SEED ENTERPRISE MANAGEMENT INSTITUTE (SEMIs)

Seed Production Field Diagnostics

Short Course

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Abiotic Disorders In Seed Production



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Introduction

•Plants diseases are caused either infectious agents/pathogenic/biotic or non-infectious/non-pathogenic/abiotic agents

•Pathogenic (fungi, bacteria, viruses, nematodes, rickettsiae, MLOs)

•Abiotic factors are unfavorable soil properties, fertility imbalances, moisture extremes, temperature extremes, chemical toxicity, physical injuries, genetic disorders, lightning injury, light deficiency

Effects of abiotic agents on plants

•Affect plant with reduced plant growth (lowered quantity and quality of the produce)

•Killing of the plants.

• Predispose plants to diseases caused by biotic agents.

Facts on abiotic factors

•Abiotic disorders in plants are very common.

•Half of the plant samples that arrive in plant diagnostic clinics are due to abiotic disorders.

•Abiotic disorders are many times confused with biotic diseases

Abiotic Disorders In Seed Production

- Plants may be affected by multiple abiotic factors
- Both abiotic disorders and biotic diseases often occur on the same plants.
- Abiotic plant problems are sometimes termed as physiological disorders
- Abiotic disorders are associated with non-living causal factors such as weather, soils/edaphic, chemicals, mechanical injuries, prolonged drought, cultural practices and, in some cases, a genetic predisposition

Abiotic Disorders In Seed Production

- Genetic mutations and reversions
- Chimeras - Leaf variegation
- Low-temperature injury
- Sunscald and frost cracking
- Frost injury
- Drought and heat
- Flooding

- Lightning and hail
- Nutrient deficiencies and excesses
- Salt injury
- Pesticides
- Air pollution

Nutrition Disorders in seed production

- Plants suffering from nutrient or physiological disorders, the plant exhibits disease-like symptoms
- Nutrient disorders are sometimes mistaken for diseases caused by biotic factors
- Nutrient deficiencies lack visible signs, they are often mistaken for virus diseases
- Nutrient disorders results in a reduction in yield/quality

Soil nutrients

Macro-nutrients
Constitute main elements required by plant for basic functioning

- Phosphorous (P),
- Potassium (K),
- Nitrogen (N),
- Calcium (Ca),
- Magnesium (Mg)
- Sulfur (S).

Micro-nutrients (trace elements)
Required in very small amounts but are essential for normal growth

- Iron (Fe),
- Zinc (Zn),
- Manganese (Mn),
- Boron (B),
- Molybdenum (Mo)
- Copper (Cu)

