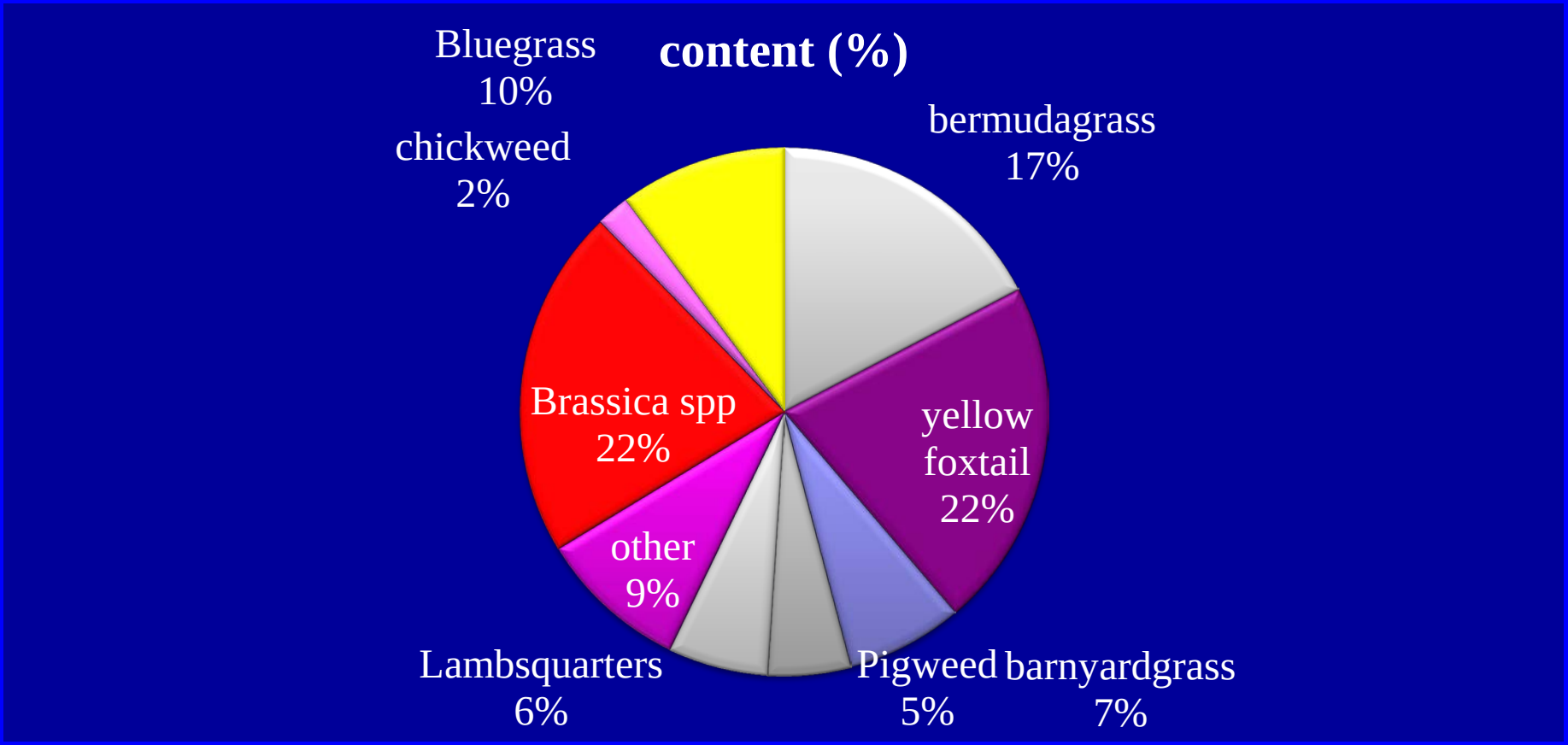
- A single sprinkler preirrigation controls 16 to 50% of the potential weeds.
- Results were a little more variable with furrow preirrigation, and it was necessary to wait longer due to wetter soil.

Prevention

- If a pest is not present in a field or geographic region, then preventing invasion is highly desirable. The scale of prevention can range from a field to a country (Norris et al. 2003).

Clean soil off equipment

Manure weed seed content



Cudney et al. 1992

Prevention: composting manure

- Compost manure to kill weed seed.
- 3 days exposure to 158˚F kills most weed seed (Wiese et al. 1998), but higher temperatures and longer exposures are needed for field bindweed (*Convolvulus arvensis*).

Sanitation/prevention

- Control weeds in the field before they have the chance to set seed
- Control weeds in the periphery of the field to prevent entry of weed seed into the field

