Managing Weeds without Chemical Herbicides

Labor 40-70% labor in traditional systems or herbicides to remove weeds

Weed!

- A weed is any plant, native or non-native, that interferes with crop production by doing more harm than good and encroaches where it is not wanted
- A successful weed has closely adapted to the life-cycle of the crop and farming practices
- What makes weeds stronger?
  - Weeds generally have high seed productivity.
  - Weeds often germinate under a variety of conditions and some portion of the population remains dormant.
  - Weed seeds in the soil are insurance against conditions that might destroy the active population.
  - Even though weed seeds in the soil are reduced by 95% due to germination and mortality, the seed bank can often recover in a single year.
  - Many weeds develop rapidly, are able to self-pollinate, have well developed seed dispersal mechanisms and tolerate a wide range of environmental conditions.

Weed problems: competition

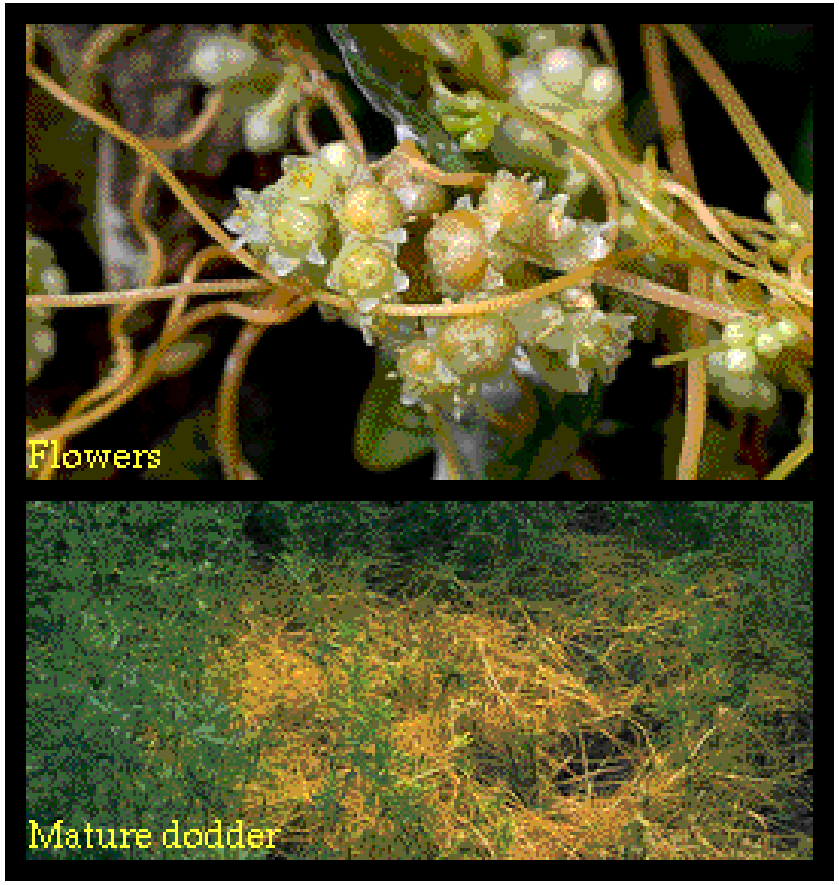
- Nutrients
- Light
- Water
- Results in lower yields and poor crop quality

Benefits of weeds

- Enhance soil structure and water penetration
- Improve soil tilth
- Capture nutrients that would otherwise be lost
- Provide habitat for beneficial insects
- Indicator plants
- Offer a habitat for both beneficial biocontrol insects and mycorrhizal fungi
- Cover bare soil after harvest keeping beneficial soil microorganism communities alive through their root exudates of sugars and proteins
- Pollen and nectar from certain weeds helps in maintaining the population of biocontrol insects

Can be directly parasitic

Cuscuta or dodder



Striga or witchweed

Weeds can harbor diseases and pathogenic fungi, esp. crop relatives

Weed control: Systems approach vs. Input substitution

- Systems approach: Direct intervention is last resort!
- First modify:
  - soil conditions
  - change crop rotation
  - cultivation and sowing practices
  - increase competitiveness of crop
  - introduction of animals as grazers
- Broad set of practices
  - Preventive and cultural agronomic practices (measures tak germination)
  - Monitoring (observation and identification of weeds thro
  - Physical control of weeds (mechanical, thermal)
  - Biological control

Preventive weed control

It is a long term planning so that the weeds could be controlled or managed more effectively and economically than is possible where these are allowed to disperse freely.
Following preventive control measures are suggested for adoption wherever possible & practicable.

