



Onion ipmPIPE - Diagnostic Pocket Series

Bulb Growth Stages of Onion (*Allium cepa* L.)



Fig 1



Fig 2



Fig 3



Fig 4



Fig 5



Fig 6



Fig 7



Fig 8

Onion ipmPIPE Diagnostic Pocket Series

Bulb Growth Stages of Onion – *Allium cepa* L.

AUTHOR: H. F. Schwartz (Colorado State University) and C. S. Cramer (New Mexico State University)

PHOTOGRAPHS: Courtesy of H. F. Schwartz

01/2011

Onion



ipmPIPE
PEST INFORMATION PLATFORM
FOR EXTENSION & EDUCATION

ADDITIONAL RESOURCES AVAILABLE AT:

<http://onion.ipmPIPE.org>

<http://wiki.bugwood.org/PIPE:Onion>

<http://www.apsnet.org/> -

Compendium of Onion & Garlic Diseases and Pests, 2nd Ed.

Allium Type: Fresh Market and Storage Onion

Both pre- and post-bulb production are technically vegetative growth phases that occur during the first cycle of growth after planting (seeds, transplants, sets).

Pre-Bulb Growth Stages

1 – radical and flag leaf emergence (10-30 days post seeding)

[Fig. 1]

2 – one to two true leaves (30-50 days p.s.)

3 – three to four leaves (50-70 days p.s.) [Fig. 2]

4 – five to seven leaves (70-90 days p.s.) [Fig. 3]

5 – eight to 12 leaves, bulb initiation (90-110 days p.s.) [Fig. 4]

Post-Bulb Growth Stages

6 – bulb diameter of 2.5 to 4.0 cm (110 to 130 days p.s.)

7 – bulb diameter of 4.0 to 7.5 cm (130 to 150 days p.s.) [Fig. 5]

8 – bulb diameter greater than 7.5 cm (150 – 170 days p.s.)

9 – bulb enlargement complete, greater than 50% cropped to dry down (more than 170 days p.s.) [Fig. 6]

Reproductive Stages do not technically begin until the second cycle of growth after vernalization of the mature bulb; the bulb will then produce a scape or seed stalk [Fig. 7] and umbel [Fig. 8] which produces true seed after fertilization.

Sponsored in Part by:

MONSANTO





Onion ipmPIPE - Diagnostic Pocket Series

Storm Damaged Onions (*Allium cepa* L.)



Fig 1



Fig 2



Fig 3



Fig 4

Onion ipmPIPE Diagnostic Pocket Series

Storm Damaged Onions – *Allium cepa* L.

AUTHORS: H. F. Schwartz (Colorado State University)

PHOTOGRAPHS: Courtesy of H. F. Schwartz 01/2011



ADDITIONAL RESOURCES AVAILABLE AT:
<http://onion.ipmpipe.org>
<http://wiki.bugwood.org/PIPE:Onion>
<http://www.apsnet.org/> -
Compendium of Onion & Garlic Diseases and Pests, 2nd Ed.

Allium Type: Fresh Market and Storage Onion; protocols based on National Crop Insurance Standards; compare damaged and non-damaged portions of field or fields of the same variety, plant age

_____ Record Stage of Plant Growth (V1 to R9)
_____ Record Dates of planting, storm event(s), evaluation

_____ **Estimate Plant Stand Loss (number/acre) [Fig. 1]**
Measure number of plants between furrows (bed width) by 10 – 20 ft = 1/1000 Acre at 5 to 6 representative sites in the affected area or field

_____ **Estimate Defoliation (percent loss) [Fig. 2 &3]**
Estimate percent of foliage damaged (bruised) or removed by the storm activity (10 – 20 ft x 1 bed wide at 5 to 6 sites)

_____ **Estimate Bulb Damage (percent affected) [Fig. 4]**
Evaluate percent of 50-100 bulbs at 5 to 6 sites for evidence of storm damage (as cuts, nicks, dents, bruises) on exposed outer 2-3 fleshy scales

Sponsored in Part by:



Onion ipmPIPE Diagnostic Pocket Series

Sponsored in part by:



Onion Insect Pests



Fig 1



Fig 2



Fig 3



Fig 4



Fig 5



Fig 6



ADDITIONAL RESOURCES AVAILABLE AT:
<http://www.alliumnet.com/http://onion.ipmpipe.org>
<http://wiki.bugwood.org/PIPE:Onion>
Compendium of Onion & Garlic Diseases and Pests, 2nd Ed.

