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Raised Bed Gardening

by David Trinklein

With the memory of water-logged gardens from abundant spring rains fresh on our minds, now is a good time to consider raised-bed gardening.The latter is a popular technique for growing flowers, vegetables, fruits, trees and shrubs in Missouri. Raised bed gardens can be attractive, productive and functional.

A primary advantage of raised-bed gardening is improved drainage.This makes raised beds a logical choice for gardeners who must contend with heavy, poorly-drained soils.Raised beds permit plant roots to develop in soil located above water-logged or compacted areas.This elevated soil is much better for root growth. As the soil in beds are amended, compost or other forms of organic matter frequently are incorporated.This practice further improves soil structure, drainage and nutrient-holding ability.

Raised beds can be temporary or permanent in nature. Temporary raised beds work well for many backyard vegetable gardeners and consist of forming raised mounds or berms from loose soil as it is tilled.When planted and mulched, temporary raised beds need no edging to keep the soil in place.However, they may need to be reconstructed from time-to-time.

Permanent raised beds are more satisfactory for most situations. Besides controlling erosion better than temporary beds, walled beds permit deep soil amendment.Although the initial cost of construction is higher, most gardeners prefer raised beds with walls because of their permanence.

The choice of framework to use for raised beds with walls depends on the availability and cost of the construction material, and how you want the final product to look in the landscape. Treated landscape timbers and used railroad ties are popular materials. Naturally decay-resistant lumber, such as redwood or cedar, may also be used. Other possibilities include concrete blocks, bricks and stones, or synthetic lumber made from recycled plastic. A group of half barrels can make a convenient raised bed for use on a patio. For a consistent look, match materials used to construct a raised bed to those used elsewhere in the landscape.

Generally, wood-based products are less expensive than stone or masonry materials. However, resourceful gardeners may be able to find used bricks, concrete blocks or other materials at little or no cost.

Concern has been raised about the safety of using treated lumber in food gardens. Pressure-treated lumber using CCA (chromated copper arsenate) as a preservative prompted this concern. CCA-treated wood recently was banned for residential use by the Environmental Protection Agency, and its production was phased out. Any remaining stock probably should not be used to construct raised beds for growing food crops.

ACQ (akaline copper quaternary) is an alternative preservative choice for pressure-treated lumber.Unlike CCA, it does not contain arsenic or chromium. It does, however, contain copper, which can leach into the soil from treated lumber. Although copper is an essential element for both plants and animals, excessive amounts can be harmful. A 2007 study of the safety of ACQ published in Human and Ecological Risk Assessment concluded that exposure to copper from contact with ACQ-treated wood is not expected to have adverse effects on the health of adults or children.

CA (copper azole) is another wood preservative based on the fungicidal properties of copper. Its toxicity risk should be similar to that of ACQ.

Creosote, which is used to treat railroad ties, may cause injury or death to plants that come into direct contact with it. The effect

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diminishes after a few years. Old, discarded ties do not injure plants.However, ties that are still oozing black, sticky creosote or have an intense odor may cause injury.

Gardeners who are uncertain about the safety of treated lumber should consider placing a heavy plastic liner between the treated lumber and the soil used for growing plants. This will prevent direct contact of plant roots with the treated lumber. Be careful not to tear or puncture the plastic when preparing the bed.

Raised beds take many forms and sizes. Typically, raised beds are rectangular in shape.Four feet is a convenient width for beds. At this width, the center of the bed is easily accessible from either side. If the bed is accessible from only one side, limit the width to three feet. Most gardeners find it uncomfortable to reach farther than three feet to tend a bed.

The length of a raised bed is not critical. It is only limited by the dimensions of the yard. However, for the sake of convenience, consider breaking up long distances into several shorter beds. For example, instead of building one long bed 50 feet in length, construct two 24-foot-long beds with a two-foot walkway between to save steps when tending the garden.

The depth of a raised bed is a matter of personal preference. Most plants need at least 6- to 12-inches of soil to develop their roots.However, deeper would be better. With deep tillage, some of the rooting depth may come from soil at or below the existing grade. Beds built higher than 18 to 24 inches require retaining walls with foundations and supports, which are topics beyond the scope of this article.

Whatever the depth, raised beds constructed from wood must be held in place.Treated wooden stakes or concrete rebar are good choices to accomplish the latter.In either case make sure sufficient reinforcement is provided to keep raised beds from falling apart.