1. Avoid using crop that are infested with weed seeds for sowing
2. Avoid feeding screenings and other material containing weed seeds to the farm animals.
3. Avoid adding weeds to the manure pits.
4. Clean the farm machinery thoroughly before moving it from one field to another. This is particularly important for seed drills
5. Avoid the use of gravel sand and soil from weed-infested

6. Inspect nursery stock for the presence of weed seedlings, tubers, rhizomes, etc.

7. Keep irrigation channels, fence-lines, and un-cropped areas clean

8.Use vigilance. Inspect your farm frequently for any strange looking weed seedlings. Destroy such patches of a new weed by digging deep and burning the weed along with its roots. Sterilize the spot with suitable chemical

9. Weed free seeds: Separating crop seeds from admixture of crop & weed seeds using physical differences like size, shape, colour, weight / texture & electrical properties

Mechanical Weed Control

Mechanical or physical methods of weed control are being employed ever since man began to grow crops. The mechanical methods include tillage, hoeing, hand weeding, digging cheeling, sickling, mowing, burning, flooding, mulching etc

1. **Tillage**: Tillage removes weeds from the soil resulting in their death. It may weaken plants through injury of root and stem pruning, reducing their competitiveness or regenerative capacity.
2. **Hoeing**: Hoe has been the most appropriate and widely used weeding tool for centuries. It is however, still a very useful implement to obtain results effectively and cheaply.
3. **Hand weeding**: It is done by physical removal or pulling out of weeds by hand or removal by implements called khurpi, which resembles sickle.

4. **Digging**: Digging is very useful in the case of perennial weeds to remove the underground propagating parts of weeds from the deeper layer of the soil.
5. **Sickling and mowing**: Sickling is also done by hand with the help of sickle to remove the top growth of weeds to prevent seed production and to starve the underground parts. **Mowing** is a machine-operated practice mostly done on roadsides and in lawns.
6. **Flooding**: Flooding kills plants by reducing oxygen availability for plant growth. The success of flooding depends upon complete submergence of weeds for longer periods.
7. **Burning:** Burning or fire is often an economical and practical means of controlling weeds.

Know the Weeds

- Correct identification
- Life cycle, reproduction
- Triggers for emergence and growth
- How the weed affects the crop
- Weak points in weed life cycle
- Prevent weed seed set

Jonhsongrass, showing root system and vegetative reproduction through rhizomes.

- No-till increases percentage of perennial weeds (annuals shaded out by residue)
- Annuals increased by crop nutrition

Observe Changes in Weed Flora and Adapt Management Accordingly

• Annual weeds increase in intensively tilled field	→Reduce tillage; mulch
• Invasive perennial weeds increase	→ Tillage targeted at the problem weeds
• Summer weeds	→Cool season vegetables
• Cool weather weeds	→Summer vegetables
• Large seeded annuals	→ Non-inversion tillage (stop plowing)

CULTURAL WEED CONTROL

Several cultural practices like tillage, planting, fertiliser application, irrigation etc., are employed for creating favourable condition for the crop. These practices if used properly, help in controlling weeds.

Field preparation:

The field has to be kept weed free. Flowering of weeds should not be allowed. This helps in prevention of build up of weed seed population.

2. Summer tillage:

The practice of summer tillage or off-season tillage is one of the effective cultural methods to check the growth of perennial weed population in crop cultivation.

3. Maintenance of optimum plant population:

Lack of adequate plant population is prone to heavy weed infestation, which becomes, difficult to control later

4. Crop rotation:

The possibility of a certain weed species or group of species occurring is greater if the same crop is grown year after year.

5. Growing of intercrops:

Inter cropping suppresses weeds better than sole cropping and thus provides an opportunity to utilize crops themselves as tools of weed management.

6. Mulching:

Mulch is a protective covering of material maintained on soil surface. Mulching has smothering effect on weed control by excluding light from the photosynthetic portions of a plant and thus inhibiting the top growth.