Onion ipmPIPE Diagnostic Pocket Series

Onion Insect Pests – Thrips (*Thrips tabaci*, *Franklinella* species), Maggots (*Delia antiqua*, *D. platura*), Leafminers (*Liriomyza* species)

AUTHORS: B. Nault (Cornell University), W. Cranshaw (Colorado State University) & D. Alston (Utah State University)

PHOTOGRAPHS: Courtesy of B. Nault & J. Ogradnick (Cornell Univ.), and W. S. Cranshaw & H. F. Schwartz (Colorado State Univ.) 01/2011

Common Hosts: Onion, Garlic

Symptoms (on Onion):

Figures 1 & 2 – Thrips (onion, western flower) feed primarily on leaves reducing bulb growth. Larvae are 0.5-1 mm (0.02-0.04 inch) long, yellow and elongate (cigar-shaped). Adults (2 mm or 0.8 inch) are winged and darker (gray to brown) in color. Onion thrips transmit *Iris yellow spot virus* (IYSV).

Figures 3 & 4– Maggot larvae tunnel in roots, seedlings and young bulbs causing reduced stands and stunted plants. Larvae are cream colored and legless (8 mm or 0.3 in long). Adults are brownish gray flies (10 mm or 0.4 in) similar in appearance to a housefly.

Figures 5 & 6 – Leafminers are the larvae of small flies that make meandering tunnels under the surface of onion (and other crop) leaves. Flies are small (1.5 – 2 mm or less than 0.08 inch), and yellow and black. Larvae are pale-colored maggots found only within the leaf mines, and may have pale green or yellow coloration as they become full grown.

Factors Favoring:

- High temperatures greater than 30°C (86°F) favor thrips, while lower temperatures favor maggots.
- Moisture stress (drought) also favors thrips; while excess moisture favors maggots.
- These insect pests are favored by frequent cropping to Alliums (every 3 – 4 years), early-season planting; and variable plant density (thrips).



Onion ipmPIPE Diagnostic Pocket Series

Sponsored in part by:



Soil-Borne Diseases



Fig 1



Fig 2



Fig 3



Fig 4

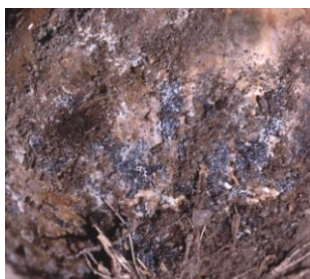


Fig 5

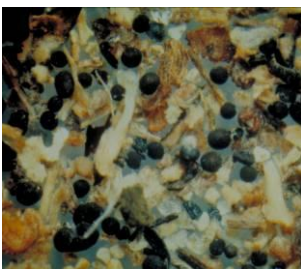


Fig 6

Onion ipmPIPE Diagnostic Pocket Series

Soil-Borne Diseases – Fusarium Basal Rot (*Fusarium oxysporum f. sp. cepae*), Pink Root (*Phoma terrestris*), White Rot (*Sclerotium cepivorum*)

AUTHORS: H. F. Schwartz and N. A. Tisserat (Colorado State University)

PHOTOGRAPHS: Courtesy of H. F. Schwartz, S. K. Mohan (Univ. of Idaho) and F. J. Crowe (Oregon State University-retired) 01/2011

Common Hosts: Onion, Garlic

Symptoms (on Onion):

Figures 1 & 2 – Fusarium basal rot appears as yellow and tan to brown leaves, usually beginning at the leaf tips and developing downward. Plants may wilt and then die; infected bulbs appear discolored (tan to brown) and roots and basal plates are rotted.

