STEPS TO SUCCESS:

1. Properly identify nuisance weeds.
2. Sanitation is critical to reduce introduction of new weeds.
3. For optimal weed control, kill weeds before they set seed.
4. Weed control is a farm wide concern, weeds in ditches and along roadways can cause a build up of diseases and insects.

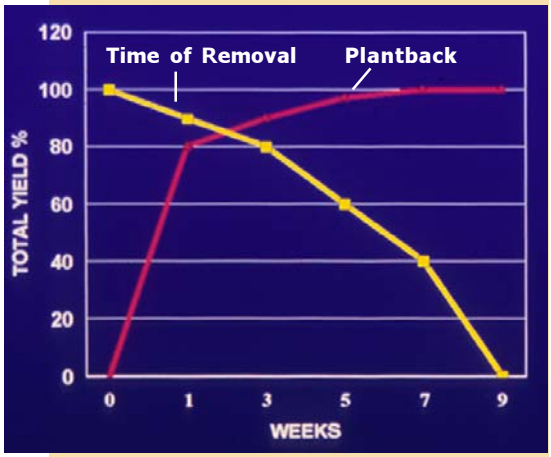

Figure 1. The graph demonstrates the total yield of watermelon and muskmelon from smooth amaranth (pigweed) interference. If the amaranth is removed (time of removal) 1 week after the crop is emerged or transplanted, the yield is 90% of the weed free crop (10% yield loss). If the weed emerges after 3 weeks (in the research plots we planted back), and grows in the crop the remainder of the season, less than 10% yield is lost. The critical period to keep the crop weed free so less than 10% yield/ loss is seen is 1-3 weeks after the crop emerges or is transplanted. Graph by: Bill Stall.

The bottom line is that the extent of weed interference with crops is influenced by:

- Weed species
- Weed population composition (mixed or pure stands)
- Time of emergence
- Time of removal

WHEN TO MANAGE WEEDS:

- Weeds reduce yield and quality of vegetables through direct competition of light, moisture and nutrients as well as by interference with harvest operations.
- Early season competition is most critical and a major emphasis on control should be made during this period.
- Weeds can be controlled but this requires good management practices in all phases of production. Because there are many kinds of weeds with much variation in growth habit, they obviously cannot be managed by a single method.
- The incorporation of several of the following management practices into vegetable production practices increases the effectiveness for controlling weeds.

CRITICAL WEED-FREE PERIODS:

- The critical period of interference (CPI) is the specific time interval during crop growth that a crop must be maintained weed-free to prevent interference from reducing yields **(Figure 1)**.
- CPI depends mainly on weed species, weed mixtures, weed density, crop species and crop planting method (direct seed or transplant).
- In transplanted tomatoes competing with multiple weeds or with troublesome individual weeds (pigweeds, nightshades, yellow nutsedge), the end of the CPI was usually at the early fruit set stage crop (5-7 weeks after transplanting (WAT)), although with purple nutsedge the end of the CPI was up to 9 WAT.
- For a given yield loss threshold in a particular crop, the minimum weed-free period and maximum weedy period may be shorter or longer depending on the weeds involved, which has clear practical implications.
- No significant yield loss was found when the crop remained weed-free during the first 36 days after transplanting.

Critical Period of Interference

Weeds	Tomato CPI	Pepper CPI
Amaranths (pigweeds)	2-4 WAT	2-4 WAT
Nightshades	2-7 WAT	1-3 WAT
Yellow nutsedge	2-10 WAT	1-7 WAT
Purple nutsedge	4-9 WAT	N/A
Dayflower	N/A	0-3 WAT

WAT = Weeks After Transplanting

Identification of weed species and their life cycles will have great impact on the selection and/or success of control measures.

Weeds are classified as grasses, broadleaf and sedges. They are further classified by the length of their life cycle (annual, biennial and perennial).

TRUE GRASS WEEDS have hollow, rounded stems and nodes (joints) that are closed and hard. The leaf blades have parallel veins, are much longer than they are wide and alternate on each side of the stem **(Figures 2 & 3)**. Some examples are crabgrass, goosegrass, crowfootgrass, sandbur, annual bluegrass, torpedograss and vaseygrass.

BROADLEAF WEEDS are a highly variable group of plants but most have showy flowers and net-like veins in their leaves. They are easy to separate from grasses due to their generally different leaf structure and habits of growth **(Figure 4)**. Some examples of broadleaf weeds are cudweed, creeping Charlie, eclipta, creeping beggarweed, cocklebur, sicklepod and Florida beggarweed.