7. Solarisation:

This is another method of utilisation of solar energy for the desiccation of weeds. In this method, the soil temperature is further raised by 5 – 10 ºC by covering a pre-soaked fallow field with thin transparent plastic sheet.

8. Stale seedbed:

A stale seedbed is one where initial one or two flushes of weeds are destroyed before planting of a crop. This is achieved by soaking a well prepared field with either irrigation or rain and allowing the weeds to germinate.

9. Blind tillage:

The tillage of the soil after sowing a crop before the crop plants emerge is known as blind tillage.

10. Crop management practices:

Good crop management practices that play an important role in weed management.Vigorous and fast growing crop varieties are better competitors with weeds

Mulching menace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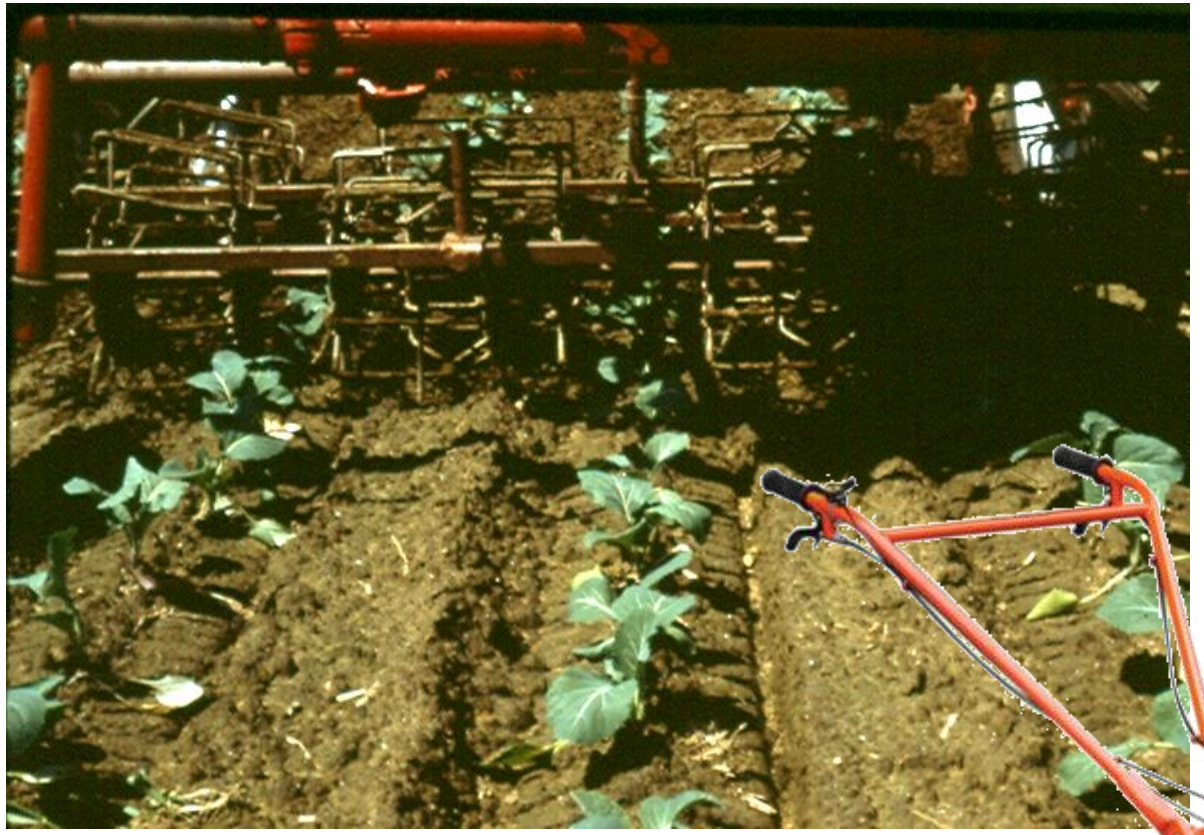
ORGANIC

Tillage or No Tillage?

