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Common Pumpkin Diseases in Virginia: A Diagnostic Guide

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Introduction

According to the 2017 US Census of Agriculture, Virginia ranks in the top ten for pumpkin production by state in the US. This follows a trend which can be seen through the 2007, 2012, and 2017 Census data on pumpkin production in the Commonwealth. In 2007, a total of 2,075 acres of pumpkins were harvested. In 2012, that number increased by 11.3% to 2,310 acres. By 2017, a total of 3,184 acres of pumpkins were harvested, an increase of 37.8% from 2012. Note also that in each of these census years, 95-99% of pumpkin production in Virginia was for the fresh market, with the other small percentage used for processing. The pumpkin sector is also of significant monetary value. In 2017, Virginia pumpkin production was valued at over $10.3 million.

At this time, the 2022 Census is still being conducted; however, the USDA does provide survey statistics for the interim years. According to the 2021 State Agriculture Overview for Virginia, pumpkin production was up to 4,700 acres harvested, valued at over $14.8 million. Thus, the indicators continue to show an upward trend in the importance of pumpkin production in VA.

As the pumpkin production trend continues upward, it is all the more important to take extra care in the prevention, identification, and mitigation of common diseases which affect pumpkins in Virginia. This publication is intended to specifically serve as a diagnostic guide, complete with comprehensive symptom identifiers, for some of the key diseases found in VA. Some information will also be given on disease treatment.

The diseases include: Plectosporium Blight, Fusarium Crown and Fruit Rot, Phytophthora Rot, Southern Blight, Cucurbit Downy Mildew, Powdery Mildew, and Viruses.

As with any disease, when prevention fails, early detection is critical. Therefore, it is recommended that growers scout for symptoms within their fields on a regular basis. Taking pictures of symptoms or even carrying a small hand lens are useful practices to aid in identification.

Diagnostic Flow Chart

Below a flow chart is included with some of the basic symptoms of pumpkin diseases. This is meant as a starting point for disease identification and is not intended to be taken as a comprehensive diagnostic tool on its own. It is recommended that growers and agents utilize the chart to first identify possible diseases present in fields based upon the symptom identifiers included. Then, continue below to the detailed information on those diseases in order to more clearly diagnose the issue.

