INTERPRETATION OF SOIL ANALYSIS RESULT AND FERTILIZER RECOMMENDATION

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Introduction

- Agriculture sector performance key

  to economic growth and food security in Myanmar

- MOALI policy framework

  to lead the agriculture sector to success

- The adoption of technologies and practices fundamental

  to sustainable agricultural production

  benefits of using inorganic fertilizers

- Critically important - Researchers

  - Stakeholders

Critical to these goals is public-private partnership

The improvement of the public and private sectors' performance with respect to their roles in:

(1) needs-based fertilizer research and development programs

(2) dissemination of research results to relevant stakeholders

(3) fertilizer-related technology transfer to agro-input dealers and farmers

(4) assurance that farmers have access to high quality fertilizers appropriate to specific zones and crops

To achieve the vision, four key objectives are established

- ❖ Improve the fertility status of Myanmar soils to support **sustainable improvement** in agricultural productivity.
- ❖ Enhance efficiency and effectiveness in the fertilizer **value chain to improve farmers' knowledge** of, access to, and use of high-quality fertilizer products.
- ❖ **Increase farmers' economic returns** from fertilizer use.
- ❖ Reduce adverse **impacts of fertilizer** on the natural environment, ecological resources, and climate change

Myanmar fertilizer use

- Myanmar has had a long history of low fertilizer use
- Fertilizer market has expanded rapidly since 2008
- Fertilizer market in Myanmar has grown at a compound growth rate of 10-15% per year
- About 1.6 million metric tons (t) in 2016
- The current fertilizer use practices also result in unbalanced nutrient applications, with an N:P:K use ratio of 6.5:1.6:1

The key ways to improve fertilizer use

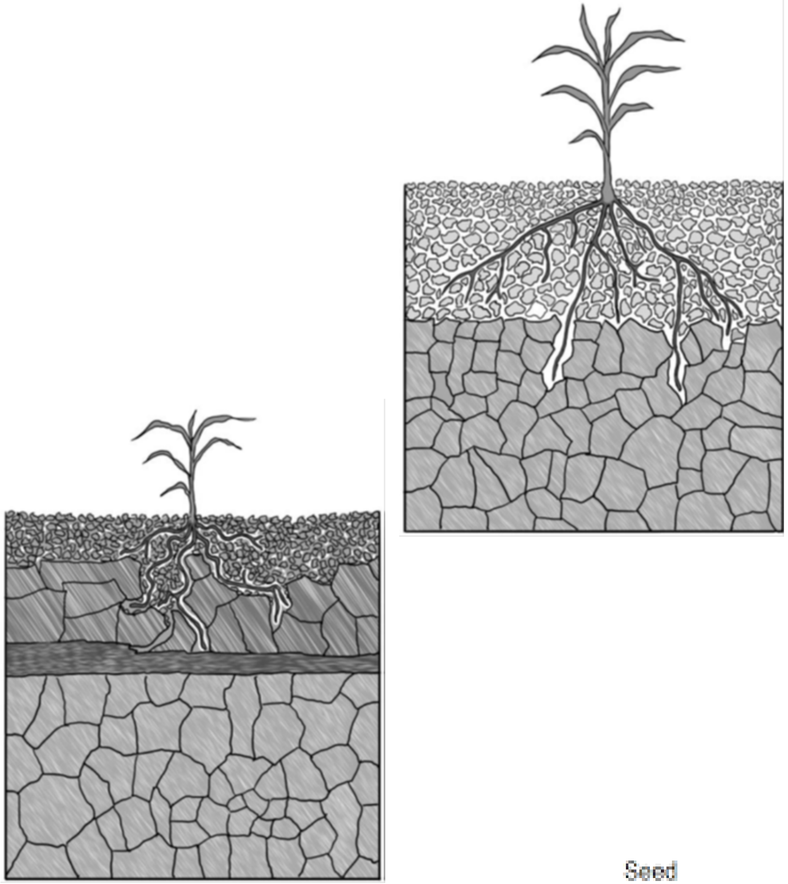
- One is to enhance **farmer knowledge**
  - specific crop
  - soil nutrient needs
  - fertilizer products (nutrient grades/formulations)
  - best match those nutrient needs
- **Choosing fertilizer** to use is often one of the most important decisions a farmer has to make.
- Myanmar farmers have limited knowledge of **modern agricultural technologies**, including fertilizers.