- Pre-plant tillage to allow weed seeds to sprout-- removing part of weed seed bank
  - may till several times depending on weed pressure
- One of main weed control methods of organic farmers
- Can also use moldboard plow to bury the weed seeds

Principles of mechanical weed management

- Designing the planter and cultivator to suit the crop spacings
- Cultivator tools and depth of action must be appropriate for the growth stages of the weeds and crop
- Create and maintain a size differential between the crop and the weeds to facilitate mechanical weed control
- Cultivation becomes less effective as weed density increases
  - Proportion of weeds that escape cultivation is approximately constant over a wide range of weed densities. Therefore, a high initial weed density means a higher density of escapes, which can reduce yields. With low initial weed density, escapes have little impact on robust crops, and can be pulled manually out of weed-sensitive, high value crops.
  - Soil clings better to the dense mass of roots characteristic of high weed populations than to individual root systems of more isolated weeds. Many implements do not penetrate as well when roots bind the soil together.
  - High weed density that forms a continuous cover of green plant tissue can "lubricate" the soil surface, which further interferes with the uprooting action of cultivation implements. As a result, the weeds reroot and resume growth more readily.



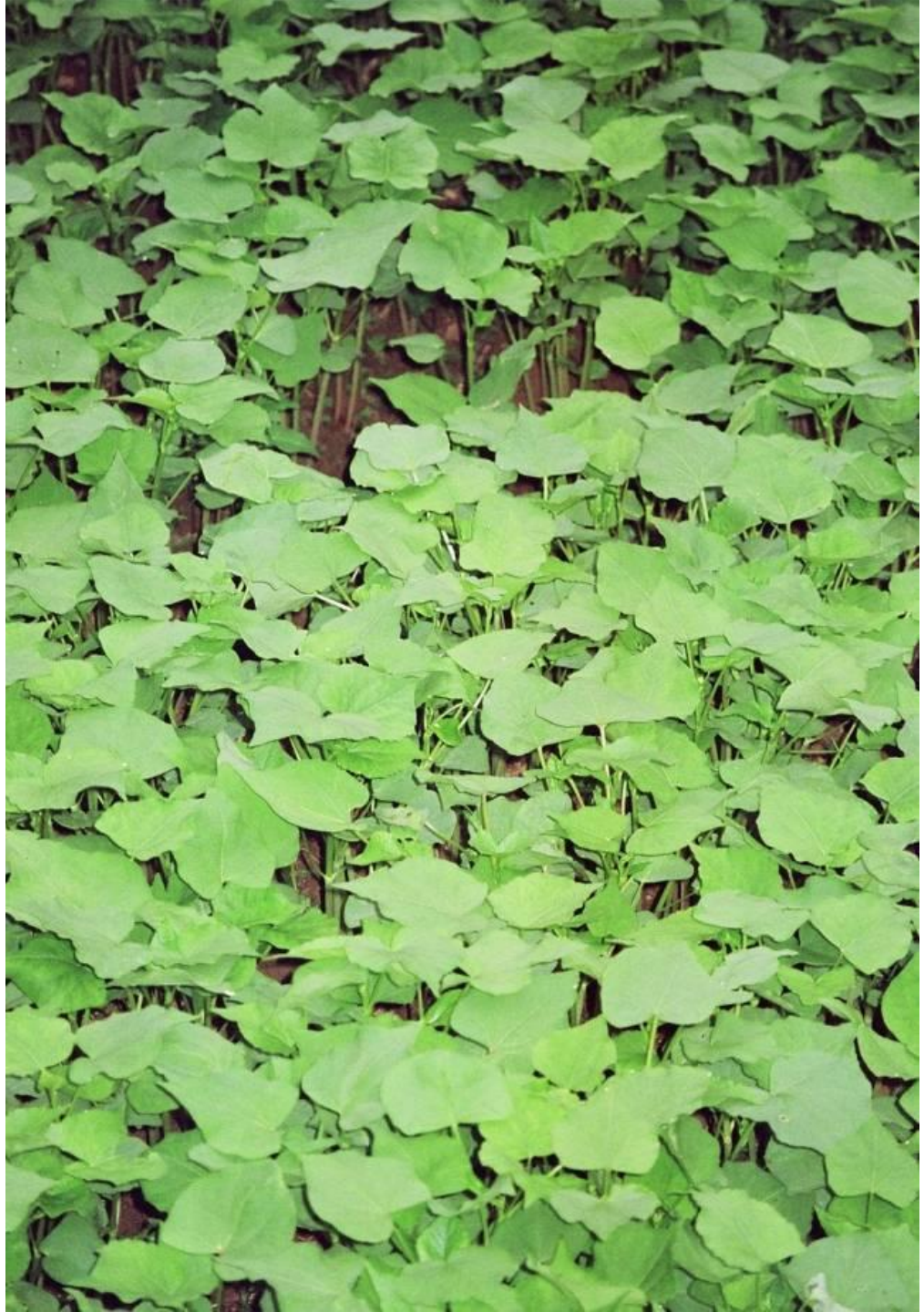
- **Solarization**:
  - Solar energy use for the desiccation of weeds. In this method, the soil temperature is further raised by 5 – 10 ºC by covering a pre-soaked fallow field with thin transparent plastic sheet.
  - Acts by
    - thermal killing of seeds,
    - thermal killing of seeds induced to germinate,
    - breaking seed dormancy and consequently killing the germinating seed, and
    - biological control through weakening or other mechanisms.

