BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

In this chapter, we look at more specific needs of different kinds of irrigated crops, including:

- ▸ fruits
- ▸ tree nuts
- ▸ nursery stock
- ▸ vegetables
- ▸ tobacco
- ▸ sod.

The charts on pages 81–97 present practices that increase crop productivity and quality and, where technology is available, save water.

First, we'll look at ways of making optimal use of water resources.

WATER EFFICIENCY

Here are some general best management practices for most crop operations using irrigation:

get required permits

- ▸ get a Permit To Take Water from the Ministry of the Environment and keep it up to date
- ▸ keep records of the water used for irrigation

match crop to suit soil conditions

- ▸ choose a crop that's right for your soil, so crops with high water needs are grown on soils with high water-holding capacity

build healthy soils – you want water to infiltrate and be available for crop use

- ▸ build organic matter (manure, green manure, compost, cover crops): your soil's structure will improve and the amount of water available to your crop will increase
  - ▷ a 0.5% increase in soil organic matter can result in as much as a 12% increase in the soil water-holding ability of sandy loam soil
- ▸ avoid compaction: don't work wet land, especially fine-textured soils
- ▸ reduce tillage: less tillage means less drying and less organic matter loss
  - ▷ with reduced tillage and higher organic matter, more macropores will develop, which will make it easier for water to enter the soil (macropores may be formed by earthworms or old root channels)
- ▸ use conservation tillage equipment to keep more residue on the surface
- ▸ use conservation tillage equipment to maintain a rough surface, which encourages snow trapping and water infiltration
- ▸ take a look at the Best Management Practices book or CD-ROM, *Soil Management*, for more suggestions on building healthy soils

Build your soil's organic matter: add manure and compost, or grow plowdowns.

Save water: choose precision irrigation systems with a high degree of distribution uniformity (such as trickle irrigation).

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

irrigate efficiently

- ▸ harvest and store water from watercourses during peak flows, or from ground water when water table is high
- ▸ sprinkle-irrigate when winds are less than 3 mph (5 km/hr)
- ▸ try new irrigation methods that bring water application closer to soil surface in order to reduce evaporation losses and wind effects
- ▸ choose drip irrigation next time you upgrade
- ▸ design the system to reduce friction losses to pressure when pumping water – friction losses are lower with larger-diameter mains
- ▸ apply the right amount of water when the crop needs it – use a technique to measure soil moisture (see page 29 for methods of determining irrigation need)
- ▸ use irrigation scheduling and take into account weather forecast information
- ▸ avoid irrigating during the heat of the day
- ▸ make use of rain gauges to measure how much and how evenly water is being applied
- ▸ match application rate to the rate at which it will soak into the soil (and avoid runoff)
- ▸ maintain your irrigation equipment for optimal performance
  - ▷ fix leaking pipes
  - ▷ replace worn-out nozzles – consider replacing nozzles with new water-efficient technology, e.g. low-pressure nozzles

This large reservoir stores water for the growing season. It is filled with water pumped from drainage ditches during the winter and spring, and is gradually emptied over summer months.

Many growers now use boom systems, which minimize water loss from evaporation and wind.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

reduce water loss from crops and soil (evapotranspiration)

- ► plant windbreaks or wind strips to slow drying winds
- ► plant perennials into chemically killed sod
- ► use dwarf grasses between orchards and nursery crops
- ► schedule short-season crops for spring or fall
- ► manage crop residues to reduce runoff, increase infiltration and so that they can act like a mulch
- ► space plants to cover soil surface quickly
- ► use plastic or organic mulches
- ► ensure a weed-free period (1–6 weeks for most crops is needed to maximize yield)
- ► mow sod and cover crops regularly
- ► reduce tillage to reduce soil water loss
- ► in some circumstances, try shallow tillage to reduce the upward movement of soil water and create a dry soil mulch layer that can reduce soil evaporation, e.g., vegetables on muck soils.

A straw mulch and grass clippings are used to reduce soil evaporation losses in this high-density apple orchard. Weed suppression in the tree row is an added benefit.

Use plastic mulches to save water. These mulches will also accelerate plant growth and development by warming soils earlier in the year. Added benefits include reduced fertilizer leaching, and shedding of water away from root zones in excessively rainy conditions.

Finally, when considering whether to irrigate, you should weigh the increased costs and potential benefits.