And away they all flew like the down on a thistle

Wind-blown weed seed

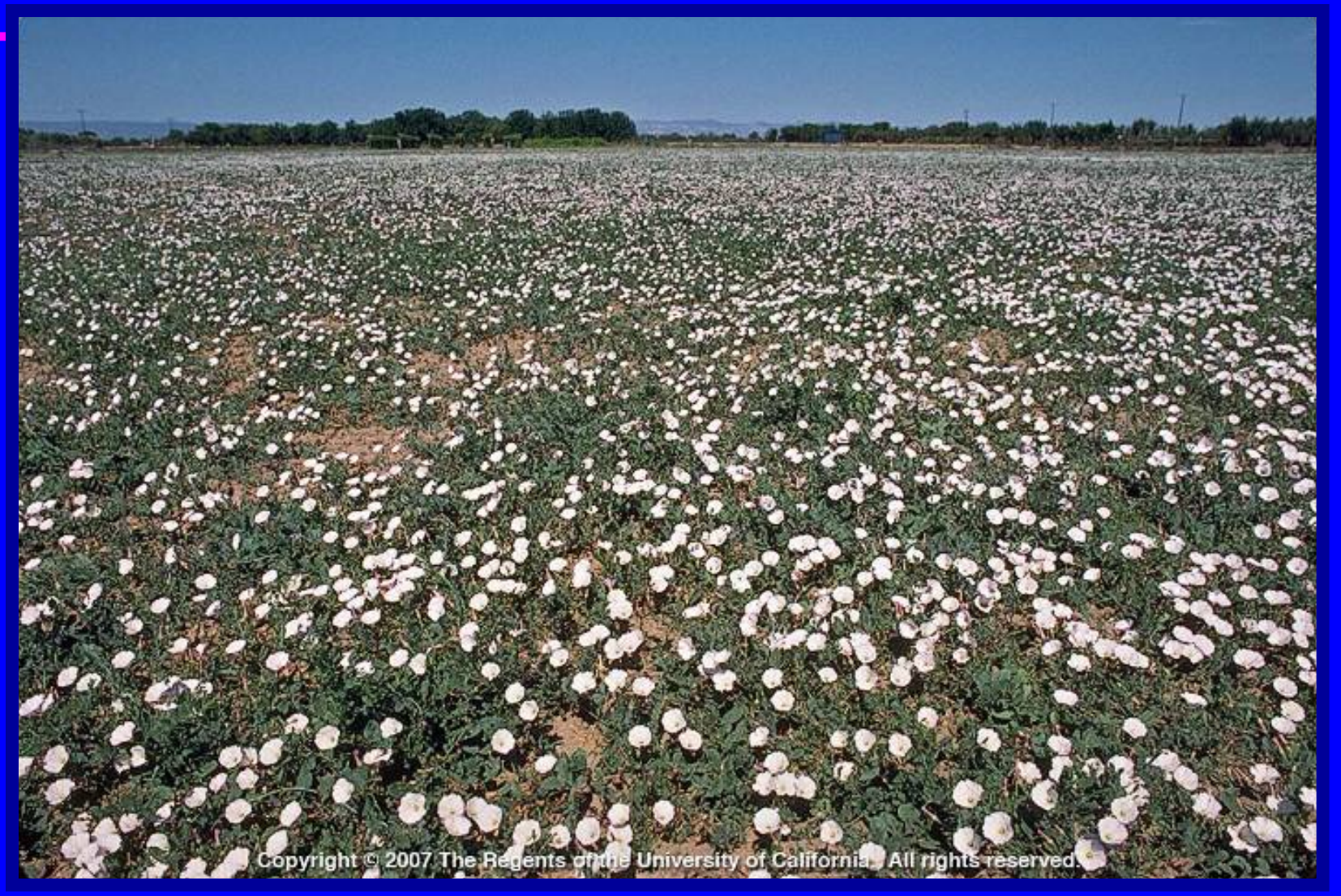
- Many weeds have seed that are capable of moving long distances by wind, water and other means.
- The practice of sanitation/prevention involves control of weeds in the periphery of the field.

Wind-blown annual weed seeds

Field selection

- Many crops do not have the weed control tools to deal with severe weed infestations and severely infested fields must be avoided.
- These trouble fields must be dealt with while fallow or in competitive agronomic crops such as field corn.

Field bindweed – a disaster



Yellow nutsedge (*Cyperus esculentus*)