For raised beds less than two feet tall, stones or cement blocks may be stacked on top of one another without mortar or footings. Carefully place irregularly shaped stones to enhance the stability of the wall. Offset seams and gaps from one layer to the next to help tie the wall together. Mortar may be used for greater strength.

Make pathways between raised beds wide enough for easy access to beds. For foot traffic only, paths one foot in width are adequate. Keep in mind, however, that plants at the border of raised beds will hang over the edge, cutting into the available walking space. To allow room for a wheelbarrow or garden cart, plan on paths two or three feet in width. A space-conserving option is to make most paths narrow, with an occasional wider path for access with garden equipment.

Good-quality existing topsoil may be used in raised beds. However, the addition of organic matter to any soil will improve its physical and chemical makeup, thus making it more productive. Peat moss, compost and decomposed manures are good sources of organic matter.

Avoid hauling in new layers of soil without mixing them into existing soil. Distinct layers of soil create barriers through which water will not readily penetrate and roots will not easily grow.To avoid the formation of soil layers, gardeners often double dig beds.

Double digging involves removing the topsoil the depth of a spade, setting the soil aside, then loosening the subsoil another spade's depth. Next, the topsoil removed is returned with added amendments, such as compost, manure or fertilizers.This labor-intensive soil preparation method provides an excellent rooting zone for plants.However, less-intensive methods also permit satisfactory plant growth.

Some advocates of intensive "square foot gardening" recommend filling raised beds with a mixture of 1/3 topsoil, 1/3 well-decomposed organic matter and 1/3 haydite or other large aggregate amendments.Mixtures such as the previous are highly porous and encourage the development of extensive root systems.However, because of their porosity, they require more frequent watering.Added expense also is a concern.

Given the amount of time, labor and expense often required to build a raised bed, their management should not be taken lightly.Good management begins with plant spacing which is closer in a raised bed than in a conventional garden. The goal is to use as much of the available area as possible, without overly crowding plants. This is accomplished by spacing plants closely together in a staggered (or diamond) pattern. By the time the plants mature, 80 percent or more of the surface area should be covered with plants.

Another way to increase the productivity of raised bed vegetable gardens is through succession planting. The latter can be defined as planting a second crop in the area vacated when the original crop is harvested. The same crop may be repeated or a different crop may be planted, depending on the date and/or food preferences of the gardener. Succession planting extends the supply of produce from the garden late into the year and helps to make optimum use of valuable garden space by growing two crops instead of one in a given area.

Plant nutrition, irrigation and pest control also are important in raised-bed gardening because of the value of the space involved. Fertilization of plants grown in raised beds is similar to that of plants grown conventionally. For most crops, a complete fertilizer such as 10-10-10 applied at the rate of one to two pounds per 100 square feet is satisfactory. Organic fertilizers and manures may also be used. For more specific fertilizer suggestions, rely on recommendations based on soil tests.

Use irrigation to supplement natural rainfall during dry periods. Soaker hoses or drip irrigation may be placed directly on the bed. Overhead sprinklers can also be used, but because they wet foliage they are more likely to encourage diseases. Organic mulches, such as straw or hay, in vegetable raised beds, or wood chips placed on landscape fabric weed barriers around ornamental bed reduce the amount of water lost through evaporation. Weed growth also is suppressed.

Insect and disease control should follow integrated pest management principles. The latter begins with trying to exclude the pest, if at all possible. Thoroughly cleaning raised beds of plant material at the end of the growing season is the first step in pest management.If chemical controls are deemed necessary, early intervention using the most eco-friendly pesticide is best.

Spotted Wing Drosophila: Monitoring and Management

by Bruce Barrett and Jaime Pinero

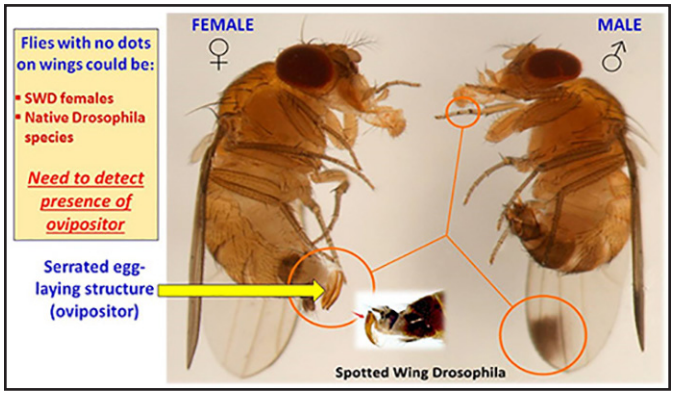
Why is Spotted Wing Drosophila (SWD) such a concern?

