UMASS EXTENSION

Vegetable Notes

For Vegetable Farmers in Massachusetts

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In this issue:

Crop conditions

The heat wave continues as farmers are harvesting sweet corn, carrots, beets, cabbage and broccoli to name a few. We are still about one week away from heavy tomato harvests. Some farmers are reporting an excellent year for blueberries; the heat seems to improve their sweetness. Market prices may rise for Massachusetts farmers as the heat wave affects farmers in heavy agricultural regions further south such as New Jersey. The National Weather service reported less than 0.25 inches of rain throughout the region last week. Daytime temperatures have been in the 90's and nighttime temperatures have dropped into the 70's. Average relative humidity is also dropping, reducing the favorable conditions for disease development. Farmers are using a lot of overhead irrigation for watering and cooling crops in this heat. If possible, water early in the day to reduce long periods of leaf wetness. Above all, don't forget to keep yourselves and field workers hydrated and well protected from the sun.

Pest alerts

Late blight continues to spread across the US, with new outbreaks confirmed on potato in Madison and Genessee Counties in New York and Allegan County, Michigan. New disease reports on tomato were confirmed in Lancaster County, Pennsylvania, and Wayne County, OH. Thus far, only strains US-7 (infects potato only; metalaxyl resistant) and US-23 (infects tomato and potato; metalaxyl sensitive) have been detected. Despite high daytime temperatures, average daily temperatures are still below 80 °F and 9 or more hours of relative humidity over 90% are occurring, so severity values continue to accrue and a 5 day spray interval is recommended. Track disease progress at USA BLIGHT. Fees for late blight diagnosis have been waived this year so if you suspect you have an infected plant contact the UMass Plant Diagnostic Lab at 413.545.3209.

A healthy cabbage harvest in Hadley, MA

Cucurbit downy mildew (CDM) In the past week additional reports of CDM have been confirmed across the south and mid-Atlantic as well as in Ohio, but the disease has not been found in any new states since July 11. To date CDM has also been found in Florida, Georgia, Texas, South Carolina, North Carolina, Alabama, Maryland, Delaware, New Jersey, Ohio, Ontario and Pennsylvania. Crops affected so far include cucumber, butternut squash, acorn squash, yellow summer squash, cantaloupe, giant pumpkin, and watermelon. Cucumber is the most commonly reported crop affected. As of July 17 the CDM IPM-PIPE disease forecast model predicts a low risk of CDM development for Southern New England and minimal risk for the rest of the Northeast region.

Table 1. GDD and BLITECAST output for Late Blight Management

DATE: 7/18/2013	GDD Base 50F	Accumulated LB Severity Values - 7 days	Accumulated Rainfall - 7 days (in)	Recommended Spray Interval (days)
Pittsfield	1032.0	17	0.05	5
Ashfield	1113.7	1	0.03	10 - 14
Deerfield	1330.6	9	0.01	5
Belchertown	1336.8	8	0.01	5
Harvard	1296.2	11	0.15	5
Dracut	1306.9	10	0.09	5
Boston	1328.3	8	0.18	5
East Bridge-water	1331.8	19	0.59	5
Sharon	1487.9	14	0.48	5
Seekonk	1379.1	14	0.64	5

Bacterial wilt has been found affecting mature, fruiting summer squash and zucchini plants at several farms across MA. This disease is vectored by striped cucumber beetles and causes interveinal chlorosis, wilt, and eventual collapse of young plants or vines of cucumber or winter squash. More mature plants tend to be less susceptible to collapse caused by bacterial wilt but this year we are seeing large, fruit-bearing plants go down.

Phytophthora capsici has been confirmed on Cucurbits and reported on Pepper causing wilt and collapse of whole plants. The disease is soil-borne so is usually a problem only where it has already been established, but it can be moved to new fields on muddy boots or tractor wheels/implements. The host range is very wide and includes Cucurbits as well as tomato, pepper, eggplant and beans. The pathogen thrives under warm, moist conditions often occurring with standing water, so scout in low-lying or poorly drained areas.