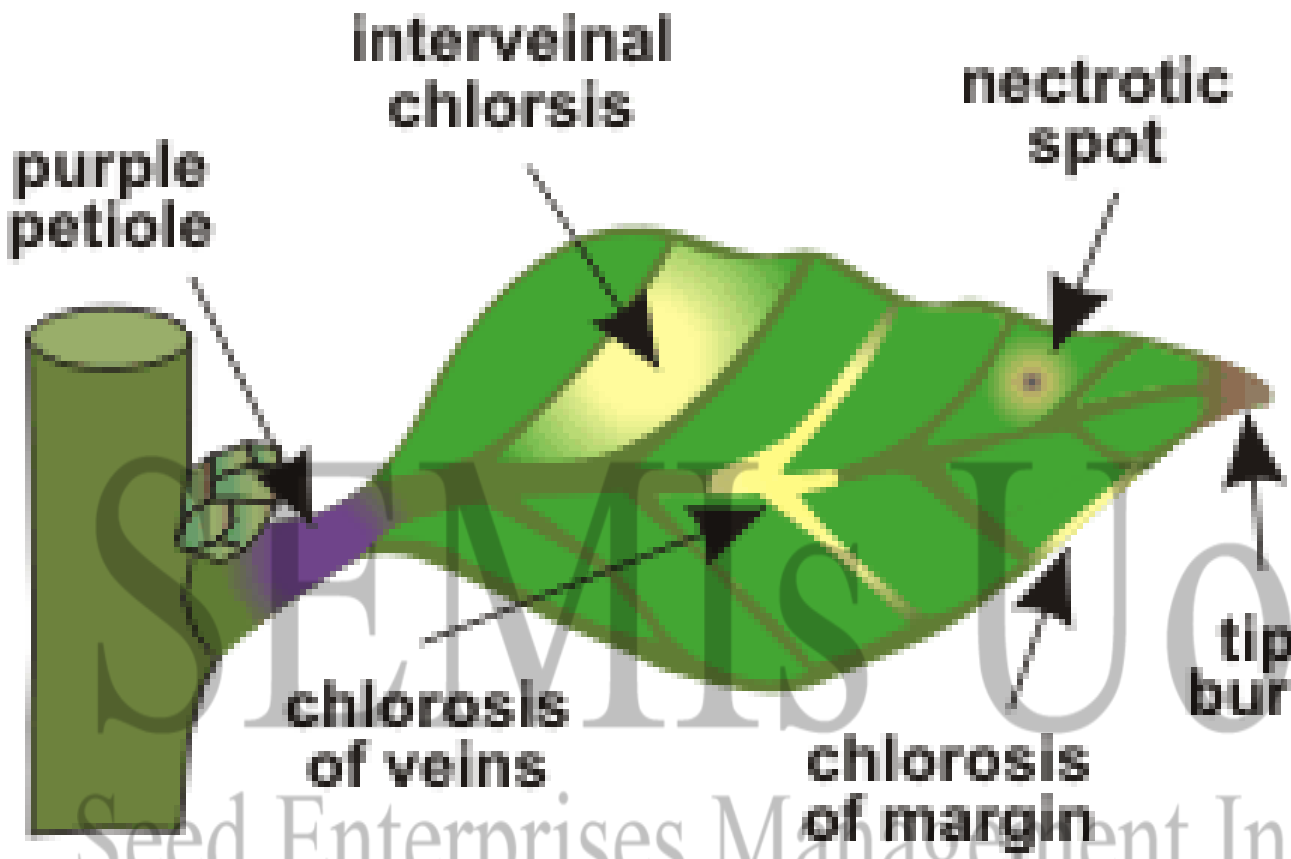


Fig 15.1 Some common leaf abnormalities resulting from nutrient deficiencies.

