

2014 Empire Producers EXPO Berry Session Presentation Summaries

Day-Neutrals: Strawberry Weed Management - *Kathy Demchak, Department of Plant Science, The Pennsylvania State University*

Weed control methods fall into one of several categories: 1) fumigation, 2) cultural controls, and 3) herbicides use. Fumigation methods and cultural controls are similar whether June-bearing or day-neutral varieties are being grown, whereas herbicide use is more limited because fruit is present for most of the growing season.

Fumigants

Weed control is one of the main reasons for the use of fumigants prior to planting. The most commonly used material is metam sodium (Vapam). 1,3-dichloropropene alone (Telone) or with chloropicrin (Telone C17, Telone C35) does not have efficacy against weeds. A newer fumigant, dimethyl disulfide (Paladin) does have efficacy against weeds. Combinations of fumigant materials are currently being tested that appear to give improved results.

Cultural Methods

Use of plastic-mulched raised beds is a main method of controlling weeds in day-neutral strawberry production. When growing strawberries on plastic, the size of planting holes should be kept as small as possible to minimize the area from which weeds can emerge. In our day-neutral plots at PSU, our weed control program consists of measures to suppress perennial weeds prior to planting (cultivation and glyphosate application), and then purely cultural controls afterwards: growing plants on plastic, applying straw mulch along the edges of the plastic to suppress weeds and keep the berries clean, mowing the row middles once weeds start to grow, and using hand-weeding and weed-whacking for touch-ups.

Other cultural methods consist of growing competitive cover crops prior to planting, cultivation before and after planting, mowing, mulching with straw, and hand-weeding. Biology of individual weeds and its effects on cultural control measures are further discussed below.

Herbicides

Not all herbicides that can be used for June-bearing strawberries can be used to the same extent in day-neutral plantings, mainly because of days-to-harvest limitations. When plants are grown in plastic-mulched raised beds, no herbicide should ever be applied over the beds, as the material can wash off the beds and become concentrated in the planting holes.

Herbicides fall into 2 categories: post-emergence, which are used to control weeds after they have emerged, and pre-emergence, which are used to prevent seed or sometimes very young weeds from being able to establish themselves. Some herbicides (Sinbar, Goal, Chateau) are used mainly for their pre-emergence activity, but also have either "kickback" activity on seedlings (Sinbar), or both burndown and preemergence activity (Goal and Chateau). Post-emergence translocated herbicides work better when weeds are not stressed by heat or drought, so that the weeds are actively growing and the herbicide will be taken up. Preemergence herbicides work better when conditions exist that would encourage weed seed germination. Descriptions of herbicides and their uses follow, including additional limitations that must be considered when growing day-neutrals. Because herbicide use is more limited in day-neutral plantings, a follow-up discussion that focuses on cultural controls of troublesome weeds, combined with pointers on getting the most from herbicide use. Rates and timings should be followed they appear on the label, and are also in the "2014 Cornell Pest Management Guidelines for Berry Crops" or other local extension publications.

Post-Emergence Herbicides

For simplicity, only one commonly-available brand name of herbicide containing each active ingredient is discussed below; however, others may be available that are equally effective. Check your states extension information for formulations that are labeled in your state.

Roundup (glyphosate) is a post-emergence material and has no residual activity once bound to the soil. It is translocated throughout the plant, and works by inhibiting amino acid production. This mode of action causes it to be non-selective, so any plant will be affected - with a few notable exceptions. It is commonly used during field preparation to kill or suppress existing weeds - this is an especially useful tactic for managing perennial weeds. Roundup can also be applied after planting with a 14-day pre-harvest interval. Because Roundup is translocated through the plant, and strawberry plants are attached to each other via runners, neighboring plants can be affected if one plant is exposed. The safest way to use Roundup after planting is with a wick or wiper to avoid the possibility of injury from drift. Symptoms of Roundup damage on strawberry plants could be mistaken for zinc deficiency. New leaves will be small and light-green or show interveinal chlorosis (yellowing), and may appear narrower than usual. In day-neutral plantings, Roundup can be used before planting, and as a spot treatment to control troublesome perennials. However,

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because of the 14-day PHI, it can only be used soon after planting, during a lull in summer production when at least 14 days will pass between application and the next harvest, or after harvest is over for the year.