This invasive insect primarily attacks blueberries, blackberries, raspberries, cherries, strawberries, elderberries, and peaches. Less preferred fruits include grapes and wine grapes, figs, boysenberries, plums, nectarines, and persimmon. Unlike other vinegar flies, SWD attacks sound ripening fruit and once eggs are laid inside fruit, insecticides will provide no control. Thus, it is imperative to control SWD before females lay eggs. Its short lifecycle and overlapping generations make spray timing difficult. An added problem is that for successful control farmers need to spray near harvest time and multiple sprays using the same insecticide class can lead to pesticide resistance. Thus, it is important to rotate insecticide classes.

Flies with no dots on wings could be swd females or native drosophila species. Need to detect prescence of ovipositor.

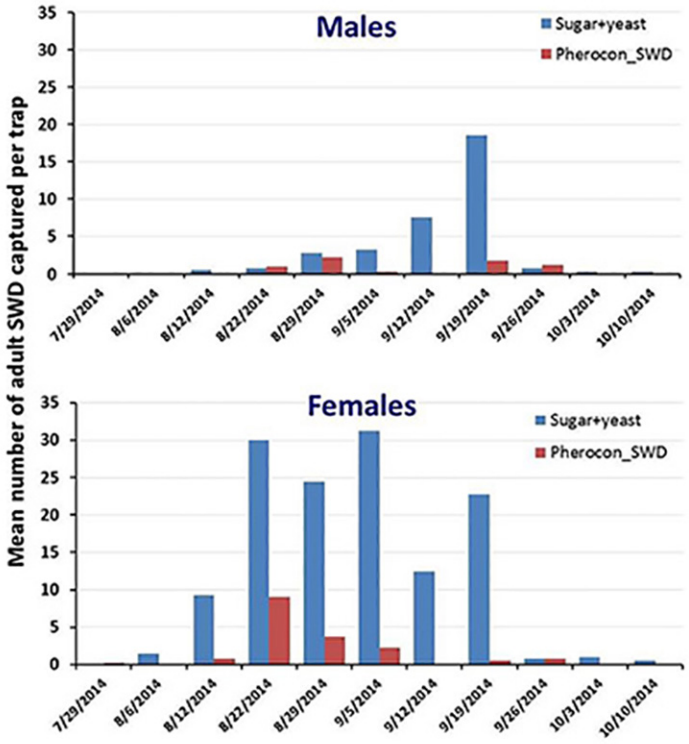
2014 evaluation of commercial and home-made lures for SWD.

From late July to late October 2014 the LU IPM program conducted a field study aimed at comparing the attractiveness of a new synthetic lure (trade name: SWD Pherocon, by Trece Inc.) versus that of the standard yeast / sugar bait (home-made lure) to male and female SWD. The study took place in an unsprayed elderberry plot at the Lincoln University Carver farm (Jefferson City, MO). Traps were deployed in pairs (n= 4), about 10 ft. apart, on fruiting plants. Traps were inspected once a week and all insects captured were taken to the lab for identification. Every week, the one-week old traps were replaced with traps having new baits / lures.



Key findings:

As shown in the graphs below, the active dry yeast + sugar bait consistently out-competed the new commercial lure.



The table below summarizes captures across the entire season. It reveals that the standard sugar / yeast bait was on average 4.8 and 20.3 times more attractive to males and females, respectively, than the new lure. Thus, the home-made lure seems to be the most effective at this moment at detecting SWD.

MALES	mean number
Sugar/yeast	2.9
Pherocon SWD	0.6
RATIO	**4.8**
FEMALES	**mean number**
Sugar/yeast	12.2
Pherocon SWD	0.6
RATIO	**20.3**

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Monitoring for SWD in 2015.

