Crop Scout
Pocket Guide

r4 Solution

Maize

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Pocket Guide
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Introduction

Crop scouting is valuable skill and an important part of crop management. Regularly checking on crop growth and development makes it possible to recognize whether a nutrient deficiency or another crop health problem is developing, and whether anything can be done to correct it. Early detection is key to success as it provides for more time to react and allows the crop a chance to recover.

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This **Crop Scout Pocket Guide** is designed to be a hands-on resource to help agronomists, extension agents, and farmers recognize common symptoms of maize nutrient deficiency and other growth disorders in the field.

Tips for Successful Crop Scouting

Successful crop scouting begins with regularly being in the field. It is recommended to have a walk through your farm at least once a week. Crop scouting is an applied skill that requires agronomic knowledge and experience. However, a trained eye with local knowledge of the field history is invaluable. An understanding of the local soil, climate and weather, and awareness of disease and pest pressures all contribute to identifying the presence of a nutrient deficiency or other plant health problems.

One key to scouting is to watch for unusual patterns – comparing problem areas in the field with normal, healthy areas. The following are some key tips for successful crop scouting:

- Inspect fields several times during the crop season.Take notes on a field map if possible. If you are consulting for a farmer, a walk through the field with the farmer adds their perspective and familiarity with the field.
- Make detailed notes of what you see and where you see it in the field. Use your camera to document problem areas. Video allows the valuable opportunity to describe both the symptoms and field conditions as you are observing them.
- Pull or dig up some plants in normal and in problem areas. The differences you see will provide useful diagnostic information. Ask yourself if a physical limitation like soil compaction or


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poor drainage is impacting growth? Too much or too little water? A nutrient limitation? A pest or disease infestation? Shallow or acidic soil?

Carefully inspect the roots, split the stalks, and examine cob development. Watch for diseases, insects, or obvious damage on leaves, stalks, cobs, or roots.

Are weeds robbing nutrients and water from the crop? Any known or unknown deficiency symptoms? Tissue testing is especially useful to detect hidden hunger or help explain growth differences between areas.

Harvest time is another opportunity to check the crop. Poorly filled, deformed cobs, and barren stalks may indicate nutrient shortages that can be corrected before the next crop is planted.

Questions to Ask While Scouting

- ❑ What is the field's cropping history? What were the previous crops grown?
- ❑ Was the weather too dry? Too hot? Too cold? Too wet?
- ❑ How were the crops fertilized?
- ❑ Was lime applied? What kind and how much?
- ❑ What tillage system was used?
- ❑ Was irrigation used?
- ❑ Have other management practices or inputs been applied? If so, which ones?
- ❑ When were the crops planted? Too early? Too late?
- ❑ Were insects, weeds, and diseases controlled?
- ❑ How has the crop looked until now?

Nutrient Deficiencies

Healthy maize leaves should have a dark green colour. This indicates high levels of chlorophyll, which is essential for trapping the sun's energy and producing sugars needed for plant growth and development. Any stress or nutrient shortage will alter the colour, reduce sugar production, and limit yield.

Some deficiencies detected early may be corrected by a supplemental fertilizer application. However, even if some deficiencies cannot be corrected in the current cropping season, knowing where they occur can be helpful in planning fertilizer programs for the season. Nutrient deficiency occurs when plants are not supplied with adequate nutrients to meet their uptake requirements for good growth and development. Soil acidity affects uptake of many plant nutrients and may cause deficiencies even when adequate supplies of nutrients are present.

A nutrient shortage does not immediately result in visible deficiency symptoms. Plant growth can be stunted before symptoms are seen. This invisible deficiency, called "hidden hunger", is far more common than visible deficiency symptoms. By the time deficiency symptoms first appear, maize has already lost yield and quality.


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Nitrogen Deficiency

- Maize is highly susceptible to nitrogen (N) deficiency. Plants will become stunted and have small cobs.
- Young plants may be uniformly pale green in colour.
- Lower leaves begin to turn yellow as N is transported to the younger leaves.
- The leaf yellowing will progress from the tip along the midrib to the base. Eventually the entire leaf can become brown and die.

Rapidly growing maize takes up large amounts of N from the soil. After the maize is about knee-high, the N demand increases rapidly until tassels appear. Nitrogen uptake can reach a peak of 8 kg N per ha per day during this time. If the deficiency is detected early, additional N fertilizer may be applied to correct the problem. Two applications of N fertilizer are generally recommended to achieve the best results.