Formula 40 (2,4-D) is a post-emergence translocated herbicide that acts like a type of plant hormone (auxin) and causes uncontrolled cell division. It is effective against perennial broadleaf weeds such as dandelion and dock, and also annual broadleaf weeds such as pigweed and nightshade. Application is allowed in strawberries at renovation or in early spring when plants are still dormant; however, since day-neutral plantings don't undergo renovation, it can only be used in early spring in plantings that are carried over for a second or third harvest year.

Stinger (clopypalid) use on strawberries is allowed through a Special Local Needs label that must be in possession of the user. Stinger, like 2,4-D, is a post-emergence translocated herbicide with a similar growth regulator effect. It has activity against a number of troublesome weeds in the legume family (clover, vetch), the aster family (thistles, groundsel, ragweed) and dock. Use is allowed in spring for established plantings, though not in the planting year, or in early fall. It has a 30-day PHI, so it can only be used in spring at least 30 days prior to the first harvest in plantings that are carried over for a second or third harvest year. Fall applications and harvest may be at conflict with each other, so the last day-neutral harvests may need to be foregone in order to apply Stinger.

Fusilade (fluazifop-P-butyl), **Poast** (sethoxydim), and **Select** (clethodim) are post-emergent translocated materials that only control grasses, and do so by killing their growing points. Fusilade can only be used in non-bearing fields, and so cannot be used in day-neutral plantings. Poast and Select have 7- and 4-day PHI's, respectively, which limits their use to times when frequent harvests are not underway. They can be applied overtop strawberry plants grown on bare-ground, but should never be applied over plastic-mulched raised beds.

Gramoxone Inteon (paraquat), **Aim** (carfentrazone-ethyl), **Axxe** (ammonium nonanoate), and **Scythe** (pelargonic acid) are non-selective burndown materials that are not translocated in the plant. Thus, they are most effective on annuals, as perennials can grow back from their root systems. Gramoxone is a restricted-use material with 21-day PHI, which limits its use in day-neutral plantings to early spring or fall after harvest is over. Aim, Axxe, and Scythe can be used pre-plant, or as shielded sprays between the rows or beds.

Pre-emergence Herbicides

Dacthal (DCPA), **Devrinol** (napropamide), and **Prowl H₂O** are preemergence materials that are primarily effective against grasses and also some small-seeded broadleaf weeds. If day-neutrals are being grown on bare-ground, Dacthal, Devrinol, or Prowl H₂O can be applied at transplanting as with June-bearing strawberries, keeping in mind that Prowl has a 35-day PHI and Dacthal and Devrinol cannot be applied after bloom starts. Dacthal tends to be fairly weak on weed control, however. All can also be applied at fall dormancy or in spring if plants are being grown on bare ground and are being kept for another year. If day-neutrals are being grown on plastic, Devrinol can be applied to the beds before laying the plastic, or between the rows of plastic, but still cannot be used after the plants begin to bloom. Prowl H₂O can only be used between the beds as a shielded spray, and the 35-day PHI still must be observed.

Sinbar (terbacil), **Chateau** (flumioxazin), and **Goal** (oxyfluorfen) are primarily effective against broadleaf weeds. Sinbar has "kickback" activity on seedlings (Sinbar), while Goal and Chateau are "hot" materials that have both burndown and preemergence activity, and hence will damage any green tissue that comes in contact with the material. Goal use is limited to field application as a burndown material at least 30 days prior to planting. Sinbar has a 110-day PHI and so its use is limited to fall or early spring dormancy for bare ground day-neutral plantings that are being carried over for an additional harvest season, though it also could be used in the fall if later harvests are foregone. Sinbar can only be used in plastic-mulched systems in Florida. In bare-ground day-neutral production, Chateau can be used only over the plants only when the plants are dormant in late fall or early spring. In plastic-mulched systems, Chateau can be applied to the beds 30 days prior to planting before the plastic is applied. It can also be used between the rows as a shielded spray, but not after fruit set in either bare-ground or plastic-mulched plantings.

