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Abiotic Diseases of Dry Beans

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The environment plays a major role in the process of infection and disease development in plants by providing the conditions necessary for pathogens to cause disease. However, adverse environmental conditions or genetic abnormalities also may be responsible for plant damage. This type of damage often is referred to as abiotic disease or stresses. Many of the symptoms of these "diseases" may be confused with true dry bean diseases, thus this publication is designed to educate those working with dry bean on how to recognize abiotic problems and avoid unnecessary disease treatments.

Figure 1. Genetic chimera symptoms in dry bean

Figure 2. Genetic yellowing symptoms in dry bean

Genetic Disorders

The genetic abnormalities leading to changes in color in dry beans include chimeras, leaf spotting, yellowing. or production of albino plants or seedlings. Chimeras are among the most common genetic disorders. These aberrations, which may be inherited, result from a single site (point) cell mutation or from

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outcrossing during seed production. They may occur any time in the season. In leaf tissues, they cause a loss of chlorophyll, giving the leaf a white to yellow variegation *(Figure 1)*. General chlorosis or yellowing traits *(Figure 2)* also may be inherited and are not likely to cause significant damage. However, the albino seedlings that may be observed early in the season, usually do not survive due to a deficiency of chlorophyll *(Figure 3)*.

Cytoplasmic male sterility is another genetic condition found in dry beans. It is a maternally inherited phenomenon that results in the inability of dry bean plants to produce or shed viable pollen, thus resulting in no pod or seed formation *(Figure 4)*.

Baldheads

Baldheads are plants with damaged or dead growing points *(Figure 5)* caused by mechanical damage to seeds during harvest or handling during storage. Affected plants may still form axillary bud shoots at the cotyledonary nodes *(Figure 6)*, but generally fail to produce pods and seeds.

Figure 3. Seedling albino dry bean plant

Figure 4. Dry bean plant affected by cytoplasmic male sterility (no flowers or pods formed).

Figure 5. Baldhead, caused by mechanical damage to the growing point of seedlings

Figure 6. Baldhead forming new shoots at cotyledonary nodes; not likely to produce pods

Figure 7. Bronzing symptoms on leaves of dry beans

Figure 8. Sunburn symptoms on dry bean leaves, stems, and pods

Bronzing

Bronzing is a form of damage caused by excessive levels of ozone, a common airborne pollutant. Ozone may be formed by lightning discharge during thunderstorm activity, but is more commonly associated with gases from combustion engines.

Bronzing forms on the newest leaves as small, water-soaked spots that become reddish-brown or bronze as lesions coalesce and become necrotic *(Figure 7)*.

Temperature

Sunburn can occur on bean leaves, stems, or pods. This problem generally occurs after periods of intense sunlight and high temperatures. Symptoms appear as water-soaked areas on the exposed portion of plants that later become reddish- brown to brown *(Figure 8)*. These areas may coalesce to form large necrotic or discolored areas on affected plant parts. The damage is primarily superficial, but when observed from a distance, may be confused with bronzing or the rust disease caused by *Uromyces appendiculatus (Figure 9)*.

Low temperature (frost) during seed fill stages can freeze plant parts and seed, causing death of tissue, water-soaking (*Figure 10*), and discoloration of seed after drying is completed *(Figure 11)*. In addition to discoloration, frozen beans may exhibit a musty odor.

Spray Damage

If chemicals are applied incorrectly, bean plants may be damaged at any point during the season. These chemicals may include growth regulator-type herbicides *(Figure 12)*, other herbicides *(Figure 13)*, insecticides *(Figure 14)*, or even by crop oils combined with any chemical product *(Figure 15)*. Damage may even be realized when chemicals are applied correctly, but other environmental conditions are adverse, including low soil temperatures, high soil moisture levels, or if young plants are exposed to high levels of various fertilizers.