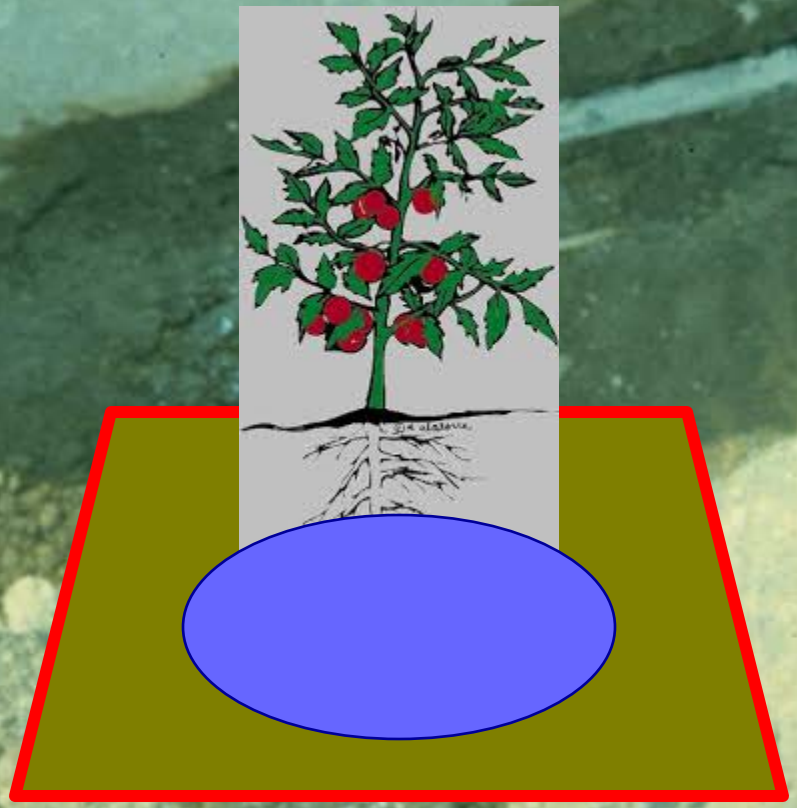
C111-03

C111-04

Field selection

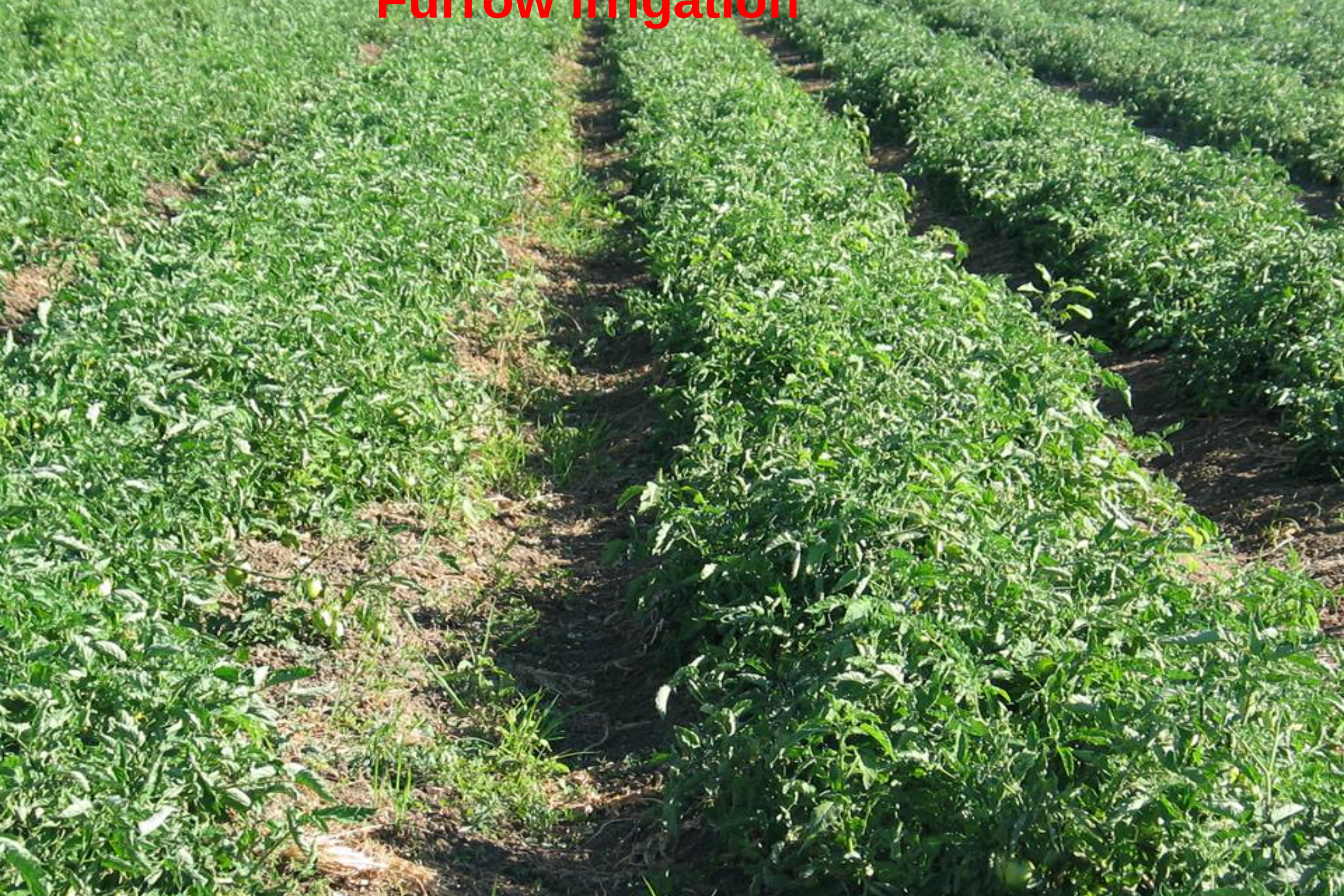
- If the field has a severe infestation of a perennial weed like field bindweed, then the field should be avoided for organic crops.

