

# Peppers



**Extension**  
UNIVERSITY OF WISCONSIN-MADISON  
DANE COUNTY



**FAIRSHARE**  
CSA COALITION

**Heidi Accola**  
**Roots & Shoots, LLC**

**Kat Becker**  
**Cattail Organics**

**Dan Fillius**  
**Featherstone Farm**

Location	Sauk Prairie, WI	Athens, WI	Rushford, MN
Acres in Vegetables	2.5	5.5	140 (250 with fallow fields)
Acres in FIELD Peppers	0.01	3 x 200 ft beds; 1/15th of a acre	5
Acres in HOOPHOUSE Peppers	0.003	3 X 100 ft beds: 1/25th acre	0

How these tasks are done for Peppers:

field prep/tillage	with a tractor	with a tractor and/or BCS	with a tractor
hoophouse prep/tillage	with a walking tractor (BCS, Troy-bilt, etc.)	with a tractor and/or BCS	do not do this task for peppers
transplanting	by hand	by hand	with a tractor
cultivating	do not do this task for peppers	by hand	with a tractor
spreading amendments	with a tractor	with a tractor	with a tractor
mulch laying	with a tractor	by hand	with a tractor
laying irrigation lines	with a tractor	with tractor and by hand	with a tractor
laying row cover	by hand	by hand	by hand
pruning	do not do this task for peppers	do not do this task for peppers	do not do this task for peppers
trellising	do not do this task for peppers	by hand	do not do this task for peppers
spraying for pests or diseases	do not do this task for peppers	do not do this task for peppers	with a tractor
harvesting	by hand	by hand	by hand
hauling crop from the field	by hand	by hand	with a tractor or truck
mowing crop residues	with a tractor	with a tractor and/or BCS	with a tractor
incorporating crops residues	with a tractor	with a tractor and/or BCS	with a tractor
farming style	certified organic	certified organic	certified organic

## Propagation

Varieties <b>Field</b>	Sweet Bell--Ace, Emerald Giant, King of the North Sweet Italian--Carmen Hot Peppers--Tiburón poblano, early jalapeno	Bell: king crimson, Ace (as a green pepper mostly) Italian - Carmen Hot: Hungarian Hot Wax, Red Flame, Early Jalapeno, Triunfo, Bastan	Sweet Bell: Red - Ace (only for first harvest), X3R Red Knight; Green - X3R Red Knight, Dashen (For 2nd and 3rd successions); Yellow - Golden California Wonder, Madonna Sweet Italian: Carmen Hot Peppers: Jalapeno - Jalafuego, Jedi; Cayenne - Red Ember; Aji - Aji Rico
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Varieties <b><u>Hoophouse</u></b>	Sweet Bells--Gilboa Sweet Italians--Carmen	<b><u>Cat tunnel 2018/19:</u></b> Gilboa, King Crimson, Olympus, Ace (limited for Green) Hoophouse <b><u>Hoophouse 2016/17:</u></b> Carmen, King Crimson, Olympus, trials of oranges and coronitos	n/a
Seed Treatment	none	none	Myco Seed Treat from AgriEnergy Resources. Sprinkled into soil per label directions as soil is being mixed and hydrated in a 100 gallon stock tank.
Soil Mix	Cowsmo green seed starting mix	vermont compost fort light	Vermont Compost Fort Light
Seedling Trays	start in 72s, pot up to 4" square pots	128s into 72 or 50	Seeded in 10-row 1020 trays. 100 seeds per row, 1000 seeds per flat. Next potted up to 72-cell 1020 trays.
Propagation Schedule	<b><u>Field:</u></b> seeding date: March 31 potting up date: May 5 transplanting date: May 26 <b><u>Hoophouse:</u></b> Same	<b><u>Field:</u></b> April 15 seed, up pot once, into field June 1 ish <b><u>Cat tunnel:</u></b> March 20 up pot into tunnel between May 5-May 20	<b><u>Field:</u></b> 3 Successions for all bell peppers, all following the propagation plan of 20-row tray>72-cell tray>field transplant. Hot peppers are only planted in the first succession. 1st succession: 3/25>4/6>5/13 2nd succession: 4/20>5/2>6/8 3rd succession: 5/6>5/18>6/24
Germination	I convert my walk-in cooler to a germ chamber, 2 crockpots filled with water, tables for holding the trays, lights for when germinated. My greenhouse isn't heated well, so I need the seedlings protected in the lighted germ chamber/cooler until they're greenhouse safe.	germ chamber around 75-80 depending on who is sharing the space	Place 20-row trays on heat mats set to 85 degrees F. Placed on a bench in NW corner of greenhouse because an outlet is there. Surface of soil kept moist by hand watering.
Greenhouse Irrigation	Hose with adjustable sprayer, as needed	watering wand	By hand using a hose and "Wonder-waterer" wand. Typically One big bout of watering all trays in the morning, followed by one or two check-ups and spot watering in the afternoon depending on how hot it is.

