Soil Tension Values for Different Soil Textures For Use in Scheduling Trickle Irrigation

Soil Texture	0% Depletion of Available Water Holding Capacity (Field Capacity)[1]	20-25% Depletion of Available Water Holding Capacity[2]
	Soil Tension Values (in centibars)	
Sand, loamy sand	5-10	17-22
Sandy loam	10-20	22-27
Loam, silt loam	15-25	25-30
Clay loam, clay	20-40	35-45

[1] At field capacity the soil contains 100 percent of AWHC; any excess water in the rootzone has drained away.

[2] Start trickle irrigation for shallow-rooted crops at this point.

Information adapted from *New Jersey Commercial Vegetable Production Guide*, New Jersey Ag Expt. Station, Rutgers; and *Water Management in Drip-irrigated Vegetable Production* by T.K. Hartz, UC-Davis, Calif., Vegetable Research and Information Center.

Frost Control

Irrigation can help protect vegetable crops, although it is not a common practice in the Midwest. With the proper equipment, growers must begin sprinkling as soon as the temperature reaches 34°F. Place a calibrated thermometer at the lowest elevation in the field at plant level, facing skyward. Continue sprinkling plants until the air temperature is greater than 30°F and the ice has melted from the plants.

To be effective, you need approximately 0.1 inch of water per hour, the sprinkling must be continuous, and the sprinklers should rotate at least once per minute. If conditions become windy and temperatures drop, it may be necessary to increase the amount of water to as much as 0.5 inch per hour. It is the process of the water freezing that gives off the heat to protect the crop. Therefore, liquid water must be present during the freezing period to protect the plants.

Bees and Pollination

Pollination is the transfer of pollen from the male portions of the flower (stamens) to the female portions of the flower (pistils). This process is vital to the production of many vegetable crops, including cucumber, cantaloupe, pumpkin, squash, and watermelon. Some crops (such as tomato) are self-fertile, but wind or bees must vibrate the flowers to release pollen for fertilization.

Honeybees are often thought of as the most prevalent pollinator for vegetable crops, but studies show that many species of native bees — including bumble bees and squash bees — play a vital role in pollinating many vegetable crops. Tomato, for example, benefit from the "buzz pollination" that bumble bees can provide. Honeybees are unable to buzz pollinate, and therefore do not play a role in tomato pollination. The squash bee, a North American native, is an important pollinator of pumpkins and other squash crops. Native bees are often active earlier in the day and at cooler temperatures than honeybees.

To ensure pollination, many vegetable growers rent honeybee hives rather than manage their own hives. Since honeybee colonies are occasionally in short supply, growers should communicate frequently with their bee providers.

In addition to renting honeybee hives, growers can improve the pollination services of native and non-native bees by increasing on-farm habitats. The Xerces Society for Invertebrate Conservation (www.xerces.org) and Pollinator Partnership (www.pollinator.org) offer guides, plant lists, and other resources about building on-farm bee habitats.

At least 90 crops grown in the United States depend to some extent upon bees as pollinators, either for seed or fruit production. The exact number of honeybee hives needed to pollinate a crop depends on a number of factors, including the strength and condition of colonies, magnitude of the natural pollinator community, amount of wild flower material competing with the crop, attractiveness of the crop to bees, projected yield, and weather.

The following are guidelines for the number of hives to use when supplemental pollination is desired:

cantaloupe	(2 to 3 colonies per acre)
cucumber	(2 to 3 colonies per acre)
pumpkin	(1 colony per acre)
squash	(1 colony per acre)
watermelon	(1 to 5 colonies per acre — the pollination requirements of seedless varieties are generally greater than seeded)

The following vegetables will set fruit without bees, but bee activity has been shown to increase yields:

eggplant	**okra**
lima bean	**pepper**

Honeybees do not assist in the pollination of the following crops, but will collect pollen and/or nectar from them:

pea	**sweet corn**
snap bean	**tomato**

Do not place hives in a field until the crop's flowers are available to visit. If the hives are placed before the flowers are available, the bees will forage to surrounding areas and may not forage sufficiently in the crop that needs pollination. Bees forage best within about 100 yards of the colony. Therefore, if the field is large, the bees should be distributed in clusters around the field.

Bees also require a source of clean water. If not available nearby, set out a shallow container with fresh water.

Bees and Pesticides

Certain pesticides and pesticide application methods may pose a hazard to honey bees, bumble bees, and native bees. Generally, early morning or late evening pesticide applications are less hazardous to bees, because bees are generally less active.