Basil downy mildew was reported in Norfolk and Franklin Counties in MA this week. Although the downy mildew pathogen has been detected in basil seed, seed transmission is probably a rare event, and air-borne dissemination from infected plants is more likely. Infected leaves develop diffuse yellowing on the top of the leaf but distinctly vein-bound patches on the bottom. When spores are produced, a characteristic gray, fuzzy growth on the underside of the leaves is evident. Control should focus on reducing humidity and leaf wetness period. Few fungicides are labeled for herb plants and there are differences in registrations for field grown plants versus greenhouse plants. Copper products, phosphites, azoxystrobin, and mancozeb are labeled for use on basil. Plant pathologists at UMass are investigating methods to control this disease with biological control agents and are interested in collecting live, infected plants from residential gardens, greenhouses and field grown basil. If you think your basil plants are infected, please call or email Dr. Rob Wick at 413.545.1045, rwick@pltpath.umass.edu.

Tomato horn worm has been observed feeding on tomato foliage and fruit. These large caterpillars typically appear in small numbers and cause their impressive feeding damage to just a few leaves or plants. Larvae consume large amounts of foliage on peppers, tomatoes, eggplant, potatoes, and related solanaceous weeds. A parasitic Braconid wasp is an important and fairly common natural enemy of the hornworms. Tomato hornworm populations usually do not warrant chemical control but when necessary, selective insecticides are available and should be used to preserve natural enemies. These include Bt and spinosad products among others.

Squash vine borer adults are active in high numbers and have likely already laid eggs on squash stems. The threshold for sprays is 5 moths per trap at weekly intervals for 2-4 weeks. Captures vary greatly from field to field, so conducting your own trapping is best. Weekly trap counts in MA are as follows: Deerfield, MA - 2; South Deerfield, MA - 54; and in Nashua, NH - 69.

Striped cabbage worm has been found on Cape Cod. This caterpillar has expanded its range North and is now being found consistently in MA. Larvae feed in groups and produce small holes in leaves until only veins remain or target terminal buds and sprouts or may burrow into heads. Plants with larvae are often completely skeletonized. Spray if 5% of the plants are infested with Cross-Striped Cabbage Worm. Use selective insecticides to preserve parasitic wasps.

Squash bug adults have been actively feeding, laying eggs and nymphs are beginning to hatch. Adults and nymphs secrete toxic saliva during feeding causing Anasa wilt, which may appear as light-colored areas that later turn brown and die, symptoms that resemble bacterial wilt. Conventional insecticides include several synthetic pyrethroids and carbamates; however note that these are toxic to bees and should be used cautiously during flowering. OMRI listed (organic) products include azadirachtin (Neemix 4.5) and pyrethrin (Pyganic 5.0). Target sprays to control nymphs as soon as they hatch, as adult squash bugs and older nymphs are more difficult to control after they develop their hard exoskeleton.

Pepper Growers should move European Corn Borer traps into their fields to monitor the 2nd flight of this moth as it can be a damaging pest in peppers. When trap counts reach 7 moths/week, spray at the product's labeled rate until the flight subsides to less than 21 moths/week.

Spotted Wing Drosophila (SWD) trap counts remain relatively low for the week, but are expected to rise in coming days. It appears that the number of males is significantly higher than last week which may indicate a rising population of females to come. Renovation of strawberry fields as soon as harvest is complete should help keep SWD populations from building up on leftover fruit. Frequent and thorough harvesting of raspberries and blueberries will help suppress infestations and getting fruit into refrigeration as quickly as possible will help avoid post-harvest infestations and maintain higher fruit quality overall.