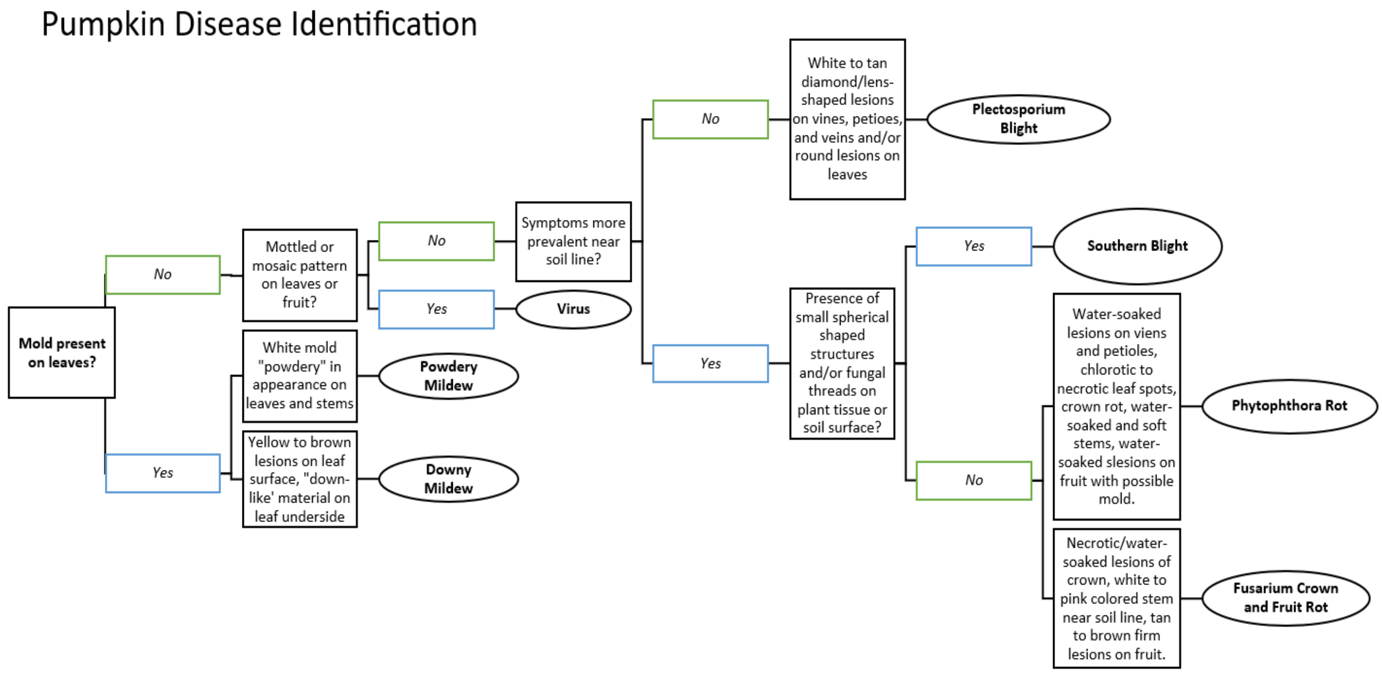

Figure 1. Pumpkin Disease Identification Flow Chart.

Note on Fungicide Recommendations

Information on recommended fungicides can be found in the *Mid-Atlantic Commercial Vegetable Recommendations* (Publication 456-20). This production guide is updated on a biennial basis; so, it is recommended that you access the most up-to-date information through your local extension agent or online through https://www.pubs.ext.vt.edu/456/456-420/456-420.html. The recommendations given below for each disease are current as of the 2022-2023 publication.

Following the fungicide label is law. All users must follow the rates and restrictions given on the label. Any practice inconsistent with label restrictions is in violation of Federal law (Wyenandt, 2022). Users should also pay close attention to FRAC codes and fungicide rotations in order to help prevent fungicide resistance.

Plectosporium Blight

Plectosporium blight, sometimes referred to as white speck or as Plecto for short, is caused by the soil-borne fungus, *Plectosporium tabacinum*. It favors warm, wet weather and can persist in the soil and overwinter in infected crop residues for many years. If little to no controls are used, Plectosporium can cause significant yield loss in cucurbits, such as pumpkins, during particularly wet years. Losses ranging from 50-100% have been observed in no-spray and low-spray fields (Keinath, Wintermantel, & Zitter, 2017, p. 61-62).

Symptoms

While it is good practice to scout for disease in fields on a regular basis, scouting fields 7-10 days following particularly rainy weather is necessary since these conditions favor disease spread.

On pumpkin leaf veins, petioles, and vines, Plectosporium is characterized by small (< 1/4 inch) white to light tan lesions that are typically diamond shaped to lens-shaped (figure 2). On leaves and fruit, the small lesions are typically round (figure 3). With favorable rainy weather, the lesions can coalesce which causes the affected plant tissues to appear white and become brittle (figure 4). Fruit may also have a rusted appearance as a result.

Figure 2. Diamond-shaped lesions on pumpkin petiole caused by a Plectosporium blight infection.

Figure 3. Leaf and mid vein lesions resulted from a Plecto infection.

Note that stems and petioles with severe infections of Plecto can shatter as a result of becoming brittle (figure 5). Yield loss most often results from lesions on the peduncle, or pumpkin stem (Egel, 2018). Additionally, the fruit lesions can allow other pathogens, such as soft rot pathogens, to infect the pumpkin.

Disease Management

The management of Plectosporium blight involves crop rotation, cultural controls, and the use of fungicides. Note that there are no resistant pumpkin varieties available currently.

Research has indicated that no-till production may reduce the incidence of disease. However, remember that Plectosporium persists in the soil and can overwinter on crop residue. Thus, fields should be rotated away from cucurbits for 2-3 years and crop residue plowed down post-harvest to promote decomposition. Wet conditions also favor Plecto; so, ensure there is good air flow in fields and use drip irrigation rather than overhead. If Plectosporium is discovered in fields, fungicide application is necessary (Keinath, Wintermantel, & Zitter, 2017, p. 61-62).

One of the following fungicides should be applied with applications repeated every 7-10 days.

Note, the FRAC Code is given in bold, the main ingredient in parentheses and the rate following.

