

Grapevine Growth Distortions

A Guide to Identifying Symptoms

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Many factors can cause distorted growth in grapevines. One cause of distorted growth is a disorder known as Short Shoot Syndrome (SSS), which is associated with mite feeding damage. However, similar abnormal growth symptoms can be caused by spring frost damage, herbicide damage, vine imbalance (overcropping of vines), nutrient deficiency or toxicity, and other pests such as cane borers or shot-hole beetles. This publication will help you identify probable causes of distorted growth.

Short Shoot Syndrome

Mite-associated SSS causes distinct shoot symptoms. All the following symptoms must be present in a vineyard at the same time for there to be a clear association with mites.

- Buds fail to break, resulting in “blind” buds
- Shortened internodes, 1–10 mm long (Figure 1)
- Cupped leaves (Figure 1)
- Shoot-tissue scarring (Figure 2)
- Damaged flower or fruit clusters and reduced cluster size (Figure 3)
- Short shoots (1–10 mm long; normal shoots are 10–30 mm long) in early spring

If all these symptoms are not present simultaneously, the symptoms may not be the result of mite feeding damage.

For more information on SSS, see OSU Extension publication EM 8944-E, *Short Shoot Syndrome of Grapes in the Pacific Northwest*.

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Figure 1.
Shortened internodes and cupped leaves characteristic of SSS.



Figure 2.
Scar tissue due to feeding by thrips or mites early in the growing season.



Figure 3.
Flower and fruit clusters damaged by SSS.

Spring frost damage

Damage to young, tender shoots during spring is a problem in cold-climates areas and in vineyards with frost pockets. Damage usually is in parts of vineyard blocks that are prone to cold damage; for example, where cool air drains down slopes and pools in low-lying areas.

Frost damage often varies dramatically from plant to plant. Even in low areas, it is not uncommon to see one vine barely affected and adjacent vines much more severely damaged.

Damage to unprotected green tissues occurs when temperatures are at or below 28°F for extended periods. Vines that have not broken bud are less prone to damage. However, susceptibility depends on the stage of bud swell; once sap starts to flow, buds are less hardy.

Frost damage occurs at the tips of shoots, which turn from green or light brown to dark brown or black. Shoot tips and leaf margins may have areas of dead tissue as a result of plant cell damage (Figure 4). In some cases, the primary shoots are completely lost. If the shoot tip (apical meristem) is killed, a secondary bud may initiate growth, depending on the severity of damage. Fewer clusters are present on these shoots, resulting in yield reduction.

Distinguishing from SSS The key difference between frost-related short shoots and mite-related SSS is the type of tissue damage. Although both frost and SSS can cause scarring, the two types of scarring are quite different. Also, keep in mind that mite-related damage will not be confined to areas susceptible to frost damage.

Herbicide damage

Herbicide damage can be caused by herbicide applications in or near the vineyard. Direct drift occurs at the time of application, but growth-regulator herbicides (commonly referred to as phenoxy) can drift up to several days after application through a process known as volatilization. Examples of growth-regulator herbicides include 2,4-D, MCPA, Crossbow, Banvel, Garlon, Weed-B-Gone, and Brush Killer. Damage symptoms vary, depending on the herbicide's active ingredient.

Damage during the early part of the growing season can reduce shoot growth, deform leaves, and cause puckering

(Figure 5). If herbicide damage occurs before flowering, fruit set and overall yields can be significantly reduced (Figure 6).

For more information on symptoms and types of herbicide damage to grapes, visit the OSU Extension Service website <http://extension.oregonstate.edu/catalog/> for the following publications:

Preventing Phenoxy Herbicide Damage to Grape Vineyards, EM 8737-E

Preventing Herbicide Drift and Injury to Grapes, EM 8860

Distinguishing from SSS Usually, shoot scarring (Figure 2) is not seen in vines damaged by herbicide.



Figure 4. Frost damage. Photo: Rhonda Smith



Figure 5. Herbicide damage caused by early-season phenoxy herbicide application. Scarring is not present. Photo: Steve Castagnoli



Figure 6. Herbicide damage has reduced fruit set in this cluster. Photo: Steve Castagnoli

Vine imbalance

Vines should be balanced with respect to the canopy leaf area and the amount of fruit on the vine. The canopy supports production and storage of carbohydrates for bud development and growth the following season.

Overcropping vines can reduce shoot growth. If carbohydrates are drawn down by a heavy crop, fewer are stored in plant tissue for the next season. As a result, bud break, shoot growth, and fruit set will be reduced. These symptoms can be mistaken for SSS, as the shoots are short and yield is reduced. You'll also note poor bud maturity, which may result in buds that do not break (blind buds) the following spring (Figure 7). The symptoms will be uniform across affected areas.

In most cases, mature vines with adequate canopy are in balance and have good fruit quality. If you experience problems with short shoots resulting from inadequate carbohydrate storage, monitor yields and pruning weights to determine whether the vines are in balance for crop size. Also, check your management program to determine whether water or nutrient stress might be contributing to the lack of shoot growth.