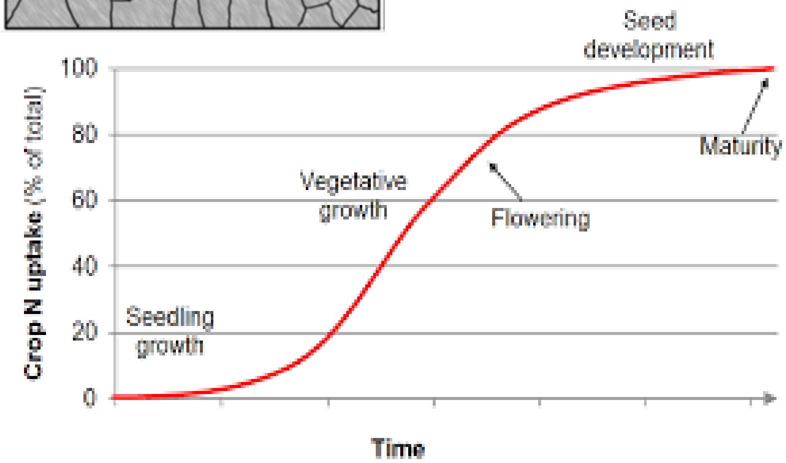
- No top-down **recommendation currently exists** in Myanmar for fertilizer based on crops and agro-ecological zones.
- Soil testing, is essential to improving soil nutrient management, is not widely done.
- **Farmers use fertilizers**, recommendations from their neighbors and/or agro-input dealers are a major influencing factor in their own decisions.
- Unfortunately, **local agro-input** dealers also have limited knowledge about fertilizer products and their efficient utilization.

Diagnosis of fertilizer requirements

The still widely used practice of **deciding rates of fertilizer use** on the basis of local experience or general data for crop requirements is certainly useful for obtaining at least **medium yield levels**, but neither very effective nor **economic.**

Soils differ widely in their capacity for providing nutrients, depending on the amount of total reserves, on mobilization or fixation dynamics, access ability of chemically available nutrients to the roots, etc.





Multinutrient fertilizers

- Since crops often require an additional supply of several nutrients, special combinations with different nutrient ratios offer a considerable simplification and facilitation of fertilizer application.
- Most combinations are of the complex NPK- type, which contains N in part as ammonium in part as nitrate, one-third of the phosphate in water-soluble from and K mostly as chloride

- All plants need at least 17 essential elements to complete their life cycle.
- In addition to carbon (C), hydrogen (H), and oxygen (O) there are 14 elements derived from soils that are essential for plant growth.
- These are called plant or crop nutrients.
- Four additional elements (including cobalt [Co], sodium [Na], silicon [Si], and barium [Ba]) are beneficial for proper development of some plants.

The plant nutrients are divided into three subgroups:

1. Macro- or primary nutrients: nitrogen (N), phosphorus (P), and potassium (K). Plants require these nutrients in higher quantities. They are important for many critical functions
2. Major or secondary nutrients: calcium (Ca), magnesium (Mg), and sulfur (S). Most plants require as much S as they do P.
3. Micronutrients (or trace elements): chlorine (Cl), iron (Fe), manganese (Mn), boron (B), zinc (Zn), copper (Cu), molybdenum (Mo), and nickel (Ni). Plants require much smaller quantities of micronutrients, but they are still important for plant growth.