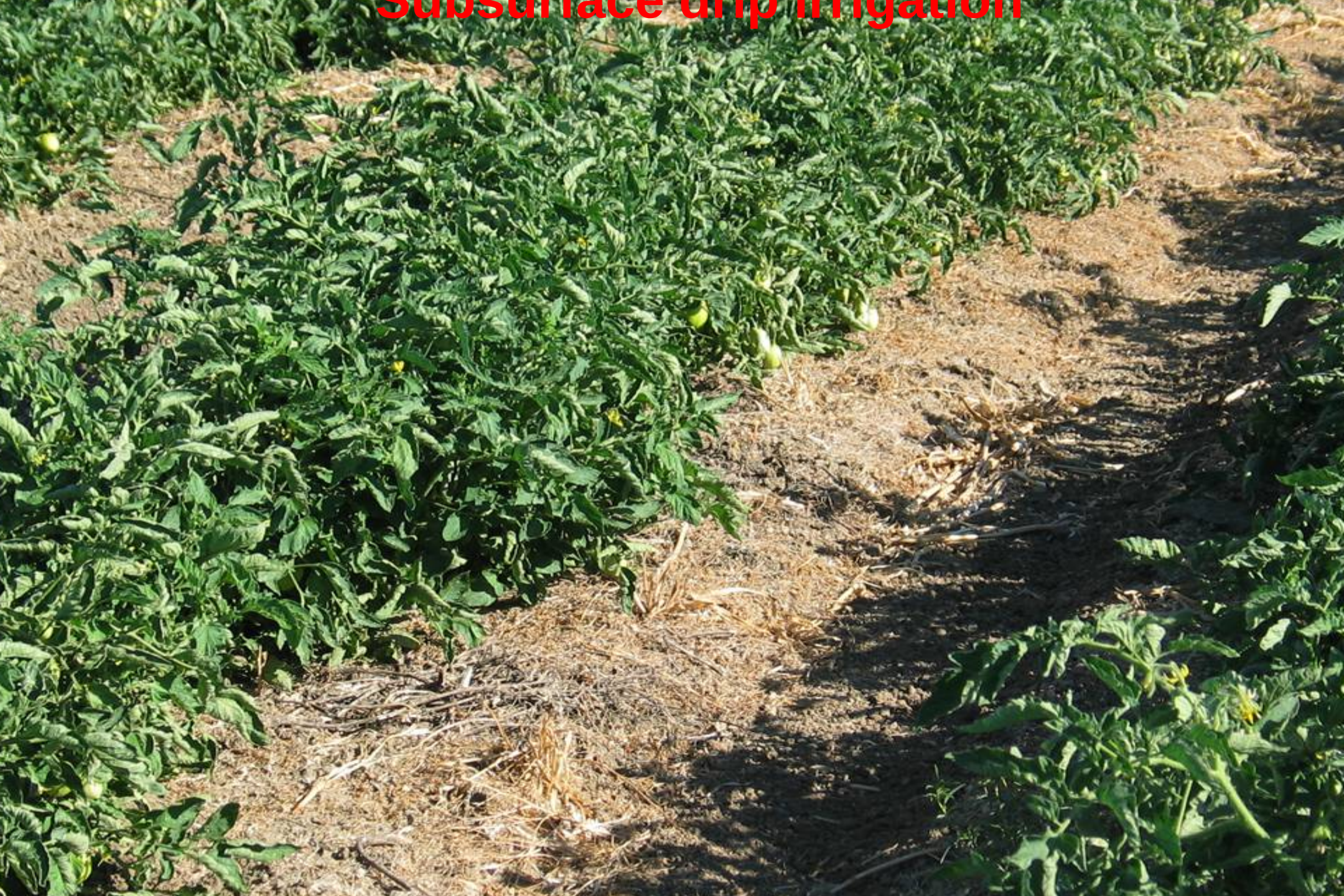
Subsurface Drip Irrigation



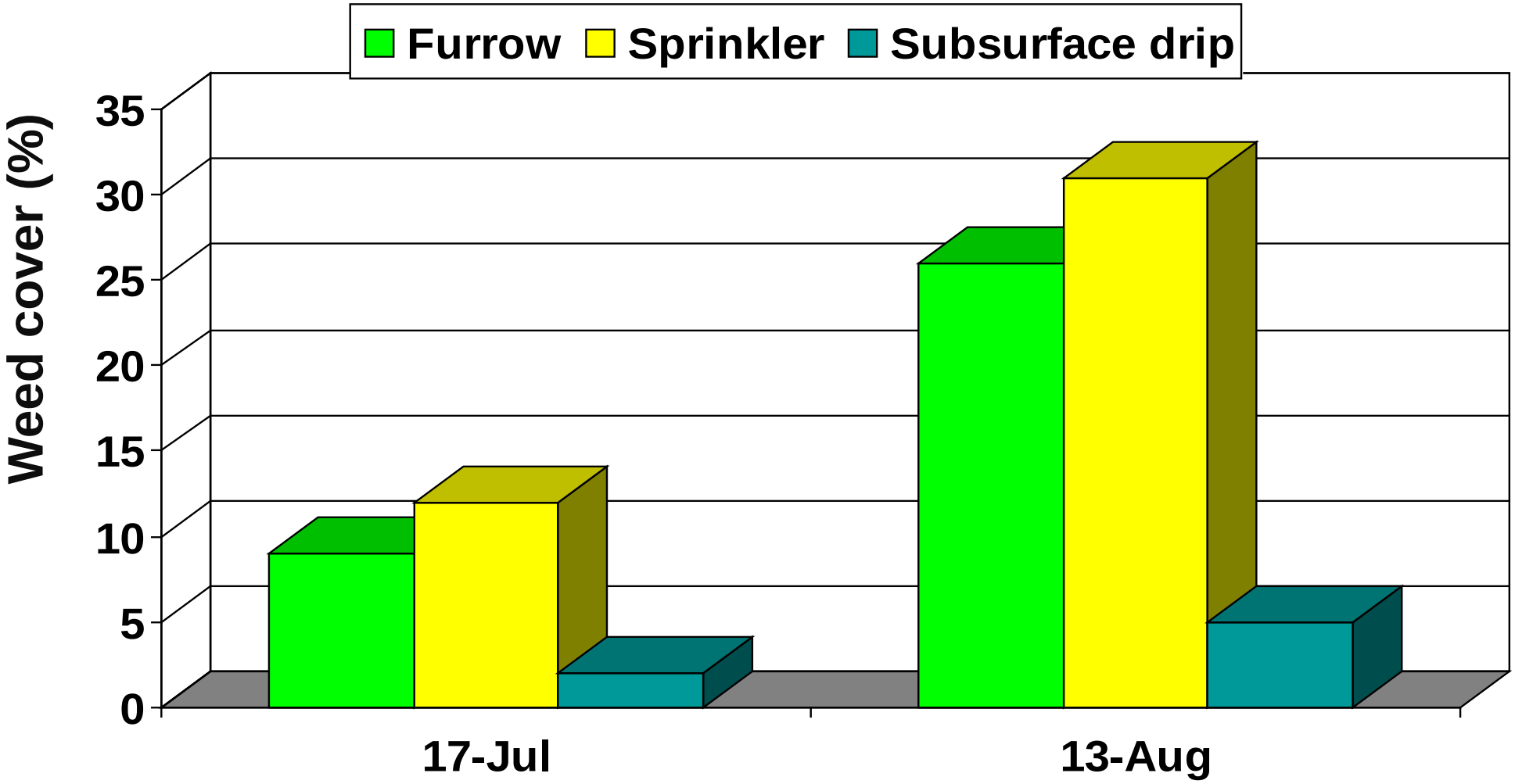
Subsurface Drip Irrigation

- Installed 9 to 12 inches deep
- Can keep the surface dry so weed seeds do not germinate


Furrow irrigation


Subsurface drip irrigation

Weed Cover (%) relative to Irrigation Method

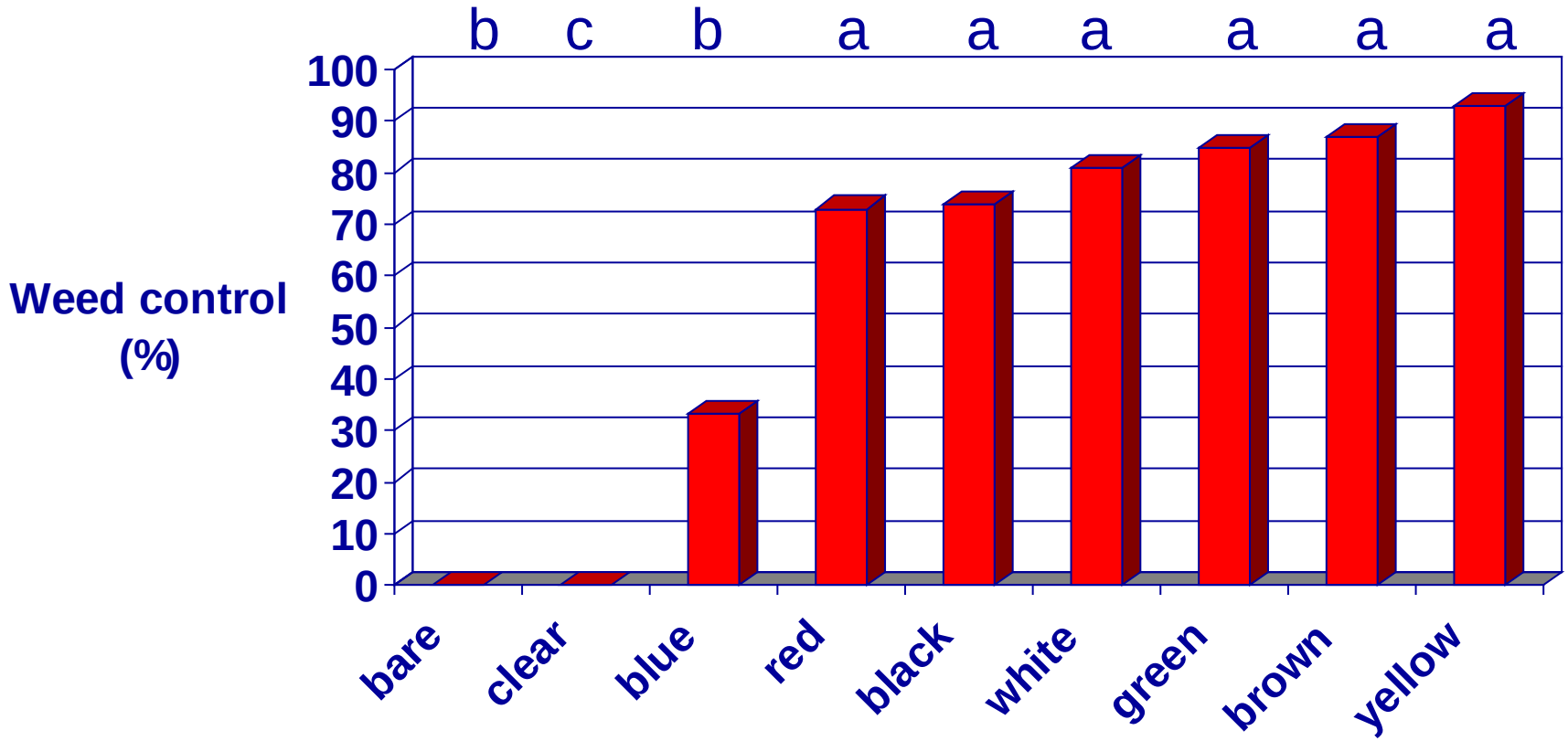


Physical control tools

- Mulches
- Cultivation & tillage
- Solarization and Steam


Aug. 4, 2004

Colored tarp weed biomass - MBA



Conclusions: colored tarp

- Clear plastic does not suppress weeds.
- Blue provides poor weed suppression.
- Brown, green, and black provided the best combination of weed suppression and yield.