- **M05** Chlorothalonil 6F (chlorothalonil)- 2.0 to 3.0 pt/A
- **3+11** Quadris Top 1.67SC (difenoconazole + azoxystrobin)- 12.0 to 14.0 fl oz/A
- *Note: Do not apply near apples.*
- **7+11** Pristine 38WG (boscalid + pyraclostrobin)- 18.5 oz/A

Figure 4. Lesions on pumpkin fruit and brittle pumpkin stem resulting from a severe Plecto infection.

Figure 5. Severe Plecto infection on pumpkin vines.

Fusarium Crown and Fruit Rot

Fusarium rot is regularly one of the most common pre-harvest and post-harvest diseases of pumpkins. It is particularly damaging in fields where pumpkins are grown year-to-year with essentially no crop rotation. Once established in a field, the losses due to Fusarium can be high.

Fusarium crown and fruit rot in pumpkins and other cucurbits is primarily caused by the fungal pathogen *Fusarium solani* f.sp. *cucurbitae*. However, Fusarium fruit rot is known to be caused by several other *Fusarium spp.* as well.

Similar to Plectosporium above, Fusarium can persist in the soil and is exacerbated by wet conditions. Additionally, *F. solani* f.sp. *cucurbitae* is seed-borne. Most infections occur in fields prior to harvest. Yet, pumpkin plants and fruit can be affected at any growth stage/age. Plant age, host, environmental factors, pathogen amounts present in the soil or in seeds, and the nature of the pathogen strains (i.e. more or less aggressive) can cause varying symptoms of Fusarium (Babadoost, 2012).

Symptoms

Wilting of plant leaves is often the first symptom noticed with Fusarium infection. Within just a few days, the entire plant could then die, making identification very important.

Pre-Harvest

A distinctive feature of Fusarium infection is the necrotic rot/water-soaked lesions of the crown (where the plant stem meets the roots) and the upper taproot. Near the soil line, the stem may have a white to pink color. The lesions may become darker and girdle the plant causing wilt. The wilt can progress to the leaves and shoots of the plant, causing stunted growth. The affected leaves can become necrotic and dry up, while the vines collapse and die. Plants may grow poorly for a time and then die.

Fruits are also affected at the soil line with the surfaces of the fruit touching the soil developing lesions that are tan to brown in color. These lesions are dry, firm, and sunken and can occur in concentric rings (figure 6). Note, the lesions can remain firm unless another secondary organism infects the fruit (figure 7).

Figure 6. Brown, sunken lesions caused by a Fusarium infection where the pumpkin fruit is touching the soil.

Figure 7. Necrotic rot caused by a Fusarium infection.

Post-Harvest

Similar symptoms can be seen in pumpkin fruits post-harvest. These symptoms are brought on or exacerbated by wounds on the harvested fruit, wet conditions in storage, and improper handling.

Disease Management

Fungicide applications are not effective in managing Fusarium. Therefore, other cultural practices are critical to mitigate losses due to this fungus. As Fusarium persists in the soil, it is best to rotate away from cucurbit crops for at least three years.

Additionally, since Fusarium is also seed-borne, growers should ensure that the seed they purchase is certified disease free. Some fungicide treated seed options may also be available. Growers can choose to grow hard rind cultivars as they are less susceptible to Fusarium than other cultivars. One such variety is Iron Man, which is resistant to both Fusarium and Phytophthora. No-till operations with a thick cover crop mulch layer, such as a winter rye and hairy vetch combination, are known to reduce the incidence of Fusarium. Note with a thicker mulch layer, the reduction in disease incidence will be greater (Keinath, Wintermantel, & Zitter, 2017, p. 29-30).

Phytophthora Rot

Phytopthora rot has been referred to as “one of the most serious threats to production of pumpkins and other cucurbits throughout the world” and can cause total crop loss. Phytophthora rot, referred to as Phytophthora blight in cucurbit infections, is caused by the oomycete *Phytophthora capsici*.

Phytophthora capsici, sometimes referred to as *Pcap*, can not only affect all cucurbits, it is also known to affect peppers, tomatoes, eggplants, snap beans, lima beans, and various weed species. Other than the cucurbits, peppers are particularly susceptible.