Phosphorus Deficiency

- Symptoms usually first appear on the edges of older leaves, especially when the plants are young.
- Purple colour of leaves is a distinct symptom of phosphorus (P) deficiency for maize.
- Inadequate P leads to weak and thin stalks. Cobs are also small and twisted.

Deficiencies sometimes appear in young plants due to cool soil temperatures, or excessively wet or dry conditions that interfere with uptake. Plants may be able to overcome this deficiency if the soil conditions improve.

Phosphorus uptake reaches a peak of 1 kg P per ha per day and steady uptake is required for most of the growing season.

When required, it is recommended that P fertilizer is applied before or at the time of planting. This prevents the occurrence of P deficiency during the growing season.

Potassium Deficiency

- Symptoms first appear as a yellowing along the edges of lower leaves as potassium (K) is transported from the older leaves to the younger leaves.
- As the deficiency continues, the edges of the lower leaves become brown and the yellowing continues towards the midrib. Eventually the yellowing and browning advances towards the higher leaves on the plant.
- The nodes on the inside of the stalk develop a dark-brown colour. The entire plant is shorter as the space between the nodes is reduced.
- The stalks of K-deficient maize tend to break late in the growing season due to poor stem strength.

Potassium is a major factor controlling plant water use, so the impact of drought is greater with K deficiency. Periods of peak demand (6 kg K per ha per day) are often equal to N, with two-thirds of the total K uptake occurring prior to silking.

Sulfur Deficiency

- Sulfur (S) is not mobile in plants, so pale-green or yellow deficiency symptoms first appear on younger leaves.
- The entire leaf becomes uniformly pale green or yellow.
- The entire plant may become pale as the deficiency persists.
- The entire plant becomes stunted and thin.

Sulfur deficiencies are most common in maize growing on sandy soils with low organic matter. Sulfur is taken up by maize continually over the entire growing season. Fertilizer containing sulfate (SO_4^-) may be applied at any time, but elemental S requires time before it is converted into sulfate in the soil.

Magnesium Deficiency

- Symptoms first appear as light striping along the lower leaves.
- Since magnesium (Mg) is mobile in plants, it is easily transported from the older leaves to the young growth where symptoms may not be seen.
- As the deficiency progresses, the underside of the leaf may develop a purplish color. The leaf edges may also begin to turn yellow and die.

Deficiencies of Mg often occur in maize growing in acid soils. Application of a liming material that contains Mg (such as dolomite) is commonly recommended in these conditions. When Mg deficiency is present in non-acidic soils, Mg-supplying fertilizers can be applied to correct deficiencies.

Zinc Deficiency

- Zinc (Zn) deficiency symptoms are frequently seen during the early growth period.
- Younger leaves first develop symptoms of yellowing, which appear along the sides of the midrib extending from the stalk to the middle of the leaf. The leaf midrib and margins may continue to be green.
- While older leaves will appear healthy, emerging young leaves may be pale green.
- The stalk internodes become stunted, resulting in shorter plants and a bunching of the leaves at the top of the stalk.

A high-yielding maize crop will take up 500 g Zn per ha, with most of that uptake occurring in the middle-third of the growing season. An adequate supply of Zn is important for healthy plant development and proper maturation for a timely harvest.

Boron Deficiency

- Boron (B) deficiency symptoms are seen at the growing points and on the youngest leaves.
- Leaves become twisted and develop yellow or white spots.
- In severe cases, barren cobs with few kernels may occur.

Maize accumulates less than 100 g B per ha during the growing season. The major periods of B uptake occur in the early vegetative stage and again about one month after silking.

Copper Deficiency

- The young leaves develop a yellow color and may be twisted in a spiral.
- Deficiencies are mainly observed on the younger growth, appearing as light streaks between the leaf veins and on the tips.

Many African soils are low in plant-available Cu and deficiencies are becoming more common. The positive crop response to supplemental Cu and other micronutrients is now recognized as an important part of successful maize production.