Do not apply pesticides to flowering plants or weeds. Applying a single pesticide product may be less hazardous to bees than mixtures or combinations. That's because potential synergistic effects can increase the toxicity of certain pesticides to bees. Systemic insecticides (applied as either granules or drenches to the soil or growing medium) are less toxic to bees than foliar applications. Emulsifiable concentrate or water-soluble formulations are typically less hazardous to bees than wettable powder formulations.

The Toxicity of Insecticides to Bees table (page 32) classifies pesticides (insecticides and miticides) based on their toxicity to honey bees. It is important to read pesticide labels carefully to determine their level of toxicity to honey bees. In addition, you can incorporate into pollination contracts a list of pesticides, application methods, and timing of applications that are mutually agreeable to both growers and beekeepers.

Ohio law requires that applicators notify beekeepers 24 hours before applying a pesticide that is toxic to honey bees when (1) the treated crop is blooming, and (2) the field is greater than a half-acre and within half-a-mile from a registered apiary. Contact your state department of agriculture to determine if similar laws exist to protect other pollinators.

Make sure to work with beekeepers to avoid applying pesticides that could harm the bees.

Toxicity of Insecticides to Bees[1]

Insecticides and miticides may vary in their toxicity to bees. Therefore, always determine the potential toxicity of insecticides or miticides to bees and apply them according to label directions. Apply these products in the early morning or late evening when bees are less active, which will minimize any direct or indirect exposure to spray residues.

Formulation may affect the toxicity of insecticides and miticides to bees. For example, the 50 WP (wettable powder) formulation of carbaryl (Sevin®) is more toxic to bees than the 4EC (emulsifiable concentrate) formulation.

This table the potential toxicity to bees of selected insecticides and miticides. This table is only a guide and should not replace carefully reading and following pesticide label instructions.

Very High Toxicity[2]	High Toxicity[3]	Moderate Toxicity[4]	Low Toxicity[5]
*Actara® (thiamethoxam)	Agri-Mek® (abamectin)	*Acramite® (bifenazate)	*Beleaf® (flonicamid)
Agri-Mek® (abamectin), >21 fl. oz./A	Asana® (esfenvalerate), 4.8 fl. oz./A	Ammo® (cypermethrin), ≤1.28 fl. oz./A	Cryolite® (cryolite)
Ambush® (permethrin)	Brigade® (bifenthrin), 2.56 fl. oz./A	*Assail® (acetamiprid)	*Dimilin® (diflubenzuron)
Ammo® (cypermethrin), >1.28 fl. oz./A	Confirm® (tebufenozide) ≤21 fl. oz./A	*Avaunt® (indoxacarb)	DiPel® (*Bacillus thuringiensis* subsp. *kurstaki*)
Asana® (esfenvalerate), 7.3 fl. oz./A	Dibrom EC® (naled)	Azatin® (azadirachtin)	Diazinon G® (diazinon)
Baythroid® (cyfluthrin)	Di-Syston 8EC® (disulfoton), 16 fl. oz./A	Brigade® (bifenthrin), <2.56 fl. oz./A	Di-Syston G® (disulfoton)
Brigade® (bifenthrin), >23.8 fl. oz./A	Malathion EC® (malathion)	*Decis® (deltamethrin)	*Esteem® (pyriproxyfen)
Danitol® (fenpropathrin)	*Proaxis® (gamma-cyhalothrin), 2.56 fl. oz./A	Diatect® (diatomaceous earth)	Garlic Barrier®
Diazinon® (diazinon)	Sevin XLR PLUS® (carbaryl), <48 fl. oz./A	Di-Syston EC® (disulfoton), 8 fl. oz./A	Hot Pepper Wax® (capsaicin)
Dibrom® WP or D (naled)	Thimet EC® (phorate)	Fulfill® (pymetrozine)	*Intrepid® (methoxyfenozide)
Dimethoate® (dimethoate)	Vydate® (oxamyl), ≥64 fl. oz./A	Lannate® (methomyl)	Kryocide® (cryolite)
Imidan® (phosmet)	Warrior® (lambda-cyhalothrin), 2.56 fl. oz./A	Malathion ULV® (malathion), <3 fl. oz./A	Malathion G® (malathion)
Lorsban® (chlorpyrifos)		Metasystox-R® (oxydemeton methyl)	Metaldehyde® Bait (metaldehyde)
Malathion WP® (malathion)		Neemix® (azadirachtin)	Mocap G® (ethoprop)
Malathion ULV® (malathion), >8 fl. oz./A		Proclaim® (emamectin benzoate)	M-Pede® (soap)
Mustang Maxx® (zeta-cypermethrin)		Thimet G® (phorate)	Mycotrol® (*Beauveria bassiana*)
Orthene® (acephate)		Vydate® (oxamyl), ≤32 fl. oz./A	Sevin G® (carbaryl)
Pounce® (permethrin)			sulfur (sulfur)
*Proaxis® (gamma-cyhalothrin), 3.84 fl. oz./A			*Surround® (kaolin)
Sevin 50WP® (carbaryl)			Vendex® (fenbutatin-oxide)
Sevin XLR-Plus®, (carbaryl) >48 fl. oz./A			
Warrior® (lambda-cyhalothrin), 3.84 fl. oz./A			