Pumpkins can be infected by *Phytophthora capsici* at any stage of development, as well as during transit and storage. Infection of seedlings, vines, leaves, and fruit can all occur, with infection first being apparent in low areas of fields where the soil stays wet for longer periods of time. Disease is typically found with wet conditions, such as extensive rainfall, excess irrigation, or soil that does not drain well, and warm conditions.

Note also that *Phytophthora capsici* can survive in water for extended periods of time. Thus, if *Pcap* contaminates irrigation waters or washes downstream in a river, other areas can become infected as well (Egel, 2018).

Symptoms

Phytophthora can cause damping off in seedlings and in post-emergence plants. Seedlings will develop a watery rot near the soil line that leads to plant death. In mature plants, infection is indicated by crown (where the plant stem meets the roots) rot with the stems turning light to dark brown by the soil line, as well as plant wilt. The stems become water-soaked and soft, while the wilt occurs without a color change in the plant. The wilt starts from the base of the plant and extends out to the ends of the vines. Plant death can occur.

Figure 8. Overall plant wilt caused by Phytophthora.

Pcap can also cause vine blight in which vines develop water-soaked lesions that start as dark olive in color before becoming dark brown in a matter of days. These lesions then girdle the stem, which causes the quick collapse and death of the foliage above the girdle.

Symptoms can occur on leaf petioles with dark brown, water-soaked lesions occurring on them. This can cause petiole collapse and leaf death. Leaf blades may show leaf spots ranging from 0.2 inches to greater than 2 inches in diameter. These spots begin as chlorotic (light green/yellow) spots but transition to necrotic (brown) spots with light to dark green borders. If the conditions become dry, the leaf spots will not expand. However, wet and warm conditions favor the spread of the leaf spots, and they could cover the entire leaf.

Fruit rot caused by infection with *Phytophthora capsici* generally starts on the side of the fruit that is in contact with the soil. Infections beginning on the parts of the fruit can result from contact with infected leaves or vines as well as from rain or overhead irrigation. Note also that rot can occur post-harvest, whether in transit or in storage. The rot starts as water-soaked lesions that expand and then are blanketed in white mold. The rot progresses very quickly and causes the fruit to completely collapse (Keinath, Wintermantel, & Zitter, 2017, p.102-104, 107).

Figure 9. Fruit rot blanketed in white mold from Phytophthora infection, coupled with small lesions from Plectosporium.

Disease Management

While some fungicides are available for use in combatting Phytophthora, cultural methods must also be used as the fungicides will be largely ineffective without them. Note, the Iron Man variety has also been shown to have resistance to Phytophthora, as well as Fusarium.

Cultural Methods

As *Phytophthora capsici* persists in water, fields with well-drained soils should be chosen and areas of the field where water could potentially pool minimized. Using raised beds and black plastic mulch can also be beneficial. However, if black plastic is used, care must be taken to ensure that the plastic is well-fitted to the dome-shaped beds so that water does not pool around the crown of the plant. Opt for drip irrigation rather than overhead irrigation, and never let irrigation water sit in the field. It is also important to monitor irrigation ponds. If a field infected with *Phytophthora capsici* were to drain to an irrigation pond, that water could then carry the pathogen to other fields (Egel, 2018).

Also, utilize crop rotation and rotate away from the susceptible crops listed above for as long as possible, at least four years ideally. Pre-plant fumigants can be used to suppress the disease. When the canopy has closed, also subsoil between the rows to allow for quicker drainage after rain (Wyendant, 2022).

Fungicides
In order to reduce the chances of resistance, fungicides of different FRAC codes should be alternated. Apply the fungicides when conditions are favorable for disease management and make sure to cover the entire plant, stems, foliage, and fruit. The following are fungicide options that have shown activity against *Phytophthora capsici*.

Note, the FRAC code is given in bold, the main ingredient in parentheses and the rate following.