A Key to Nutrient Deficiency Symptoms in Maize

NUTRIENT	Colour change in lower leaves (translocated nutrients)
Nitrogen	Plants light green; older leaves yellow (chlorosis), yellowing begins at leaf tip and extends along mid-ribs.
Phosphorus	Plants dark green, often with a purple colour (mostly on the leaf margins); leaves and plants small.
Potassium	Yellow/brown discolouration and scorching along outer margin of older leaves; begins at leaf tip.
Magnesium	Older leaves have yellow discolouration between veins, finally reddish-purple from edge inward.
NUTRIENT	**Colour change in upper leaves (nutrients not translocated)**
	Terminal growing point dies
Calcium	Emergence of primary leaves delayed; terminal buds deteriorate. Leaf tips may be stuck together.
Boron	Leaves near growing point yellowed; growth points appear white or light brown dead tissue.
	Terminal growing point remains alive
Sulfur	Leaves, including veins, turn pale green to yellow, young leaves first.
Zinc	Broad white to yellow bands appear on the leaves on each side of the midrib plants stunted, shortened internodes.

	Terminal growing point remains alive (cont'd)
Iron	Leaves yellow to almost white; interveinal chlorosis to leaf tip.
Manganese	Leaves yellowish-gray or reddish gray with green veins.
Copper	Young leaves uniformly pale yellow; may wilt and wither without chlorosis.
Chloride	Wilting of upper leaves, then chlorosis.
Molybdenum	Young leaves wilt and die along margins; chlorosis of older leaves due to inability to properly utilize N.

Remember:

- Deficiency symptoms are not always easy to identify. Leaf disorders from nutrient interactions, disease, or insects can make accurate diagnosis difficult.
- Maize crops often lose yield and quality before any deficiency symptoms are seen. This is commonly referred to as hidden hunger.
- Deficiency symptoms always indicate severe starvation, never slight or moderate starvation.

Symptoms of Nutrient Deficiency & Common Growth Disorders

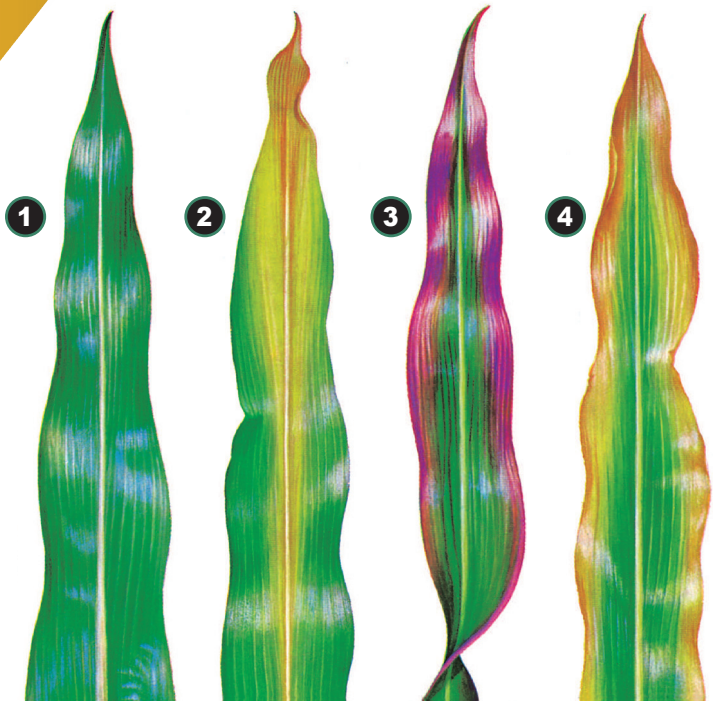
LEAVES

(1) Healthy leaves shine with a rich, dark green colour.

(2) Nitrogen deficiency starts as yellowing at the tip of older leaves and moves along the middle of leaf.

(3) Phosphorus deficiency marks leaves with reddish-purple, particularly on young plants.

(4) Potassium deficiency appears as a yellowing or drying along the tips and edges of lowest leaves.