European Corn Borer

Carrot seed moth
Photo by Nolie Schneider

Sweet corn report

Corn harvest is underway, and successions are ripening fast in the heat. European Corn Borer (ECB) trap counts vary around the state and from farm to farm. Some growers report no trap captures and little tassel damage, while others have reported total weekly ECB captures from 8 to up to 30 moths, with greater than 15% green tassel infestation, which is the threshold for treatment. Final instars from the first flight have been observed tunneling in stalks, and in some ears, while 1st instar larvae from the second flight were observed in one field by a NH Extension specialist. Weekly silk sprays are recommended where ECB flight is greater than 12 per week. Scout pre-tassel fields for new ECB larvae and for fall armyworm. Fall Armyworm captures are zero throughout the region, except for a count of 2 in Rehoboth. Corn Earworm (CEW) trap counts remain low at most sites, at 0-1 moth, though a few sites report counts of 2-3, necessitating a 6 day spray interval on silk. A grower in Rehoboth counted 10 moths, for a recommended spray interval of 4 days.

For those trapping for ECB and CEW, it is possible to also find Carrot Seed Moth and Gypsy Moth now. High numbers of Carrot Seed Moth (*Sitochroa palealis*) which is similar in size to ECB, but is white, where ECB is tan (see photos above) have been found in a trap in Eastern MA. Be careful not to confuse these moths when making trap counts.

Table 2. MA Corn Trap Counts 7/10/13 - 7/17/13

Location	Total ECB reported	CEW Nightly Average	CEW Weekly Total	Spray interval for CEW
CT Valley				
South Deerfield	0	n/a	n/a	-
Sunderland	8	0.1	1	*no spray*
Hatfield	3	0.0	0	*no spray*
Hadley	2	0	0	*no spray*
Feeding Hills	0	0.1	1	*no spray*
Central & Eastern MA				
Spencer	4	0	0	*no spray*
Tyngsborough	0	0	1	*no spray*
Concord	0	0.1	1	*no spray*
Millis	14	0.1	1	*no spray*
Sharon	n/a	0.3	3	*6 days*
Northbridge	4	0	0	*no spray*
Seekonk	30	0	0	*no spray*
Rehoboth -1	0	n/a	n/a	-
Rehoboth -2	8	1.4	10	*4 days*
Sandwich	6	n/a	n/a	-
East Falmouth	15	n/a	n/a	-
New Hampshire				
Litchfield	1	0.3	2	*6 days*
Hollis	0	0.0	0	*no spray*
Mason	2	0.3	2	*6 days*

Also watch for sap beetles which feed on silk and lay eggs in the tips of ears, producing tiny white larvae that nibble on kernels and render ears unmarketable. They often move in where they find decayed tissue following ECB feeding damage. A grower in Western MA has reported that they're a big problem this year and with moth numbers low, have been needing to spray to control these pests.

- L. McKeag and R. Hazzard, University of Massachusetts Vegetable Extension

Late Blight Management Update: Summer 2013

Late blight, caused by *Phytophthora infestans*, has been confirmed on tomato in Franklin County, MA and on potato in Central, NY. It is likely that late blight will also appear on potato in MA. Despite high daytime temperatures, average daily temperatures are still below 80 F with 9 or more hours of relative humidity over 90% so severity values continue to accrue and a 5 day spray interval is recommended. Preventative, protectant fungicide programs containing chlorothalonil, mancozeb or copper have kept the disease at bay, but now that the disease has arrived in MA, sellective oomycete fungicides are the preffered chemistry. Keep abreast of spray schedules and disease forecasting by checking the VegNotes Pest Alerts section weekly, track Severity Values at http://newa.cornell.edu, or register with USABlight.org (http://usablight.org/alerts) to receive regular alerts. Once symptoms are widespread in the field, the disease cannot be controlled and plants should be destroyed to prevent the disease from spreading into other fields or into high tunnels. For tomatoes, this will mean a crop loss. Potatoes may still produce a decent crop if the tops are mowed down and the tubers are left intact. Because the pathogen moves rapidly from field to field, it is critical that farmers recognize disease symptoms, understand the pathogen's lifecycle, know how to manage infected fields, and communicate with neighbors.