The following should be applied pre-plant for control early in the growing season:

- **4** MetaStar 2E AG (metalaxyl)- 4.0-8.0 pt/A
- **4** Ridomil Gold 4SL (mefenoxam)- 1.0-2.0 pt/A
- **4** Ultra Flourish 2E (mefenoxam)- 2.0-4.0 pt/A
- **4+11** Uniform 3.66SE (mefenoxam + azoxystrobin)- 0.34 fl oz/1000 ft row
- **28** Previcur Flex 6F (propamocarb hydrochloride)- 1/2 pt/A applied with drip irrigation, transplant water, or sprayed onto plant base and soil
- **49+4** Orondis Gold 1.67SC (oxathiapiprolin + mefenoxam)- 28.0-55.0 fl oz/A applied by drip irrigation or furrow

The following are to be tank mixed with fixed copper (unless otherwise noted) and applied when conditions are favorable for disease development:

- **49+40** Orondis Ultra 2.3SC (oxithiapiprolin + mandipropamid)- 5.5-8.0 fl oz/A
- **49+M05** Orondis Opti (oxithiapiprolin + chlorothalonil)- 1.75-2.5 pt/
- **21** Ranman 400SC (cyazofamid)- 2.75 fl oz/A (do not apply with copper; see label)*
- **40+45** Zampro 525SC (dimethomorph + ametoctradin)- 14.0 fl oz/A
- **22** Elumin 4SC (ethaboxam)- 8.0 fl oz/A
- **40** Revus 2.08F (madipropamid)- 8.0 fl oz/A*
- **40** Forum 4.17SC (dimethomorph)- 6.0 fl oz/A
- **43** Presidio 4SC (fluopicolide)- 4.0 fl oz/A*
- **M05+22** Zing! 4.9SC (chlorothalonil + zoxamide)- 36 fl oz/A

*While these three options do show activity against *Phytophthora capsici,* they need to be paired with Ridomil Gold 4SL (mefenoxam), soil fumigation, or resistant cultivar selection.

Southern Blight

Southern blight is caused by the fungus *Sclerotium rolfsii* (recently renamed to *Athelia rolfsii*) and infects a wide host range of plants, more than 500 plant species. Crop loss can occur from this lethal fungus. The fungus survives in soils, on plants and weeds, and in plant debris. Movement of contaminated soils, plants, and plant debris can spread *Athlelia rolfsii*. Additionally, the fungus can persist in the form of hardened sclerotia that may survive for a number of years. Warm and moist conditions are favorable for disease spread.

Symptoms

Southern blight often first manifests as water-soaked lower leaves or water-soaked lesions on lower stems. Plant parts that are in contact with the soil are all susceptible. Plants with Southern blight will turn yellow in color and wilt. This can occur within just days of infection during favorable conditions, meaning moist and warm weather. Rots of pumpkin fruit, as well as crown and root rot can occur.

The sclerotia, which are small (think mustard seed), spherical-shaped structures, are distinctive in Southern blight infections (figure 10). They can be light tan to dark reddish-brown in color. These sclerotia develop on the infected plant tissue and on the soil surface. Mycelia, or fungal threads, can also form thick mats growing from infected tissues out onto the surrounding soil (Keinath, Wintermantel, & Zitter, 2017, p. 107-108).

Figure 10. Pumpkin fruit with distinctive Southern blight sclerotia and mycelia.

Disease Management

Ensure that fields have adequate drainage and airflow between plants to prevent the humid conditions that favor disease spread. Crop rotation, specifically to certain graminaceous crops, can help to reduce the levels of *A. rolfsii* in the soil.

Upon discovery of Southern blight, if the scale of the operation allows, remove all plants, roots included. Also remove a layer of soil, 3 inches deep, from around the affected area. This area should be round with a diameter of 12 inches from the plant to the edge. Begin removing material from the edge of the area and work in towards the plant. Place all of this material in a bag, seal it, and dispose of it in the landfill. If individual plant removal is not feasible, deep plow to more than 4 inches in depth.

Some biological control agents, fumigants, and fungicides are available for the control of Southern blight. However, no specific recommendations are given in the *Mid-Atlantic Commercial Vegetable Recommendations* at this time. As a result, it is best to consult with your local extension office for updated recommendations (Garcia-Gonzalez, 2021).

Cucurbit Downy Mildew

Cucurbit downy mildew, which is caused by a fungus-like oomycete pathogen *Pseudoperonospora cubensis,* or *P. cubenis*, can affect all cucurbit crops. Pumpkins are typically infected with *P. cubenis* clade 1 isolates, rather than clade 2 isolates. Clade 1 isolates do not tend to become as resistant to fungicides as clade 2 isolates, which is good news for pumpkin growers.

The development of downy mildew is favored by high humidity and durations of continued moisture for 6-12 hours. This moisture could come from rain, overhead irrigation, or even morning dews. Cool temperatures of around 60°F can also encourage disease development.