Cost/benefit is directly related to soil type, site location (climate), crop, planting density, and plant-training system. For example, a strawberry grower in a climatically preferred region with soils that have good moisture-holding capacity may choose to go without a system. Drought and frost losses totalling a few thousand dollars in one out of four years may be acceptable compared to an investment of $50,000–$100,000 for an irrigation system.

If, however, soils have low moisture-holding capacity, frost damage is common or crop value is very high, the cost of an irrigation system will be low compared to the benefits it may provide in ensuring an excellent crop year after year. See pages 109–116 to calculate the cost/benefit of an irrigation system for your operation.

Newly established orchard trees need irrigation.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

MANAGING RATE OF WATER USE

Total available water is of course important. However, the rate of withdrawal may be even more important, especially if you are withdrawing from a watercourse. Consider these steps to help you ensure water is available when you need it:

- ▸ construct a pond to reduce pumping rate from watercourse
  - ▷ fill pond gradually at a low-flow rate; irrigate from pond at a high-flow rate
- ▸ construct a pond to provide water storage, i.e., store water when it's plentiful (in the spring or after a large rain) for use during water shortages in the growing season
- ▸ pump at a low-flow rate from many different water sources (watercourse and well) to fill a pond – the pond is used as a water reservoir, enabling you to irrigate from the pond at a high-flow rate
- ▸ irrigate less acreage at a time
  - ▷ e.g., with a solid-set system, irrigate the area in zones
  - ▷ breaking the irrigated area into two zones will reduce your rate of water withdrawal by 50%
- ▸ schedule water-takings with neighbours (see sketch below)
  - ▷ e.g., if four farmers all irrigate from the same water course at 500 gpm, the total rate of water withdrawal from the creek is 2000 gpm
  - ▷ if each neighbour takes a turn to irrigate, the total rate of water withdrawal from the creek will be 500 gpm
  - ▷ water scheduling may mean some people irrigate during the day, which is less efficient – other options may be to irrigate alternate days
  - ▷ talk to your neighbours and see what is possible for your situation
- ▸ consider nozzles that operate at a lower flow rate.

2000 gpm	All four farms withdrawing.
1500 gpm (75%)	Three of four farms withdrawing.
1000 gpm (50%)	Two of four farms withdrawing at one time.
500 gpm (25%)	Only one farm withdrawing at one time.

Scheduling water-taking reduces the impact of irrigation on local water levels. This is particularly important when withdrawing water from creeks or small lakes.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

For best management practices for specific crops, find your crops in the charts that follow. They summarize some of the documented benefits of irrigation. Crops appear in this order:

- ▸fruit crops
- ▸tree fruit and grapes
- ▸berry crops
- ▸vegetable crops
- ▸tree nut crops
- ▸tobacco
- ▸field-grown nursery stock
- ▸container-grown nursery stock
- ▸sod.

FRUIT CROPS

Rooting depth to 3–4' (0.9 –1.2 m)
AMOUNT OF WATER REQUIRED: – up to 8 Imp gal/mature tree/day (36.4 L/day) during July and August
– approx. 1" (25 mm) every 14 days to maintain 50–100% available soil moisture
– approx. 1" (25 mm) every week during July & Aug.
Irrigation scheduling may help you determine how much water to apply, and how often.

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
APPLES low to medium density on vigorous or semi-vigorous root systems 💧💧 high-density systems (M26, M9 root stocks or equivalent) 💧💧💧	• increased fruit size and yield • more fruit bud initiation • less biennial bearing • reduces probability of bitter pit • improved quality • better growth and development of nursery stock • moderation of June drop • better production of new unsuberized roots, which are responsible for nutrient uptake • better tree establishment	• May–September • bloom through cell division stage • fruit bud initiation (June) • fruit swell (August–September)	• trickle • travelling gun • fixed-volume gun	• more important on fully dwarfing rootstock • use short wettings or trickle irrigation to avoid scab and fireblight spread • uniform soil moisture may reduce bitterpit • moderate to excessive summer pruning under drought conditions (without irrigation) may have a negative effect on crop volume and finish • do not root prune on droughty soils unless irrigation is available – the added stress may also affect winter hardiness • light summer pruning reduces whole canopy transpiration • organic mulches help conserve water

Under average growing conditions, adding fertilizer materials to irrigation water using the technique of "fertigation" has shown no appreciable extra benefit in high-density apple culture in northeastern North America.