Fallow

- For control of perennial weeds like
  - Johnson grass, crab grass and Bermuda grass
- Tillage can actually increase infestation

Minimize Niches for Weed Growth

- Minimize bare soil in time and space.
- Plan tight crop rotations.
- Cover crop during fallow period longer than 30 days.
- Choose row spacings that hasten canopy closure.
- Intercrop or overseed to fill alleys.
- Mulch between wide-spaced crop rows.



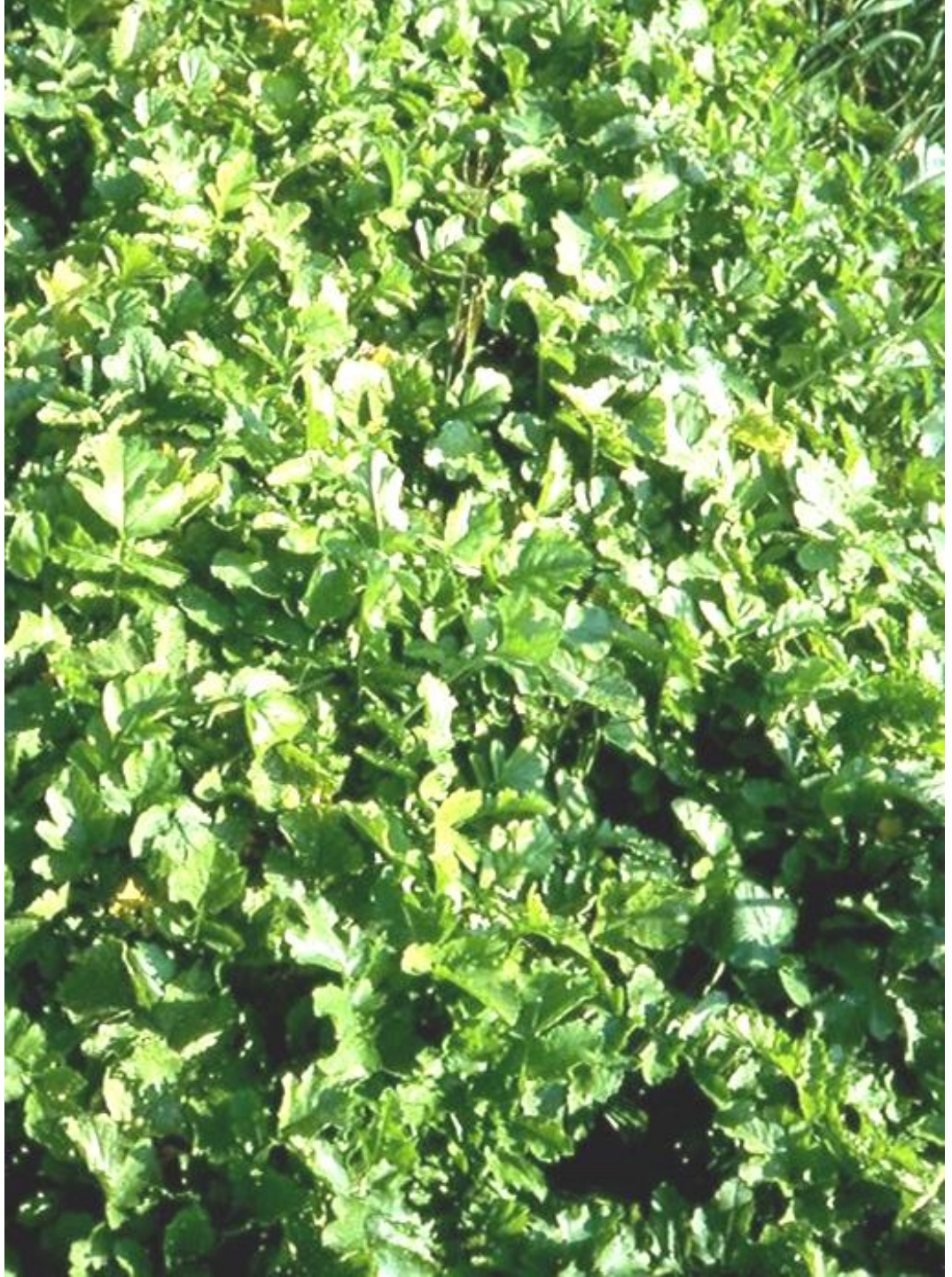
Keep the Weeds Guessing with Crop Rotation