Figures 3 & 4 – Pink root appears as discolored roots (yellow to brown to red to purple); infected roots may disintegrate. Leaf number and bulb size may be reduced by severe infection.

Figures 5 & 6 – White rot appears as yellowing and dying of older leaves, stunting of plants, and death of foliage. Infected roots will exhibit white, fluffy mycelium on the basal plate with presence of small, poppy-sized brown to black sclerotia in and on tissues.

Factors Favoring:

- Temperatures greater than 28°C (82°F) during late vegetative to mid bulbing stages favor infection by Fusarium basal rot and pink root; while white rot is favored by lower temperatures.
- Moisture stress (deficiency or excess) may predispose the crop to infection by Fusarium and pink root.
- These soil-borne diseases are favored by frequent cropping to Alliums (every 3 – 4 years), planting of contaminated transplants and sets of susceptible varieties, and injury to roots by cultivation and insect feeding.

Onion



ipmPIPE
PEST INFORMATION PLATFORM
FOR EXTENSION & EDUCATION

ADDITIONAL RESOURCES AVAILABLE AT:

<http://onion.ipmPIPE.org>

<http://wiki.bugwood.org/PIPE:Onion>

<http://www.apsnet.org/> -

Compendium of Onion & Garlic Diseases and Pests, 2nd Ed.

Onion ipmPIPE Diagnostic Pocket Series

Sponsored in part by:



Virus Diseases



Fig 1



Fig 2



Fig 3



Fig 4

Onion



ipmPIPE
PEST INFORMATION PLATFORM
FOR EXTENSION & EDUCATION

ADDITIONAL RESOURCES AVAILABLE AT:

<http://onion.ipmPIPE.org>

<http://wiki.bugwood.org/PIPE:Onion>

<http://www.apsnet.org/> -

Compendium of Onion & Garlic Diseases and Pests, 2nd Ed.

Onion ipmPIPE Diagnostic Pocket Series

Virus Diseases – IYSV (*Iris yellow spot virus*), OYDV (*Onion yellow dwarf virus*), Garlic Mosaic (OYDV, *Leek yellow stripe virus*)

AUTHOR: H. R. Pappu (Washington State University)

PHOTOGRAPHS: Courtesy of H. R. Pappu, Agri-Food Canada and R. M. Davis (APS Onion & Garlic Compendium) 01/2011

Common Hosts: Onion, Garlic

Symptoms (on Onion):

Figures 1 & 2 – IYSV symptoms include dry, straw-colored, diamond-shaped lesions on leaves and scapes. Lesions often develop on the margins of the youngest, fully developed leaves or the swollen part of the scape. Lesion centers may have a green or concentric ring of green and white tissue. Lesions may coalesce, cause tip blight and extensive death of foliage and lodging of scapes.

Figure 3 – OYDV appears as yellow streaks at the bases of leaves which may crinkled, flattened, and fall over. Scapes may show extensive yellowing, twisting and curling with small flower heads and poor quality seed.

Figure 4 – Garlic Mosaic appears as a mild to strong mosaic, chlorotic mottling, striping and streaking of leaves. Infected plants are stunted.

Factors Favoring:

- High temperatures greater than 30°C (86°F) may stress plants and favor pests and IYSV vectors like thrips.
- Moisture stress (drought) also favors thrips which in turn may aggravate IYSV if present in the region.
- Viral diseases are affected by planting of contaminated transplants and sets; insect vectors like onion and tobacco thrips (IYSV) and aphids (OYDV, Garlic Mosaic); variable plant stands; and plant stress (fertility, moisture, temperature).