Late Blight symptoms on Potato

Spores of Phytophthora infestans

Late Blight symptoms on Tomato

Symptoms: On tomato, symptoms appear as large (often at least nickel-sized) olive-green to brown spots on leaves with slightly fuzzy white fungal growth on the underside when conditions are humid or wet. On potato, the lesions can be smaller in size. On both hosts, sometimes the lesion border is yellow or has a water-soaked appearance. Leaf lesions begin as tiny irregularly shaped brown spots. Brown to blackish lesions also develop on upper stems. Firm, brown spots (Buck-eye rot) develop on tomato fruit and lesions can occur on both potato and tomato after harvest. In tomato, late blight can sometimes be confused with early blight, Botrytis leaf spot, or Fulvia leaf mold. If symptoms develop on the oldest leaves, it is likely due to infection of one of the above mentioned pathogens. In potato, symptoms can be confused with early blight or hopper burn. If the lesions have concentric rings or are sunken in appearance, the disease is likely early blight. If the lesions are mostly concentrated around the leaf perimeters it may be caused by heavy leaf hopper feeding. When scouting for late blight, it is often reported that the healthiest looking plants are the first to be infected. This is becuase *P. infestans* is an obligate parasite, needing a living host to survive, and so lush plants make attractive hosts. It is best to have a sample confirmed by a diagnostic lab before making any management decisions.

Contact information for the UMass Diagnostic Lab:
Phone: (413) 545-3209
Website: http://ag.umass.edu/plant-problem-diagnostics/vegetable-floriculture-diagnostics

Prevention and Management Suggestions for Summer 2013:

- Destroy volunteer plants that sprout from overwintered tubers. Eliminate cull piles near production fields. The late blight organism requires living tissue to survive; it does not survive in the soil and is not carried on tomato seed.
- Control solanaceous weeds such as horsenettle, smooth ground cherry, hairy nightshade, jimson weed, golden henbane, and others.
- Scout fields weekly. Scouting should be concentrated in low-lying areas, field edges along creeks or ponds, areas prone to morning fog, near center-pivot irrigation rigs, in areas near woodlots or any area that is shaded or protected from the drying effects of wind. Areas where it is difficult to apply fungicides such as edges and corners should also be examined.
- If symptoms are already appearing on plants, promptly inform neighbors growing susceptible crops so they can take action to protect their plants. Late blight is a community disease due to its explosive reproduction and spread. When late blight is found in small, localized areas, promptly destroy all symptomatic plants plus a border of healthy appearing plants to prevent disease spread. Pull up affected plants, kill them with an herbicide, or disk them under deeply.
- Most fungicides are effective preventatively. Preventative applications of copper are the only option for Organic growers. When late blight has been confirmed in the area, begin applications of systemic, Oomycete specific materials.

Fungicides for tomatoes: http://vegetablemdonline.ppath.cornell.edu/NewsArticles/TEP%20Labeled%20Rates.pdf

Fungicides for potatoes: http://vegetablemdonline.ppath.cornell.edu/NewsArticles/Potato_LabRates_Roster.pdf

- updated for 2013 by B. Dicklow and K. Campbell-Nelson from T. Smith and R. Hazzard, University of Massachusetts Extension and T. Zitter and M. McGrath, Cornell University, New York Extension

GARLIC HARVEST, CURING AND STORAGE

Many farmers are beginning to think about harvesting garlic, a big task that usually occurs around this time, mid-late July. Timing the harvest can be tricky—heads should be left in the ground as long as possible to attain maximum bulb size (which doubles in the last stage of growth), but not so long that the cloves begin to separate, as these bulbs sell and store poorly. Harvest when leaves begin to turn yellow, but when about 60% of the foliage is still green. Check bulbs by cutting through the head sideways to see how well developed the cloves are. Cloves should fill the wrappers - if they seem a little loose, the garlic has a little ways to grow. Some of the outer wrapper may have started to discolor at this point. Harvest before the bulbs pop, which can happen relatively quickly, especially in a wet year. Remember that it is better to harvest too early than too late.

Use hand tools to loosen soil under the bulbs or a mechanical harvester to undercut the bed. Pulling bulbs out when they are tight in the ground can open wounds at the stem-bulb junction and allow for entry of pathogens. Fresh bulbs bruise easily and these wounds can also encourage infection. Don't knock off dirt by banging bulbs against boots, shovels, or buckets – shake or rub gently and leave the rest to dry out during curing.

