Spinach Seed Production in the Pacific Northwest USA

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# Global Spinach Seed Production

<table>
<thead>
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<tbody>
<tr>
<td>Denmark</td>
<td>&gt;7,000</td>
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<tr>
<td>USA (OR, WA)</td>
<td>1,500-2,000</td>
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<tr>
<td>Holland</td>
<td>500</td>
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<tr>
<td>Italy</td>
<td>250</td>
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<tr>
<td>France</td>
<td>220</td>
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<tr>
<td>New Zealand</td>
<td>400</td>
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<tr>
<td>Chile</td>
<td>20</td>
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<td>China (Asian markets)</td>
<td>LOTS! (mostly Asian types, including <em>Tetragonia</em> spp.)</td>
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1 ha hybrid spinach seed crop

~10 ha baby leaf spinach crop
Spinach Seed Production in USA
Crop Profile for Spinach Seed Crops in Washington State
http://www.ipmcenters.org/cropprofiles/docs/waspinachseed.html
www.seedalliance.org
Seed crop isolation
Criteria for the spinach seed industry

- trueness-to-type (genetically)
- seed germination
- seed vigor
- pathogen-free seed
- no weed seed/debris
- cost of production - US$, labor
- resistance to races of downy mildew
Grower expenses/returns

- by contract only, company dependent
- expenses:
  - WA: ~$1,400-$1,600/acre
  - OR: higher (irrigation needed)
- seed production costs increased 4x
- price of competing crops
- growers paid: $1.80-$2.00/lb seed
- yields variable based on parent lines
  - earlier bolting lines similar in DK & US
  - later bolting lines less yield in US vs. DK
March-April

Plow, mulch, fertilize; then limestone applied/incorporated

RoNeet (cycloate) herbicide applied/incorporated
Late Mar. - mid-May: Planting, in-furrow fertilizer, granular insecticide
Planting spinach stock seed

- Treated seed: mefenoxam + thiram or Farmore 300 (mefenoxam + fludioxonil + azoxystrobin); now also thiophanate-methyl or thiabendazole (Fusarium and Verticillium wilts)
- Insecticides: craneflies, springtails
  - carbofuran no longer used
- Male:female ratio, staggered planting male rows
- OP crops = smaller-scale, organic seed crops
- Stock seed priming:
  - cold imbibing to change daylength response
  - nicking of male & female rows
  - reduce % inbred seed
  - cannot store seed > 3 months
Spinaid (phenmedipam) at 2-4 true leaf stage

Other herbicides:
- Nortron (ethofumesate)
- Dual Magnum (S-metolachlor)
- Fusilade (fluazifop-P-buty1)
- Asulox (asulam)

Cultivate, side-dress (27-0-0) or top-dress (CaNO₃)
Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties up to $7,500.

In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action by WSDA and/or the U.S. Food and Drug Administration.

It is your responsibility to check the label before using the product to ensure lawful use and obtain all necessary permits in advance.
Rogue off-types & males in female rows: 3-7x/crop

Fungicide applications: leaf spots, downy mildew; early anthesis, preceding rains
Fusarium Wilt

Fusarium oxysporum f. sp. spinaciae
Spinach Fusarium Wilt Soil Bioassay & Parent Line Screen
Offered every winter since 2009-2010, >350 fields tested
$200/field, $75/parent line

Risk assessment: Spinach Fusarium wilt

Partially resistant line
Moderately-susceptible line
Susceptible line

A. 2009–10 bioassay

B. 2010–11 bioassay
Verticillium wilt
Leaf spot fungi

*Cladosporium variabile*

*Stemphylium botryosum*

Photo by M.L. Derie
Downy mildew
Cucumber mosaic virus

Influence of parent line on rate of seed transmission

du Toit et al., 2007. Phytopathology 97:530
Aphids (vector viruses)
Root aphids

Leafminer

Thrips

Lygus bugs

Others: springtail, cranefly, cutworm, armyworm, looper
Windrowing

Combining
Integrated spinach seed crop disease management in the PNW USA

- Rotation of 10 to >15 years, bioassay for risk assessment
  - for Fusarium wilt, Verticillium wilt
  - resistance of parent lines in previous crops
  - biofumigant cover crops or soil amendments
    - agricultural limestone: 1-2 tons/acre, several years
- Clean stock seed:
  - assay for fungi & CMV, seed treatment combinations
- Susceptibility of parent lines
- Orientation of rows in primary wind direction
- Fertilizers: ammonium vs. urea, foliar feeds
- Fungicides: timing (anthesis & rains), modes of action, organic & conventional
- Scouting & rogueing, accurate diagnoses
- Management of crop residues & volunteers
- Testing of harvested seed (quality and health assays)