Onion ipmPIPE Diagnostic Pocket Series

Sponsored in part by:



Foliar Fungal Diseases



Fig 1



Fig 2



Fig 3



Fig 4



Fig 5



Fig 6

Onion ipmPIPE Diagnostic Pocket Series

Foliar Fungal Diseases – Purple Blotch (*Alternaria porri*), Powdery Mildew (*Leveillula taurica*), Downy Mildew (*Peronospora destructor*), Botrytis Diseases (*Botrytis*)

AUTHORS: S. K. Mohan (Univ. of Idaho), M. K. Hausbeck (Michigan State University) and N. A. Tisserat (Colorado State University)

PHOTOGRAPHS: Courtesy of S. K. Mohan and H. F. Schwartz 01/2011

Common Hosts: Onion, Garlic

Symptoms (on Onion):

Figure 1 – Purple blotch may appear on leaves or seed stalks as small, water-soaked lesions that develop white centers. The lesion margin is a shade of red or purple, surrounded by a yellow zone that may extend 1 inch [2.5 cm] or larger. Lesion centers may contain brown to dark gray spores of the fungus.

Figure 2 – Powdery mildew includes circular to oblong, white to grayish white patches of fungal growth with irregular margins; often after initiation of bulbing.

Figures 3 & 4 – Downy mildew commonly starts in spots in a field and spreads to surrounding areas. Initial symptoms appear as pale, elongate patches that turn light tan to brown on the foliage, affected leaf or seed stem tissues during moist periods.

Figures 5 & 6 – Botrytis (blast, leaf blight) may appear as a small white, sunken, elliptical lesion (less than 1/8 inch or 2 mm) with necrotic center. Multiple lesions may develop on the leaf, and cause a tip die-back and blighting of the leaf.

Factors Favoring:

- Most of these fungi are favored by temperatures below 27°C (80°F); but can be active up to 32°C (90°F).
- These pathogens are favored by free moisture and high humidity (greater than 75%) during production and pre-harvest.
- These foliar diseases are favored by frequent cropping to Alliums (every 3 – 4 years), planting of contaminated seed (Botrytis), transplants and sets of susceptible varieties; high plant density; and storms.

Onion



ipmPIPE
PEST INFORMATION PLATFORM
FOR EXTENSION & EDUCATION

ADDITIONAL RESOURCES AVAILABLE AT:

<http://onion.ipmPIPE.org>
<http://wiki.bugwood.org/PIPE:Onion>
<http://www.apsnet.org/> -

Compendium of Onion & Garlic Diseases and Pests, 2nd Ed.



Onion ipmPIPE Diagnostic Pocket Series

Sponsored in part by:

MONSANTO



Bacterial Diseases



Fig 1



Fig 2



Fig 3



Fig 4



Fig 5



Fig 6

Onion ipmPIPE Diagnostic Pocket Series

Bacterial Diseases – Xanthomonas Leaf Blight (*Xanthomonas axonopodis* pv. *allii*), Slippery Skin (*Burkholderia gladioli* pv. *alliiicola*), Sour Skin (*B. cepacia*), Center Rot (*Pantoea ananatis*), Enterobacter Bulb Decay (*Enterobacter cloacae*), Soft Rots (*Dickeya chrysanthemi*, *Pectobacterium carotovorum* subsp. *carotovorum*)

AUTHORS: B. K. Schroeder (Washington State University) and H. F. Schwartz (Colorado State University)

PHOTOGRAPHS: Courtesy of H. F. Schwartz, L. J. du Toit and B. K. Schroeder

01/2011

Common Hosts: Onion, Garlic

Symptoms (on Onion Leaves and Bulbs):

Figure 1 – Xanthomonas leaf blight lesions appear as irregularly shaped, white flecks, pale spots, or lenticular lesions with water-soaked margins. Lesions enlarge, become tan to brown, cause extensive water-soaking, dieback and blighting of foliage, but bulb infection.

