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Abiotic Diseases of Sunflower in Nebraska

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Introduction

The environment plays a major role in the process of infection and disease development in sunflower plants by providing the weather conditions necessary for pathogens to cause disease. However, other environmental factors, such as wind, water, temperature, or genetic abnormalities and animal interactions, also may induce damage to plants that is distinct from the more traditional pathogenic organisms. These types of problems are often referred to as abiotic diseases or disorders, but in many situations may mimic biotic diseases. The purpose of this publication is to identify and distinguish some of the common stresses in sunflowers that may be confused with those caused by pathogenic agents. Accurate recognition of the problem is critical for making proper management decisions later.

Environmental Conditions Affecting Abiotic Disorders

Hail

Hail damage symptoms may range from a mild tattering of leaves (*Figure 1*), to severe shredding of exposed foliage (*Figure 2*). This range is dependent upon storm intensity and duration. Plants with stems damaged early in the season may survive

Figure 1. Mild damage to sunflower leaves due to hail.

Figure 2. Severe shredding of sunflower leaves due to hail.

Figure 3. Young sunflower plant damaged by hail but surviving.

Figure 4. Field of surviving plants injured by hail, but they will not yield properly.

Figure 5. Localized area of a field severely affected by a hailstorm.

(*Figure 3*), but will never develop properly or produce acceptable yields (*Figure 4*). Severe damage may also reduce initial stands in localized areas of the field (*Figure 5*), delay maturity of the crop, or even cause complete crop failure as a result of plant mortality (*Figure 6*). Hailstones additionally serve as a common mechanism for wounding stems (*Figure 7*) or heads (*Figure 8*). This creates an opening for opportunistic pathogens to invade damaged plants, subsequently resulting in disease.

Figure 6. An entire sunflower field destroyed by a hailstorm.

Figure 7. Hailstone wounds on sunflower stems.

Figure 8. Individual wounds from hail with necrosis and the initiation of disease developing.

Figure 9. Wind damage on young sunflower plant due to soil particles blown across the soil surface.

Figure 10. Young sunflower plant killed and buried by deposited soil particles.

Wind Damage

High winds from a storm can affect plants of any age, but the greatest potential for economic loss occurs in the early stages of growth before canopy closure (*Figure 9*). This damage is often associated with soil particles being blown across the soil surface. These particles act as an abrasive and can cut or shred the plant material seriously enough that death may result.

In extreme cases, portions of the root system may be exposed as soil is removed or small plants may be buried by soil deposits (*Figure 10*).

Prolonged periods of wind without movement of soil particles may also cause girdling of plants. Girdling results from the oscillation of plants back and forth in the wind, which causes a breakdown of the hypocotyl or root tissue near the soil line (*Figure 11*).

Late in the season, high winds accompanied with other factors that compromise the integrity of the stalk or root system can result in stem breakage (*Figure 12*) or complete collapse of plants from the weight of mature heads (*Figure 13*).

Figure 11. Wind-damaged stem of sunflower plant at the soil line.

Figure 12. Lodging of sunflower plants from stem breakage after windstorm.

Figure 13. Lodging of plants from large areas of a field after high winds.

Figure 14. Wilting symptoms of a young sunflower plant due to heat canker. Note the small gall on the plant at the soil line.

Figure 15. Wilting and death of a young sunflower plant affected by heat canker on the right compared with unaffected plant on the left.

Heat Canker

Heat canker is a condition resulting in stem tissue damage caused by high temperatures at or just below the soil surface. For example, soil temperatures at a 2-inch depth in Nebraska in mid-summer have been documented to exceed 130° F. Sunny, warm days are conducive to heat canker injury to young sunflower plants, which is more likely to occur in compacted or heavy dark soils that have become crusted by rain. These environmental conditions can cause a gall-like swelling of the stem at the soil line (*Figure 14*). This swelling causes a constriction of the stalk, impeding the movement of water or nutrients into foliage, often resulting in wilting and/or death of young (*Figure 15*) or mature plants (*Figure 16*). On mature plants, the outer tissues are injured, and plants compensate by producing additional cork-like tissue as an overgrowth to the injury (*Figure 17*). This part of the plant at the soil line also becomes brittle, predisposing plants to lodging after late season stresses such as strong winds (*Figure 13*).