[1]**Source:** *How to Reduce Bee Poisoning from Pesticides*. Pacific Northwest Extension Publication PNW 518.
[2]Do not apply these to blooming crops or weeds at any time of day or night.
[3]Apply only during late evening (6 pm to midnight).
[4]Apply only during late evening, night or early morning (6 pm to 7 am).
[5]Can be applied at any time with reasonable safety to bees.
*Products marked are relatively new and do not appear in the source cited, but information on their toxicity was taken from various Extension sources.

Approximate Time from Pollination to Market Maturity Under Warm Growing Conditions

Vegetable	Days to Market Maturity
Bean	7-18
Cantaloupe	40-50
Corn, market	18-23[1]
Corn, processing	21-27[1]
Cucumber, pickling (3/4-1 1/8-inch diameter)	4-5
Cucumber, slicing	15-18
Eggplant (2/3 maximum size)	25-40
Okra	4-6
Pepper, green stage (about maximum size)	45-55
Pepper, red stage	60-70
Pumpkin, jack-o-lantern	60-90
Pumpkin, baking	65-75
Squash, summer, zucchini	3-4[2]
Squash, winter, butternut	60-70
Squash, winter, hubbard	80-90
Squash, winter, acorn	55-60
Tomato, mature green stage	34-45
Tomato, red ripe stage	45-60
Watermelon	40-50

[1]From 50% silking.
[2]For a weight of 0.25-0.5 lbs.

Precautions with Pesticides

Pesticides are designed to poison or otherwise manage pests. Many pesticide products may poison people, pets, livestock, wildlife, ornamental plants, and other non-target organisms. Pesticide applicators and their families are at increased risk of pesticide exposure. It is important to keep all pesticide exposures to an absolute minimum.

You must protect your family members, field workers, and other people from pesticide injuries. Most pesticide accidents result from careless practices or lack of knowledge about safe handling. The time you spend to learn about the safe use of pesticides is an investment in the health and safety of you, your family, and others.

The U.S. Environmental Protection Agency (EPA) places certain restrictions on the use of pesticide chemicals. These restrictions apply to chemicals applied to control insects, mites, plant diseases, weeds, nematodes, and other pests. Such restrictions may prohibit the use of a chemical or allow residue tolerances on harvested vegetables. Growers must know what chemical to use on each vegetable; how to apply the products; the post-treatment re-entry interval, if any; when to use the chemicals with respect to farm worker and/or picker safety; and the environment and the harvest of each vegetable crop.

Growers must follow all label instructions regarding harvest restrictions to assure consumers that the food is free of dangerous residues and to comply with the law to prevent seizure of their crops. Here are some rules for the safe use of pesticides:

- Only mix the amount of a pesticide you can use in one day.
- If you do have leftover spray mix, the best way to dispose of it is by applying it to a labeled crop in a legal manner.
- Never dispose of surplus pesticides in a way that will result in the contamination of ground or surface waters.
- Rinse all empty containers three times before disposal.
- Pour the rinse water into the spray tank. Puncture or break triple-rinsed containers to facilitate drainage and to prevent reuse for any other purpose.
- Then dispose of the container according to label directions.

Pesticide Signal Words

Each pesticide container is required by law to have signal words to quickly communicate information about the product's acute toxicity. The three signal words, as provided by the National Pesticide Information Center, are:

- CAUTION. This signal word means the pesticide is slightly toxic if eaten, absorbed through the skin, or inhaled, or it causes slight eye or skin irritation.
- WARNING. This signal word means the pesticide is moderately toxic if eaten, absorbed through the skin, or inhaled, or it causes moderate eye or skin irritation.
- DANGER. This signal word means the pesticide is highly toxic by at least one route of exposure. It may be corrosive, which would cause irreversible damage to the skin or eyes. It may be highly toxic if eaten, absorbed through the skin, or inhaled. If this is the case, then POISON must also be included in red letters on the front panel of the product label.