Figure 2 – In the field, early stages of bacterial leaf infection will appear as watersoaking along the entire length of the leaf; **Figure 3** – later stages appear bleached (white to tan) and desiccated. No fungal structures will be present.

Figure 4 – Soft rot may appear in the field or in storage as water-soaked tissue of leaves, neck and/or bulb; usually progressing from leaves to the neck to the bulb. The interior of the bulb may break down and a watery, foul-smelling liquid may ooze from the neck if the affected bulb is squeezed.

Figure 5 – Bacterial bulb infection can be observed while plants are in the field or in storage. Softening of the neck may be observed and bulb tissue may appear translucent or water-soaked.

Figure 6 – Enterobacter bulb decay appears firm and healthy until cut to expose interior scales which are brown, soft and rotten; progressing downward from the neck.

Factors Favoring:

Most bacteria are favored by:

- Harvest and storage temperatures above 30°C (86°F); some are favored by lower temperatures.
- Free moisture and high humidity (greater than 75%) during production and harvest.
- Planting of contaminated seed, transplants, sets
- Irrigation water; storm damage; excess nitrogen after bulb initiation; insects like thrips and maggots; and bruising during harvest.

Onion



ipmPIPE
PEST INFORMATION PLATFORM
FOR EXTENSION & EDUCATION

ADDITIONAL RESOURCES AVAILABLE AT:

<http://onion.ipmPIPE.org>

<http://wiki.bugwood.org/PIPE:Onion>

<http://www.apsnet.org/> -

Compendium of Onion & Garlic Diseases and Pests, 2nd Ed.

Onion ipmPIPE Diagnostic Pocket Series

Sponsored in part by:



Storage Fungal Diseases



Fig 1



Fig 2



Fig 3



Fig 4



Fig 5



Fig 6

Onion



ADDITIONAL RESOURCES AVAILABLE AT:

<http://onion.ipmPIPE.org>

<http://wiki.bugwood.org/PIPE:Onion>

<http://www.apsnet.org/> -

Compendium of Onion & Garlic Diseases and Pests, 2nd Ed.

Onion ipmPIPE Diagnostic Pocket Series

Storage Fungal Diseases – Black mold (*Aspergillus niger*), Blue mold (*Penicillium* species), Gray mold or neck rot (*Botrytis* species), Fusarium rot (*Fusarium oxysporum* f. sp. *cepae*)

AUTHORS: L. J. du Toit (Washington State University) and H. F. Schwartz (Colorado State University)

PHOTOGRAPHS: Courtesy H. F. Schwartz, L. J. du Toit, and S. K. Mohan (University of Idaho) 01/2011

Common Hosts: Onion, Garlic

Symptoms (on onion):

Figures 1 & 2 – Black mold develops as black discoloration (usually at the neck), shallow lesions on outer scales, streaks of black mycelium and conidia beneath the outer dry scales, and black discoloration in bruised areas. Bulbs usually do not rot, unless secondary bacterial infection occurs.

Figures 3 & 4 – Gray mold (neck rot) develops as a semi-watery decay, usually in the neck, that progresses down through the bulb. Fleшы scales soften and become water-soaked and translucent, with white to gray mycelium between scales. Gray to black sclerotia and gray mold may form on outer and inner scales.

Figure 5 – Blue mold first appears as pale yellow blemishes, watery soft spots, and occasionally purple-red stain on scales. A green to blue mold may develop on the surface of lesions, there may be a light tan or gray color on the fleshy scales, and bulbs may become tough (punky) with a musty odor.

Figure 6 – Fusarium basal rot starts in the field and can progress in storage from a dry basal plate rot to a dry rot of the fleshy scales.

Factors Favoring:

- Black mold is favored by harvest and storage >24°C (75°F); blue and gray molds, and Fusarium basal rot are favored by lower temperatures.
- These diseases are favored by free moisture and high humidity (>75%) during harvest and storage.
- These diseases are also favored by planting infected seed, transplants or sets; crop injury; and bruising of bulbs.