Agronomic Spotlight

Managing Pigweed in Vegetable Crops

- Several species in the pigweed family can be problematic weeds in vegetable production fields.
- Pigweeds are summer annuals that usually emerge in the late spring and early summer.
- Pigweed management strategies often focus on eliminating seedlings and suppressing pigweed plant growth.

Pigweeds are broadleaf summer annuals that can cause substantial weed problems for warm-season vegetable crops.[1,2] Pigweeds are members of the Amaranthaceae plant family, which also includes beets, spinach, and Swiss chard. There are several species of pigweed present in North America, including redroot pigweed (*Amaranthus retroflexus*), smooth pigweed (*A. hybridus*), Powell amaranth (*A. powellii*), Palmer amaranth (*A. palmeri*), and waterhemp (*A. tuberculatus*).[1,2,3]

Identification

Pigweed species are differentiated by their leaf shape, length of the petiole, hairiness of the stem, plant height at maturity, and whether male and female flowers are produced on the same or separate plants (monoecious vs. dioecious). Redroot pigweed, smooth pigweed, and Powell amaranth produce erect, bushy plants that grow up to six feet tall. These three species are monoecious, producing both female and male flowers on the same plant. Palmer amaranth and waterhemp plants can be up to ten feet tall and are dioecious, with separate female and male plants.[4]

Figure 1. A young redroot pigweed plant. Howard F. Schwartz, Colorado State University, Bugwood.org.

Redroot and smooth pigweed have oval to diamond-shaped leaves that form alternately on the stem (Figure 1). The stems of smooth pigweed are hairier than those of redroot pigweed. Young seedlings of both species have a pair of long, narrow cotyledons and a pair of broader-shaped true leaves. Reddish color may develop on taproots, lower stems, and the undersides of leaves. Both species produce many green flowers in dense clusters at the leaf stem joints and branch ends (Figure 2). Smooth pigweed produces many branched flower heads on thinner branches than redroot pigweed. The seeds of both species are small, spherical, shiny, and dark reddish brown to black (Figure 3).[1,2,4]

Figure 2. A red root pigweed flower head.

The leaves of Palmer and Powell amaranth are diamond-shaped, but Palmer amaranth has petioles that are longer than the leaf blade, while Powell amaranth has short petioles. Waterhemp has long linear leaves with short petioles.[4]

Life Cycle and Growth

Pigweeds are frost-tender and complete their life cycles, from seedling emergence to new seed formation, during the frost-free part of the year. Seeds are their only method of reproduction, and a single plant can produce 100,000 to 600,000 seeds in a season. The high rate of seed production makes these weeds difficult to manage as the seeds are easily spread within and between fields in soil on equipment, shoes, tires, etc., and by flowing irrigation or flood water. The seeds can also survive ingestion by animals and be spread in an animal's manure.[1,2]

Pigweed seeds can remain viable in the soil for many years. A 50% reduction in seed viability has been documented after three years in the soil, and it can take up to twenty years to achieve a 99% reduction of pigweed seed in a soil seedbank.[5] Germination is stimulated by high soil temperatures (86° to 104°F), fluctuating day/night temperatures, and possibly by light. Germination often occurs between 150 and 300 growing degree days (GDD), base 48°F. Seeds in the upper one-half to one inch of the soil are the most likely to germinate. The rate of germination declines with increasing soil depth below one inch. However, deeply buried seeds can remain viable for several years and germinate when brought to the surface by operations such as tillage.[1,2,3] Disturbing the soil can also enhance germination, but no-till and minimum-till practices that minimize the burial of seed usually result in greater pigweed populations in the following season.

Pigweed plants grow rapidly at high temperatures, and they can compete with crop plants for light, moisture, and nutrients. Pigweeds can overtop and shade out shorter crops such as broccoli and snap beans. Seed germination and plant growth are enhanced by high nutrient levels (N, P, and K). However, pigweeds are shade intolerant and grow slowly under dense crop canopies.[2,5] Flowering is initiated when day length starts to decrease after the summer solstice, usually about six weeks after plant emergence. The rate of flowering and seed development increases as day lengths continue to become shorter. The life cycle completes before the first frost.[1,2]

Management

Effective management of pigweed can require a multi-year process.