The spores of *P. cubenis* are transmitted by air currents and infected plants. Note that *P. cubenis* only overwinters on plant material in areas with warm weather, such as Florida, and in greenhouse operations. Once present, downy mildew can severely affect plant leaves rapidly, causing them to defoliate and die. This, in turn, can cause sun scald on fruit (Schooley et al., 2013).

As a result of its destructive nature and its ability to spread through air currents, various plant pathologists have teamed up to create a valuable downy mildew monitoring service. Growers can sign up at https://cdm.ipmpipe.org/ for alerts as to where downy mildew has been confirmed and when it may reach their area. This resource can then aid growers in timing their planting and their fungicide schedules (Gugino, Britton, and Keever n.d., 2022).

Symptoms

Cucurbit downy mildew, not to be confused with powdery mildew which is described below, can be identified by the angular-shaped yellow to brown lesions found on the tops of leaves (figure 11 & 12). Note that these lesions are restricted by leaf veins as well; so, the lesions will not cross over the leaf veins. The underside of the leaf may show the lesions covered in dark colored down-like growth, similar to down feathers (figure 13). This is typically seen when conditions are favorable for growth as this downy material is actually clusters of *P. cubenis* spores which then can germinate and spread the pathogen. A 20X hand lens can be used to look at these clusters on the underside of leaves (Quesada-Ocampo, 2018b).

Figure 11. Early stages of yellow lesion development on top of pumpkin leaf caused by cucurbit downy mildew.

Figure 12. Later stages of cucurbit downy mildew infection including angular, yellow lesion development on top of pumpkin leaf.

Figure 13. Clusters of P. cubenis shown as dark downy material on underside of pumpkin leaf.

Disease Management

Growers should first sign up for the downy mildew alerts mentioned above. Site selection for adequate drainage and the use of drip irrigation rather than overhead irrigation should be used when possible to reduce the length of time leaves are wet/moist. Growers can also schedule plantings earlier in the season to reduce disease pressure when possible. Scout for disease regularly and remove infected plant material immediately.

Fungicide sprays are much more effective as a preventative measure than as a curative treatment. Targeted sprays should be used when downy mildew is expected in the growing area. Note, not all strains of downy mildew infect pumpkins. Thus, it is recommended that sprays not be applied until downy mildew is predicted in the growing area for clade 1 crops, such as watermelon and pumpkin. Remember again to choose materials with different FRAC codes to help prevent resistance. Fungicide options are given below.

Note, the FRAC Code is given in bold, the main ingredient in parentheses and the rate following.

The following sprays must be a tank mix with a protectant fungicide like mancozeb or chlorothalonil.

- **49+40** Orondis Ultra 2.33SC (oxathiapiprolin + mandipropamid)- 5.5-8.0 fl oz/A
- **49+M05** Orondis Opti (oxathiapiprolin + chlorothalonil)- 1.75-2.5 pt/A
- **21** Ranman 400SC (cyazofamid)- 2.10-2.75 fl oz/A

The following sprays are options for rotations as tank mix partners with a protectant:

- **43** Presidio 4SC (fluopicolide)- 3.0-4.0 fl oz/A
- **28** Previcur Flex 6F (propamocarb hydrochloride)- 1.2 pt/A
- **40+45** Zampro 525SC (dimethmorph + ametoctradin)- 14.0 fl oz/A
- **22** Elumin 4SC (ethaboxam)- 8.0 fl oz/A
- **M03+22** Gavel 75DF (mancozeb + zoxamide)- 1.5-2.0 lb/A contains protectant
- **M05+22** Zing! 4.9SC (chlorothalonil + zoxamide)- 36 fl oz/A contains protectant
- **M05+27** Ariston 42SC (chlorothalonil _ cymoxanil)- 1.9-3.0 pt/A contains protectant
- **11+27** Tanos 50DF (famoxadone + cymoxanil)- 8.0 oz/A
- **27** Curate 60DF (cymoxanil)- 2.2-5.0 oz/A
- **29** Omega 500F (fluazinam)- 12.0-24.0 fl oz/A
- **40** Forum 4.17SC (dimethomorph)- 6.0 fl oz/A

Note: These sprays should be applied at 7-day intervals when downy mildew is forecasted or present in the growing area. In severe cases with weather conducive to disease development, growers can check the fungicide label to see if this interval can be shortened.