To assess vine balance, you'll need to know pruning weights (after dormant pruning) and yield from the previous year. Calculate the ratio of vine yield to pruning weight (the Ravaz Index). If the ratio is 5–10, the vine is in balance. Higher ratios usually indicate overcropping.

When dormant pruning, take into account vine health and condition (weak or healthy). If vines are weak, leave fewer buds to stimulate vigor. Crop thinning might also be necessary to reduce yield after fruit set.

Distinguishing from SSS Overcropping does not cause tissue scarring.

Nutrient considerations

Boron (B) and zinc (Zn) deficiencies result in stunted growth of the entire shoot (Figure 8) and of vines overall. Boron and zinc are needed to produce auxin, a plant hormone that drives cellular division, especially in the shoot tip. If these nutrients are deficient, less auxin is produced and the shoot is stunted. Internodes are short, and the shoot remains short. In the case of Zn deficiency, internodes might form a zigzag pattern on the shoot.

Clusters composed primarily of shot berries that remain small and green are usually associated with

Zn deficiency. However, Zn deficiency can also result in a range of berry sizes (normal to shot), with some berries that do ripen. The berry shape is “normal” for the variety. Shot berries resulting from B deficiency are oblate (flattened at the bottom) and usually ripen.

If you know the soil profile and micronutrient status of your vineyard, you should see a direct correlation between nutrient-deficient soils and vines displaying nutrient deficiency symptoms.

If you suspect micronutrient deficiency, collect and analyze vine tissue samples. This is usually done with petiole samples collected at bloom or before veraison. Tissue analysis can confirm the diagnosis and allow you to develop a vineyard fertilization plan to correct the deficiency.



Figure 7. Vine imbalance. Overcropping can lead to bud failure, as seen on this Merlot vine. Note flowers with little or no leaf area. These flowers will not set fruit, resulting in blank areas of the cane or cordon. These symptoms are usually uniform throughout the affected areas.



Figure 8. Shortened internodes and small leaves due to B or Zn deficiency.

Nutrient toxicities can also cause symptoms that look similar to SSS, as leaves become cupped, puckered, and deformed. In the case of B toxicity, leaf edges fail to grow and expand, while the internal cells of the leaf blade continue to grow, causing cupping and puckering. Necrotic spots (dead tissue) may form along the leaf margins and within the leaf blade (Figure 9).

Many vineyards throughout Oregon are deficient in B due to low soil B; therefore, many growers apply foliar B during or slightly before bloom. Thus, B toxicity can be due to high levels of B in the soil or to excess B application. There are fine lines between deficiency, adequate levels, and toxicity!

Distinguishing from SSS With nutrient deficiencies, shoots remain short throughout the growing season. Conversely, in mite-related SSS, scarring and compressed internodes at the base of the shoots are visible only when mites feed on shoots early in the season. The shoots often grow more normally as the season progresses. Scarring is not observed in nutrient deficiencies.

Zn and B deficiency can reduce yields, but the mechanism of yield reduction differs from that associated with mite-related SSS. SSS results in small clusters due to damage to the cluster primordia in the bud. However, the berries are often of normal size. Generally B and Zn deficiencies result in poor fruit set and shot berries.

The tricky part of distinguishing micronutrient deficiencies or toxicities from mite-related SSS is that the symptoms of mite-related SSS (see page 1) may **not** simultaneously occur in SSS-affected vineyards if vines are deficient in B or Zn! However, mite-related SSS can be ruled out, depending on the answers to the following questions.

- Did tissue or soil analyses show adequate nutrient levels?
- Were foliar B or Zn sprays applied during the season, based on tissue or soil analysis or on previously observed vine deficiency symptoms?
- Is there a pattern of short shoots across vineyard blocks or within a block?



Figure 9. Boron toxicity. Note the cupped leaves and wide leaf sinuses. Photo: Patty Skinkis



Figure 10. Close-up of bud damaged by cane borer (arrow).

Insect pest damage

Cane borers can cause buds not to break due to destroyed tissues. The most important cane borer in Oregon is *Melalgus confertus*, the branch and twig borer. These borers emerge from riparian areas and occupy older or abandoned orchards and vineyards. Symptoms were found in isolated cases in several Oregon vineyards during 2007 and 2008.

The branch and twig borer is a wood-feeding insect. Adults feed in tissues and burrow inside the cane. Canes are not killed, but developing bud tissues can be damaged (Figure 10). Symptoms often are random within a vineyard and on random shoots and buds of a given vine (Figure 11, page 5).

Presence of borers in a vineyard may be due to two factors: (1) proximity to riparian or wooded

areas, old orchards, wood piles, abandoned vineyards, or recently logged forest land, or (2) failure to destroy or remove prunings from vines damaged by disease (*Eutypa*) or prunings resulting from cultural practices such as T-budding, lowering the vine head, or mechanical pruning.

Good cultural practices—such as removing vineyard pruning wood, wood piles, and secondary hosts—will reduce populations. Burn and chop refuse early in the season before adults become active and disperse to the vineyard. Incorporate wood-chip residue into the soil or compost it before adults emerge. For more information on this pest, see the current-year *Pacific Northwest Insect Management Handbook* (<http://pnwpest.org/pnw/insects>).