Cultural: Rotate between warm-season vegetable crops and cool-season crops to reduce the presence of bare soil in the late spring and early summer. Rotating fields to small grains or other crops that develop dense canopies early in the season can help reduce populations of pigweeds in the soil seedbank. Planting early or transplanting can help crops outgrow and shade out pigweed seedlings. Applying nitrogen and phosphorus after crop establishment or using slow-release fertilizers can also help crops outcompete pigweed seedlings. Cleaning soil from equipment between infested and non-infested fields can help reduce the introduction and spread of pigweed seeds. Cover crops and organic mulches can also be used to help suppress the growth of pigweed seedlings.[1,2,5]

Eliminating seedlings: Pigweeds are easier to manage when in the seedling stage and more difficult to manage as they grow. Seedlings can be eliminated by tilling and cultivation in the first two to four weeks after emergence, depending on growing conditions, remaining susceptible to tillage longer in cooler climate areas. Fields should be monitored regularly for pigweed emergence and seedlings eliminated by tillage or flame weeding before they are one to one-and-a-half inches tall.[1,2] A rotary hoe can be used if the seedlings are less than ¼ inch tall.[5] For summer planted crops, prepare seedbeds for planting after the peak flushes of pigweed emergence. Alternatively, growers can encourage pigweed germination in stale seedbeds after field preparation and repeatedly remove emerged seedlings by cultivation or flame weeding before planting. This will help reduce the number of pigweed seeds in the soil seedbank.[1,2] A final shallow cultivation (1.5 inches) just before planting will help minimize bringing up additional buried seed. In established plantings, soil can be mounded around and against the plants in the crop row and can be used to bury and eliminate young pigweed seedlings.[1,2]

Mowing and grazing: Once the crop is too large for cultivation, pigweed plants can be removed by mowing, weed whacking, or hand pulling. This should be done before the pigweed plants start to form seeds. Livestock can also be allowed to graze on pigweed in situations where livestock manure will not come into contact with harvested products. Grazing should be done before the pigweed plants start to produce seed because the seed can survive and be spread in manure.[1,2]

Nutrients and moisture: Using slow-release fertilizers, applying fertilizers after the crop becomes established, and applying fertilizers in a band over the row or as a sidedress can help limit the stimulation of pigweed growth. Irrigating the crop using drip irrigation also can suppress pigweed germination and growth by limiting moisture levels in the upper layers of the soil away from the crop row.

Manage the seedbank: The presence of seed-producing pigweed plants in a field may not affect the yield of the current crop, but the seeds from those plants can contribute to the pigweed population in the soil seed bank, which can affect future crops. Therefore, it is important to eliminate pigweed plants by cultivation, pulling, or cutting before they flower when possible. If plants have started to flower, then plants should be pulled or cut and removed from the field. When large numbers of seeds have been deposited, deep tilling can be used to bury the seed below the optimal germination zone. Following deep tillage, only shallow tillage and cultivation should be done for the next three to four years to minimize the number of buried seeds brought up to the optimal germination zone.[2]

Chemical: Because pigweeds emerge in the late spring and early summer, post-emergence herbicides are typically used for their management.[5] Several herbicides are labeled for use in managing pigweeds/amaranths in vegetable crops.[6] Herbicide resistance has become an issue with some species.

Sources:
[1] Melendez, M. and Besancon, T. 2022. Redroot and smooth pigweed life cycle disruptions for effective control in specialty crops. Rutgers New Jersey Agricultural Experiment Station, Cooperative Extension Fact Sheet FS1350.
[2] Schonbeck, M. 2012. Weed profile: pigweeds (Amaranthus spp.). eOrganic. https://eorganic.org/node/5120.
[3] Phillips, B., Nair, A., Bergefurd, B., Egel, D., Ingwell, L., and Meyers, S. 2023. Midwest vegetable production guide for commercial growers 2023. https://mwveguide.org/.
[4] How to identify pigweeds. Cornell Weed Science. https://cals.cornell.edu/weed-science/weed-identification/pigweed-identification/how-identify-pigweeds.
[5] Pigweeds: Redroot pigweed, smooth pigweed, and Powell amaranth. https://www.canr.msu.edu/weeds/extension/pigweeds-redroot-pigweed-smooth-pigweed-and-powell-amaranth.
[6] Phillips, B., Nair, A., Bergefurd, B., Egel, D., Ingwell, L., and Meyers, S. 2023. Midwest vegetable production guide for commercial growers 2023. https://mwveguide.org/.

Websites verified 7/27/2023

For additional agronomic information, please contact your local seed representative.

Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. The recommendations in this article are based upon information obtained from the cited sources and should be used as a quick reference for information about vegetable production. The content of this article should not be substituted for the professional opinion of a producer, grower, agronomist, pathologist and similar professional dealing with vegetable crops.

5023_275200 Published 08/18/2023