Powdery Mildew

Powdery mildew in cucurbits is mainly caused by the fungus *Podosphaera xanthii*. The spread of powdery mildew is favored by dense foliage, low sunlight, humidity ranging from 50-90%, and temperatures ranging from 68-80°F. Unlike downy mildew, which prefers wet conditions, powdery mildew prefers more dry conditions.

Powdery mildew directly infects plant leaves, stems, and petioles. Infected plants yield less fruit that are typically smaller than fruit from a non-infected plant. There can be a greater occurrence of sun scald and incomplete ripening as well, thus decreasing yield.

In Virginia, the initial inoculum of pathogen causing powdery mildew can originate from old cucurbit plant debris in fields or be blown in by the wind from areas south of Virginia with an infestation (Schooley et al., 2013).

Symptoms

Powdery mildew is known for the white, powdery growth it causes on leaves, stems, and petioles (figure14). This infection typically starts on older, more shaded leaves The mold can be found on both the tops and bottoms of leaves. The mold can quickly expand to even cover all leaf surfaces. Leaves can then curl upward and senesce early (figure 15).

Figure 14. Powdery mildew growth on upper surface of pumpkin leaf.

Figure 15. Pumpkin leaf upper showing white growth and leaf cupping from powdery mildew, coupled with lesions from Plectosporium.

Disease Management

Growers should consider growing resistant or tolerant cultivars of pumpkin to help combat powdery mildew. Tolerant cultivars will help delay the development of the disease and allow fungicides to perform better. Growing these resistant or tolerant cultivars, as well as following the cultural practices mentioned below, provide a significant help in the management of powdery mildew as fungicide resistance, particularly to high-risk fungicides, FRAC code 11 fungicides, and FRAC code 3 fungicides, has been reported.

There are many cultivars that have been developed with powdery mildew resistance, with new resistant cultivars being released regularly. As such, growers can reference the *Mid-Atlantic Commercial Vegetable Recommendations* (Publication 456-20) https://www.pubs.ext.vt.edu/456/456-420/456-420.html for the most up-to-date recommendations.

In terms of cultural practices, ensure all plants have adequate spacing. Also make sure all debris, weeds, and any volunteers which may harbor *Podosphaera xanthii* are removed from growing fields.

Keep in mind that powdery mildew more prominent from mid-July to the end of the growing season. Growers should scout for powdery mildew in fields by inspecting at least 100 leaves. If there is one or more infection site per every 45 established leaves, fungicide application is necessary (Keinath, Wintermantel, & Zitter, 2017, p. 62-64).

Fungicide options are given below.

Note, the FRAC Code is given in bold, the main ingredient in parentheses and the rate following.

The following should be tank mixed with a protectant, i.e. chlorothalonil 6F (2.0-3.0 pt/A):

- **50** Vivando 2.55C (metrafenone)- 15.4 fl oz/A
- **3+7** Luna Experience 3.34SC (tebuconazole + fluopyram)- 6.0-17.0 fl oz/A
- **13** Quintec 2.08SC (quinoxyfen)- 4.0-6.0 fl oz/A

Alternate the above with one of the following from different FRAC Codes with a protectant like chlorothalonil 6F (2.0-3.0 pt/A):

- **3** tebuconazole 3.6F (tebuconazole)- 4.0-6.0 fl oz/A
- **3** Procure 480SC (triflumizole)- 4.0-8.0 fl oz/A
- **3** Proline 480SC (prothioconazole)- 5.7 fl oz/A

- **3** Rally 40WSP (myclobutanil)- 2.5-5.0 oz/A
- **3** Rhyme 2.08SC (flutriafol)- 5.0-7.0 fl oz/A
- **3+9** Inspire Super 2.82EW (difenoconazole + cyprodinil)- 16.0-20.0 fl oz/A
- **3+7** Aprovia Top 1.62EC (difenoconazole + benzovindiflupyr)
- **7+11** Pristine 38WG (boscalid + pyraclostrobin)- 12.5-18.5 oz/A
- **39** Magister 1.6SC (fenazaquin)- 24.0-36.0 fl oz/A
- **7+12** Mirages Prime (pydiflumetofen + fludioxonil)- 9.2-11.4 fl oz/A
- **P05** Regalia (OMRI) (Extract of Reynoutria sachalinensis)- 4.0 qt/A