Nutrient deficiencies

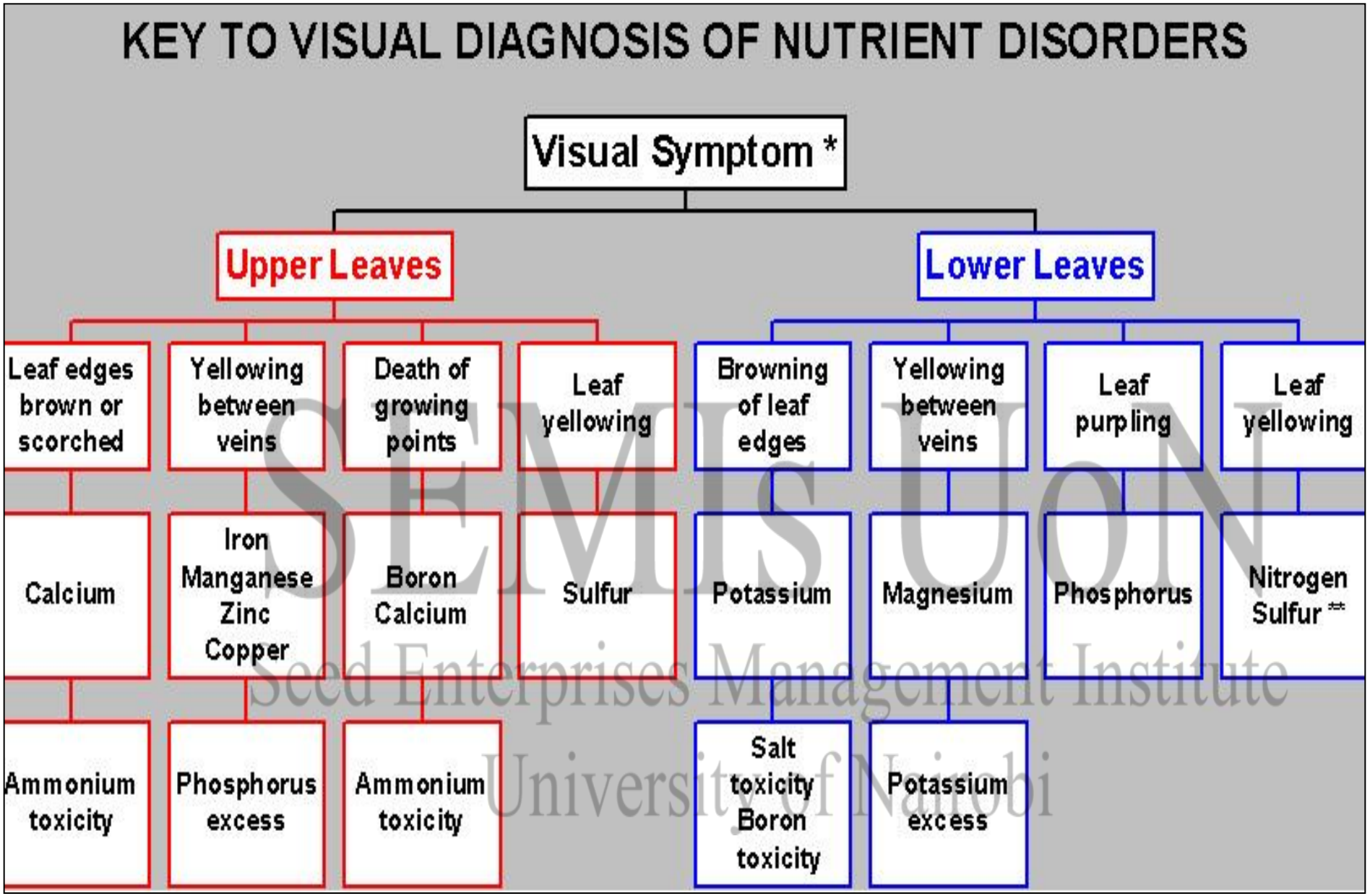
- Symptoms of nutritional disorders occur in defined patterns and are specific for each nutrient
- Symptoms are first seen in older leaves for some deficiencies, and in young leaves and/or tissues for others
- Mobile nutrients (N, P, K and Mg) deficiencies are first seen in older leaves
- Immobile nutrients (Ca, B, Cu, Zn and Fe) deficiencies are first seen in youngest leaves and/or growing tissue

•Pesticide toxicity or disease symptoms may resemble nutrient deficiencies or toxicities

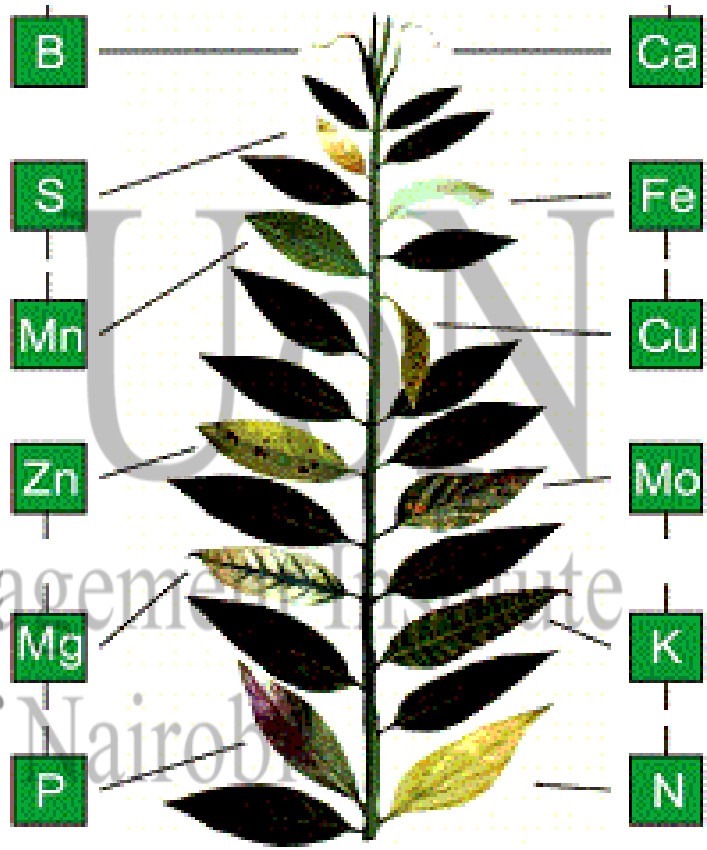
•Symptoms of nutritional disorders are often species or variety dependent