High-density apple systems are quite suitable to trickle irrigation. Note the added benefits of mulch for water conservation. A nematode-resistant dwarf perennial rye sod is between tree rows.

code:
- 💧 **seldom expect response**
- 💧💧 **some response 30–60% of time**
- 💧💧💧 **expect response most years (75%)**
- 💧💧💧💧 **expect response 9 years out of 10**

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

FRUIT CROPS

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
PEACHES & NECTARINES 💧💧💧💧	• less thinning needed • fewer split pits with with regular irrigation • less stress to tree, therefore less winter injury • increased marketable yield • improved stand establishment	• May–September • pit hardening through fruit swell	• travelling gun • trickle • fixed-volume gun	• maintain 50% available soil water • irrigation is critical if sod is established between rows • longer tree life is expected from season-long irrigation • use trickle or low risers to avoid spread of brown rot and bacterial spot
PEARS 💧💧💧	• larger fruit and yields • more fruit bud initiation • less biennial bearing • increased growth • more critical in high-density systems • improved stand establishment • increased quality	• May–September • fruit bud initiation (July) • fruit swell (July–September)	• travelling gun • trickle • fixed-volume gun	• overhead irrigation may wash psylla residue off, but may help spread fireblight (less risk of fireblight with trickle), scab and leaf spot disease • avoid excessive growth with balanced nutrition • more critical in high-density systems

Consider using a low-trajectory sprinkler system (under canopy) or sled to avoid washing crop protection materials from the tree canopy and to reduce wetting periods that encourage disease.

Incidence of split pits in peach can be reduced with regular irrigation.

These peaches, which were grown on sandy soil with no sod strips or irrigation, show reduced vigour compared with those shown in the photo on the right.

Shown here is the same cultivar (Garnet Beauty) with sod strips and irrigation. Note the overall improvement in vigour and vegetative growth.

code:
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- 💧💧💧 **expect response most years (75%)**
- 💧💧💧💧 **expect response 9 years out of 10**

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

TREE FRUIT AND GRAPES

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
PLUMS 💧💧💧	• larger fruit • reduces the probability of heat spot and gummosis • reduced winter injury • improved stand establishment • improved yield	• May–September • pit hardening through fruit swell	• travelling gun • trickle • fixed-volume gun	• use short wetting to reduce spread of brown rot with overhead irrigation • regular and uniform irrigation may reduce gummosis • thin crop for maximum response
CHERRIES 💧💧	• larger fruit • healthier trees • better recovery after mechanical harvest for sour cherries • rapid tree establishment – critical for new dwarfing rootstocks like the Gisela series	• May–September • pit hardening through fruit swell	• travelling gun • trickle • fixed-volume gun	• no overhead irrigation after fruit colour to avoid splitting and brown rot (can use trickle irrigation) • use short wettings to avoid leaf spot infections with overhead • irrigate soon after mechanical harvest if under stress from dry conditions
APRICOTS 💧💧💧	• larger fruit • less thinning required • reduced winter injury due to less stress on trees	• May–September • pit hardening through fruit swell	• travelling gun • trickle • fixed-volume gun	• greater risk of spreading brown rot and bacterial spot with overhead than with trickle
GRAPES 💧💧💧	• larger berry size • increased vine growth • increased yield in some years • increased sugar content during very dry years when leaf function may be limited • improved vineyard establishment	• berry set through to ripening period (veraison) • avoid irrigation after this period to maintain sugar levels and reduce probability of late growth and winter injury	• trickle • travelling gun	• more response on heavy clays, very coarse soils and shallow light soils • greater berry size response in labrusca table and juice grapes • timely pesticide application is important when using overhead irrigation to reduce disease spread, e.g., downy mildew • well-pruned vinifera vines with small crops have a lower risk of water stress

Avoid sweet cherry cracking – do not sprinkle-irrigate after fruit colour. Water absorption leading to cracking takes place primarily through the skin of the ripe cherry.

Gummosis (heat spot) of plum can be more prevalent under dry growing conditions.

In tree fruit crops, maximum growth response to irrigation can be expected in the first five years after planting.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

BERRY CROPS

Berry Crops: Rooting depth of 1-2.5' (0.3-0.8 m)
AMOUNT OF WATER REQUIRED: – approx. 1–2" (25-50 mm) per week
Irrigation scheduling may help you determine how much water to apply, and how often.