Curing is important for successful bulb storage and finding the ideal conditions for curing can also be a challenge. Curing in the field runs the risk of sunscald, while poorly ventilated barns can result in loss from disease. Avoid high temperatures (over 90 °F) and bright sunlight. Rapid curing can be achieved by placing bulbs roots up on 1" wire mesh in a hoophouse covered with a shade cloth, and with the sides and ends open. A well-ventilated barn will also work, but be sure that bulbs are hung with adequate air circulation or on open racks up off the floor. Curing takes 10-14 days. Stems may be cut before or after curing. Curing is complete when the outer skins are dry and crispy, the neck is constricted, and the center of the cut stem is hard.

Storage. After curing, garlic can be kept in good condition for 1 to 2 months at ambient temperatures of 68 to 86 °F under low relative humidity, ie. < 75%. However, under these conditions bulbs will eventually become soft, spongy and shriveled due to water loss. For long-term storage, garlic is best maintained at temperatures of 30 to 32 °F with low RH (60 to 70%). Good airflow throughout storage containers is necessary to prevent any moisture accumulation. Under these conditions, well-cured garlic can be stored for 6-7 months. Storage at higher temperatures (60 °F) may be adequate for the short term, but it is important to select a place with low relative humidity and good air flow. As with onions, relative humidity needs to be lower than for most vegetables because high humidity causes root and mold growth; on the other hand, if it is too dry the bulbs will dry out.

Seed. Garlic bulbs that are to be used as seed for fall planting of next year's crop should be stored at 50 °F and at relative humidity of 65-70%. Garlic cloves break dormancy most rapidly between 40 to 50 °F, hence prolonged storage at this temperature range should be avoided. Storage of planting stock at temperatures below 40 °F results in rough bulbs, side-shoot sprouting (witches-brooms) and early maturity, while storage above 65 °F results in delayed sprouting and late maturity.

Garlic cloves used for seed should be of the highest quality, with no disease infections, as these can be spread to new fields and to next year's crop. Be on the lookout for garlic blight nematode which may have been distributed around New England on infested seed garlic. This nematode, which is also known as a bulb and stem nematode, causes bloated, twisted, swollen leaves, and distorted and cracked bulbs with dark rings. Infestation with this nematode can weaken plants, causing them to be susceptible to secondary infections. The UMass Plant Disease Diagnostic Lab can make a positive identification; call 413-545-3209 to submit a sample

-updated by S. Scheufele from R Hazzard. Resources:
New England Vegetable Mgt Guide, Oregon State, ATTRA, Wishingstone Farm, Astarte Farm, USDA Handbook 66.

HOW HIGH HEAT AFFECTS VEGETABLES

Heat injury in plants includes scalding and scorching of leaves and stems, sunburn on fruits and stems, leaf drop, rapid leaf death, and reduction in growth. Wilting is the major sign of water loss which can lead to heat damage. Plants often will drop leaves or in severe cases will "dry in place" where death is so rapid, abscission layers have not had time to form.

Normally, plant temperature is just above air temperature, but, plant temperature can rise to a critical level under certain conditions. The plant temperature at which tissue dies is around 115°F. Plants have 3 major ways in which they dissipate excess heat: 1) long-wave radiation, 2) heat convection into the air and 3) transpiration.

A critical factor is transpiration. If transpiration is interrupted by stomatal closure due to water stress, inadequate water uptake, injury, vascular system plugging or other factors, a major cooling mechanism is lost. Plants suffering from vascular infections or from root rot are not capable of optimum transpiration and will show signs of drought stress first. Without transpiration, the only way that plants can lose heat is by radiation back into the air or by wind cooling. Under high temperatures, radiated heat builds up in the atmosphere around leaves, limiting further heat dissipation.

Dry soil conditions start a process that can also lead to excess heating in plants. In dry soils, roots produce Abscisic Acid. This is transported to leaves and signals stomate guard cells to close. As stomates close, transpiration is reduced. Without water available for transpiration, plants cannot dissipate much of the heat in their tissues. This will cause internal leaf temperatures to rise.

