Cucurbit: Production practices and techniques

Dr. Ajay Nair
Department of Horticulture
Iowa State University

Iowa Fresh and Processing Vegetables Acreages

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Fresh and Processing (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkins</td>
<td>1,476</td>
</tr>
<tr>
<td>Green Peas</td>
<td>811</td>
</tr>
<tr>
<td>Squash</td>
<td>227</td>
</tr>
<tr>
<td>Tomato</td>
<td>226</td>
</tr>
<tr>
<td>Watermelon</td>
<td>167</td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>155</td>
</tr>
<tr>
<td>Bell Peppers</td>
<td>116</td>
</tr>
<tr>
<td>Snap beans</td>
<td>107</td>
</tr>
<tr>
<td>Cabbage (head)</td>
<td>90</td>
</tr>
<tr>
<td>Onions</td>
<td>69</td>
</tr>
<tr>
<td>Others</td>
<td>xx</td>
</tr>
</tbody>
</table>

IA Ag Statistics, 2012

CUCURBITACEAE

Melon or squash family = “Cucurbits”
Cucumbers, melons, squash, pumpkin, gourd

Cucurbitaceae: Genera

- **Cucurbita** genus:
  - Summer squash
  - Winter squash and pumpkins
- **Cucumis** genus:
  - Muskmelons and Honeydew melons
  - Cucumbers
- **Citrullus** genus
  - Watermelon
Common Characteristics

- Warm season
- Annual
- Insect pollinated
- Day-neutral
- Moderate N requirements
- Moderate water requirements
- Insect and Disease Pests Similar

Flower types

- Female (pistillate)
- Male (staminate)
- Perfect
- Monocious (if on same plant)

http://extension.missouri.edu/explore/manuals/m00173.htm

Iowa Cucurbit Acreage

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Total Harvested (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkin</td>
<td>1,175</td>
</tr>
<tr>
<td>Watermelon</td>
<td>167</td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>157</td>
</tr>
<tr>
<td>Squash</td>
<td>227</td>
</tr>
<tr>
<td>Cucumber</td>
<td>62</td>
</tr>
</tbody>
</table>

2012 CENSUS OF AGRICULTURE - STATE DATA
**Flowers and fertilization**

- **Monoecious**: Separate male and female flowers on same plant. Male flowers form first, then female.

- **Andromonoecious**: Male flowers first, then perfect (hermaphrodite) flowers.

- **Gynoecious**: All female flowers (not very common)

  - Most cucumbers and squash (Cucurbita species), watermelon
  - Most muskmelons (Cucumis)
  - Some cucumbers e.g. ‘Diva’, ‘Olympian’

**Pollination**

Adequate pollination:
- 10-12 visits per flower
- More visits, more seeds, bigger fruit
- One bee per 100 flowers
- 1 strong colony per acre = 6-8 hives

**Cucurbita pepo**

- **Summer squash & zucchini**
  - Zucchini
  - Crook-neck
  - Patty-pan

**Cucurbita pepo (cont’d)**

- **Winter Squash & Pumpkin**
  - Acorn
  - Spaghetti
  - Jack-o-Lantern Pumpkin

Photos: Johnny’s Selected Seed
**Cucurbita maxima**  
Winter squash & pumpkin

- Kobacha
- Buttercup
- Hubbard

**Cucurbita moschata**  
Butternut squash & Dickinson “Pumpkin”

- Dickinson “Pumpkin”

Photo: Johnny's Selected Seed  
http://formaggiokitchen.files.wordpress.com/2010/09/libbys-pumpkins.jpg

IOWA STATE UNIVERSITY  
Extension and Outreach

Winter squash (butternut) in Western Michigan

Summer squash in SW Michigan
Plan it before you plant it!

- Know your market
- Cultivar selection
- Primary market considerations
  - Earliness
  - Local
  - Reduced chemicals
  - Storage
  - Quality!!!!!