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Greenhouse Conditions	My greenhouse is a lean-to greenhouse with only space heaters. Nothing is optimal about it. The peppers need to tough it out, just like everything else.	I don't maintain them but 80 degrees would be nice and ideal.	We only have enough heat mats for our peppers when they are in 20-row trays. We still want our peppers to stay warm, so we typically place the trays on benches away from the edge of the house once they are potted up. At that point, we don't do anything else that is particularly special for them.
Hardening Off	Set in shaded area immediately outside of greenhouse 1 week before transplanting.	don't have a great place, try to move out a day before if possible or into hoophouse first.	We harden off peppers 1-week prior to their scheduled field planting date. We move them from the benches in the house onto converted hay-rack wagons that each fit about 80-90 trays. We roll these into an empty greenhouse if the temperatures are cold and/or if storms are predicted. These wagons are towed out to the field with the transplant crews at transplant time.
Greenhouse Pests or Diseases	No.	nope	Our yellow peppers are typically chlorotic to varying degrees, and we are unsure why!
Other Notes on Propagation		I am going with bigger plants, up potting, and using field and caterpillar tunnel to get greens for CSA and to get slightly earlier but focused on later ripe peppers. Hoophouse is great but we are trying to avoid anything in the tomato family	Our peppers often do not fully root up in their cells by the transplant date. The tops are strong, though leggy, but we often have to pop the pepper plants out of their trays in order to not tear their root balls. Correcting this is a goal of ours.

**Bed Prep**

Preceding Cash Crop	<b>Field:</b> Year 1: potatoes Year 2: cucurbits Year 3: peppers, eggplant, tomatoes <b>Hoophouse:</b> greens	<b>Field:</b> in 2019 it will be brassicas which were double cropped with beans or lettuce <b>Cat tunnel:</b> n/a in 2019 (was hay) <b>Hoophouse</b> (in the past): cucurbits/fall greens	<b>Field:</b> We don't have a hard and fast rotation. Our general rotation groups are Brassicas; Cucurbits and Solanaceae; Everything Else; and Fallow. Peppers have followed brassicas more than anything else, but they have followed corn, beans, and parsley too.
Preceding Cover Crop	<b>Hoophouse:</b> None	<b>Field:</b> none this year, oats/peas in 2020 <b>Cat tunnel 2019:</b> buckwheat, tilled then sorghum sudan	<b>Field:</b> Often we will leave the first succession's field bare or with a winter-killed cover crop. Second and third successions will often have rye or rye/vetch.