- Vary crop species and crop architecture.
- Vary planting and harvest dates.
- Vary tillage and cultivation methods.

Put the weeds out of work – grow cover crops!

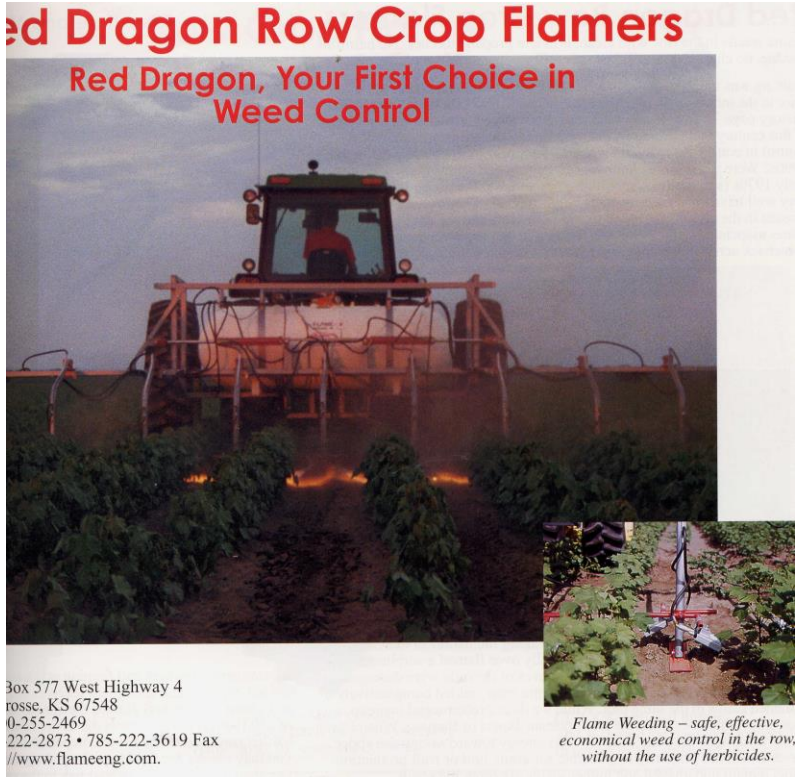
Cover crops suppress weeds by:

- Direct competition
- Occupying the niche
- Allelopathy: eg. Cassia and parthenium
- Modifying light environment for seeds



Controls

- Solarization
- Biological control
- Vinegar (salt not recommended) 5% (household white vinegar)-10% concentrations of organic vinegar
- Adding clove oil can help
- Flaming



Manage the Soil Weed Seed Bank

- Prevent weeds from setting seed.
- Prevent vegetative propagation by invasive perennials.
- Draw down the weed seed bank with stale seedbed.
- Promote weed seed predation and decay.

Policy Interventions Needed

- Include in MNREGA?
- Collective Efforts
- Weed Literacy Programmes through FFS
- What else?

Summary

- Weeds are part of the ecosystem
- Changes in management practices influences weeds
- Plan and design cropping patterns based on resources and situation
- Prevention is better than cure