CULTIVARS

Slicers
- Boa
- Cobra
- Dasher II
- Daytona
- Intimidator
- Python
- Speedway
- Tasty Green
- Turbo

Recommended cultivars and characteristics

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Yield (lb/A)</th>
<th>Soluble solids</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honeydew</td>
<td>51,600</td>
<td>13.8</td>
<td>Should be cut from vine to prevent fruit cracking, great flavor if allowed to mature on vine</td>
</tr>
<tr>
<td>Jade Delight</td>
<td>38,044</td>
<td>14.3</td>
<td>Green to white flesh, needs to be cut from vine before full slip to reduce fruit cracking</td>
</tr>
</tbody>
</table>

Muskmelons

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Yield (lb/A)</th>
<th>Soluble solids</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphrodite</td>
<td>35,516</td>
<td>13.3</td>
<td>Early maturing, large fruit with thick firm flesh, good quality, standard recommended cultivar</td>
</tr>
<tr>
<td>Athena</td>
<td>37,636</td>
<td>11.7</td>
<td>Oval shape, firm flesh with high quality, standard recommended cultivar</td>
</tr>
<tr>
<td>Atlantis</td>
<td>42,011</td>
<td>10.9</td>
<td>Oval to oblong, thick firm flesh, uniform size and appearance</td>
</tr>
<tr>
<td>Avanti</td>
<td>55,856</td>
<td>10.5</td>
<td>Large fruit, thick walls</td>
</tr>
<tr>
<td>United Gem</td>
<td>48,035</td>
<td></td>
<td>Concentrated fruit set, firm, uniform size and appearance</td>
</tr>
<tr>
<td>Hoku</td>
<td>32,089</td>
<td>12.1</td>
<td>Seedless fruit with green sutures, large cavity, sweet flesh</td>
</tr>
<tr>
<td>Orange Sultam</td>
<td>38,515</td>
<td>10.8</td>
<td>Small round fruit with great flavor</td>
</tr>
<tr>
<td>Sugar Filer</td>
<td>21,337</td>
<td>12.8</td>
<td>Small personal size-muskmelon with exceptional flavor</td>
</tr>
</tbody>
</table>

Recommended watermelon cultivars and characteristics

<table>
<thead>
<tr>
<th>Watermelon</th>
<th>Skin color, pattern, and shape</th>
<th>Average weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distinction</td>
<td>Medium, green with mottled green stripes</td>
<td>16-20</td>
</tr>
<tr>
<td>Fascination</td>
<td>Medium green, oval, with hazy stripes</td>
<td>16-20</td>
</tr>
<tr>
<td>Legacy</td>
<td>Light green, round-globe, and striped</td>
<td>13-17</td>
</tr>
<tr>
<td>Indiana</td>
<td>Round-oval, splashed green, dark background</td>
<td>13-15</td>
</tr>
<tr>
<td>Sangria</td>
<td>Medium, blocky-oval, dark green hazy stripes</td>
<td>13-15</td>
</tr>
<tr>
<td>Troubadour</td>
<td>Medium, blocky, green background dark green stripes</td>
<td>14-17</td>
</tr>
</tbody>
</table>

Seeded

<table>
<thead>
<tr>
<th>Watermelon</th>
<th>Skin color, pattern, and shape</th>
<th>Average weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denver</td>
<td>Green, round-oval, striped</td>
<td>20-24</td>
</tr>
<tr>
<td>Jamboree</td>
<td>Dark green, long blocky, broken light green stripes</td>
<td>20-27</td>
</tr>
<tr>
<td>Sangria</td>
<td>Dark green, blocky-oval, striped</td>
<td>18-22</td>
</tr>
<tr>
<td>Sangria</td>
<td>Dark green, blocky-oval, striped, long</td>
<td>20-26</td>
</tr>
</tbody>
</table>
Special pollinizers and seeded (edible) cultivars for pollination in seedless watermelon production

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crimson sweet</td>
<td>Seeded; edible</td>
</tr>
<tr>
<td>Royal Sweet</td>
<td>Seeded; edible</td>
</tr>
<tr>
<td>Sangria</td>
<td>Seeded; edible</td>
</tr>
<tr>
<td>Companion</td>
<td>Special pollinizer</td>
</tr>
<tr>
<td>Pinnacle</td>
<td>Special pollinizer</td>
</tr>
<tr>
<td>Sidekick</td>
<td>Special pollinizer</td>
</tr>
</tbody>
</table>

Should I use transplants?