Putting It All Together – Management of Troublesome Weeds

Weeds are classified as summer annuals, which live through the spring or summer and into the fall; winter annuals, which germinate in the fall and live through the next spring; or perennials, which can continue growing for more than one year. Weather conditions affect exactly when they are most active. Our most problematic weeds are prolific seed producers, often equipped with seed dispersal mechanisms. Some weeds can also be propagated vegetatively, sometimes unintentionally with our help, and/or have large storage organs to ensure survival.

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Summer annuals

Purslane, also known as wild portulaca, has succulent fleshy leaves and stems, which if broken off or tilled, can re-root at each node. It needs high light and warmth, and soil temperatures of 70 to 75 degrees to germinate. One plant can produce 250,000 seeds, which can survive for 40 years. In wet years, its seeds will germinate all summer.

Pigweed (4 species – redroot, tumble, smooth, and Powell amaranth). Pigweed seeds germinate all summer, but mainly from bare soils. Germination is inhibited at temperatures above 95 degrees. Over 10,000 seeds are produced per plant, and seeds can survive for more than 10 years. Pigweed plants secrete a chemical that prevents other seeds from germinating. Tumble pigweed is the plant seen blowing around in old Westerns, as it was native to the Great Plains, but now is found in the east as well. The plants abscise at the ground when they mature, and their tumbling serves as a seed dispersal mechanism.

Eastern black nightshade is in the tomato family. The vegetative portions and immature fruit are poisonous, but ripe fruit is not. One plant can produce 1000 berries, and each berry can contain between 50 and 110 seeds. The berries are eaten by birds, which then disperse the seeds.

Lambsquarters, like other weeds, is a prolific seed producer and the seeds have a long dormancy period, though exact numbers aren't available.

Horseweed isn't usually a problem in June-bearing strawberries, but can be in day-neutrals where less tillage may be taking place. It can behave like a winter annual, summer annual, or biennial. It usually grows as an unnoticed rosette in the fall and/or spring, bolts and makes most of its growth in the summer, then goes to seed.

Cultural controls for summer annuals consist of hand-pulling, or mowing which is useful for taller summer annuals – the stub may survive, but seed production will be greatly reduced or eliminated, and avoids new weed seeds being brought to the soil surface. Cultivation helps, but should be done shallowly when weeds are still young, and is best performed when soil is dry.

Spot-treating with an allowable burndown herbicide is useful for summer annuals. Thorough coverage is important, especially with "softer" materials. With day-neutrals, allowable herbicides are limited because of fruit presence. Dacthal can be applied at planting, but is weak against all species mentioned above except for purslane and lambsquarters. Devrinol can be applied at planting for day-neutrals grown on bare-ground, or to beds before plastic is laid for plastic-mulched plantings. Devrinol has fair to good efficacy ratings for purslane, pigweed, and lambsquarters, but has little to no effect on nightshade and horseweed. Prowl H₂O has good activity on purslane and lambsquarters, and can be applied at planting if plants are grown on bare ground, or between the rows of plastic-mulched beds with a shielded sprayer, remembering to observe the 35-day PHI. Sinbar is efficacious against all the mentioned species, but timing is limited to dormancy in bare-ground systems because of its 110-day PHI. Chateau can be used as a shielded spray between the rows only prior to fruit set or at dormancy in carried-over plantings.

Winter Annuals

Winter annuals usually germinate in the fall, but can also germinate at other times of the year if weather conditions are conducive. Typically they die off when weather becomes hot and dry in the summer, but may persist if the summer is wet and cool.

Common chickweed (not to be confused with mouseear chickweed, a perennial) germinates mainly in the fall, though it will germinate anytime weather is cool and moisture is sufficient. It can even germinate and grow under the snow, which explains those "Where'd that come from?" moments in the spring. It also tolerates shade better than most weeds. As the plant grows, it roots at its nodes, thus potentially forming a large mat of a plant that can produce over 10,000 seeds. Seeds can survive in the soil for over 10 years. It flowers and sets seed in the spring and early summer, and the seed is capable of germinating immediately. The plant only needs 5 weeks of growing conditions to progress from emergence to seed set. Typically there is only one generation per year, but two are possible. Chickweed does not tolerate drought, so it is rarely a problem in unirrigated row middles in the summer.