SEDGES are an important group of "grass-like" weeds, but they are not true grasses. They are characterized by a solid, triangular-shaped stem with leaves extending in three directions and are usually referred to as nutgrass. There are two major perennial sedges that plague Florida vegetable growers: Yellow & Purple Nutsedge.

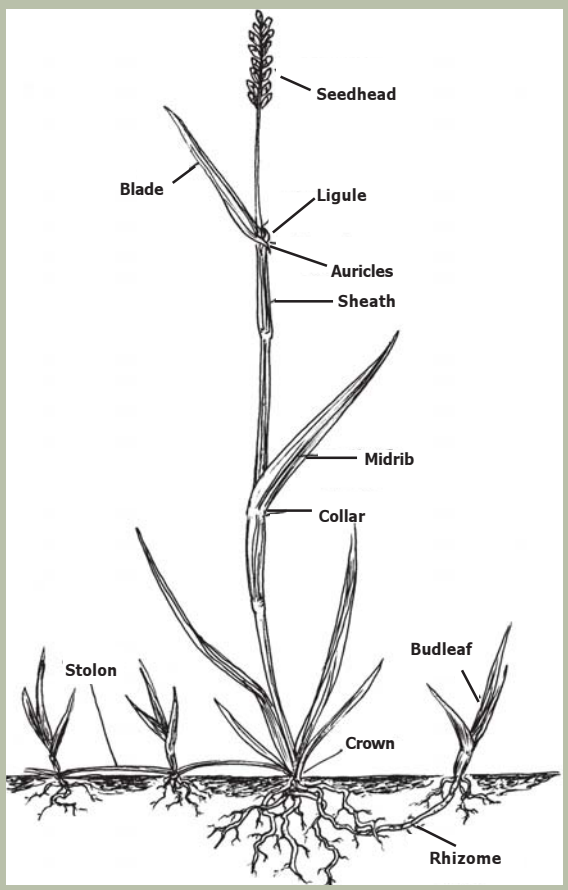

Figure 2. Anatomy of a grass.

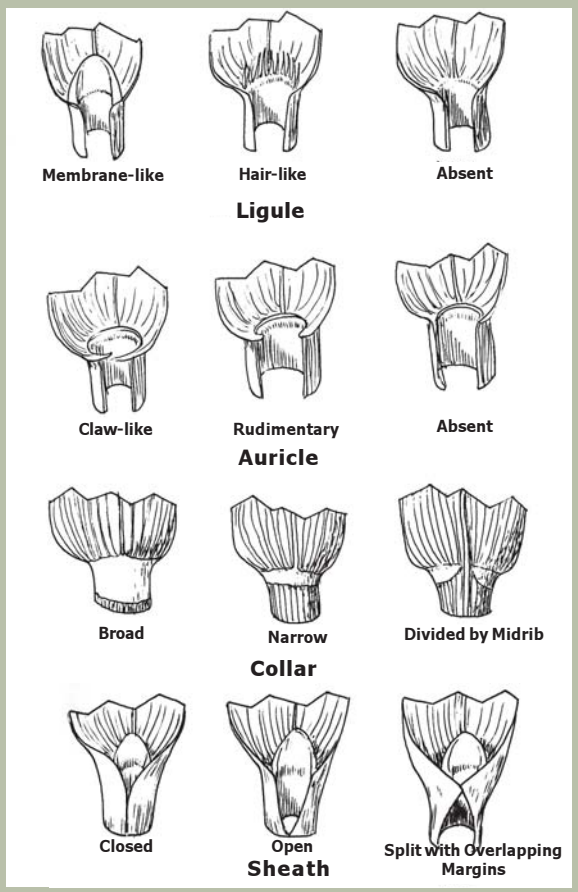

Figure 3. Ligule structures for grass identification.

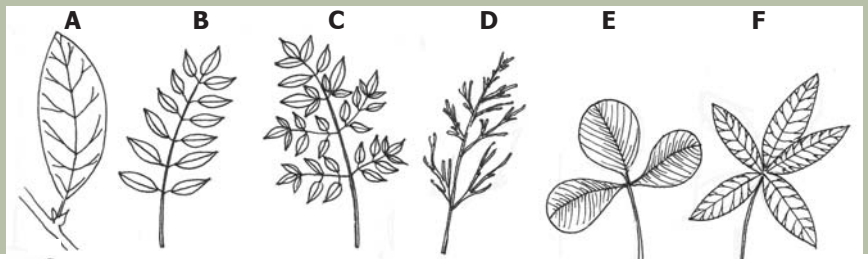

Figure 4. A=Simple leaf type; B - F = Compound leaf types: B=Pinnate; C=Bipinnate; D=Dissected; E=Trifoliate; F= Palmate.