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
LOWBUSH BLUEBERRIES 💧💧	• plant vigour and health • larger fruit • increased yields • increased root growth • improved quality	• bloom (frost protection) • berry sizing through harvest • post-mowing (renovation)	• hand-move portable • solid-set	• avoid wet plants overnight
HIGHBUSH BLUEBERRIES 💧💧💧💧	• plant vigour and health • larger fruit • increased yields • improved quality	• May–September • bloom • berry sizing	• solid-set • travelling gun • trickle	• avoid wet plants overnight • irrigation critical for establishment and growth • requires 2" (50 mm)/week during fruit development • use a maximum 4 Imp gal/day (18 L/day) per bush • ensure entire root mass is irrigated by wetting greater soil volume
RASPBERRIES 💧💧💧💧	• larger fruit • taller canes • increased yield • more root growth • annual production • less winter injury • frost protection for fall-bearing cultivars	• bloom • fruit sizing through harvest • primocane growth	• trickle • solid-set • travelling gun	• avoid wet plants overnight • high moisture requirements • keep irrigation off primocanes to reduce disease • overhead irrigation can be used for frost protection in spring with summer-fruiting cultivars or fall with fall-bearing cultivars

Drip (i.e., trickle or micro-) irrigation will help yield larger blueberries. Highbush blueberries are very responsive to irrigation. By using a drip system, plant foliage is not wetted and cultural practices can be carried out while the irrigation system is running.

Drip irrigation is water-efficient, but doesn't provide frost protection to berry plants in bloom.

code:
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BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

BERRY CROPS

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
STRAW-BERRIES 💧💧💧💧	• larger fruit • increased yields • frost protection • regrowth after renovation • evaporative cooling • improved quality	• bloom (frost protection) • fruit sizing • post-renovation	• hand-move portable • solid-set • travelling gun • trickle	• avoid wet plants overnight to prevent fruit rot • very responsive to irrigation • avoid leaching on sandy soil • maintain available soil moisture above 50% (do not exceed 100%) • irrigation for frost protection can increase the incidence of bacterial angular leaf spot • strawberries are only responsive up until first fruit colour – don't use water during last half of harvest • irrigation is critical after renovation
OTHER BUSH BERRIES 💧💧💧	• larger fruit • larger bushes • increased yields • improved quality	• bloom • fruit sizing through harvest	• hand-move portable • travelling gun • trickle	• avoid wet plants overnight to prevent fruit rot • very responsive to irrigation • avoid leaching on sandy soil • maintain available soil moisture above 50% (do not exceed 100%)

GENERAL NOTES ON IRRIGATION FOR ALL FRUIT

Irrigation improves plant establishment, nutrient use, bearing area and plant health. It can also be used for frost control (sprinkler) and fertigation.

Overhead irrigation is recommended for frost protection and evaporative cooling. Trickle irrigation is more suitable for fertigation than overhead sprinklers, and will cause fewer infections of scab, fireblight, brown rot, Botrytis fruit rot, etc. Some measure of frost protection may be gained from under-canopy, low-trajectory sprinkler irrigation systems. They are probably best suited for high-density plantings not taller than 6.5 feet (2 m), but have not been fully evaluated in Ontario.

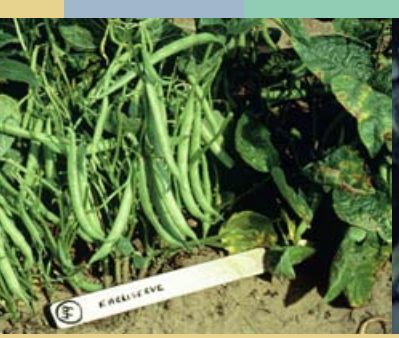
See pages 106–107 for more information on the ice encapsulation method of frost control.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

VEGETABLE CROPS

Shallow-rooted Vegetables: rooting depth of 1–2' (0.3–0.6 m) in most soils
AMOUNT OF WATER REQUIRED: – approx. 1" (25 mm) per week during vegetative growth
– approx. 1.5–2" (40–50 mm) per week during critical periods
Irrigation scheduling will help determine how much to water to apply and how often.