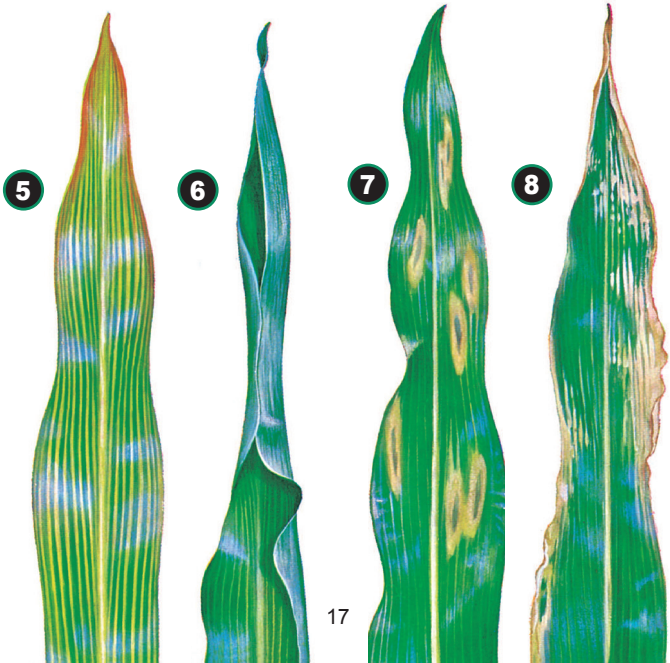


(5) Magnesium deficiency causes whitish stripes along the veins and often a purplish colour on the underside of the lower leaves.

(6) Drought causes maize plants to have a greyish-green colour; leaves may roll up to the size of a pencil.

(7) Disease infection starts in small spots (e.g., leaf blight shown), and gradually spreads across leaf.

(8) Chemical damage may sometimes burn tips of edges of leaves at the point of contact. Tissue dies, leaf becomes bleached.



Symptoms of Nutrient Deficiency & Common Growth Disorders

STALKS

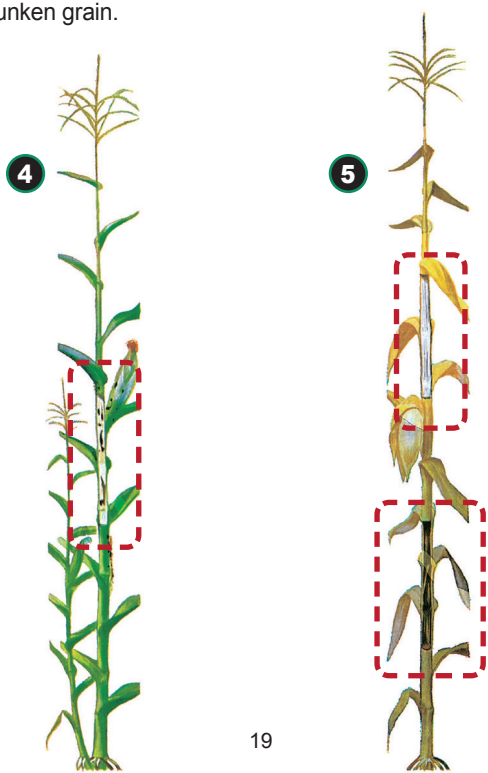
(1) Healthy stalks have normal size. Cut-away stalk section below the cob shows healthy, white pith area.

(2) Phosphorus deficiency leads to weak, spindly stalks, often barren of cobs. Note purple colouration of lower leaves.

(3) Potassium deficiency leads to a dark brown discolouration at the nodes (see cut-away section).

(4) Suckers (tillers) may form when maize gets too much N early in the season. Maize varieties that produce tillers are not necessarily lower yielding. Cut-away section illustration also shows insect (maize borer) damage.

(5) Disease symptoms found in stalks include the black bundles in the upper cut-away, and the darker pith in the lower cut-away. Stalk rot works inside first, causing early death and breakage of the stalk, and shrivelled cobs with chaffy, low-test-light weight and shrunken grain.



Symptoms of Nutrient Deficiency & Common Growth Disorders

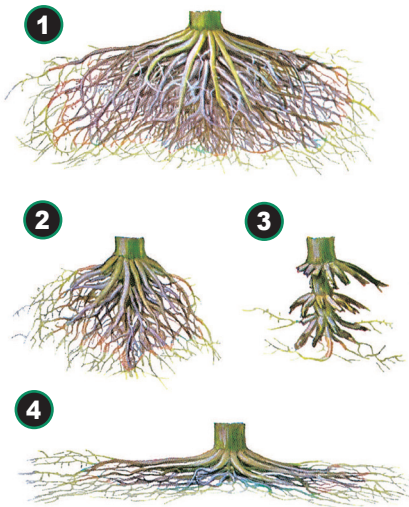
ROOTS

(1) Deep spreading roots of healthy, high-yielding plants will explore a large area of the soil profile.