Vegetables can dissipate a large amount of heat if they are functioning normally. However, in extreme temperatures (high 90s or 100s) there is a large increase in the water Vapor Pressure Deficit (the difference between the moisture in the air and the amount of moisture the air can hold). Rapid water loss from the plant in these conditions causes leaf stomates to close, again limiting cooling and spiking leaf temperatures, potentially to critical levels causing damage or tissue death.

Photosynthesis rapidly decreases above 94°F so high temperatures will limit yields in many vegetables. While daytime temperatures can cause major heat related problems in plants, high night temperatures also have great effects on vegetables, especially fruiting vegetables. The warmer the night temperature, the faster respiration proceeds. This limits the amount of sugars and other storage products that can go into fruits and developing seeds.

On black plastic mulch, surface temperatures can exceed 150°F. This heat can be radiated and reflected onto vegetables causing tremendous heat loading. This is particularly a problem in young plants that do not shade the plastic much and can cause heat lesions just above the plastic. Heat lesions are usually first seen on the south or south-west side of stems. Using overhead irrigation over black plastic can help to reduce this excess heat.

The major method to reduce heat stress is by overhead watering, sprinkling, and misting for improved water supply, reduction of tissue temperature, and lessening of the water Vapor Pressure Deficit. Mulches can also help greatly. You can increase reflection and dissipation of radiative heat using reflective mulches or use low density, organic mulches such as straw to reduce surface radiation and conserve moisture.

- Adapted by L. McKeag from articles by Gordon Johnson, Extension Vegetable & Fruit Specialist, University of Delaware Cooperative Extension. Much of this information was adapted from an article Heat Stress Syndrome by Kim D. Coder, Professor, Silvics/Ecology, Warnell School of Forest Resources, the University of Georgia.

MEASURING PESTICIDES FOR BACKPACK SPRAYERS

Growers with diverse crops and small plantings often need to be able to apply pesticide to beds or plots of several hundred square feet. It can be difficult to figure out how to calibrate a backpack sprayer for spraying a small area. Some labels give rates for backpack sprayers (i.e. amount per gallon of water), but most only provide rates per acre (i.e. amount per land area treated). Rates may have to be calculated by converting from the rate per acre (per 43,560 sq ft) to rates for a few hundred square feet. Careful division gives you the amount you need. However, it is also critical to properly calibrate your sprayer by determining how much water you use to cover a given area. For some products, spraying small areas may mean that you need to measure extremely small amounts. Some labels provide conversions of volume to weight, but many do not. For example, if you are using spinosad (Entrust formulation, a dry powder) you may need to weigh product in grams. If a gram scale is unavailable, then it is possible to measure Entrust by volume. Based on repeated samples, we found that, on average, the volume was 1.7 gm per teaspoon (shaved level and tamped slightly) of Entrust powder. One ounce (dry weight) equals 28.45 grams.

Liquid measured in (fluid) ounces is already a volume so it is easier to measure. One fluid ounce equals 29.6 milliliters (mL). Some pesticides call for very low rates per acre and may need to be measured in mL when treating small areas. Neonicotinoid insecticides are an example. An inexpensive measuring device for mL can be found in the children's medicine section of drug stores. Even if you are using pesticide products that are relatively safe, always store in a safe place, handle carefully, follow the directions on the label, and use the required protective gear for mixing, spraying, and cleaning your sprayer. Mix in a designated area that is away from workers and the public. Only mix the amount of product that you are going to use for a given application. Never store mixed pesticides in a backpack sprayer or any other vessel, and never store any pesticides in anything other than the original labeled container. When calibrating and using your sprayer, be consistent. The amount of spray you apply to an area will depend on four variables: your walking speed, the pressure you select, your spray swath width, and the nozzle tip you've chosen. If you change any one of these, you change the amount of spray you apply.

Walking speed. This constant walking speed should be one that you can comfortably maintain over the entire time you intend to spray. It also must be the same speed at which you calibrate the sprayer. If you double your walking speed while maintaining pressure and swath width, you'll apply half as much spray. You would then require twice as much pesticide per gallon (that is, a greater concentration) to apply the same amount of pesticide per acre.