The following are two other alternate options for rotation. However, sulfur can injure plants, particularly at high temperatures; so, check the fungicide label for recommendations:

- **M02** Micronized Wettable Sulfur 80W (sulfur)- 4.0 lb/A
- **U06** Torino 0.85SC (cyflufenamid)- 3.4 fl oz/A

Viruses

Viruses can occur in all cucurbit crops, including pumpkins. It is very difficult, if not virtually impossible, to identify which specific virus is causing problems in pumpkin fields by visual symptoms alone. Therefore, it is likely that only a general diagnosis of a viral infection will be given by plant pathologists unless specific tests are ordered through a testing lab.

Most cucurbit viruses are spread by aphids, though there is some vectoring of viruses by cucumber beetles as well. Often, this infection occurs very quickly, making management of the insect pests very difficult as well. The aphid or beetle could vector the virus from certain weed species or other cucurbit fields and spread it to neighboring cucurbit fields in as little as a few seconds to a minute. Some examples of weeds that harbor the virus include Virginia pepperweed, chicory, and dandelion, among many others. Note also that virus transfer from plant to plant can happen in fields by way of workers and tools that have come in contact with infected sap.

Symptoms

Plants infected with a virus, or a combination of viruses, will often have mottled or mosaic patterns on their leaves that are green and yellow in color. The leaves can also be deformed in appearance with cupping, puckering, deep lobes, or even an overall thin look (figure 16). Note, leaf symptoms are often most severe on younger leaves. Vines may exhibit stunted growth (Keinath, Wintermantel, & Zitter, 2017, p. 108-109).

Figure 16. Mottled and cupped pumpkin leaves caused by a virus infection.

The effects on fruit depend on when the virus infected the plant. If the plant was infected early, fruit production could be very low or nonexistent (figure 17). If infection occurs later, fruits may have a mottled or mosaic pattern, off-coloration, or ring spots (figure 18).

Figure 17. Developing fruit showing virus infection.

Figure 18. Mature fruit showing ring spots (upper fruit) and mottling (lower fruit) caused by virus infection.

Note, the most common viruses of pumpkins in the Mid-Atlantic are WMV (Watermelon Mosaic Virus), PRSV (Papaya Ring-spot Virus), ZYMV (Zucchini Yellow Mosaic Virus), and CMV (Cucumber Mosaic Virus) (Wyenandt, 2022).

Disease Management

The best way to mitigate virus pressure in pumpkin fields is to plant resistant cultivars. Below are lists of varieties resistant to each of the common viruses mentioned above (WMV, PRSV, ZYMV, and CMV) found at https://www.vegetables.cornell.edu/pest-management/disease-factsheets/disease-resistant-vegetable-varieties/disease-resistant-cucurbit-varieties/ via Cornell University.

WMV Resistant

- Casperita F1
- Corvette F1
- Poco Blanco (mini)

PRSV Resistant

- Flat Stacker F1
- Jamboree F1

ZYMV Resistant

- Corvette F1
- Fireball F1
- Flat Stacker F1
- Harvest Moon
- Indian Doll F1
- Jade Knight F1
- Magician F1
- Moonstone
- Moonstruck
- Munchkin (mini)
- Silver Moon F1 (white)
- Speckled Pup F1
- Zeus F1

CMV Resistant

- Flat Stacker F1
- Jamboree F1

New cucurbit fields should be planted as far away as possible from existing cucurbits and possible alternate weed hosts. This can serve to decrease aphid or beetle transmission of viruses. While soaps and oils can be used to control aphids, there is no chemical control to stop the spread of a virus once it has infected the plant. Note also that insecticides to kill aphid populations are not always very effective as transmission of viruses occurs so quickly.

Growers can also choose to utilize reflective mulch. The light reflecting from the mulch, particularly before pumpkin plants cover the plastic, confuses the aphids and causes them not to land on the developing plants. Fully developed plants block this light; so, this method is helpful for preventing early transmission of viruses. When combined with early planting dates, virus effects on fruits can be minimized (Keinath, Wintermantel, & Zitter, 2017, p. 108-109).

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