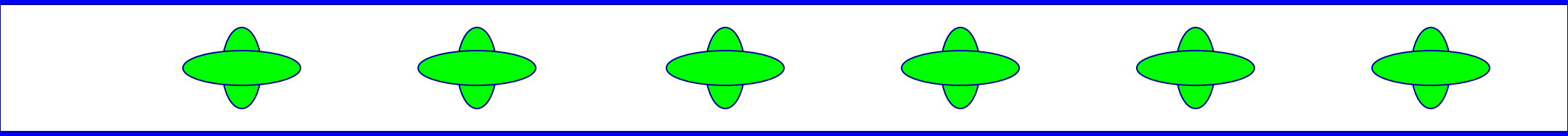

JOHN DEERE

Natural mulches

- Work best in agronomic crops (Price et al 2011)
- Difficult/impossible to use with seeded horticultural crops like broccoli, carrot, lettuce, onion
- Possible will work with transplanted vegetables like processing tomato

Cultivation

A traditional inter-row cultivator does not reach into the seedline



An intra-row cultivator weeds around and in the row

Finger weeder

Robovator on 80 inch beds

Intelligent cultivators

- Organic vegetables are probably the most ready application of this technology, but plenty of interest in conventional Ag
- Can operate at night
- European versions at the moment,
- BlueRiver is developing first made in USA version

EFFECT OF CULTIVATOR ON WEED CONTROL AND WEEDING TIME

	Weed control		Hand weed time	
Cultivator	2014-L	2015-B	2014-L	2015-B
	Control (%)		Hours Acre^{-1}	
Standard	57 b	35 b	38 a	24 a
Robovator	84 a	74 a	27 b	13 b
Difference %	+27%	+39%	-29%	-46%

Thermal weed control

- Heat – soil disinfestation
  - Steam
  - Solarization
- Flaming

Soil Solarization

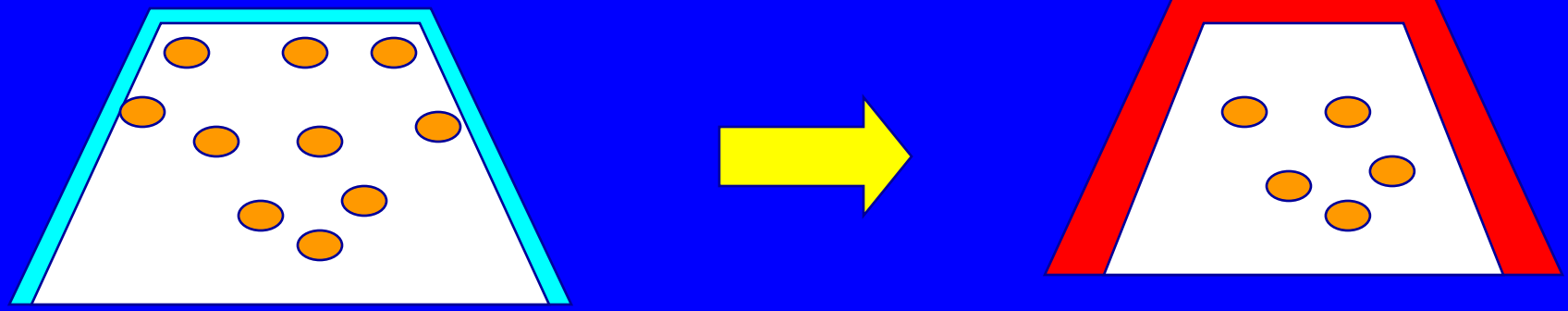
- A method to control ungerminated weed seeds in the soil seedbank.
- Uses clear plastic mulch during the summer months to raise soil temperatures to the thermal death point.
- Also controls some diseases.