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<p>Soil Amendments</p>	<p><b>Field:</b> manure Midwest Bioag Veggies Sol (when not using manure) per application rate on bag <b>Hoophouse:</b> use Cowsmo compost at 4 tons per year for 30 x 96 hoophouse Midwest Bioag granular amendments Will start using citric acid in irrigation system in 2019 for pH</p>	<p><b>Field:</b> using a custom blend from cashton to deal with large micro nutrient issues and low P and K blended with chicken manure composted <b>Cat tunnel:</b> trialing SP 1 and dramm <b>Hoophouse:</b> various amendments according to soil test, including lime, custom cashton, sustane 8-4-4</p>	<p><b>Field:</b> Typically, peppers receive turkey litter at 2-3 tons per acre. We use this as a general soil conditioner and also for the immediately available nutrients. We have found it to be the most cost-effective fertilizer for us, and the folks we buy it from (SFS Fertilizer) spread it, which decreases our labor need. We also apply a 0-0-22-13s blend under the plastic for all our Solanaceae crops at 200 lb/acre. This is custom blended by Midwestern BioAg.</p>
<p>Bed Prep</p>	<p><b>Field:</b> Till, lay plastic mulch/drip tape within 1 week of planting. <b>Hoophouse:</b> rototiller immediately before planting</p>	<p><b>Field:</b> BCS and hand hill <b>Cat tunnel:</b> premaking bed with rainflow and setting tunnels on top of these beds.</p>	<p><b>Field:</b> Immediately after turkey litter is spread, we chisel plow. If a living cover crop was in the field previously, we will follow this a few days later with an offset disc to kill the cover crop, otherwise we let the field sit because we have found it will dry fastest when it is left in the post-chiseled state. Then immediately before we lay plastic beds, we run over the field with a finish disc. This leaves it nice and fluffy for the discs on the plastic layer to cover the edges of the plastic. We make sure to only disc the amount of ground that we know we can cover with plastic in a day so we aren't over-working our soil.</p>
<p>Pre-Planting Mulch</p>	<p><b>Field:</b> Rainflo plastic and drip tape Heats soil and controls weeds, irrigation Applied with tractor attachment rented from friend farmer <b>Hoophouse:</b> no mulch</p>	<p><b>Field:</b> Toro drip tape with landscape fabric over it; laid by hand over raised beds and stapled. Used for weed control; heats soil but permeable to rain. Using the Nolts lighter fabric. Holes burned with torch, staples on raised beds - mowable cover crop between beds. Rotate crops, treat with sanidate, and store in the freezing cold to prevent disease transmission to the next crop. <b>Cat tunnel:</b> Same <b>Hoophouse:</b> Same</p>	<p><b>Field:</b> We use embossed 4' Black Plastic Mulch, RainFlo item number BLK440. We use it for increased heat, weed prevention in the bed, and we lay it with a Rainflo 2600 bed shaper/mulch layer. The 2600 has a fertility hopper that dispenses our Solanaceous blend of dry fertility also. We lay blocks of 8 beds at ~5.75' on center. We then leave a 12' field road before we start the next block of 8 beds. This road is used for harvest and spraying.</p>

**Planting**

Bed Width	<p><b>Field:</b> tilled 5' wide, approx 3' wide after mulch layer</p> <p><b>Hoophouse:</b> 5'</p>	<p><b>Field:</b> 3 ft</p> <p><b>Hoophouse:</b> 4 ft</p>	<p><b>Field:</b> 5.75'</p>
Plant Spacing	<p><b>Field:</b> 2 rows per bed 2.5-3 feet between rows 1 foot in-row spacing</p> <p><b>Hoophouse:</b> 2 rows per bed 3 feet between rows 1 foot in-row spacing</p>	<p><b>Field:</b> 1.5 2 rows</p> <p><b>Hoophouse:</b> Same</p>	<p><b>Field:</b> 2 rows per bed, 18" apart between plants and 18" between rows.</p>
Transplanting Process	<p><b>Field:</b> turn on irrigation, find the "wet spot" showing on the plastic every 12 inches, use digging tool to puncture plastic and dig deep hole, plant in the hole as deeply as can be accommodated.</p>	<p>I have landscape fabric laid over drip tape (2 rows/bed). Using staples the drip is secured and moved into the edge of the burnt hole and run it for at least an hour (depending on what other irrigation is on). With 2 people, one person walks down the 200 foot beds throwing plants into holes on both sides (to keep varieties in blocks). The person behind is transplanting as comfortable for them - bent, kneeling etc. Once the bed is full the person throwing helps finish transplanting. with three people the slow point is actually the person dropping the plants with two people going down (one on each side).</p>	<p><b>Field:</b> We use a rainflo waterwheel to transplant. 3-4 people are used on this, 1 driver, two riders, and one walker. If the plants are pulling well, the walker is not needed, but this rarely happens for us. Because we want to be able to harvest 4 rows across at a time using a harvest conveyor, we need to have 4 beds of identical plants side-by-side. Typically that means that a block of 8 beds will be either all the same or split down the middle with 4 beds of one variety on one side and 4 beds of another variety on the other side. Sometimes, we will have smaller plantings and these get planted 4 beds across but only, say, 50 feet long. Then another variety fills up the rest of that block. This can be difficult to execute while planting with a waterwheel that is going up the field one way and back the opposite way but is very valuable come harvest time.</p>
Fertilizer at Planting			<p><b>Field:</b> We put 2.5 gallons of Drammatic O in with the water in the 160-gallon tank of the waterwheel to water in the transplants.</p>
Water at Planting	<p>watered with drip tape during and after transplanting.</p>	<p>drip run 1-2 hours before planting</p>	<p>Crop is watered in with a generous flow from the transplanter due to poor root establishment. Irrigation is usually run for the first time within a day or two of planting if rain hasn't occurred.</p>