Line drawings by: Jeff HansPetersen.

ANNUAL WEEDS complete their life cycle within one year. They germinate from seed, produce seed and die in 12 months or less. They may be annual grasses, sedges or broadleaf weeds. In addition, their life cycle may begin at different seasons of the year.

Figure 5. Row middles are quickly colonized by annual and perennial weeds. Photograph by: Phyllis Gilreath.

Summer annuals emerge in the spring and mature before winter. Weeds such as crabgrass and cocklebur are typical summer annuals.

Winter annual weeds sprout from seed in the fall and complete their life cycle before summer of the next calendar year. Wild radish, henbit, annual bluegrass and chickweed are examples of winter annual weeds.

BIENNIAL WEEDS have a 2-year life cycle. They germinate from seed in the fall; develop large root systems and a compact cluster of leaves during the first year, the second year they mature, produce seed and die. Examples of biennial weeds are cudweed, Carolina false dandelion, wild carrot and bull thistle.

PERENNIAL WEEDS live more than two years. They reproduce by vegetative parts such as tubers, bulbs, rhizomes (underground stems) or stolons (above-ground stems). Some also produce seed in addition to vegetative reproduction.

During the winter season, most survive in a dormant state, and many lose their above ground foliage and stems. With the beginning of spring, they regenerate from food reserves in their root systems **(Figure 5)**. Torpedograss, nutsedge and various vines are members of this group of weeds **(Figure 6)**.

Figure 6. Purple Nutsedge *Cyperus rotundus* is a perennial weed that reproduces mainly from tubers that develop along an underground rhizome. Photograph by: UF/IFAS.

WEEDS AS ALTERNATE HOSTS:

- Nightshade and volunteer tomatoes are hosts to various pests and diseases including whiteflies, nematodes, bacterial spot and viruses.
- Reducing populations of these pests can be accomplished with good weed control.
- Most growers concentrate on weed control in row middles; however, peripheral areas of the farm include: roadways, fallow fields, equipment parking areas, well and pump areas, fence rows and associated perimeter areas and ditches must be diligently managed.

Prepared by: Drs. Jason Ferrell & Bill Stall

PREVENTION:

- Good prevention techniques can save growers money in weed control. Consider the ways weed seed enters the field and is distributed: wind, water, machinery*, in cover crop seed etc. Eliminate sources of weed seed **(Figure 7)**.
- The use of certified, registered, foundation seed or clean planting material cannot be overemphasized in preventing weeds from infesting fields.
- Fence rows and ditch banks are often neglected when controlling weeds in the crop. Seed produced in these areas may move into the field. Weeds in these areas can also harbor insects and diseases (especially viruses) that may move onto the crop.
- Clean equipment before entering fields or when moving from a field with a high weed infestation to a relatively clean field*.

*Nutsedge tubers especially are moved easily on discs, cultivators and other equipment.

Figure.7 An individual Palmer amaranth can produce between 200,000 to 600,000 seeds. Killing weeds before they go to seed is an important control strategy. Photograph by: Bill Stall.

CROP COMPETITION:

- An often overlooked tool in reducing weed competition is to establish a good crop stand, in which plants emerge and rapidly shade the ground.
- Plants that emerge first and grow the most rapidly are the plants that will have the competitive advantage.
- Utilization of good production management practices such as fertility, well-adapted varieties, proper water control (irrigation & drainage) and establishment of adequate plant population is very helpful in reducing weed competition.
- Everything possible should be done to insure that vegetables, not weeds, have the competitive advantage.

CROP ROTATION:

- If the same crop is planted in the same field year after year, there will be some weed or weeds favored by the cultural practices and herbicides used on that crop.
- By rotating to other crops, the cultural practices and herbicide program are changed. This often reduces the population of specific weeds which were tolerant in the previous cropping rotation.
- Care should be taken to not replant vegetables back into soil treated with a non-registered herbicide. Crop injury as well as vegetables containing illegal residues may result.
- Check the labels for plant-back limitations before application and planting rotational crops.

FALLOWING:

- Fallowing is a control method where the field is kept clean, i.e. free of cover crops and weeds during the time between crop seasons **(Figure 8)**. Fallowing can be accomplished by mechanical (disking or plowing), chemical (herbicides) or by a combination.
- Fallowing keeps any weeds that emerge during the off season from going to seed, it reduces the weed-seed bank in the soil and it will reduce any insects or nematodes that would survive on the weed hosts during the off season.