How to Solarize Soil

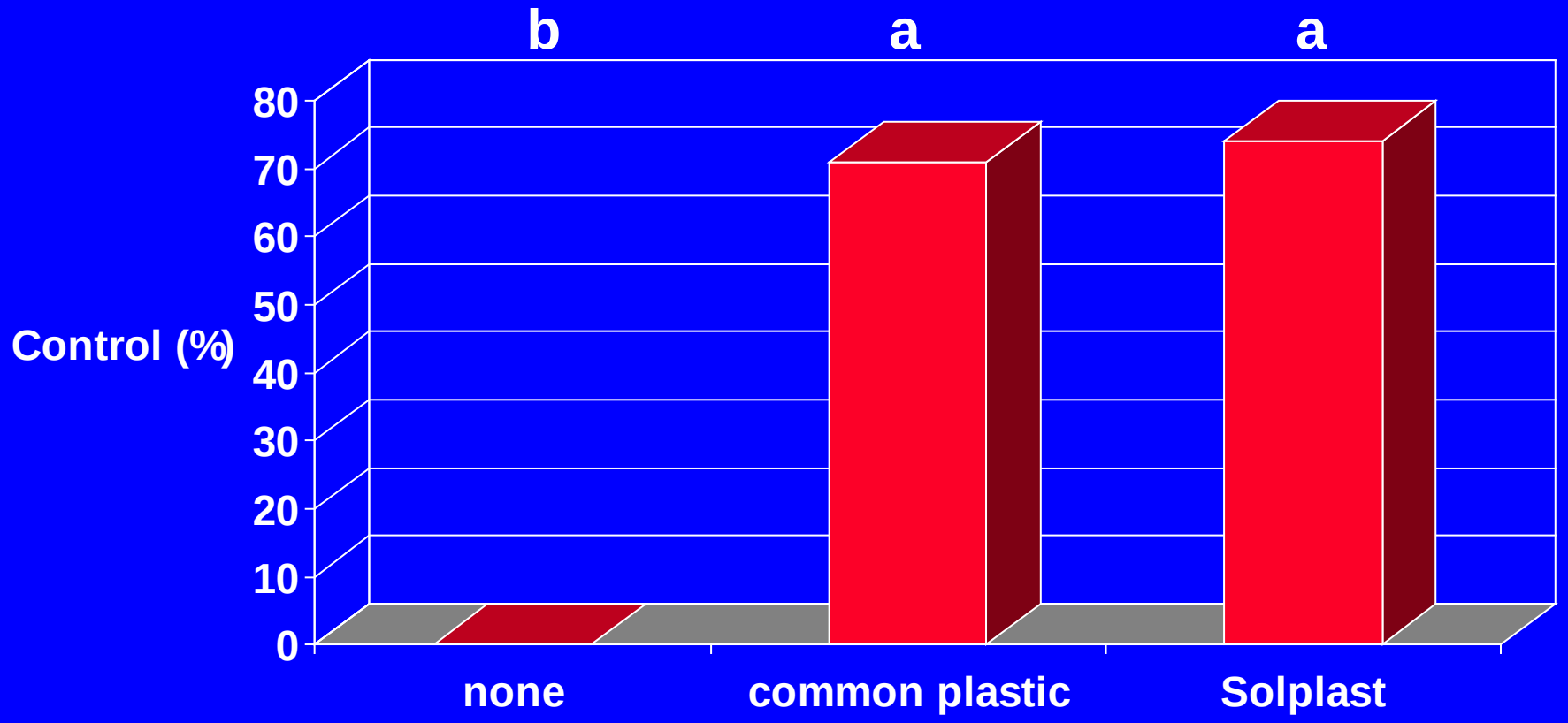
- Prepare a smooth soil surface
- Wet the soil
- Lay and anchor the clear plastic (25-50 µm)
- Leave plastic in place 4-6 weeks
- In coastal areas solarize during May-June or August-September

Solarization to control weeds

Solarize



Soil solarization: weed control



2012-13 Steam evaluation in Albion strawberry

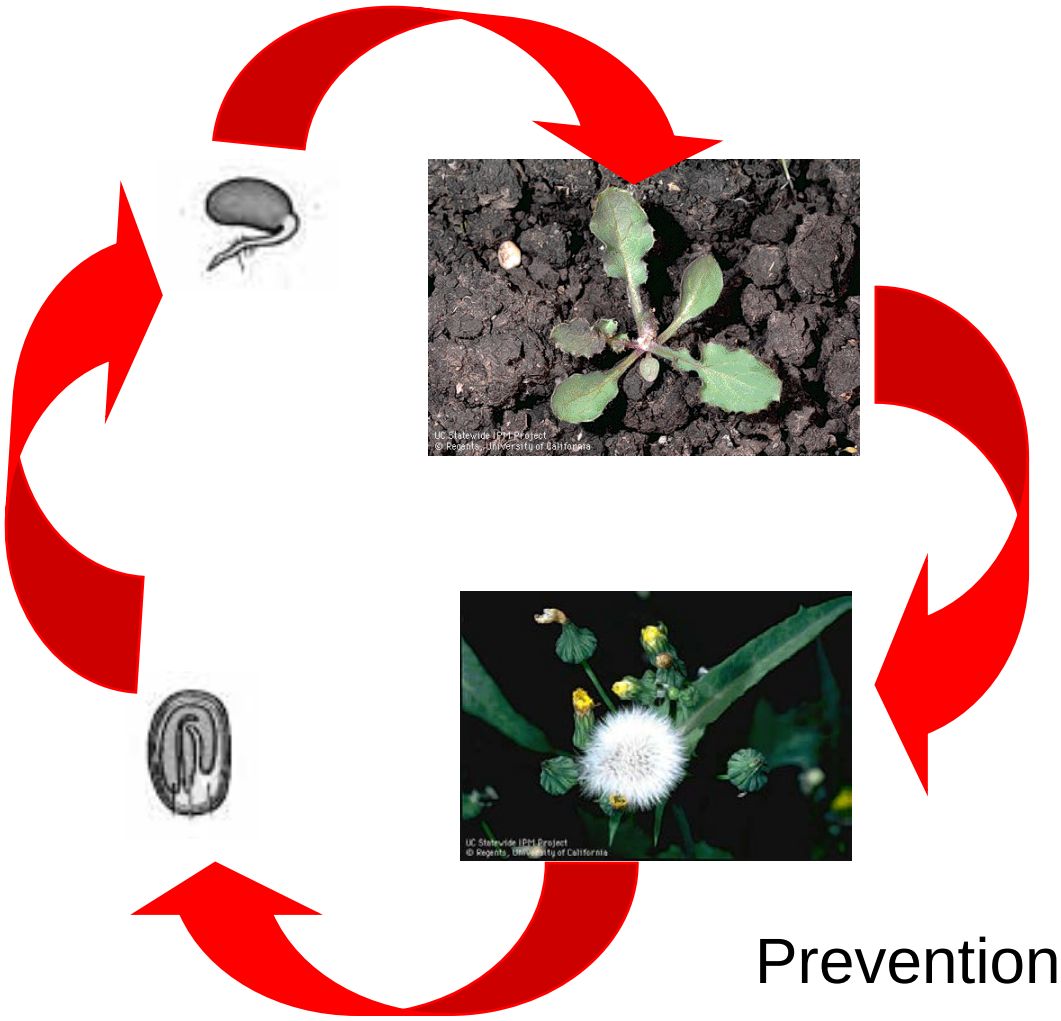
http://www.flameengineering.com./GP_Flamers.html