Figure 9. Damage in field due to bean rust

Figure 10. Freeze damage to dry bean plants showing water-soaked pods after thawing

Figure 11. Freeze damage of dry bean pods and seeds (left) compared with healthy pods and seeds (right)

Figure 12. Phenoxy (2,4, D) injury on dry bean roots (left) and leaves (right)

Figure 13. Herbicide (Eptam®) injury on dry bean leaves

Figure 14. Insecticide (Asana®) injury on dry bean leaves

Hail

Hail damage symptoms may include mild tattering of leaves *(Figure 16),* crushed branches and stems, or bruised areas of stems (*Figure 17*), petioles, pods, or defoliation of leaves (*Figure 18*) that were in direct contact with hailstones. Degree of damage depends upon the storm's duration and intensity. Stems damaged early in the season (*Figure 19*) may continue to develop until seed fill when the weight of the pods can result in breakage at the site of initial damage. Severe damage may reduce initial stands, delay crop maturity, or even cause widespread plant death in fields. Hailstone wounds serve as a site of opportunity for bacterial pathogens to infect damaged plants and spread within and among fields (*Figure 20*).

Soil Compaction

Dry beans are very susceptible to soil compaction. A layer of compacted soil or a plowpan (hardpan) may inhibit or stunt plant growth (*Figure 21*), causing severely restricted feeder roots and stunting (*Figure 22*) and often a delay in maturation (*Figure 23*). Restricted root systems are also more susceptible to some of the opportunistic root diseases. Soils that tend to compact should be deep-tilled or in row ripped prior to planting to break up the compacted layer and allow water and roots to penetrate into the subsoil. Zone tillage and broadcast ripping tillage are recommended to alleviate soil compaction

Soil Moisture

Dry bean plants may be affected by either high or low levels of soil moisture. High levels (flooding) (*Figure 24*) can cause stunting, plant chlorosis, and poor growth from lack of water and nutrient uptake. Below-ground organs are also more prone to root rot problems due to anaerobic conditions and secondary invasion by root pathogens on compromised plants. Higher (but not excessive) levels of soil moisture can also benefit plants by improving emergence and early plant growth (*Figure 25*).

Figure 15. Injury on dry bean plants due to crop oil combined with other chemicals

Figure 16. Mild symptoms of hail on dry beans leaves; no permanent damage.

Figure 17. Hail damage in dry beans showing severely bruised stems

Figure 18. Severe defoliation and mechanical damage on dry bean plants due to hail

Low levels of soil moisture can also be harmful to plants, causing wilting (*Figure 26*) and predisposition to certain root pathogens. Dry soil conditions in combination with high air temperatures, can also increase abortion of flowers, thus reducing overall yields.

Nutrient Deficiencies and Toxicities

Dry beans may also be adversely affected by deficiencies of numerous minerals, including nitrogen, phosphorus, potassium, calcium, and various micronutrients such as magnesium, copper, molybdenum, zinc (*Figure 27*), and iron (*Figure 28*). They are particularly sensitive to extremes in soil pH (< 5.5 and > 8.0) (*Figure 29*), and high levels of salinity (*Figure 30*) whether in soil or irrigation water. Toxicity problems have also been encountered due to aluminum and manganese, depending on the soil type and pH.

This publication has been peer-reviewed.

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Figure 19. Hail damage to dry bean seedlings

Figure 20. Bacterial disease on dry bean leaves associated with foliar hail damage

Figure 21. Severe stunting at mid-season due to soil compaction.

Figure 22. Severe damage of dry bean plant (left) due to soil compaction. Note stunting. Restricted root growth and poor pod yield compared to healthy plant (right).

Figure 23. Effects of compaction in the field on dry bean plants. Note stunting and delay of maturation in the one row compared to unaffected plants on the right.

Figure 24. Symptoms of excess water (flooding) in the field

Figure 25. Improved growth of dry beans planted into residue (right) compared to no residue on left.

Figure 26. Drought symptoms (wilting) in dry beans in foreground

Figure 27. Symptoms of zinc deficiency in dry beans

Figure 28. Symptoms of iron deficiency in dry beans

Figure 29. Leaf scorch due to high pH

Figure 30. Burn symptoms on bean leaves due to high salt levels in irrigation water