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Row Cover		depends on weather - used for frost protection with or without wire hoops	We use row cover on plantings early and late if frost threatens. Our plantings are larger than our stock of row cover though, so we prioritize certain parts of the crop. Mostly, this is an effort in the tail end of the season to protect bell peppers for later sales. If frost is predicted in mid to late May, we delay planting.
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**Crop Maintenance**

Irrigation	<p><b>Field:</b> When rain is less than 1" per week, crop is drip irrigated as needed to replicate 1" of rain. Finger-poke test.</p> <p><b>Hoophouse:</b> Overhead irrigation, not ideal. As needed per conditions in hoophouse (heat, wind).</p>	<p><b>Field:</b> toro drip tape 12 inch spacing. Well water</p> <p><b>Hoophouse:</b> drip run to about 1 inch per week</p>	<p><b>Field:</b> We irrigate with drip tape - 2 tapes underneath the plastic mulch. We use 8-mil T-tape, with emitters every 12". We get 7500' rolls from Rainflo, item number 508-12-220. We irrigate most weeks, unless we receive 2+ inches of rain. We figure not all of the water makes it under the plastic. After checking under the plastic for moisture, we'll irrigate up to 12 hours. Around 12 hours will simulate 1.5" of rain. We source water either from a well or from the Root River.</p>
Irrigation Modifications	No.	<p><b>Field:</b> try not to over water at one time to prevent disease and wet spots</p> <p><b>Hoophouse:</b> just try to keep it regular and not too much</p>	<p><b>Field:</b> We keep irrigation steady throughout the life of the plant.</p>
Trellising		<p><b>Hoophouse:</b> 2, 8 foot spaced t posts make a corral with twine if needed</p>	

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Insects & Pests		no	<p><b>Field:</b> We have had devastating outbreaks of European Corn Borer. Some years are worse than others. In 2016, 90% of our peppers had a worm inside. The last 2 years, we have deployed parasitoid <i>Trichogramma ostrinae</i> wasps for control. We have had very low pest pressure since. We order the wasps from IPM Labs in New York state. We look at the MN Cooperative Extension website to see when they have historically trapped higher populations of ECB and order wasps to arrive during those weeks. I think we deployed wasps 10 times in 2018, with a 2-3 week break in July.</p>
Diseases	<p><b>Field:</b> Starting to get a lot of disease issues in the field peppers. Need to get the disease identified. Lots of brown mottling and black tissue destruction.</p>	<p><b>Field:</b> Anthracnose; some calcium issues. Not a disease, but occasional and seemingly unpredictable sunscald  <b>Hoophouse:</b> Same</p>	<p><b>Field:</b> Anthracnose is a problem in some years (1 in 5 years?). We spray bordeaux mix on pepper plants until they begin to fruit to try and combat this.</p>
Weeding	<p><b>Field:</b> Peppers are on plastic, and almost no weeding is necessary. Occasionally hand weed the "holes" as needed.  <b>Hoophouse:</b> Scuffle hoe as needed.</p>	<p><b>Field:</b> hand weed and hoe if any space between landscape  <b>Hoophouse:</b> hand, almost no weeds because landscape touches</p>	<p><b>Field:</b> We cultivate the paths between the plastic using tractors. We hand-pull weeds that emerge in the planting holes. We have to hand-pull once or twice. To cultivate, we first use large sweeps to throw soil and bury small weeds for the first few cultivations. Afterwards, we use "side-knives" followed by hilling discs to slice away close to the edge of the plastic and then re-bury the edge. This is fairly effective at slicing or uprooting larger weeds that escaped the burying work from earlier cultivations. Any big weeds that are missed from these steps are hand-pulled or hoed when the hole-weeding crew goes through. Once peppers are too tall to straddle with a cultivating tractor, we use a high crop tractor with a 3-point mounted tool bar with sweeps on very long shanks to maintain cleanish paths.</p>