Just prior to flaming

10 minutes after flaming

IPM inputs I

Preplant irrigation



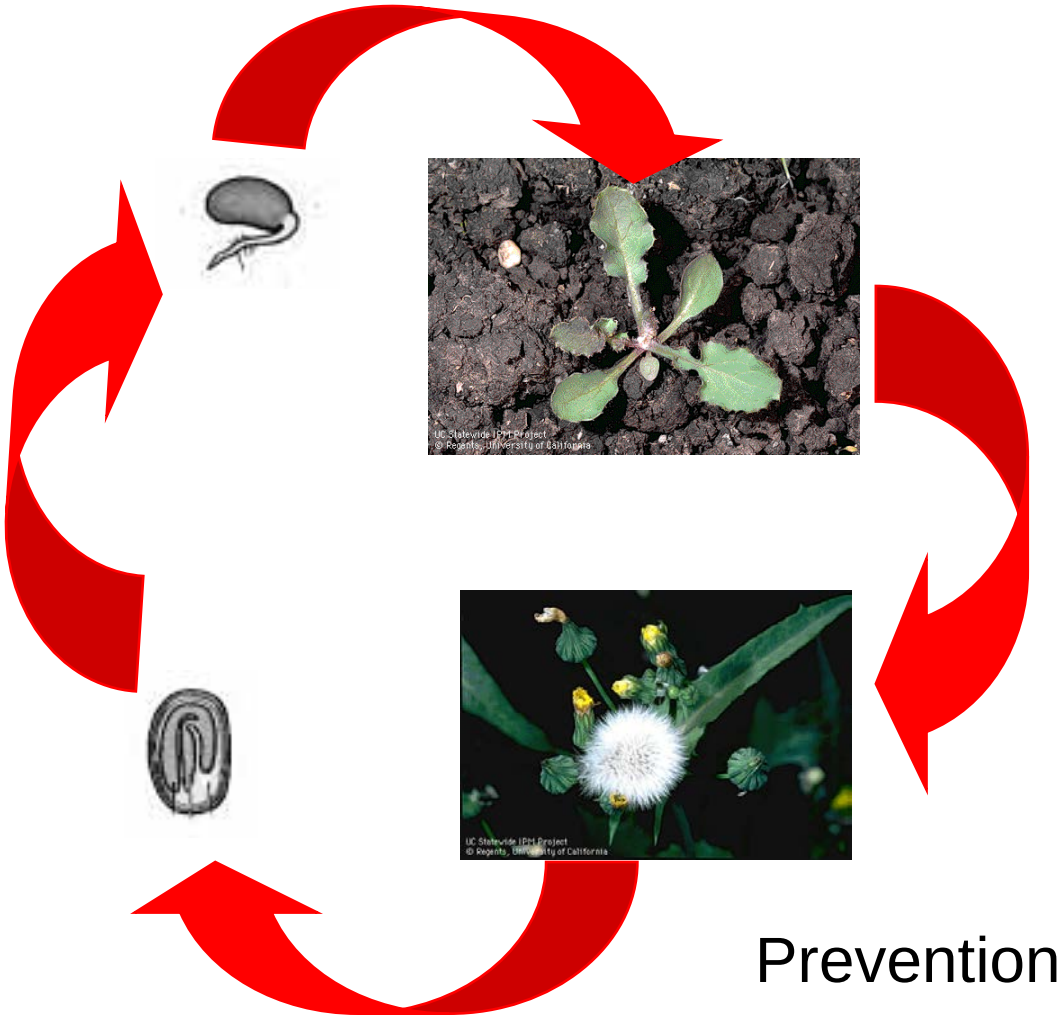
Flaming, Tillage, Hand weed,

Prevention

Solarization, Steam Biofumigants

IPM inputs II

tillage



Competition
Smothering
mulching

Prevention

Predation
Winter kill
Deep burial

Summary I

- Practice prevention: avoid introducing new weed species, and where possible prevent the introduction of weed seed in inputs such as manure, compost ect. even if the weeds are already present.
- For some crops such as vegetables & organic crops it is necessary to avoid fields heavily infested with perennial weeds.

Summary II

- The central lesson concerning IPM is to be familiar with the pests in your field, to manage weeds before planting and after planting.
- Manage the farm using the best combination of weed control tools to reduce weed seedbanks and perennial populations.