ပိုစံကွဲပြားသောဓါတ်မြေဩဇာများ

Table 1: Nitrogen Fertilizers

Name	Content
Ammonium Chloride	28 % N
Ammonium Sulfate	21 % N, 24% S
Ammonium Bicarbonate	17 % N
Urea (NH_2 – CO-NH_2)	46 % N
Monoammonium Phosphate (MAP)	11 % N, 22 % P
Diammonium Phosphate (DAP)	18-21 % N, 20% P
Urea phosphate	18 % N, 20% P

Table 2: Phosphorus Fertilizer

Name	Content
Single superphosphate	7-9 % P, 13-20% Ca, 12% S
Triple superphosphate	18-22 % P, 9-14% Ca,1.4%S
Monoammonium phosphate (MAP)	22 % P, 11% N
Diammonium phosphate (DAP)	20-23 %P, 18-21% N (most common 20%P)
Urea Phosphate (UP)	20%P, 18%N
Partly acidulated rock	10-11%P
Rock phosphate, finely powdered	11-17% P,33-36 % Ca

Table 3: Potassium (K) Fertilizers

Name	Content
Potassium chloride	50% K
Potassium nitrate	37%K, 13%N
Potassium sulfate	40-43%K, 18% S
Langbeinite	18%K, 11%Mg, 22%S
Compound Fertilizer	Variable

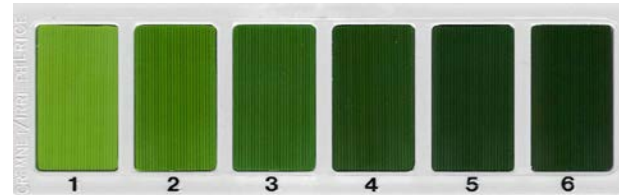
Common basic fertilizer materials used for blending and their nutrient contents

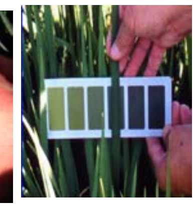
Material	Analysis	N %	P_2O_5 %	K_2O %
Ammonium nitrate	33-0-0	33	0	0
Ammonium sulfate*	21-0-0-24S	21	0	0
Diammonium phosphate	18-46-0	18	46	0
Potassium chloride (muriate of potash)	0-0-60	0	0	60
Potassium sulfate**	0-0-50-16S	0	0	50
Potassium magnesium sulfate***	0-0-22-23S-11Mg	0	0	22
Triple super phosphate	0-46-0	0	46	0
Urea	46-0-0	46	0	0

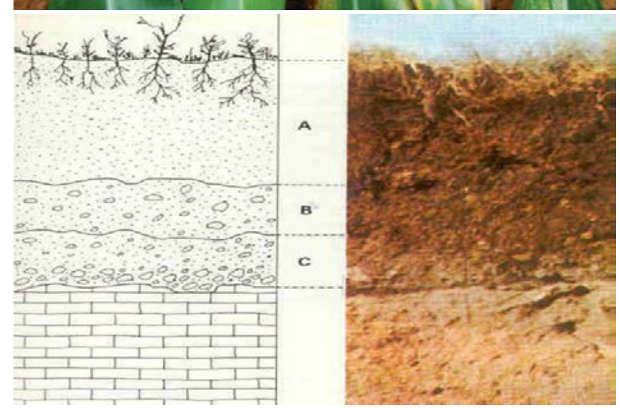
Note: *Ammonium sulfate contains 24% sulfur (S)
**Potassium sulfate contains 16% S
***Potassium magnesium sulfate contains 23% S and 11% magnesium (Mg)