•Soil and plant tissue analysis should be used to help confirm whether the symptoms truly are nutritional

•Magnesium deficiencies are often confused with viruses and other nutrient problems. However, symptoms of viruses are typically manifested in the young, growing part of the plant.



Abiotic Disorders In Seed Production



SYMPTOMS OF ABIOTIC DISORDERS

LEGUMES

Iron Deficiency of Peanut

Iron deficiency in cowpea

Iron

Iron deficiency in soybean, upper leaves

Iron deficiency

Manganese Deficient Soybean

Manganese Deficiency of Peanut

Molybdenum

Molybdenum Deficiency of Peanut (Right) Grown in Strongly Acid Soil (PH

Molybdenum Deficiency of Peanut (Right) Grown in Strongly Acid Soil (PH 4.5)

SYMPTOMS ON CEREALS

a healthy corn plant leaf is deep green and glossy

a leaf from a plant with nitrogen deficiency yellows down the midvein starting at the tip and moving back towards the stem

a leaf displaying phosphorus deficiency turns red-purple along the leaf margins

a leaf from a potassium-deprived plant features firing and yellowing along the leaf margins

Phosphorus

Potassium

Potassium

Potassium deficiency in corn, lower leave

Potassium deficiency
Not chiseled (left), chiseled (right)

Potassium

Nitrogen

Nitrogen

Wheat

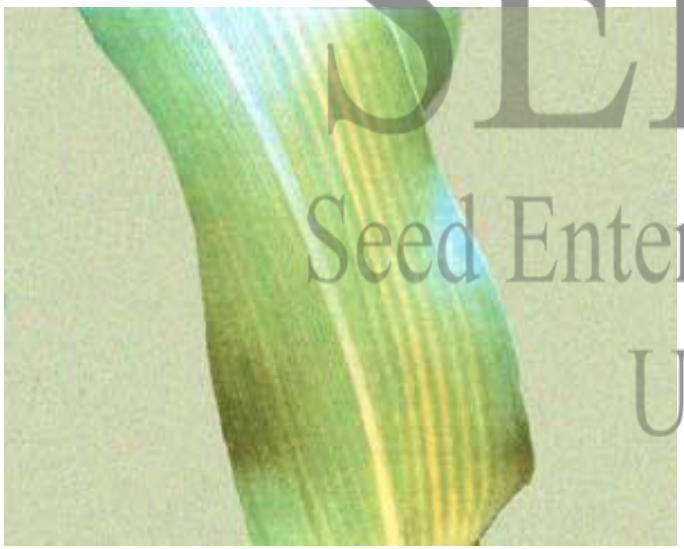
Nitrogen deficiency

Potassium deficiency

Phosphorus deficiency

Magnesium

Sulphur



Boron

Manganese

Manganese deficiency

Zinc

Zinc Deficiency of Rice

Zinc Deficiency of maize

Zinc

Iron

Copper

Calcium

Boron Deficiency in Papaya

Conditions leading to nutrient deficiency

Nitrogen –

- Infection by root pathogens such as root-knot nematodes
- Nitrogen deficiencies can cause increased susceptibility to certain leaf pathogens such as *Alternaria solani,*
- Excessive plant N levels may result in increased susceptibility to other pathogens

Phosphorus –

- Acid and clay soils are particularly prone to P deficiency.
- Cool conditions or poor oxygen availability to the roots can lead to P deficiency

Iron (Fe) –

- Most soils have adequate supplies of Fe;
- Availability decreases as soil pH increase

Potassium (K) –

- Availability reduced by presence of competing cations such as $Ca)^{2+}$ and $NH_4^{+;}$
- Potassium can also be readily leached from sandy soils.
- Plant uptake of K may be reduced by certain environmental conditions including temperature, soil moisture, and oxygen availability.