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
BEANS Snap, Lima 💧💧	• straighter, better quality pods	• flowering, pod set	• hand-move portable • fixed-volume gun • travelling gun • low-pressure boom	• improper irrigation can promote mould • avoid excessive irrigation during flowering • avoid watering in the evening • allow foliage to dry before night to discourage diseases
BEET (red) 💧💧💧	• better quality, better-shaped roots • improved seed germination	• stand establishment • root enlargement	• hand-move portable • fixed-volume gun • travelling gun • low-pressure boom	• uniform moisture required at all growth stages
COLE CROPS e.g., Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Rutabaga 💧💧💧	• larger head size, quality • prevention of premature heading (buttoning) of cauliflower • prevents tipburn of cabbage	• head formation and enlargement	• hand-move portable • fixed-volume gun • travelling gun • low-pressure boom	• rutabaga seedbeds can be irrigated to stimulate germination if soil moisture is lacking • excess irrigation may cause head splitting in cabbage, head-rot in cauliflower and broccoli • boron may be applied through irrigation if required • frequent irrigation is required for cauliflower grown in warm months to prevent buttoning



Irrigation will yield straighter and larger pods in beans.

Irrigation can produce higher quality, larger heads.

Plan irrigation carefully. Excess water can promote head-rot in broccoli and cauliflower.

code: 💧 **seldom expect response**
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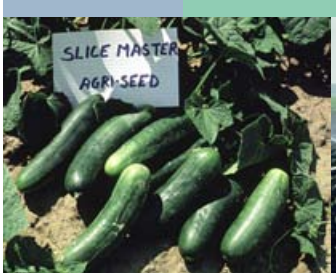
💧💧💧💧 **expect response 9 years out of 10**

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

VEGETABLE CROPS

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
CARROT 💧💧💧	• seed germination • better quality, longer roots	• root enlargement	• fixed-volume gun • travelling gun • low-pressure boom • sub-irrigation	• high moisture requirement • uniformity is important, as excess moisture causes cracking and short roots
CELERY 💧💧💧	• celery is very susceptible to drought at all stages • drought causes blackheart (calcium-related breakdown of the centre of the plant) and buttoning	• crop establishment to harvest	• hand-move portable • travelling gun • low-pressure boom	• celery shouldn't be grown without irrigation • requires approx 2" (50 mm) weekly
CUCUMBER Muskmelon Zucchini 💧💧	• larger fruit • less crooked fruit • better quality • less hollow heart	• flowering • fruit set • fruit sizing	• hand-move portable • fixed-volume gun • travelling gun • trickle	• fertigation may be used with trickle to improve yield • plastic mulch may be used for maximum moisture retention and increased soil temperature
GARLIC on coarse-textured soils 💧💧💧	• better quality, larger cloves	• vegetative growth, bulbing	• hand-move portable • fixed-volume gun • travelling gun	• requires 1–2" (25–50 mm) weekly, especially in hot weather • avoid watering in the evening to reduce disease development • avoid watering shortly before harvest as excess water may discolour the bulb papers
LETTUCE 💧💧💧	• improved germination of direct-seeded lettuce	• head formation and sizing	• hand-move portable • low-pressure boom	• irrigation important for seeded lettuce, especially in hot weather • avoid watering in the evening, allow foliage to dry before night to reduce disease development
ONION 💧💧	• larger bulbs • more single centres	• bulbing and enlargement	• hand-move portable • travelling gun • sub-irrigation	• requires 1–2" (25–50 mm) weekly • excess water as the bulbs mature will result in thick necks, immature bulbs, and storage problems – decrease moisture supply gradually as bulbs mature



Cucumber crispness can be improved with irrigation.

Celery requires irrigation immediately after transplanting and throughout the season. Irrigation should be done in the early morning to reduce the spread of disease.

Both sprinklers and irrigation guns are appropriate for onions. Irrigation of onions may be necessary on shallow muck or mineral soils.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

VEGETABLE CROPS

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
PEPPER & EGGPLANT 💧💧💧	• larger fruit, better quality, less sunscald and blossom-end rot • higher yield	• flowering • fruit set • fruit sizing	• hand-move portable • fixed-volume gun • travelling gun • trickle	• fertigation may be used with trickle to improve yield • plastic mulch may be used for maximum moisture retention and increased soil temperature • frequent light irrigation is best for these shallow-rooted crops • over-irrigation may promote root disease
POTATO 💧💧💧💧	• better sizing, better chipping quality, prevention of hollow-heart • higher yield	• tuber formation and enlargement • from tuber initiation to marketable-size potatoes requires a minimum of 1" of water per week	• centre pivot • lateral move • fixed-volume gun • travelling gun • low-pressure boom	• irrigation may reduce soil temperature and improve tuber set in hot weather • excess irrigation causes cracking and hollow-heart

This photo shows placement of drip irrigation tape between rows of peppers. In this case the tape is buried slightly, with the emitter facing up.