Early start; uniform seed germination
Cucurbits (cucumbers, pumpkins, squash)
- Do not like their root systems disturbed
- Be very careful while handling transplants

Hardening off

Any problem in these transplants?
Site Selection
(warm is the key)

- Sandy to clay loam
- Must be well-drained
- pH = on the lower end (5.5 – 6.0)
- Ideal = sandy loam: dries out early and warms up faster in the spring.
- Slope = to the south. A 20 degree slope absorbs 6% more heat than level.

CLIMATIC REQUIREMENTS

- Warm season crop
- Optimum temperature 80-85°F
- Temp. above 92°F or below 60°F slow down growth. Also implicated in bitterness (but not proven)
- Can be grown on wide range of soil (Sandy or organic soils)
- pH 6 to 7 ideal

Land preparation

On plastic mulch
- Cucumber, squash
- Earliness
- Weed control
- High yield and quality
- Low fertilizer and water use
PUMPKIN
2-3' between plants
7-8' between rows

Summer Squash
2' between plants
7' between rows

18" between plants
5' between rows (outside)

18" between plants
3' between rows (high tunnel)
CULTURAL PRACTICES

Fertilization

- Cucurbits respond well to fertilizers (75 to 150 lb/A)
- Amount of fertilizer depend on soil type and fertility
- Too much Nitrogen favors vegetative growth
- Split application of N recommended
  - 50% close to planting
  - 50% side dressed in several applications at vining
- Over 40 lbs/A side dressed once may damage the roots

Nutrient recommendation

<table>
<thead>
<tr>
<th>Nutrient concentration(s) from soil test</th>
<th>Status</th>
<th>Fertilizer needed (lb/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorus (ppm)</td>
<td></td>
<td>Phosphate (P₂O₅)</td>
</tr>
<tr>
<td>Less than or equal to 15</td>
<td>Low</td>
<td>150</td>
</tr>
<tr>
<td>16 - 30</td>
<td>Medium</td>
<td>100</td>
</tr>
<tr>
<td>31 - 50</td>
<td>High</td>
<td>50</td>
</tr>
<tr>
<td>51 and higher</td>
<td>Very High</td>
<td>0</td>
</tr>
<tr>
<td>Potassium (ppm)</td>
<td>Potash (K₂O)</td>
<td></td>
</tr>
<tr>
<td>Less than or equal to 80</td>
<td>Low</td>
<td>150</td>
</tr>
<tr>
<td>81 – 140</td>
<td>Medium</td>
<td>100</td>
</tr>
<tr>
<td>141 - 200</td>
<td>High</td>
<td>75</td>
</tr>
<tr>
<td>201 and higher</td>
<td>Very High</td>
<td>50</td>
</tr>
<tr>
<td>Organic matter (%)</td>
<td>Nitrogen (N)</td>
<td></td>
</tr>
<tr>
<td>Less than or equal to 3%</td>
<td>Low</td>
<td>100</td>
</tr>
<tr>
<td>3.1 – 19.0</td>
<td>Medium</td>
<td>80</td>
</tr>
<tr>
<td>19.1 and higher</td>
<td>High</td>
<td>60</td>
</tr>
</tbody>
</table>

Sample N fertilization management schedule

<table>
<thead>
<tr>
<th>Total amount of N for the season:</th>
<th>Pre-plant fertilization can be done using urea, UAN, ammonium sulfate, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-plant</td>
<td>50 lb/A</td>
</tr>
<tr>
<td>Fertigation amount:</td>
<td>50 lb/A</td>
</tr>
<tr>
<td>Number of weeks of fertigation:</td>
<td>8 weeks</td>
</tr>
<tr>
<td>(muskmelon)</td>
<td>(watermelon)</td>
</tr>
<tr>
<td>Amount of N needed per week:</td>
<td>6.3 lb/A (muskmelon)</td>
</tr>
<tr>
<td></td>
<td>4.2 lb/A (watermelon)</td>
</tr>
</tbody>
</table>

Pre-plant fertilization can be done using urea, UAN, ammonium sulfate, etc.
- Fertigation is commonly done using calcium or potassium nitrate.
- Fertigation should begin about two weeks after transplanting or when vines begin to "run".
**Irrigation**

- An important cultural factor that determines yield and quality.
- Watermelon may get by without irrigation due to deep tap root system.
- Muskmelons benefit greatly from supplemental irrigation.
- Cucumber requires large amounts of water (1-2” per week).