The first adult Spotted Wing Drosophila was captured by a monitoring trap in the Jefferson City area on May 27th, 2015. This trap was hung from a mulberry tree that has ripening fruit. Since then, SWD has been found in most locations where SWD monitoring traps have been setup by the LU / MU IPM programs. Consequently, farmers are encouraged to monitor for this insect pest Ideally, monitoring traps should be deployed starting 3-4 weeks before berry ripening and throughout the harvest season. Place one monitoring trap baited with active dry yeast (1/2 tablespoon), sugar (2 tablespoons) and water (6 ounces) per acre. The trap needs to be hang on a plant, stake, or trellis 3–5 feet above the ground on the most shaded / cooler side of the plant canopy. **Because SWD reproduces so quickly under warm weather conditions, the first SWD trapping data are vital to activate pest management programs to prevent rapid population increases and potential infestations on a farm.**

The process of identifying SWD: (*a) view of trap with many small insects on the sticky card and in the sugar/yeast bait; (b) view of container with insects floating on clean water after sieving them from the old bait(on the right); (c) after spreading out insects onto a tray, use a paint brush or similar to split them into smaller groups, and then systematically look for small flies that have either spots on wings (male SWD, see red circle) or flies that have the egg-laying structure (shown enlarged in [d]).*

For 2015, the LU / MU IPM programs will be monitoring the presence and abundance of SWD in selected locations throughout Missouri. Information will be posted weekly at the MU IPM Pest Monitoring Network website: http://ipm.missouri.edu/pestmonitoring.

SWD Management for the 2015 season.

Farmers are advised to apply an insecticide as soon as SWD is detected and fruit is at susceptible stage. Cultural controls such as sanitation (i.e., clean up and destroy over-ripe fruit) and pruning to reduce amount of foliage can help reduce breeding sites and can also improve insecticide coverage. Articles discussing the importance of SWD monitoring, how to make your own monitoring trap, management options including organic tools can be found at: http://www.LU-IPM.net. Note that the Spotted Wing Drosophila tab has a scroll down menu. Fact Sheets and Guide Sheets listing the most effective organic and reduced-risk insecticides that can be applied against SWD are available the LU IPM program website http://www.lincolnu.edu/web/programs-and-projects/ipm.

Current & Potential Impacts of the 2015 Wet Weather Pattern on the Turfgrass Industry

The Missouri turfgrass industry is being adversely affected by the persistent wet weather, but not nearly to the extent as the annually planted row crop industry in the state. As we experience what could be the wettest May – July period in Missouri history, below are a few bullet points that point out some of the hardships this current pattern has brought to the turfgrass industry.

Aside from just keeping up with mowing between rain events, increased weed (left) and disease (right) pressure has resulted from the wet weather in May - July 2015.

Turfgrass Establishment/Sod Farms

- If spring seeding was attempted to establish lawns, sports fields, or golf courses, the majority of that seeding failed. Spring seeding of cool-season turfgrasses is discouraged in Missouri because the establishment period is short and is followed by stressful environmental conditions that are conducive for abiotic stresses (i.e. heat, drought, flooding) and disease occurrence (Rhizoctonia/Pythium damping off, melting out). The conditions this year drove home this point.
- Most warm season turfgrasses (bermudagrass and zoysiagrass) used in Missouri are established vegetatively with sod, sprigs, or plugs. As opposed to cool-season species, early June is the most effective time for establishment of these species because warm summer temperatures will encourage rooting and spread before cool fall temperatures induce dormancy and growth cessation. The weather pattern has caused several problems for those attempting to establish warm-season turfgrasses.
    - Getting into the field with heavy equipment necessary for sprigging or cutting sod has been nearly impossible. Sod farms have had particular hardships with timely delivery of sod of either cool-season or warm-season species. o If planted, cool nighttime temperatures associated with jet stream dips and cool fronts have severely limited the spread and establishment of new warm-season turfgrass areas.
    - Similarly, low light conditions from frequent cloud cover have reduced the growth potential of turfgrasses. This impacts warm-season turfgrass species more severely than cool-season.
    - Roots of newly established warm-season areas are stuck in a saturated, anaerobic environment that is not allowing soil penetration or proper establishment. If a dry down does occur, the plant will not be able to take up enough water to sustain itself and dieback may occur. The saturated environment will also play a role in subsequent tolerance of next year's winter conditions, as juvenile plants with limited root systems are more prone to winterkill and cold dessication.
- Sod producers have had limited time to harvest sod or sprigs, particularly on fields prone to flooding.
- Due to intense demand, seed companies may sell out of many types of grass seed and face shortages. Buying seed now and storing in a cool, dry place may be wise if planning on cool-season turfgrass establishment this fall.