Irrigation will produce potatoes that are bigger, and have better chipping quality and less hollow-heart.

Tuber set can be improved in hot weather with irrigation.

code:
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- 💧💧💧 **expect response most years (75%)**
- 💧💧💧💧 **expect response 9 years out of 10**

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

VEGETABLE CROPS

Medium-rooted Vegetables: rooting depth of 1–2.5' (0.3–0.8 m) in most soils
AMOUNT OF WATER REQUIRED: – approx 1" (25 mm) every 10 days during vegetative growth
– approx 1.5–2" (40–50 mm) every 10 days during critical periods
Irrigation scheduling will help determine how much to water to apply and how often.

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES /CONSIDERATIONS
TOMATO (Fresh Market) 💧💧💧	• larger fruit, better quality, less blossom-end rot, less cracking, higher yield	• flowering, fruit set, fruit sizing	• hand-move portable • fixed-volume gun • travelling gun • trickle	• fertigation may be used with trickle to improve yield • plastic mulch may be used for maximum moisture retention and increased soil temperature
TOMATO (Processing) 💧💧💧	• larger fruit, better quality, less blossom-end rot, less cracking, higher yield	• flowering, fruit set, fruit sizing	• travelling gun • low-pressure boom • trickle	• research has shown a benefit of irrigation for processing tomatoes on a range of soil types from sand to clay loam • fertigation may be used with trickle irrigation to improve yield

Chemically killed rye windstrips will reduce erosion and moisture loss in processing tomato production.

Flowering is a critical period for the irrigation of fresh-market tomatoes.

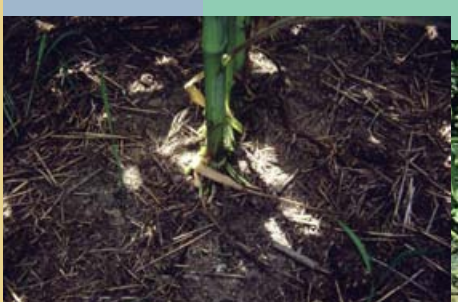
These tomatoes show signs of blossom-end rot (BER). This disorder occurs when insufficient moisture is available to transport calcium to the developing fruit. Properly scheduled irrigation reduces the incidence of BER.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

VEGETABLE CROPS

Deep-rooted Vegetables: rooting depth of 2.0–3.5' (0.6–1.1 m) in most soils
AMOUNT OF WATER REQUIRED: – approx 2" (50 mm) every 14 days
Irrigation scheduling will help determine how much to water to apply and how often.

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
ASPARAGUS 💧	• improved seed germination and seedling establishment • irrigation sometimes used to control wind-induced abrasion	• stand establishment – limited response in mature asparagus	• travelling gun • fixed-volume gun	• very deep-rooted crop; limited response in mature asparagus • irrigation can be used for frost control in spring • irrigation sometimes used after harvest is complete during periods of very dry growing conditions
SWEET CORN 💧💧	• better pollination, fewer blank kernels, better tip-fill	• tasselling, pollination, ear filling	• travelling gun	• irrigation promotes good tipfill • maximum 2–3 irrigations required in very dry years
SWEET POTATO 💧💧	• greater yield, quality and tuber size • irrigation sometimes used to control wind-induced abrasion • improves plant survival	• early August into early September	• travelling gun • hand-move portable	• sweet potato is known for high drought tolerance
WATERMELON Pumpkin Squash (winter) 💧💧	• larger fruit, better fruit shape	• flowering, fruit set, fruit sizing	• hand-move portable • fixed-volume gun • travelling gun	• deep-rooted crops respond to irrigation during very dry conditions • summer squash may show a more definite response pattern as it is a medium-rooted crop • transplanted pumpkins and squash develop medium-root systems and will require more frequent irrigation (1-1.5" per week during fruit bulking, depending on soil type)



Residue management in sweet corn reduces soil erosion and helps retain moisture.