Figure 16. Wilting and death of two mature sunflower plants affected by heat canker.

Soil Conditions Affecting Abiotic Disorders

Soil Moisture—Excess

Sunflowers may be adversely affected by either high or low levels of soil moisture. Excess water (flooding) may cause sudden and permanent wilting (*Figure 18*), plant chlorosis, and overall poor growth from lack of proper water and nutrient uptake.

When soil temperatures are high and plants are exposed to saturated soils for several days, roots are more prone to root rot problems due to anaerobic conditions and secondary invasion by root pathogens on previously compromised plants (*Figure 19*). This often occurs in low areas of fields where water may stand in shallow depths for prolonged periods (*Figure 20*).

Figure 18. Dying plants from a flooded field.

Figure 19. Rotted root of a plant killed from flooded conditions.

Figure 17. Heat canker gall of mature plant.

Figure 20. Dead plants from a previously flooded area of a field.

Figure 21. Wilting plants at the edge of a field affected by drought.

Figure 22. Wilting plants showing effects of coarse-textured soil from a large area of a field.

Figure 23. Drought-affected sunflower plants showing death of lower (older) leaves.

Soil Moisture—Deficit

Low levels of soil moisture can also be harmful to plants, as they are unable to extract water from the soil as rapidly as they lose it to transpiration. Wilting symptoms of water stress (*Figure 21*) often will appear on field edges during the afternoon when temperatures are high and will be seen first on rocky or coarse-textured soils or areas of fields where water drains more rapidly (*Figure 22*).

Water stress conditions can occur anytime during the growing season. If rainfall or irrigation occurs within a few days of the onset of water stress, the condition will be temporary and only minor wilting of leaves will occur. However, if the condition is prolonged, young seedlings may die outright while on more mature plants, the older leaves will die first (*Figure 23*).

Stress due to lack of water may also predispose sunflower plants to certain root diseases such as charcoal rot. Dry soil conditions in combination with high air temperatures will adversely affect the growth and size of plants and heads, thus reducing overall yields.

Soil Compaction

Although sunflowers are often thought to have a greater ability to penetrate through compacted soils compared with other crops, a layer of compacted soil may still inhibit growth or even cause death of plants early in the season (*Figure 24*). A hardpan stops the downward progression of the root, encouraging the tap root to move horizontally until it finds a path of less resistance (*Figure 25*), resulting in a restricted root system that is less able to utilize available subsoil moisture and nutrients.

Restricted root systems are also more susceptible to other stresses such as heat canker and some of the root diseases caused by weaker, but more opportunistic soil pathogens. Compaction problems are also associated with heavier-textured soils or those that were worked in some manner under wet conditions (*Figure 26*). Soils that are prone to compaction should be tilled prior to planting to break up the compacted layer and allow water and roots to penetrate into the subsoil.

Genetic Disorders

Several genetic abnormalities may induce sunflower plants to change in color, including chimeras and the production of albino plants or seedlings. Chimeras are among the most common genetic disorders. These defections can be heritable and are due to single site (point) mutations in cells or as a result of out-crossing during seed production. They may occur at any time within the season. In leaf tissues, they cause a loss of chlorophyll, giving the leaf a white or yellow variegated pattern (*Figure 27*). Chimeras cause no significant damage.

Conversely, albinism is damaging in affected plants. It is a condition controlled by a single recessive gene that is characterized by the loss of chlorophyll production within plants, resulting in a bleached, chlorotic appearance (*Figure 28*), rather than the variegation associated with chimeras. Therefore, albino seedlings observed early in the season usually do not survive due to a complete lack of chlorophyll, which is required for photosynthesis. The seedlings will die quickly as their limited starch reserves are depleted.

Figure 26. Sunflower field showing effects of soil compaction on emerging plants. The shorter plants seen on the right and in the foreground were planted into wet, compacted soil compared with those on the left planted several days later after drying.