Pressure. If you change the pressure while you spray, you change output. Increased pressure results in higher output; the exact relationship depends on your nozzle type.

Nozzle tip selection. The proper tip will depend on the situation. Tips are available that cover a wide range of output volumes, spray widths, and pressures. Most backpack sprayers come with a single flat fan nozzle, but a cone tip may be more appropriate for covering foliage.

Swath width/nozzle height. Tips are designed for use within certain heights and pressures. Within these ranges, some tips deliver narrow bands; others, like flooding tips, provide swath widths up to 7 feet. The wider each swath width, the less time the operator spends walking up and down fields. The height at which you hold the spray tip above the target influences the swath width. Spraying as close to the target as is practical minimizes drift and operator contact.

First, check your sprayer coverage and operation. Select the spray tip or boom setup that provides the desired coverage. Add water, and spray the ground or dry pavement as if you were spraying your field. Check the spray pattern for uniformity (and proper spray pattern overlap if you're using a boom). You can also check it over the crop to see if you are getting good coverage. Adjust nozzle spacing and/or height until you achieve the desired pattern. Be certain you're getting uniform coverage before you proceed! Check fittings and hoses for leaks. Below are examples of two different ways to calibrate and mix backpack sprayers.

Method 1. Concentration: Using the Labeled Rate per Gallon for a Backpack Sprayer.

Some pesticide labels provide a rate of product to use per gallon, or concentration, for backpack sprayers. If this is given, add that amount of pesticide to each gallon of water. Spray to cover the crop foliage, but not to runoff on the ground. Mix the amount you need to cover your crop area.

The following rates for two commonly used organic insecticides are listed on the product label:

Product	Amount per gallon	Amount per 3 gal (for 1000 sq ft)	Rate per acre
Entrust	0.43g = 0.015 dry oz	1.3 gm = 0.046 dry oz =3/4 tsp	2 oz
Surround WP	1 ½ - 3 cups	4.5 - 9 cups	50 lb

For Entrust, do not use more than 3 gallons of water per 1,000 sq ft.

Method 2. Match the amount of pesticide to the amount of water needed to spray the crop area.

1. Calculate what portion of an acre is being sprayed. Determine sq ft of area to be sprayed (multiply bed or canopy width by row length by number of rows). Calculate how much of an acre this is (this may be a small fraction of an acre):

   Acres to be sprayed = number of ft^2 to spray / 43,560 ft^2 per acre

2. Calculate how much pesticide to use. Multiply the rate per acre for the crop and pest (from the label) times the proportion of an acre to be sprayed.

   Amount of pesticide needed = amount per acre X proportion of acre to be sprayed

3. Measure water needed per sq ft of crop. Add a known amount of water (eg 1 or 2 gallons) to the tank. Spray the water as if you were actually spraying your field. Remember, you must maintain constant pressure, constant walking speed, and consistent nozzle height and boom setup or wand motion to achieve the coverage you need. This amount will change with different crops and size of crop canopy. When the water is gone, stop and mark the spot. Measure the area you sprayed and calculate the square feet (length of swath x width). Calculate how many gallons needed per sq ft.:

   Gallon per ft^2= number of gallons used/ number of ft^2 sprayed

4. Determine total water needed:

   Gallons of water needed = gal./ft^2 X number of sq ft to be sprayed.

5. Mix the required amount of pesticide in the required amount of water. It is best to add half the water, add the pesticide, agitate, then add the remaining water. Spray, using the walking speed, pressure, nozzle and boom setup or wand motion that you used for calibrating

Vegetable Notes. Ruth Hazzard, Katie Campbell Nelson, Lisa McKeag, Susan Scheufele, co-editors. Vegetable Notes is published weekly from May to September and at intervals during the off-season, and includes contributions from the faculty and staff of the UMass Extension Vegetable Program, other universities and USDA agencies, growers, and private IPM consultants. Authors of articles are noted.