Irrigation will increase the fruit size of deep-rooted crops such as watermelon.

code:
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BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

TREE NUT CROPS

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
FILBERT / HAZELNUT	• accelerated tree establishment • increased precocity • more vigorous bloom, better nut fill, higher yields, larger nuts	• 6 weeks post-bloom • nut fill from mid-July to mid-August	• trickle • fixed-volume gun • travelling gun	• irrigation is necessary on annual basis • sufficient water must be used to wet entire rooting zone • irrigation is most important in planting establishment to promote adequate root development
HEARTNUT & SWEET CHESTNUT	• accelerated tree growth and improved yields • better nut size	• nut fill mid-August to mid-September	• trickle • fixed-volume gun • travelling gun	• heartnut may require irrigation on an annual basis, depending on soil type • chestnut requires irrigation every year on coarse-textured soils • chestnut flowers very late (June) and must develop the bulk of crop volume over a very short time

Chestnuts will need irrigation every year on sandy and gravelly soils.

Heartnuts fill in mid-August to mid-September on the tree. Irrigation can be important at this time. This heartnut has started to germinate in the nursery seedbed. Half the shell has been removed.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

TREE NUT CROPS

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
WALNUTS & PECANS	• accelerates tree growth and development • improves yields • better quality nuts, larger size • spring frost protection	• mid-July to mid-August for walnut • mid-August to 1st week October for pecan	• trickle • fixed-volume gun • travelling gun	• excessive irrigation may promote root and crown disease, depending on rootstock • soil moisture regime must be adequate for good tree performance • under severe stress, walnut cannot produce or maintain foliage or fruit • Carpathian, black walnut and pecan are the most drought-resistant nut trees – on average, irrigation will produce a noticeable economic advantage one year in three

Note: Micro sprinklers will distribute the water over a larger surface area, requiring fewer emitters for large mature trees.

This picture shows a filbert and pecan orchard in September 1990, the year of its planting.

Here is the same orchard 34 months later, having benefitted from a trickle irrigation system.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

TOBACCO

BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	AMOUNT PER APPLICATION	APPLICATION RATES	BEST MANAGEMENT PRACTICES / CONSIDERATIONS
• improves quality • increases yield	• in order of importance: 1. just prior to topping and until the tip leaves have fully grown out 2. rapid vegetative stage of growth starting in late June and until July before topping 3. during harvest, especially when higher rates of nitrogen fertilizer have been used	• travelling gun • solid set • fixed-volume gun • travelling boom • lateral move	• 0.75–1.5" (20–40 mm) • amount depends primarily on the soil's initial moisture content and its maximum water-holding capacity	• 0.25–0.5" (7.5 –12.0 mm)/hr • when guns are used, nozzle sizes should be between 1–1.25" (25–31.8 mm) and operated between 550–560 kPa (80–94.5 psi)	• soil moisture must be maintained at or above 60% of field capacity • irrigation can be done anytime during day or night, but will be more efficient at night since less water is lost through evaporation and usually there is very little wind

For optimum growth, tobacco soils must be maintained at or above 60% of field capacity.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

FIELD-GROWN NURSERY STOCK

TYPE OF STOCK	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	AMOUNT OF WATER	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES/ CONSIDERATIONS
SEEDBEDS	• improves germination	• during germination and growth until root system is established	• 0.5–1" (12.5–25.0 mm) per week, maintain near field capacity	• hand-move portable • semi-permanent • solid-set	• keep soil moist during seedling germination
LINER BEDS & ROWS 7" (180 mm) rooting depth	• improves transplant establishment • increases plant size	• after transplanting until root system is established • during dry periods with young nursery stock	• 0.5–1" (12.5–25.0 mm) per week, maintain near field capacity	• hand-move portable • semi-permanent • solid-set • travelling gun	• irrigate budding understock prior to budding • irrigate post planting • irrigate when soils are at 50–70% of field capacity
CALIPER TREES	• improves transplant establishment	• after transplanting until established	• 0.5–1" (12.5–25.0 mm) per week, maintain near field capacity	• hand-move portable • travelling gun • trickle	• irrigate post-planting