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<p>Hoophouse Environmental Control</p>	<p><b>Hoophouse:</b> My hoophouse grows a variety of crops at all times, so there aren't ideal conditions for any one crop. Regardless, the protection of the hoophouse does yield large peppers without any disease problems.</p>	<p><b>Caterpillar tunnels:</b> usually open partially during the day (after cooler may weather) and closed at night</p>	
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**Harvest and Yields**

<p>Green Pepper Harvest Window</p>	<p><b>Field:</b> I start harvesting green peppers when full sized, leaving enough to mature. (approx mid-July) I harvest mature peppers as available. I strip all the plants once frost threatens, saving nice-sized in the cooler for 1-2 weeks of shares, using small peppers for home use. <b>Hoophouse:</b> Variable</p>	<p><b>Field:</b> mid/late July - October, harvest when full-sized, then harvest freely but with breaks <b>Cat tunnel:</b> a little earlier than field</p>	<p><b>Field:</b> We harvest from July 1st through frost, which historically is around October 1st. We then strip all remaining saleable fruits and sell out of warehouse inventory</p>
<p>Mature Pepper Harvest Window</p>	<p><b>Field:</b> Variable, per weather and heat. <b>Hoophouse:</b> Variable</p>	<p><b>Field:</b> harvest late July/early August through late Sept/Oct depending on frost then take all fruit at that time. Taking mature ripe fruit once a week/field.</p>	<p><b>Field:</b> We harvest from the end of July through frost, which historically is around October 1st. We then strip all remaining saleable fruits and sell out of warehouse inventory</p>
<p>Hot Pepper Harvest Window</p>	<p><b>Field:</b> Variable, per weather and heat. <b>Hoophouse:</b> Variable</p>	<p><b>Field:</b> Same as above. Poblanos get left as long as possible <b>Hoophouse:</b> N/A</p>	<p><b>Field:</b> We harvest from the end of July through frost, which historically is around October 1st. We then strip all remaining saleable fruits and sell out of warehouse inventory</p>
<p>Harvest Procedure</p>	<p>Hand harvest, sharp knife, not a specific time of day. Use black harvest crates for marketable peppers, CSA bin for "seconds" (given to worker shares or used by our family) A black harvest crate is set down as a "base", with another resting on top. We harvest into the top crate, dragging the bottom one down the aisle as we go.</p>	<p>wait until plants are dry (ideally) late morning, knife or pruners (pruners for employees). Place in harvest crate.</p>	<p>We harvest boxes by hand, mostly to order. Due to perishability we usually don't harvest ahead of time and just pick the number of boxes that we need. A harvest conveyor would speed up the harvest considerably, and we do use this tool when we are clean picking the plants at the end of the year, but it doesn't make as much sense when we are just harvesting to order. We harvest any time of day.</p>
<p>Cleaning</p>	<p>Fill wash tank with water, dunk peppers in water to dislodge any dirt or leaves. Peppers are pulled out of wash water and drained in clean harvest crate, then brought to walk-in cooler.</p>	<p>wipe off or if dirty sprayed/dunked</p>	<p>We field pack fruit unless they are dirty. If they are dirty, we run them through a green brush-washer line with a loading conveyor and sorting turn-table.</p>