**When to irrigate? Moisture sensors**

**Tensiometers:**
- Water in plastic tube with porous ceramic tip.
- Vacuum above water column is measured.
- As soil dries, greater tension.

**Watermark Soil Moisture Meter**

- $279
- $39
Weed Management

- There are several herbicides that are labeled for use in cucumber crop production

<table>
<thead>
<tr>
<th>Pre-emergent broadleaves</th>
<th>Halosulfuron (Sandia®) and Imazosulfuron (League®)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-emergent grasses</td>
<td>OCPA (Dacthal®) and Bensulide (Prefar®)</td>
</tr>
<tr>
<td>Pre-emergent broadleaves and grasses</td>
<td>s-metolachlor (Dual II Magnum®), pendimethalin (Prowl H2O®), trifluralin (Trifluralin®), clomazone (Command® 3ME), and ethafluralin + clomazone (Strategy®)</td>
</tr>
<tr>
<td>Post emergence grasses</td>
<td>Sethoxydim (Poast®) and Clethodim (Select Max®)</td>
</tr>
</tbody>
</table>

Organic methods of weed suppression

Major pest and diseases

**Insects:**
1. Cucumber beetle
2. Squash vine borer
3. Squash bug

**Diseases:**
1. Bacterial wilt – Could be devastating; plant is infected then no control; spread by cucumber beetles
2. Downy mildew
3. Anthracnose
4. Powdery mildew
**Active ingredient** | **Chemical class** | **Insecticide**  
--- | --- | ---  
Imidacloprid | Neonicotinoid | Admire Pro®, Gaucho®, Genesis®  
Thiamethoxam | Neonicotinoid | Actara®, Platinum®  
Acetamiprid | Neonicotinoid | Assail®  
Cyfluthrin | Pyrethroid | Baythroid XL®, Asana XL®  
Esfenvalerate | Pyrethroid | Asana XL®  
Zeta cypermethrin | Pyrethroid | Mustang Maxx®  
Permethrin | Pyrethroid | Ambush®, Pounce®  
Spinosad | Spinosyn | Entrust®, Spintor®  
*Bacillus thuringiensis* | Bacterium | Dipel®, Javelin®

---

**Squash Bug**

*Simple Life Cycle*

*Sucking Mouthparts*

---

**Squash Bug**

*Remove eggs*
*Treat when eggs begin to hatch.*

*Large nymphs and adults are difficult to control.*

*Most of the same insecticides as for Cucumber Beetles*
Squash Vine Borer

Clearwing moth
Complete life cycle
Overwinter as pupae in soil
Moths appear in mid-June
Eggs laid at base of plant

Spray when moths are flying to prevent caterpillar attack
Most of the same insecticides as for cucumber beetles

Squash Vine Borer

Larvae tunnel in vines
Wilting or death
Holes & frass
Larvae in squash

Downy mildew

- *Pseudoperonospora cubensis*

- Management
  - Resistance
  - Fungicides
Anthracnose

- Foliar disease
  - Colletotrichum lagenarium
- Overwinters in residue
- High relative humidity and temperature
- Control
  - Resistance
  - Rotation
  - Fungicides

Angular leaf spot

- Similar to anthracnose
- Bacterial
- Management
  - Resistance
  - Copper sprays