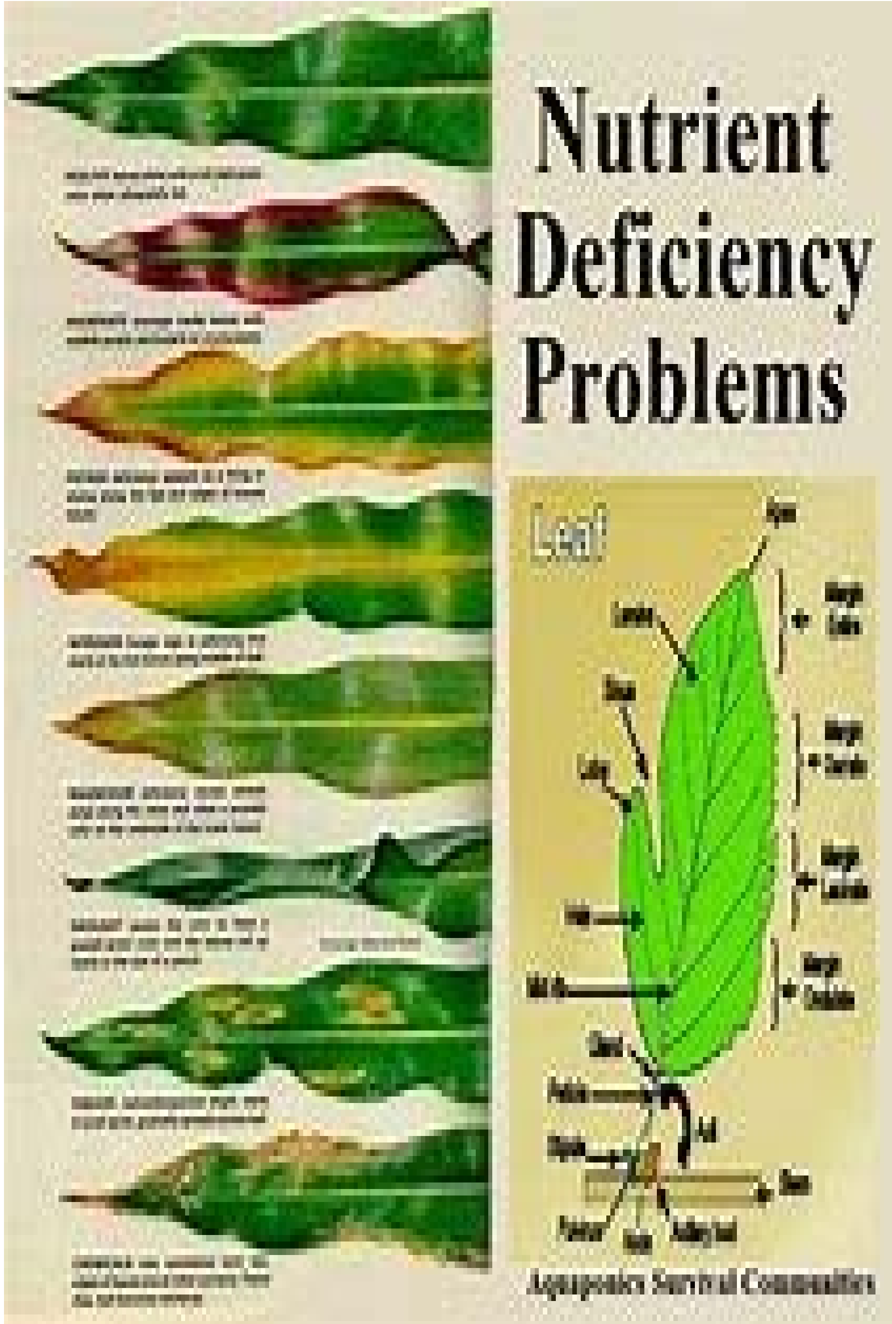
Diagnostic criteria

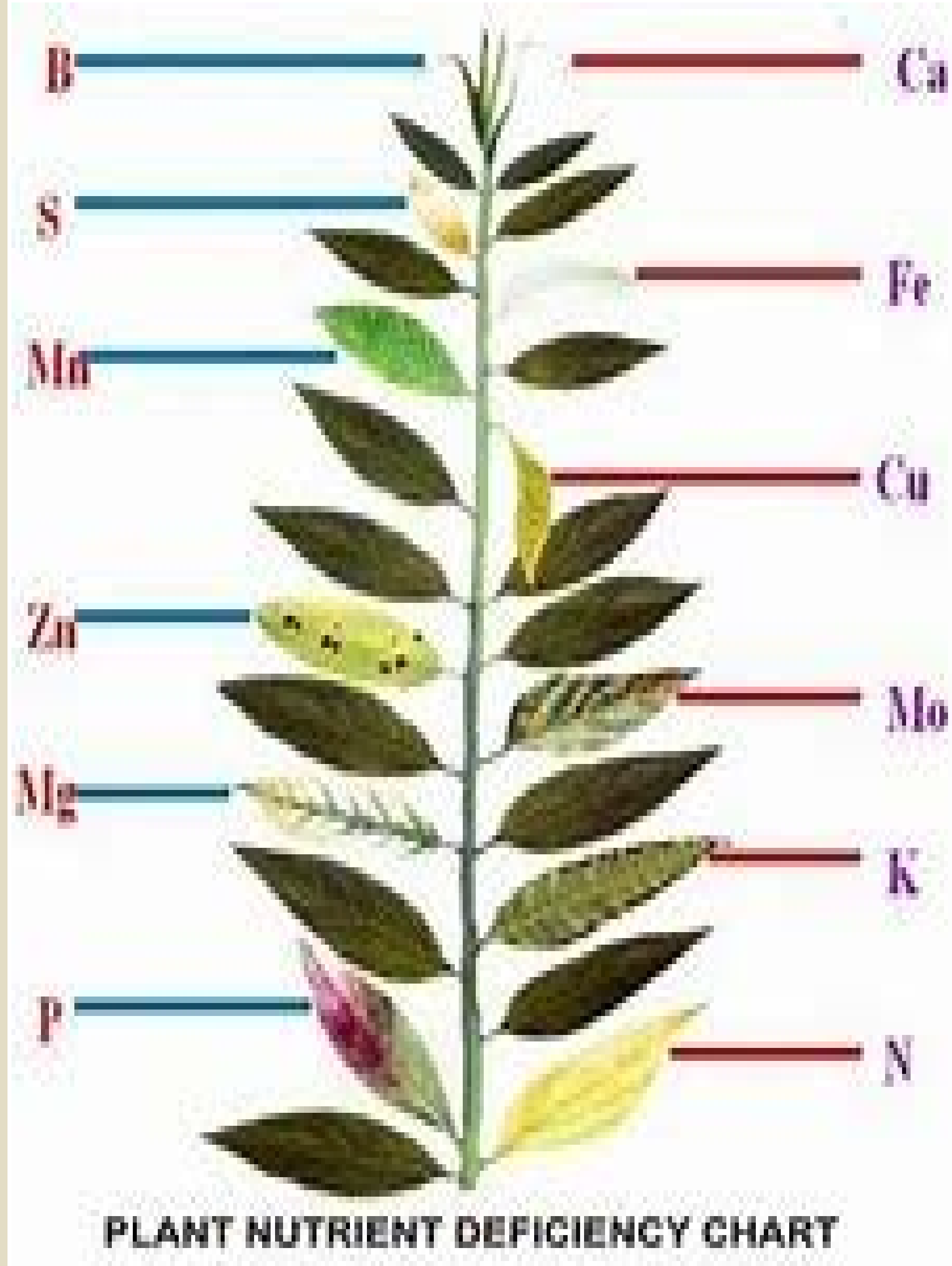
- ❖Visual Diagnosis
- ❖Plant analysis
- ❖Quantitative analysis
- ❖Tissue testing
- ❖Biochemical test
- ❖Soil test








Nutrient
Deficiency
Problems
Leaf


B
S
Mn
Zn
Mg
P
Ca
Fe
Cu
Mo
K
N
PLANT NUTRIENT DEFICIENCY CHART

What is Soil ? (1)

- ❖Soil is a Natural product.
- ❖Soil is created from minerals, water, air, and biota under the interrelationships between these factors, reflecting the surrounding environments on the surface of earth.
- ❖Soil is one of the bases for all the living activities on the earth.

What is Soil ? (2)

- ❖Soil is a Man-made product.
- ❖Human can work on soils, and change the soil properties so that he can obtain his desired products.