Home Lawns

- Due to the frequent rains, disease pressure has been very high. Brown patch of tall fescue has caused severe blighting on home lawns in some urban areas. A related disease on zoysiagrass, large patch, is still actively causing decline in St. Louis in early July, whereas in most years, large patch activity steeply declines in early or mid June. Fungicides bought over the counter are ineffective, particularly when applied curatively. Frequent, costly fungicide applications have been applied to high amenity lawns for disease control. On many regular or low maintenance lawns, reseeding of tall fescue this fall will be necessary, and weed control will be more difficult due to reduced stand density.
- Yellow nutsedge is a prevalent, troublesome weed species that commonly infests turfgrass areas during the summer months in Missouri. Nutsedge also grows well in saturated, wet soils, and has been a prominent weed issue this year. The weed is difficult to control, as rhizomes and nutlets are underground and simply pulling the plants often results in fast regrowth. Also, no pre-emergent herbicide is available to control this weed. Control relies on the use of specialized post-emergent herbicides (i.e. halosulfuron, sulfentrazone, bentazon) that may require addition of a non-ionic surfactant and may require more

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than one application for control. Also, these herbicides may impact reseeding efforts in the fall, so its important to read and adhere to the label carefully before using.

- Most home lawns in Missouri (~85-90%) are comprised of cool-season turfgrass species, mostly tall fescue. Cool temperatures and frequent rains have caused significant foliar growth of these species. On the surface all may seem fine, but a lush foliage without a sustaining root system has significant caveats.
    - If any sustained period of drought and heat does follow this wet weather pattern, many home lawns may not have the root development necessary to keep up with the transpiration needs of the plant. Tall fescue has a good adaptive mechanism to go into drought dormancy when this occurs, but losses of Kentucky bluegrass, fine fescues, or perennial ryegrass stands may occur quickly.
    - Homeowners and lawn care operators alike are required to mow in the brief instances when the sun does shine. Oftentimes the underlying soil is still saturated, and the equipment and traffic may cause considerable compaction. Aerification practices in the fall will be necessary to remediate. Additionally, mowing is not being conducted as frequently as necessary, resulting in unsightly clippings that if left on the turf surface provide a ripe environment for disease issues.
- Profitability of lawn care companies, particularly full-service operations, may increase due to this weather. Many pre-emergent herbicides applied for weed control will break down with the continued rainfall, meaning post-emergent products may be applied. Fungicide applications for disease control are also near or at a record high.

Golf/Sports Turf

- Similar to the farming community, golf superintendents and sports turf managers have had significant trouble finding dry times to get into their fields. Necessary fertilization, chemical applications and cultivation practices have suffered. Along with this, lost revenue will be realized due to cancelled sporting events and less rounds of golf across the state.
- Since golf putting greens are the most intensively managed (mowing heights 1/10" or less), they have been most adversely affected thus far. In the last six weeks, 3 - 8 samples of declining creeping bentgrass putting greens have been submitted to the Clinic per week. Various problems have been observed related to consistently waterlogged soils.
    - Many bentgrass putting greens are beginning to go into physiological decline, with a particular condition known as wet wilt. During even brief periods of high temperatures and high humidity, bentgrass roots in saturated, anaerobic soils can not sustain the transpirational needs of the foliage. A rapid decline of the putting green subsequently occurs, and very little can be done to avoid it.
    - Roots may also in fact "cook" in saturated soils during high temperature periods. Bentgrass putting greens have a low amount of verdure and are prone to rapid increases in soil temperature. If drainage is compromised or too much organic matter is present to hold water, soil temperatures may remain high for extended amounts of time due to water's high heat capacity. This is starting to be witnessed in southern areas of MO. Cooler temperatures have negated most of this stress in early summer for urban areas, but it could become a considerable issue as the season progresses.
    - Foliar diseases such as dollar spot and brown patch have been issues on putting greens, but these diseases pale in comparison to the impact of soilborne diseases. Pythium root rot, which is spurred by saturated soils, has caused considerable damage on golf putting greens in the region, and has been observed in most sample submissions. Take-all patch and also summer patch have also been observed infecting most roots of declining putting greens. Routine summer aerification or venting of putting greens can reduce the incidence of these diseases, but the frequent rains have limited opportunities to use the heavy machinery necessary. Most superintendents do not apply preventive controls effectively for these diseases, since Pythium fungicides are in different chemical classes than most other fungicides, and fungicides must be applied in high water volumes or immediately watered-in to the root zone for effective soilborne disease control.
- Turfgrass used for athletic fields has also observed hardships akin to those in the golf industry. Summer patch on Kentucky bluegrass has been an issue on several sports fields in the state. Once this disease sets in, turfgrass recovery is difficult, and weed encroachment can become an issue.