Figure 11. Random bud failure due to cane borer damage (Sherwood, Oregon).

Summary

Short shoot growth during spring and failure of buds to develop can occur due to many living and non-living factors. It is important to take the following steps to determine the cause of short shoots in vineyards.

- Monitor patterns of symptoms within the vineyard.
- Maintain records of yield and pruning weights; calculate the Ravaz index to gauge vine balance.
- Scout the vineyard for insect damage, symptoms, and infestations.
- Keep a log of weather patterns and frosts.
- Submit soil or tissue samples for testing if needed.

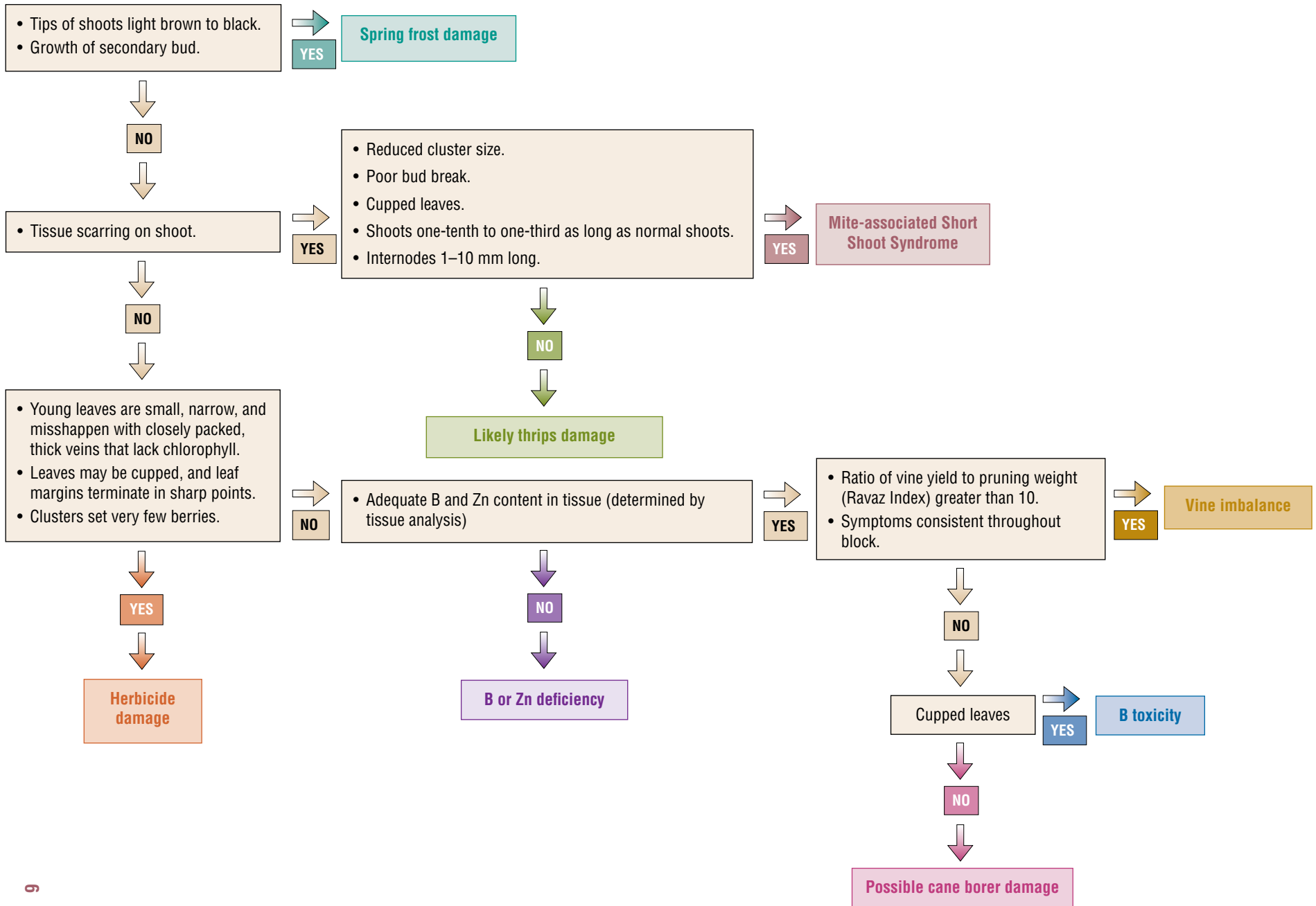
The decision aid on page 6 is a systematic guide to identifying the causes of distorted shoot growth.

Plant materials can be submitted to the OSU Plant Clinic for analysis of insect, disease, and abiotic symptoms. For tissue nutrient analysis, submit samples to an analytical lab (see *Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis*, EM 8677, <http://extension.oregonstate.edu/catalog/html/em/em8677/>). If you need assistance in diagnosis, you can also contact your local OSU Extension horticulturist or agriculturist or a local consultant.

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Flowchart for determining possible cause of distorted grapevine shoots.

All elements in each box must be true for the decision to be “Yes.”



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