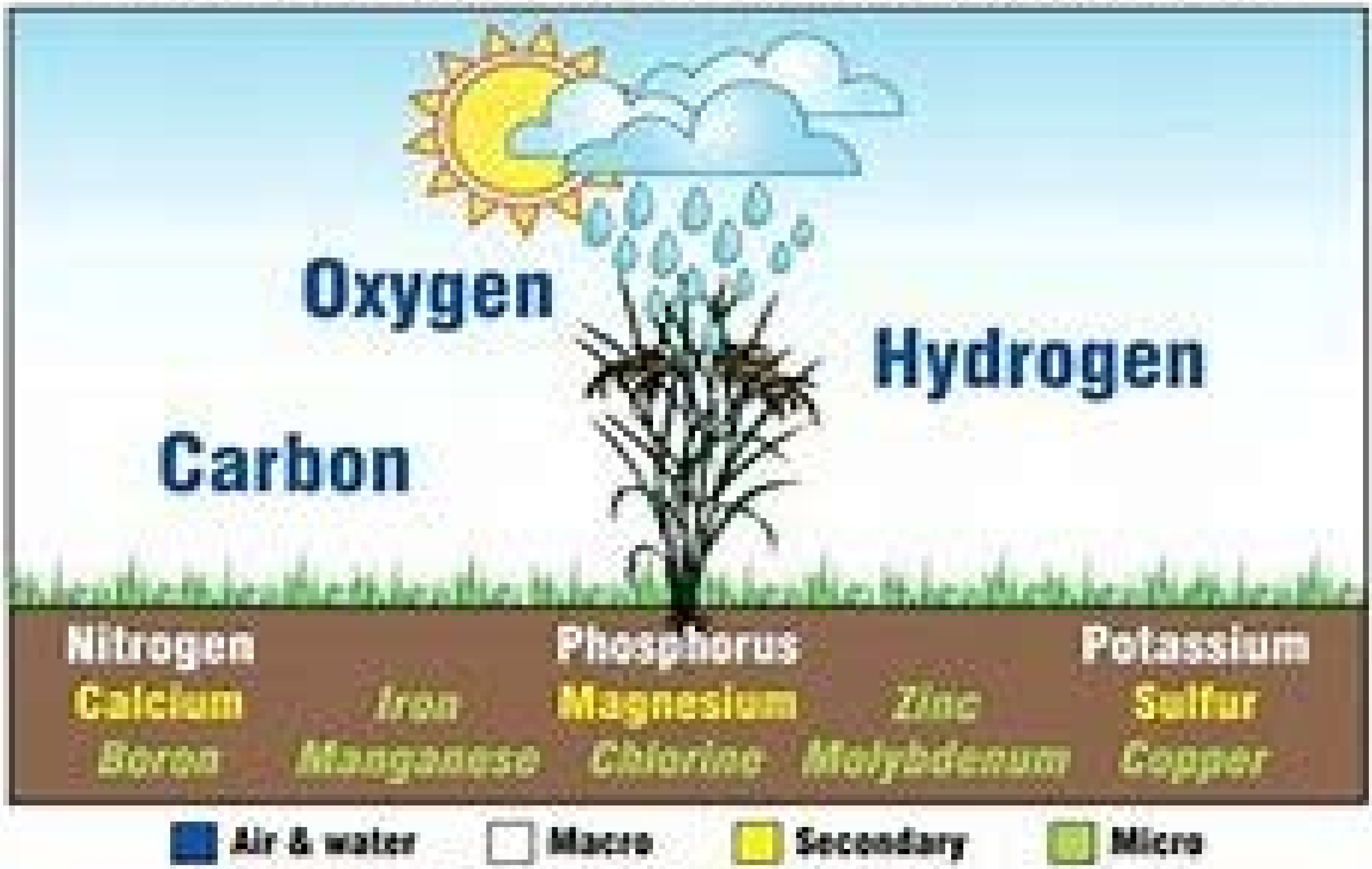
- ❖→ Soil is a basis for agricultural production

Calculating Nutrient Requirement

- The first step in applying the correct rate of fertilizer is calculating crop nutrient requirements.
- A soil test is the only way to measure how much P_2O_5 and K_2O are available in soils, and soil tests are available through several private and public laboratories.
- An explanation of how to perform soil tests and interpret results is available.

- Applications of P_2O_5 and K_2O may not be required annually
- depending on how much is available in particular soils,
- the amount of P_2O_5 and K_2O that is required to meet production goals for the specific crop to be grown.
- As N is much more mobile in soils and must be applied every year to non-leagumes
- N requirements are based on the crop to be grown and the soil type that influences yield goals.
- These recommendations are generally made in conjunction with soil test reports.