The most effective ways of combating disease is the use of crop rotation, disease-free seed, resistant cultivars, pesticide rotation, sanitation, and regular scouting.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Crops Affected</th>
<th>Rotation years required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common blight</td>
<td>Beans</td>
<td>3-8</td>
</tr>
<tr>
<td>Alternaria leafspot</td>
<td>Cole crops</td>
<td>many</td>
</tr>
<tr>
<td>Black rot</td>
<td>Cole crops</td>
<td>&gt;9</td>
</tr>
<tr>
<td>Damping off</td>
<td>Cole crops</td>
<td>6-10</td>
</tr>
<tr>
<td>Fusarium yellowblight</td>
<td>Cole crops</td>
<td>-</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>Cole crops, cucurbits</td>
<td>no</td>
</tr>
<tr>
<td>Bacterial leaf spot</td>
<td>Cucurbits</td>
<td>yes</td>
</tr>
<tr>
<td>Angular leaf spot</td>
<td>Cucurbits</td>
<td>&gt;2</td>
</tr>
<tr>
<td>Anthracnose</td>
<td>Cucurbits</td>
<td>&gt;2</td>
</tr>
<tr>
<td>Downy mildew</td>
<td>Cucurbits</td>
<td>&gt;2</td>
</tr>
<tr>
<td>Verticillium nelsonii</td>
<td>Cucurbits</td>
<td>-</td>
</tr>
<tr>
<td>Rotovirus leaf blight</td>
<td>Cucurbits</td>
<td>-</td>
</tr>
<tr>
<td>Bell rot</td>
<td>Cucumber</td>
<td>&gt;2</td>
</tr>
<tr>
<td>Rhytismatos rot</td>
<td>Cucumber</td>
<td>-</td>
</tr>
<tr>
<td>Gray leaf blight</td>
<td>Cucumber</td>
<td>&gt;2</td>
</tr>
</tbody>
</table>

Adapted from Mary Peet, NC State
http://www.cals.ncsu.edu/sustainable/peet/IPM/diseases/table15.html
Cucumber and Squash Harvest

- Hand and multiple harvests
- If fruit not harvested, new fruit are inhibited
- May be harvested every 2 days during the summer

Winter Squash Harvest

- Hand and one to two harvests
- Mature fruit
- Ground spot yellow as an indicator (acorn squash)
- Quality improves with maturity
- Avoid exposure to hard frost in the field – shortens storage and reduces quality

Pumpkin Harvest

Muskmelon Ripeness:

- The vine attachment separates from the fruit easily at maturity, referred to as "slip" – used for melons to be eaten right away.
- When some pulling or help is needed, referred to as "half-slip" – used for melons to be shipped or stored.
- Ripening can continue off the vine, but flavor and or sweetness is not usually as good as vine ripened.
Watermelon Ripeness

- The tendril on the vine nearest where the fruit attaches browns or dies.
- The spot where the melon rests on the ground turns yellow.
- A hollow or “punk” sound as opposed to a “pink” or “pank” sound when thumped with a finger.

Curing winter squash and pumpkins

- After harvest, cure at 80-85 F; 80-90% RH for 10 days
- Heals wounds, after-ripening
- Prolongs storage time
- Do not cure acorn squashes; detrimental; they lose quality

Optimal Storage Conditions

<table>
<thead>
<tr>
<th>Non-Chilling sensitive (store at ~ 32F)</th>
<th>Chilling sensitive (store at ~ 50F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>Beans, snap</td>
</tr>
<tr>
<td>Broccoli</td>
<td>Eggplant</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Peppers</td>
</tr>
<tr>
<td>Carrots</td>
<td>Potato</td>
</tr>
<tr>
<td>Celery</td>
<td>Cucumber</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Summer squash</td>
</tr>
<tr>
<td>Peas</td>
<td>Sweet potato</td>
</tr>
<tr>
<td>Spinach</td>
<td>Tomato</td>
</tr>
<tr>
<td>Radishes</td>
<td>Muskmelon</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>Watermelon</td>
</tr>
<tr>
<td>Sweet corn</td>
<td>Winter squash</td>
</tr>
<tr>
<td>Onions</td>
<td>Pumpkin</td>
</tr>
</tbody>
</table>

Relative storage lengths

- C. pepo: Acorn
  - 1-2 mo storage
- C. moschata: Butternut
  - 2-6 mo storage
- C. maxima: Buttercup
  - 6+ mo storage
Official vegetable of Iowa

1. Pumpkin ✓
2. Sweet corn
3. Cucumber
4. Watermelon

Acknowledgements

Brandon Carpenter
Dana Jokela
Jennifer Tillman
Ray Kruse
Kristine Neu
John-Krzton Presson
Moriah Bilenky
Pete Lawlor
Nick Howell
Vince Lawson

Contact
Dr. Ajay Nair
Email: nairajay@iastate.edu
Phone: 515-294-7080

Updates:
http://iowavegetables.blogspot.com
www.extension.iastate.edu/vegetablelab

It's a balancing act!