(2) Phosphorus deficiency during early weeks causes a shallow root system with little spread.

(3) Rootworms can prune heavily as they eat small roots and tunnel in larger ones.

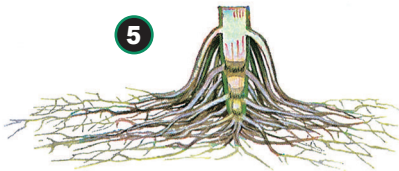
(4) Poor drainage and hardpan will lead to a flat, shallow root system. Maize with poor roots can't withstand drought and easily blown over by high winds.

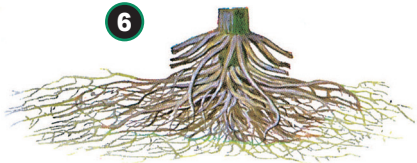


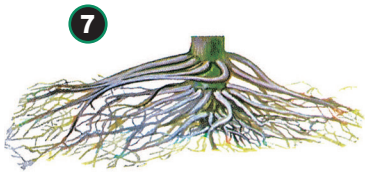
(5) Damage from an overly acid soil is indicated when the lower part of the root is discoloured and decayed, particularly when brace roots shoot from third or fourth node of the stalk. Roots become thick and stubby.

(6) Pruned roots will result from tillage that went too deep or too close to the stalk.

(7) Chemical damage makes roots curl and twist. Joined brace roots are another symptom.







Symptoms of Nutrient Deficiency & Common Growth Disorders

COBS

(1) Normal cobs from properly fertilized, high-producing maize often weigh 150 to 225 grams. Cob tips may not be completely filled with grain.

(2) Big cobs in excess of 225 grams and with kernels covering the tip of the cob, indicate that plant population may be too low for most profitable yields.

(3) Small cobs may be a sign of low fertility, excessive plant population, or other problems.

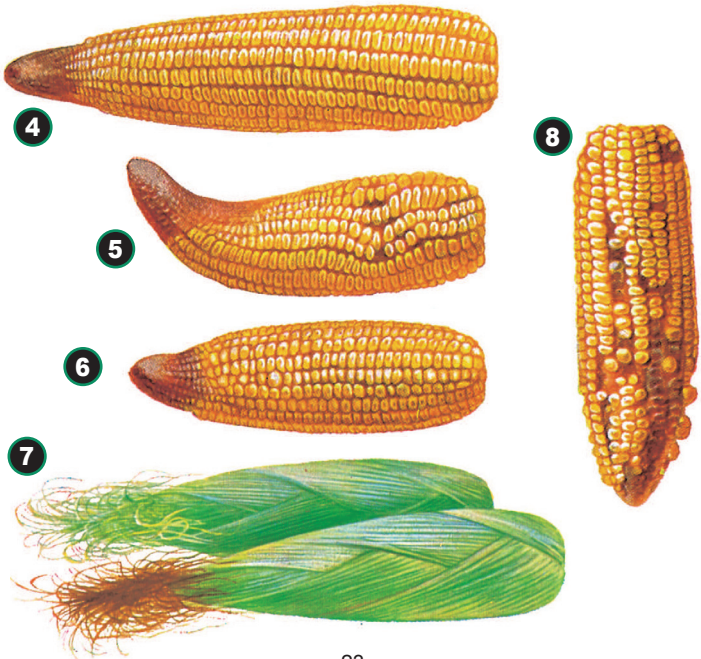
(4) **Potassium** deficiency leads to cobs with poorly filled tips and loose, lightweight, and shrunken kernels.

(5) **Phosphorus** deficiency interferes with pollination and kernel filling. Cobs are small and twisted with undeveloped kernels.

(6) **Nitrogen** deficiency leads to small cobs with incomplete kernel fill at the tip.

(7) **Green silks** at maturity may be caused by too much N in relation to other nutrients.

(8) **Dry weather** slows silking; kernels are not well pollinated.



FIELD NOTES/MAPS

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ABOUT **APNI**

The **African Plant Nutrition Institute** research and outreach activities focus on improving the understanding of spatial and temporal variability of nutrient needs for Africa's diverse cropping systems. APNI promotes balanced and site-specific soil nutrient management for greater crop yield and quality, and develops nutrient management strategies to improve soil health, reduce environmental footprints, and improve adaptation to climate change.

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