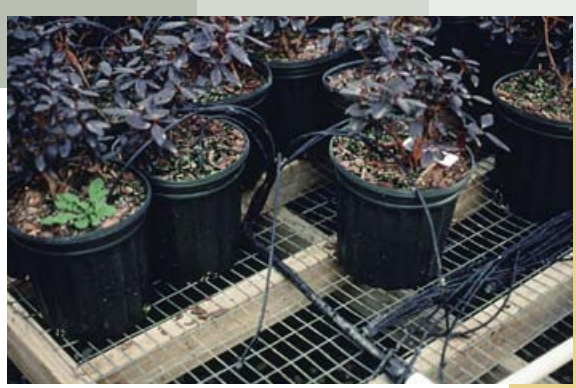
Irrigation improves germination rates in seedbeds.

Caliper trees require irrigation post-planting.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

CONTAINER-GROWN NURSERY STOCK

TYPE OF STOCK	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES/ CONSIDERATIONS
CONTAINER-GROWN SEEDLINGS	• improves seedling germination • maintains uniform and vigorous growth	• daily for newly potted plants, every 1–2 days after rooting out into media • essential for seedling establishment and growth	• hand-move portable • semi-permanent • solid-set • low-pressure boom • mist lines • hand watering	• good for a greenhouse or an enclosed production area • requires careful judgement and experience • ensure even coverage of water: each cavity must receive the same amount of water • water must have low salts and be free of disease organisms • plants vary in response to watering • covering cavity with grit will help conserve moisture • amount depends on medium, temperature and plant



Drip irrigation maintains rapid and vigorous growth in container-grown stock.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

CONTAINER-GROWN NURSERY STOCK

TYPE OF STOCK	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES/ CONSIDERATIONS
NEWLY POTTED & ESTABLISHED CONTAINER STOCK	• helps nutrient uptake from control-release fertilizers • evaporative cooling of plants • maintains rapid and vigorous growth of established stock	• following transplanting until liner establishment • in the fall prior to covering polyhouses • can be used to leach when total salt readings exceed 3.5 mS/cm • daily for newly potted plants, every 1–2 days after rooting out into media • during growth throughout the growing season	• trickle or drip • solid-set	• good for container sizes of 1–5 Imp gal (4.5–22.7 L) • overhead irrigation is inefficient – only 15–55% of water reaches the media **To improve efficiency:** • offsetting spacing of containers is more efficient than square spacing • group plants according to their water requirements, pot size, rate of growth and age • shift plants into larger containers before plants have reached their maximum canopy size, instead of spacing containers • use control release fertilizers • consider pulse irrigation – using an automated system, water is applied in regularly timed intervals, e.g., a cycle may consist of 4 intervals on for 15 minutes, and then off for 30 minutes – this allows water to percolate through the pot (uses 30% less water)

Overhead irrigation is used for container stock. To make it more effective, group plants according to their water requirements, pot size, rate of growth and age.

BEST MANAGEMENT PRACTICES FOR CROP PRODUCTION

CONTAINER-GROWN NURSERY STOCK

CROP	BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES/ CONSIDERATIONS
CONTAINER-GROWN NURSERY STOCK	• maintains rapid and vigorous growth • reduces or eliminates transplant shock	• daily during growing season	• solid-set • trickle or drip	• consider drip system for containers larger than 5 Imp gal (22.7 L) • trickle uses 75% less water than overhead irrigation system • requires an automated system capable of delivering 0.16–0.33 Imp gal (.75–1.5 L) per 2 gal container per day
PROPAGATION OF NURSERY STOCK	• prevents cuttings from dehydration	• until cuttings are rooted	• solid-set • intermittent mist lines	• keep water on the leaves to maintain evaporative cooling • requires a time clock or electronic leaf, interval adjusted to crop requirements

Irrigation prevents cuttings from dehydration in propagation beds.

SOD

BENEFITS OF IRRIGATION	CRITICAL IRRIGATION PERIODS	COMMONLY USED SYSTEMS	BEST MANAGEMENT PRACTICES /CONSIDERATIONS
• brings turf out of dormancy to allow sod to be harvested • moistens root zone prior to harvest	• mid-summer	• centre pivot • lateral move • travelling gun • travelling boom	• rooting depth: 4–8" (100–200 mm) • excess irrigation during evening or night can promote disease • to minimize evaporation losses, avoid irrigating during the heat of the day and during periods of high winds

Sod crops require irrigation to ensure vigour.