I. CULTURAL PRACTICES: -

Crop selection, rotation, variety selection, planting date, plant population and spacing, plus fertility and irrigation are all cultural practices that affect weed management.

1. **Crop Selection: -** Selection of a crop determines strategies for the subsequent battle with weeds. Crop selection will determine the level of weed control needed for efficient crop production and, in many cases, which weeds will be most competitive. Some crops by nature are not competitive, such as many vegetables, whereas others tend to be more competitive, such as small grains.

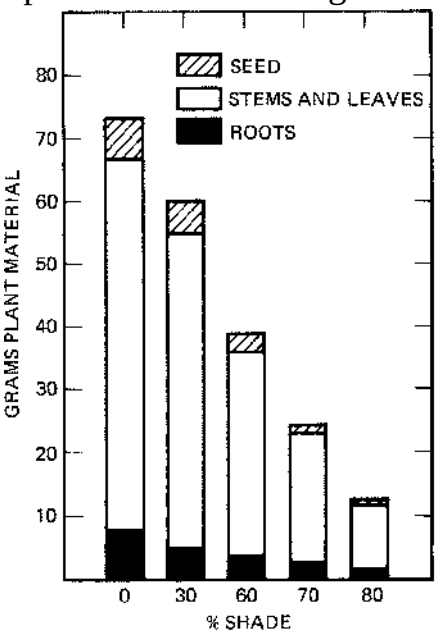
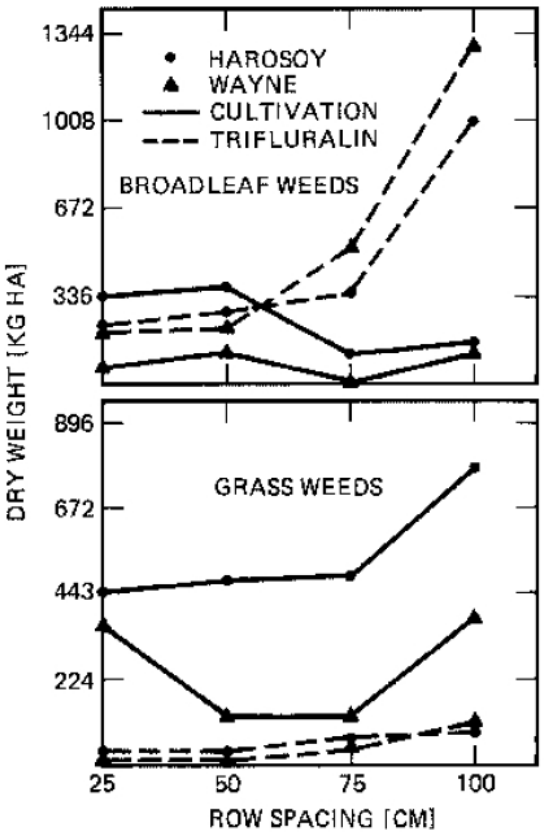


Figure ( ) Effect of shade on weight of roots, stems, leaves, and seeds of giant foxtail

2. **Crop characteristics** that have been shown to be most important in helping crops compete with weeds include (1) rapid germination (2) root development (3) early aboveground growth and vigor
   (4) rapid establishment of leaf area and canopy (5) development and duration of a large leaf area (6) greater plant height. Practices such as creating narrow rows and increased crop density promote early crop canopy closure and help maximize the effect of crop competition. These practices can be used in less competitive crops to reduce weed influences.
3. **Crop Rotation: -** Crop rotations help prevent the buildup of weeds adapted to a particular cropping system. Certain weeds are more common in some crops than others. Rotating crops also often means that a different set of management tools (especially herbicides) will be used.
4. **Crop Varieties: -** Development of new higher-yielding crop varieties is generally done under conditions of minimal weed, insect, and disease interference. Normal variety development schemes yield little information on the differential competitive ability of cultivars.

5. Planting Date: - The trend in crop production is for earlier planting to increase yields. The resulting longer exposure to sunlight is primarily responsible for the higher yields associated with this practice. Early planting can establish adapted crops before weeds emerge and provide the crop with a competitive edge.

6. Plant Population and Spacing: - Historically, crops were planted in rows spaced widely enough to allow passage of draft animals pulling cultivation equipment to control weeds. Development of herbicides removed this constraint and allowed adoption of narrow-row production systems that can produce higher crop yields and permit higher plant densities to aid in weed suppression. In most close-row systems, herbicides play an important role in early-season weed control so the crop can gain a competitive advantage.



Effects of row spacing, soybean variety, and weed control method on weight of weeds.