Figure 24. Death of young sunflower plants due to severe soil compaction.

Figure 27. Yellow variegations (chimera) on a young sunflower plant.

Figure 25. Symptoms of sunflower plant responding to soil compaction.

Figure 28. Young albino sunflower plant on the right compared with an unaffected one on the left.

Figure 29. Sunflower plant affected by apical chlorosis. Note the fading of the chlorosis in older leaves and the healthy green color in newly developing leaves.

Figure 30. Death of several randomly distributed sunflower plants. Note the shallow hole around the fallen plants.

Figure 31. Close-up view of a sunflower plant dug up by rabbits searching for a water source.

Albino plants also may be confused with early symptoms of apical chlorosis, a bacterial disease that also results in the production of a bright yellow chlorosis of infected plants (*Figure 29*). The two problems can be differentiated over time as plants affected by apical chlorosis will generally recover and continue growing normally.

Wildlife Damage

Rodents

A number of rodent species, such as mice, gophers, squirrels, and rabbits, may cause damage by eating sunflower plants. Evidence of a rodent infestation may be noted by the presence of a burrow, a mound of soil, or dead or dying plants (*Figure 30*).

Rabbits may start eating sunflower plants soon after seedling emergence, and damage is typically more noticeable on field edges. Rabbits tend to select a row and go from one plant to the next, causing gaps in the row. During a recent drought in Nebraska, jackrabbits were observed digging up sunflower plants, presumably searching for water in the roots (*Figure 31*).

Large populations of other rodents, particularly mice, can also affect stand establishment in some situations. The mice dig up seeds, and eat the internal contents. This was readily noticed with small holes in beds accompanied with scattered, cracked, and empty seed shells (*Figure 32*).

Deer

Sporadic damage from feeding by deer also has been observed. They tend to forage near cover, such as wooded areas. The animals generally begin eating when the plants reach 8 to 10 inches, but can continue until near maturity

Figure 32. Discarded shells of seeds dug up by mice before germination and emergence.

and harvest (*Figure 33*). Often, deer may also push down the stalk to make foraging easier, but their feeding is not usually economically damaging, due to the low incidence of plants affected within fields.

Birds

Early in the spring, birds have been reported to dig up and eat sunflower seeds, causing gaps without plants in the rows. In the fall, sunflower is vulnerable to bird feeding. Birds may sit on the heads and pick the seeds from them. Damage is usually visible at the edges of the head (*Figure 34*).

Unlike the foraging of deer, bird feeding can negatively affect yields if populations are high enough (*Figure 35*).

Herbicide Damage

Herbicide injury to sunflower plants can occur in a number of different ways, including misapplications to the crop (*Figure 36*), dispersal and drift from neighboring fields, or the carryover in soils from applications in preceding cropping seasons. Damage may be observed anytime during the growing season. Symptoms can vary substantially, depending upon the part of the plant that may come into contact with the herbicide or the mode of action of the chemical used.

Figure 33. Mature sunflower head damaged by foraging deer.

Figure 34. Mature sunflower head damaged by bird feeding (note absence of seed at the top of the head).

Figure 35. Evidence of bird damage showing seeds and shells from eaten seeds in furrows at harvest.

Figure 36. Guess-row area of a field where herbicide was misapplied. Note surviving but severely stunted plants in vacant strip of the field.

Figure 37. Herbicide-damaged plants on the edge of a field. Note the decreasing degree of damage moving from left to right.

Growth regulator-type herbicides such as 2,4-D can cause stunting and leaf distortion on affected plants (*Figure 37*). This type of damage is often seen on the edges of fields and may be due to the overlap of sprays for weed control.

These types of herbicides also have been known to cause malformation of root tissues with galls, resembling nematode infections (*Figure 38*).

Other herbicides contacting sunflowers as a result of drift from adjacent fields may also cause leaf spotting, which may be confused with symptoms consistent with a viral infection (*Figure 39*).

Figure 38. Symptoms and galls on sunflower roots damaged by herbicide.

Figure 39. Sunflower plant with yellow blotches due to herbicide drift.

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