Management of abiotic disorders

Diagnosis of abiotic disorders

- Accurate diagnosis is necessary to manage the disorders
- Can be difficult since many disorders cause similar symptoms
- E.G wilting-low soil moisture, excess soil moisture, root damage, vascular diseases, chemical toxicities among others
- Diagnosis is dependent on elimination process
- Correctly identify the crop/biology of the host (appearance, crop growth needs)
- Look at patterns of damage- abiotic disorders produce similar symptoms on different plant species
- Site evaluation is key to note environmental causes e.g. Drainage, soil compaction, wind damage, weather parameters
- Cultural or maintenance practices being applied e.g irrigation, pesticide application, other agronomic practices
- Lab diagnostic may be necessary to confirm the causal agent e.g. Soil or plant analysis
- Analysis can show nutrient deficiency or toxicities and pesticide residues

GUIDE FOR DIAGNOSING ABIOTIC PROBLEMS

Symptom	Possible Causes
Older leaves turning yellow	Early heat and drought stress Early stage of poor soil drainage Nutritional problems Normal deterioration of older foliage
Interveinal leaf yellowing (chlorosis)	Soil pH problem Very early stages of heat and drought stress
Leaf scorch (brown edges) throughout the tree or shrub	Heat and drought stress Soluble salt damage Poor soil drainage Soil compaction
Leaves dropping while still green or beginning to turn yellow	Heat and drought stress
Leaves twisting and curling	Herbicide damage
Die-back of branches	Severe drought stress Severe soluble salt damage Poor soil drainage Girdling roots Mechanical damage to trunk Changes in soil grade

Stunted, poor growth, lack of establishment	Soil compaction Planting too deeply Drought and heat stress Excessive mulch Poor soil drainage
Decline and eventual death of established trees and shrubs	Girdling roots Mechanical girdling of the trunk /stem Planting too deeply Soil grade changes Changes in water flow
Bark rotting at the base of the tree or shrub	Planting too deeply Excessive mulch Girdling roots
Bark cracking along trunk	Mechanical root damage Lower trunk damage Girdling roots Planting too deeply Severe heat and drought stress Frost cracking and sunscald Lightening injury

Management of abiotic disorders

- Weather/environmental disorders—choice of crop growing area/ use protected environment, choice of the appropriate crop varieties
- Nutritional disorders---analyze plant nutrient status and remedy the situation appropriately by adding or adjusting the nutrient levels. Deal with pH issues for nutrients affected by pH
- Excess/lack of adequate moisture---Look for drainage and compaction issues
- Salt toxicity--Check for quality of irrigation water, reclaim sodic soils

- Pesticide phytotoxicity---Get a chemical use history and advise accordingly (application rates, sensitive crops). Judicious use of pesticides (IPM approaches)
- Environmental pollutants e.g. Air pollution. Avoidance for instance areas near source of dust (particulate matter pollution)

Nutrient disorders and their remedies

Deficiency	Symptoms	Remedies
Phosphorous (P)	Poor germination, seedling establishment & plant growth; leaves may be dull bluish/greyish-green or have red pigment in leaf bases and dying leaves; oldest leaves may turn yellow & drop.	Apply phosphorus fertilisers & manure
Potassium (K)	Yellowing on older leaves; scorching of edges and/or interveinal region	Apply K fertilizer
Nitrogen (N)	Poor plant growth; older leaves are pale green to yellow and they eventually dry and drop; fruit and tubers are small.	Add N fertilizer improve irrigation management.