Henbit (not to be confused with purple deadnettle) is in the mint family, and also roots at its nodes. It has a similar germination and flowering pattern as common chickweed. One plant can produce 2000 seeds, and its seeds remain viable for 25 to 40 years. Its seedlings are easily controlled by tillage, but timing is critical.

Shepherd's purse germinates in early fall, later summer, or early spring in the Northeast, and produces seed in late spring and early summer. One plant can produce as many as 38,500 seeds, which remain viable in the soil for up to 35 years.

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Cultural management of winter annuals consists of keeping the strawberry planting healthy so it can outcompete the weeds, hand weeding even if you only see a few weeds, filling in any bare spots where seeds may germinate with straw mulch, and cultivating shallowly to avoid bringing up more weed seeds.

In June-bearing plantings in the establishment year, Devrinol or Sinbar can be applied around Labor Day, but this is not allowed if fall fruit is to be harvested from day-neutral plantings. Herbicide applications may be made dormancy in the fall prior to applying straw mulch as long as plants are not being grown on plastic. Chateau and Sinbar are effective against all three of the above-mentioned weeds. Devrinol is effective against chickweed; Prowl is weak on all three.

Perennials

Perennial weeds have multiple methods of propagation. Controls should be heavily focused towards pre-plant efforts, as many more options for management exist then.

Dandelion is a pervasive problem because of its windblown seeds and its large taproot that allows the plant to resprout several times if broken off. The flowers can continue to mature seeds even once the plants are pulled. If dandelion plants are recently established, shallow tillage can be effective, but if the weeds are established, hand-pulling and tillage have little effect. Plants can be mowed or weed-whacked close to the ground before bloom. In day-neutral systems, 2,4-D at spring dormancy, or Roundup with a wick applicator as long as the 14-day PHI is observed are the best options. Chateau, Devrinol, and Sinbar are effective pre-emergence materials and can be used at timings discussed above.

Canada thistle has both vertical roots for food storage, and horizontal roots which allow it to spread. Shoots that emerge in the spring flower and produce wind-blown seed, while shoots that are produced in the fall make food for the winter. Mowing it or using a burndown herbicide in the spring is more effective than at other times of the year, as its food reserves are already low then. Frequent tillage, repeated as soon as the plants resprout, is also effective, but tillage used infrequently only multiplies it. Roundup is most effective in late spring and early summer just prior to bloom – a timing that cannot be used with day-neutrals. In the fall, either Roundup or Stinger can be used prior to frost - thistle plants become less susceptible to herbicides after frost. Some fall harvests may need to be forgone if either of these materials are used. No pre-emergent herbicides are very effective.

Quackgrass is active in late spring and early fall when temperatures are moderate, and goes "dormant" during midsummer heat. It reproduces by seed and rhizomes, which can travel several feet before sending up a new shoot. Control should be focused before planting, when repeated tillage can be used to chop the rhizomes into small pieces. The young plants that try to regrow will be susceptible to Poast, Select, or Roundup when they have 6 to 8 leaves as their reserves are already low, but little effect may be observed if a hot dry spell occurs at this time. Plants should not be allowed to re-establish.

Yellow nutsedge can be identified by having a 3-sided (triangular) base, and leaves in groups of three. This helps to distinguish it from grasses. It should be noted that the 3-sided base is only apparent on young plants below the soil line – otherwise, it may be mistaken for a grass. It produces nutlets, rhizomes, and seeds. One plant can produce hundreds to thousands of nutlets, which sprout once they are chilled over the winter, and can resprout 6 to 8 times if tilled. The rhizomes grow and produce new plants in late spring through summer, but in the fall, grow downward, produce nutlets, and die, which then separates the nutlets from the mother plant. Cultural controls consist of keeping the planting vigorous as nutsedge does not tolerate shade. Nutsedge prefers high moisture, and is often found in wet spots or soils with poor drainage. Control measures should be focused on the period before planting. Repeatedly mowing can prevent the plants from going to seed, and tillage prior to winter (before planting) can bring nutlets to the surface where they freeze. Tillage in the spring only disseminates the nutlets. Crop rotations that allow the use of herbicides that effective against nutsedge are helpful (for example, corn). Roundup, when used, should be applied after 5-6 leaves are present and before flowering. Use a low gallonage of water to keep the material more concentrated, as little is retained on the plant. More than one application will probably be needed.