Figure 8. Field tillage and herbicide are being applied to maintain a fallow condition during the off season. Photograph by: Joe Noling.

MULCH:

- The use of polyethylene mulch increases yield and earliness of vegetables. The proper injection of fumigants under the mulch will control nematodes, soil insects, soil-borne diseases and weed seeds.
- Mulches act as a barrier to the growth of many weeds. Nutsedge can and will grow through most mulches. **More information about Mulches is available on pgs. 174-175**.

MECHANICAL CONTROL:

- Mechanical control practices are among the oldest of weed management techniques and include field preparation by plowing or disking, cultivation, mowing, hoeing and hand pulling of weeds. It is a primary reason for preparing land for crops planted in rows.
- Seedbed preparation by plowing or disking exposes many weed seeds to variations in light, temperature and moisture. For some weeds, this process breaks weed-seed dormancy, leading to early season control with herbicides or additional cultivation.
- Cultivate only deep enough in the row to achieve weed control. Deep cultivation may prune crop roots, bring weed seeds to the surface and disturb the soil previously treated with an herbicide.
- When seeds can be controlled without cultivation, there is no advantage to cultivating. There may be disadvantages such as drying out the soil surface, bringing weed seeds to the surface and disturbing the root system of the crop.
- The burial of active growing points of annual weeds is an effective method of control. Burial is usually less effective on perennial weeds which have underground stems and roots and are capable of re-growth from these underground storage organs.
- Mowing is usually most effective on tall growing annuals and not as effective on short growing plants, perennials or grasses. The growth habit of the plant usually indicates how effective mowing will be. Annual weeds are usually mowed to prevent seed production and to allow the crop a better competitive advantage.

Prepared by: Dr. Bill Stall

CHEMICAL SELECTION:

- Properly selected herbicides are effective tools for weed control. Herbicides may be classified several ways, depending on how they are applied and their mode of action in or on the plant.
- Generally herbicides are either soil applied or foliage applied.
- Herbicides may be selective or non-selective, and they may be either contact or translocated through the plant. For example, paraquat is a foliage applied, contact, non-selective herbicide, while atrazine usually is described as a soil-applied, translocated, selective herbicide.
- Correctly identifying problem weed species is essential for selecting the correct control methods and herbicide. Contact your county extension agent for assistance with identification.

Figure 9. Aim damage from drift due to improper application of the herbicide. Photograph by: Bill Stall.

See **Appendix 4** for a table listing herbicides registered for use in tomato and pepper in Florida and their effectiveness on select weeds.

DEFINITIONS:

Fumigants are pesticides or mixtures of pesticides which produce vapors (gases) that fill an area (i.e. soil) and kill the pest. Fumigants can be applied as solids, liquids or gasses. The degree of control depends on the pesticide or mixture and the rate, plus the time the gas is in the soil.

Contact herbicides kill only those parts of the plant which the spray touches, i.e. paraquat.

Translocated/systemic herbicides are taken into the plant and moved throughout the plant tissues, i.e. glyphosate (Roundup ®) or sethoxydim (Poast®).

Foliage applied herbicides may be applied to leaves, stems and shoots of plants. They require good coverage and the addition of either a specified surfactant or specific formulation for best control.

Soil-applied herbicides that are applied to the surface and not incorporated require moisture shortly after application for best results.

Incorporated herbicides are not dependent on rainfall or irrigation and have generally given more consistent and wider-spectrum control. Soil incorporated herbicides improve the contact of the herbicide with the weed seed and/or minimize the loss of the herbicide by volatilization or photo degradation. They do, however, require more time and equipment.

IMPLEMENTING WEED CONTROL:

- Identifying weed problems and selecting multiple appropriate control methods are essential steps in designing or modifying a weed control program.
- Generally, for pre-plant and pre-emergence applications, the weed problem must be anticipated since weeds have not emerged at the time of application. This can be done by observing the field in the previous season and recording (mapping) those weeds which are present and in what areas of the field they occur.
- Weed maps can be very useful the next season in refreshing your memory and making decisions on which herbicides to purchase.
- Crop rotation is an excellent way to reduce weed shifts due to specific herbicide use **(Figure 10)**. Be aware of plant-back restrictions on herbicides used the previous crop.
- Once weed problems have been determined, the tables on **pg. 203** can be helpful in determining the herbicides which is most effective for control of those weeds.

Figure 10. Watermelon is commonly used as a crop rotation in the form of double cropping. Photograph by: Phyllis Gilreath.

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