7. Fertility and Irrigation: - Crops and weeds generally require and will compete for the same nutrients. Changes in soil fertility levels have a great influence on the competitive interactions between weeds and crops. Weeds respond in a positive manner to

Effect of Quackgrass Interference on Yield of Irrigated and Nonirrigated Soybeans

Soybean Treatment		
Irrigation	Quackgrass	Soybean yield (ton/acre)
No	No	1.3
Yes	No	1.2
No	Yes	0.7
Yes	Yes	1.0

increasing nutrient levels, which allow them to better compete with the crop for other necessary growth factors.

Biological Control

V. **Biological Control: -** Biological control of weeds involves the use of any organism, or management practice using an organism, to reduce or eliminate the potential detrimental effects of weed populations. There are two common approaches used in the introduction of classical biological control agents into a system.

1) The first approach is the ***inoculative*** or ***classic*** method whereby an organism is released, reproduces, and disperses on its own in habitats with the target weed. When this approach is successful, there are no recurring weed control costs.
2) The second approach is called ***inundative*** or ***augmentative***, using an agent sometimes referred to as a bioherbicide or a mycoherbicide. In this method, the weed is controlled in the area where an abundant supply of the agent (usually a fungal pathogen) is applied. This method is unlike the inoculative approach, in that the biocontrol agent is applied repeatedly and does not remain in an active form in the environment over time.

Two major characteristics of classical biological control are that (1) they affect one weed species only and (2) that the effect progresses slowly. Because of these characteristics, biological control is not well suited for weed control in crops because cropland usually contains a complex of weeds

Partial List of some Biological control Programs

Weed	Biological Agent	Type of Agent
Musk Thistle	***Rhinocyllus concicus***	Beetle
Hydrilla	***Ctenopharyngodon idella***	Fish
Russian knapweed	***Subanguina picridis***	Nematode
St. Johnswort	***Chrysolina quadrigemina***	Beetle
Japanese Knotweed	***Fallopia japonica***	

Types of Biological Weed Control Agents:-

1. **Insects: -** Plant-attacking insects are currently the most widely used biological control agents for weed control. They have a specific host range, can be mobile (which promotes their dispersion), and can destroy both vegetative and reproductive portions of weeds. Insect attacks can also predispose weeds to attack by other factors such as disease; in fact, research is investigating a combination approach of insects as disease vectors for biological control. The action of several biocontrol agents on a weed is often more effective than attack by only one agent such as Saint-John's-wort (*Hypericum perforatum*), a poisonous plant controlled by leaf-eating beetles (*Chrysolina* spp.).

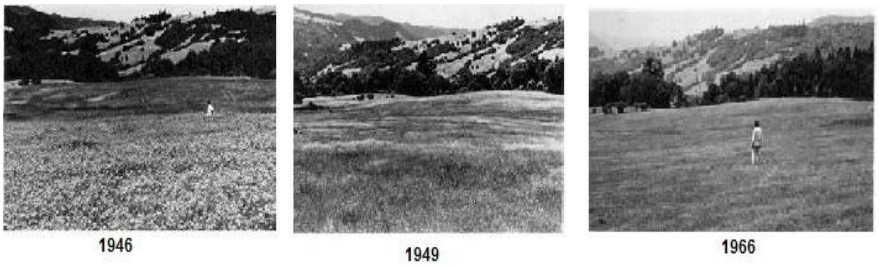


Figure 3-7. Saint-John's-wort or Klamath weed, control by *Chrysolina quadrigemina* (beetles) at Blocksburg, California. (Photograph taken in 1946: The foreground shows weeds in heavy flower, whereas the rest of the field has just been killed by beetles. (Photograph taken in 1949):Portion of the same location taken in 1949 when heavy cover of grass had developed. (Photograph taken in 1966): showing degree of control that has persisted since 1949. Similar results were reported throughout the state. (C. B. Huffaker, University of California, Berkeley.)

2. **Pathogens:-** The inoculum (classic) and inundative (mycoherbicide) methods are both used for employing plant pathogens, primarily fungi, for biological control of weeds. The mycoherbicide approach offers the best potential for extension of biological weed control into nontraditional disturbed areas and is being used commonly in citrus groves and rice fields. There many examples such as ***Phomopsis convolvulus*** for control of field bindweed (***Convolvulus arvensis***), ***Bipolaris sorghicola*** for johnsongrass (***Sorghum halepense***), and ***Sclerotinia sclerotiorum*** for Canada thistle (***Cirsium canadensis***), spotted knapweed (***Centauria maculosas***), and dandelion (***Taraxacum officinale***).

3. **Herbivores Grazing Animals: -** Grazing animals such as geese, goats, sheep, and cattle have been used selectively to control weeds in crops, pastures, and non-cropland. Geese of the white Chinese breed have found specialized use for control of small seedling grass weeds in a number of broadleaf row crops, especially cotton. They have also been used in orchards, nurseries, and for some perennial crops. Additional control measures are needed to manage broadleaf weeds where the geese are used.