August Gardening Calendar

Category	Week				Activity
	1	2	3	4	
Ornamentals	x	x	x	x	Continue spraying roses that are susceptible to black spot and other fungus diseases.
	x	x	x	x	Annuals may appear leggy and worn now. These can be cut back hard and fertilized to produce a new flush of bloom.
	x	x	x	x	Deadhead annuals and perennials as needed.
	x	x			Divide oriental poppies now.
	x	x			Feed mums, asters and other fall-blooming perennials for the last time.
	x	x			Roses should receive no further nitrogen fertilizer after August 15th.
	x	x			Powdery mildew on lilacs is unsightly, but causes no harm and rarely warrants control, though common rose fungicides will prove effective.
	x	x			Madonna lilies, bleeding heart (Dicentra) and bloodroot (Sanguinaria) can be divided and replanted.
	x	x			Divide bearded iris now. Discard old center sections and borer damaged parts. Replant so tops of rhizomes are just above ground level.
	x	x			Prune to shape hedges for the last time this season.
		x	x	x	Order bulbs now for fall planting.
		x	x	x	Evergreens can be planted or transplanted now to ensure good rooting before winter arrives. Water both the plant and the planting site several days before moving.
		x	x	x	If you want to grow big dahlia flowers, keep side shoots pinched off and plants watered and fertilized regularly.
Lawns	x	x			Zoysia lawns can receive their final fertilizer application now.
	x	x			Apply insecticides now for grub control on lawns being damaged by their activity.
			x	x	Lawns scheduled for renovation this fall should be killed with Roundup now. Have soil tested to determine fertility needs.
				x	Dormant lawns should be soaked now to encourage strong fall growth.
				x	Verify control of lawn white grubs from earlier insecticide applications.
Vegetables	x	x	x	x	Compost or till under residues from harvested crops.
	x	x	x		Sow seeds of beans, beets, spinach and turnips now for the fall garden. Spinach may germinate better if seeds are refrigerated for one week before planting.
	x	x	x		Cure onions in a warm, dry place for 2 weeks before storing.

Gardening Calendar supplied by the staff of the William T. Kemper Center for Home Gardening located at the Missouri Botanical Garden in St. Louis, Missouri. (www.GardeningHelp.org)

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August Gardening Calendar

Category	Week				Activity
	1	2	3	4	
		x	x	x	Begin planting lettuce and radishes for fall now.
			x	x	Pinch the growing tips of gourds once adequate fruit set is achieved. This directs energy into ripening fruits, rather than vine production.
Fruits	x	x	x	x	Prop up branches of fruit trees that are threatening to break under the weight of a heavy crop.
	x	x	x		Protect ripening fruits from birds by covering plants with a netting.
	x	x	x		Continue to spray ripening fruits to prevent brown rot fungus.
	x				Thornless blackberries are ripening now.
		x	x	x	Watch for fall webworm activity now.
		x	x	x	Cultivate strawberries. Weed preventers can be applied immediately after fertilizing.
		x	x		Spray peach and other stone fruits now to protect against peach tree borers.
		x	x		Fall-bearing red raspberries are ripening now.
		x	x		Sprays will be necessary to protect late peaches from oriental fruit moth damage.
Miscellaneous	x	x	x	x	Soak shrubs periodically during dry spells with enough water to moisten the soil to a depth of 8-10 inches.
	x	x	x	x	Once bagworms reach full size, insecticides are ineffective. Pruning off and burning large bags provides better control.
	x	x			Spray black locust trees now to protect against damage by the locust borer.
		x	x	x	Hummingbirds are migrating through gardens now.
		x	x		Watch Scotch and Austrian pines now for Zimmerman pine moth damage. Yellowing or browning of branch tips and presence of pitch tubes near leaf whorls are indicative. Prune and destroy infected parts.
			x	x	Clean out cold frames to prepare for fall use.
			x	x	Monitor plants for spider mite activity. Hose these pests off with a forceful spray of water.
			x	x	2nd generation pine needle scale crawlers may be present on mugo pine now.

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