Nutrient disorders and their remedies

Calcium (Ca)	**Retarded growth; yellowing & distortion of young leaves; blossom end rot in cucurbits and tomatoes**	**Side dress with a Ca fertilizer**
Magnesium (Mg)	Growth retarded; chlorotic patches between the veins of older leaves; a triangle of green remains at base of leaf; leaf margins may burn.	Application of fertilizer or weekly foliar sprays
Sulfur (S)	Yellowing of young leaves while older leaves remain dark green; growth stunted.	Application of sulfate compounds.
Boron (B)	Bushy stunted growth & dying growing tips; internal brown rot; brittle plant tissue & split easily; hollow areas in stems.	Application of boron-fertilizers

Nutrient disorders and their remedies

Iron (Fe)	**Leaves turn yellow/bleached between vein margins; stunting & abnormal growth; fruit may not mature.**	**Spray iron sulphate; reduce soil pH below 7.5**
Manganese (Mn)	Yellow patches between veins; reduced flower formation.	Foliar sprays with manganese sulphate
Molybdenum (Mo)	stunting & pale green or yellowish green colour between the veins & along edges of leaves; leaf tissue of margins dies;	Liming to increase soil pH to 6.5; foliar applications of sodium or ammonium molybdate.
Zinc (Zn)	Stunted & pale with creamy yellow interveinal area; distorted young leaves.	Application of Zn foliar spray
Copper (Cu)	Chlorosis in young leaves; tips of leaves distorted; stunted growth.	Apply a copper fertiliser

Nutrient toxicities

- Chloride toxicity – Caused by saline water and soil conditions; plants wilt when soil moisture seems adequate; test and monitor irrigation water quality; plants vary in their tolerance to salinity.

- Manganese toxicity – Yellowing of margins of older leaves; poor root development; favoured by acidic, waterlogged soil; lime soil to correct pH.

- Ammonium toxicity– Poor emergence followed by wilting and death of seedlings; browning of the central root tissue; favoured by excess ammonium from fertiliser or poultry manure in cold wet soil.

Physiological disorders

- Tipburn (physiological/nutritional) – a result of a calcium transport problem within the plant.
- Blossom end rot (physiological/nutritional) – caused by a deficiency of calcium or insufficient calcium uptake and translocation to growing points.
- Riciness of cauliflower.
- Gomasho (grey speck) of cabbage and Chinese cabbage.
- Measles on smooth skinned melons and cucumbers.

Other abiotic disorders

Hail damage on maize cob

Sulfur dioxide damage on raspberry

Lightning injury

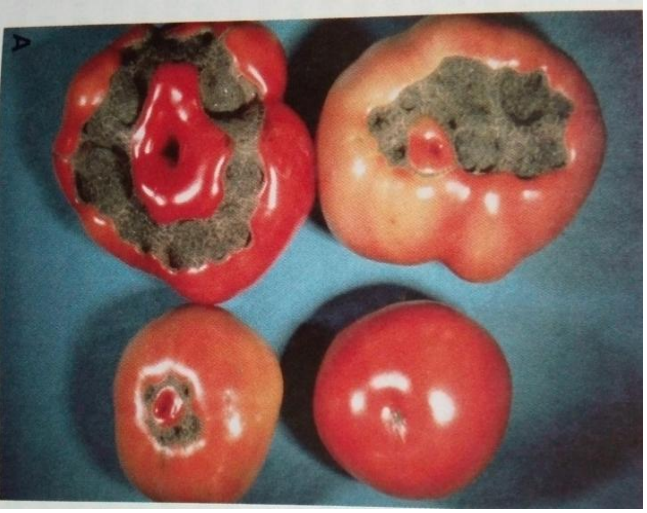
Fluoride injury on plums

Other Abiotic Disorders In Seed Production

Two examples of improper use of non-selective herbicide.

Salt injury on taxus.

Leaf cupping/ curling due to a growth regulator herbicide.



Low temperature damage (catface)

Malformation due to exposure to 2,4-D

Papaya leaf distortion due to herbicide injury

Hail damage on water melon and cabbage

Blossom end rot on water melon and tomato due to Ca deficiency

Measles on water mellon

Gomosho or pepper spot/grey speck on Chinese cabbage

Riciness in cauliflower

End

Thanks for listening