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Packing	Clean peppers are placed in deep bulb crates, then loosely covered with wet towels and stacked in cooler.	sorted and packed into wax boxes	Peppers are sorted on the sorting turn-table. Good peppers are boxed directly and culls are removed into a cull bin. We pack into 1 1/9 bushel boxes
Storage	I have one walk-in cooler kept at 40 degrees. Peppers stored typically no longer than 7 days, usually closer to 1-2 days, before being used in share.	in the "warm" section of our cooler 45-50	We store peppers at roughly 55 degrees. In-season, we ship them very quickly, but after frost, we hold them for up to 3 weeks. Green peppers we sometimes hold up to 10 days, fully colored peppers last much shorter.
Yield	Not calculated.	<b>Field:</b> so variable year to year - average of 3-5 peppers/plant depending on type <b>Hoophouse:</b> similar but larger fruit higher marketable yield	<b>Field:</b> Bell Pepper (green and red together). Sorry, our record keeping here was historically lacking) - 1.64 lbs/bed foot Jalapeno Pepper - 1.4 lbs/bed foot
Other Notes on Harvest & Yield	<p><b>Dan Fillius Featherstone Farm:</b>                  We plant Ace peppers only for early red production. After X3R Red Knight succession 2 begins producing reds, we usually abandon the harvest of Ace.                  We had a problem where we would harvest Green and Red bells from X3R succession 1, and then succession 2 would begin to turn red before we started harvesting green from it. We discovered Dashen through trialing some newer varieties and noticed that it had tremendous leaf-coverage and lovely green fruit that held for a very long time before breaking to red. We now plan Dashen in succession 2 and 3 as Green peppers so that we don't miss out on later successions of green peppers. Dashen is not suitable for Succession 1 plantings though, since it is SO delayed in producing green or red fruit.                  Red Ember cayenne replaced Red Flame for us. When trialing Red Ember next to Red Flame, which had been our standard we noticed that Red Ember had more of a determinate fruit set, producing large flushes of peppers that ripened together, while Red Flame would trickle the ripens out. Having large flushes available for CSA periodically through the season was important to us, so we made the switch.                  Yellow peppers seem to always rot on us, we are not sure why we can't get them to mature, but maybe it's related to the chlorosis we see in the greenhouse?</p>		

**Equipment**

General	Knives, \$5 each Harvest crates, \$4 each Rented mulch layer, \$100/yr (used also for eggplants, onions and tomatoes) Inputs, not calculated for peppers only, but very minimal cost.	Landscape fabric reusable about \$35/200 ft bed plus labor burning holes and sanidate to sanitize; knives and crates general use farm; bed maker \$1500-4000 depending on type	Rainflo 2600 with fertility hopper and 2x drip tape applicators - \$7,300.00 Harvest Conveyor (with unpriced wagon) - \$2,150.00 from Nolt's. We sometimes use this and think it would make a big difference to speed of harvest if we could orchestrate the harvest better.
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Biggest Impact	Inputs. Without fertility, any crop will struggle. Mulch layer. I haven't done a side-by-side comparison, but I believe the soil warming up faster with plastic mulch is very helpful for pepper production and maturity in our northern climate.	landscape and bed maker - simple weed free system without the plastic nightmare. We also plant much faster and get much better take on seedling by hand.	Plastic bed shaper most likely. Having perfectly formed and spaced beds with the option to use dry fertility makes a great environment for the plants to grow.
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**Marketing**

Markets	CSA	CSA, farmers market, direct to grocery, direct to restaurants	CSA, direct to grocery, wholesale
CSA	Variable. Last season (2018) was a disastrous pepper season for me. My members got 33 green bell and Italians in the summer shares, no hot, no mature.	pobanos 1 time 3-4 peppers; jalapeno and hot wax 1-2 peppers 5 times; green peppers 10-12/season; colored 10-20	We have 2 sizes of shares, Sustainer (large) and Solo (small). Numbers from 2017 shares. Green Bell: Sust - 5 lbs, Solo - 2.41 lbs. Red Bell: Sust - 6.175 lbs, Solo - 3.98 lbs. Carmen: Sust - 4.86 lbs, Solo - 3.39 lbs. Hot pepper: Sust - 1.35 lbs, Solo - 0.75 lbs.
Farmers Market Prices		all prices the same for market and wholesale \$3/lb green and colored; \$5/lb all hot types	
Direct to Grocery Prices		all prices the same for market and wholesale \$3/lb green and colored; \$5/lb all hot types	Green Bells: \$35.00/25 lb case Red & Yellow Bells: \$58.00/25 lb case Hot Peppers: \$30.00/10 lb case
Direct to Restaurant Prices		all prices the same for market and wholesale \$3/lb green and colored; \$5/lb all hot types	
Wholesale Prices		all prices the same for market and wholesale \$3/lb green and colored; \$5/lb all hot types	Green Bell: \$29.13/25lb case Red & Yellow Bell: \$46.75/25 lb case