16 Essential Nutrients for maximum plant growth



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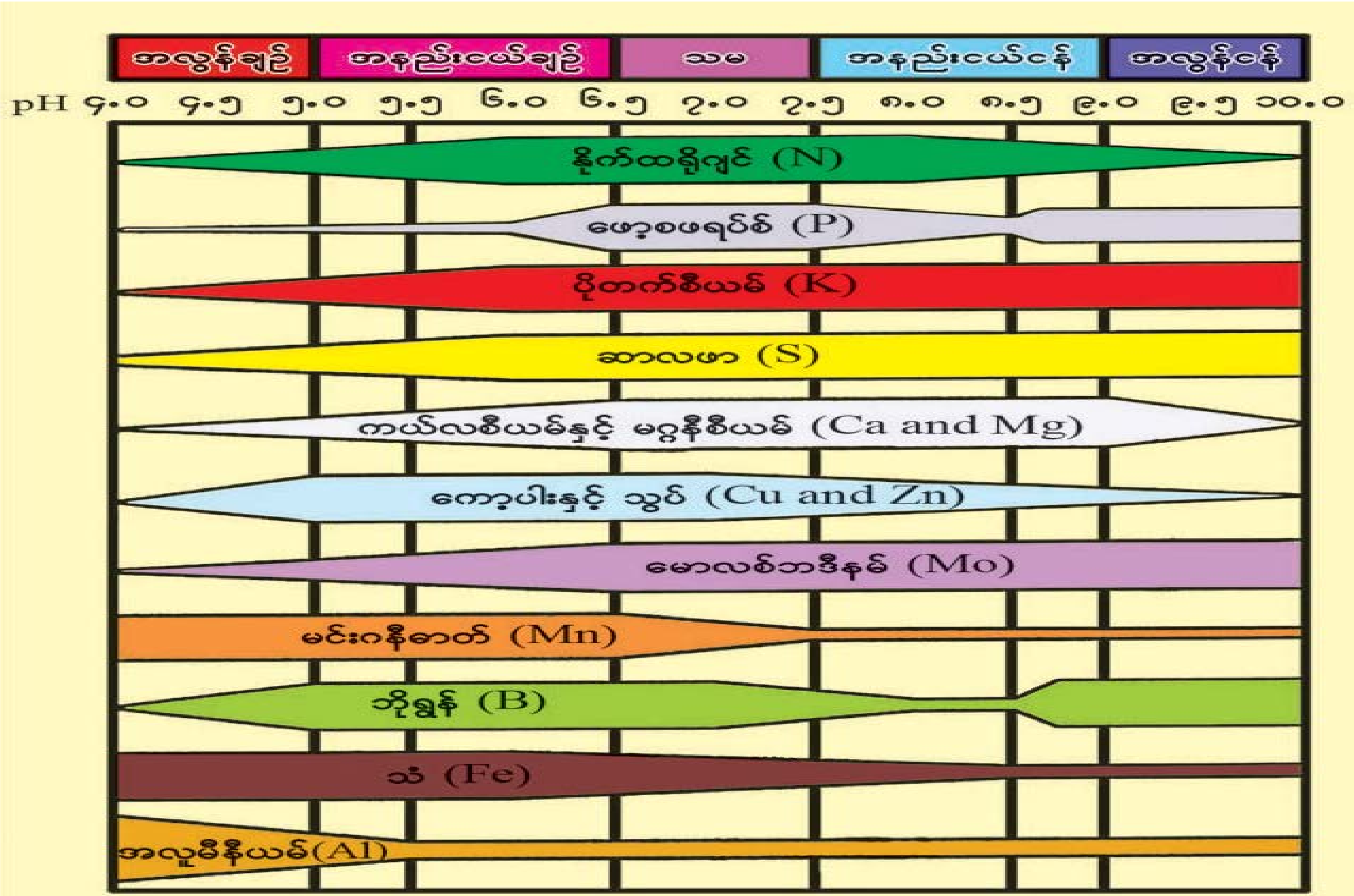
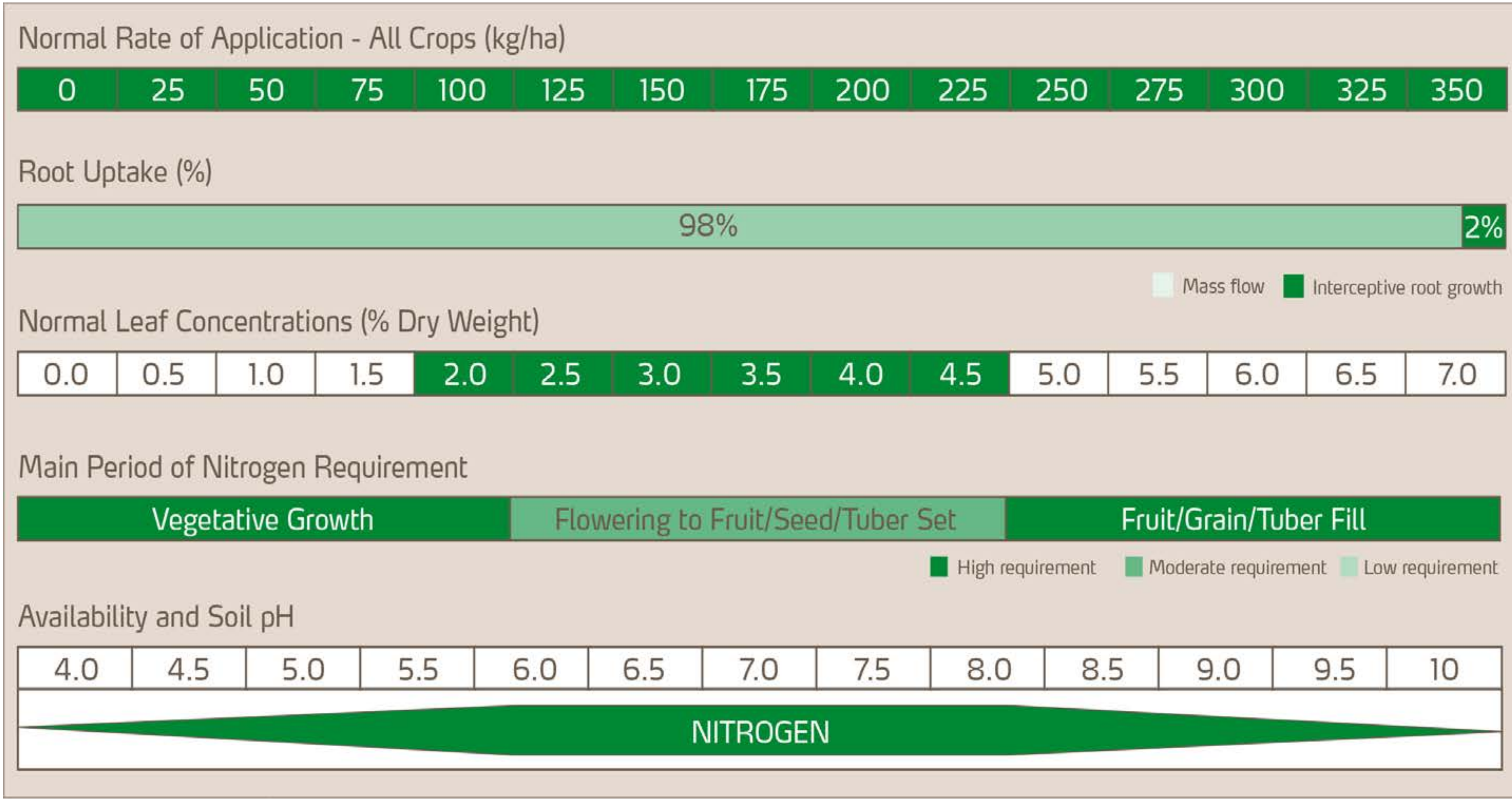


Nitrogen (N) summary



- **High N rates will inhibit K uptake, eg. Tomatoes**
- **High N rates will reduce mobility of Cu, eg. cereals**

Phosphorus (P) summary

Normal Rate of Application - All Crops (kg/ha)

0	25	50	75	100	125	150	175	200	225	250	275	300	325	350	P_2O_5
0	25	50	75	100	125	150	175	200	225	250	275	300	325	350	P

Root Uptake (%)

6%	91%	3%

Mass flow · Diffusion · Interceptive root growth

Normal Leaf Concentrations (% Dry Weight)

0.0	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70

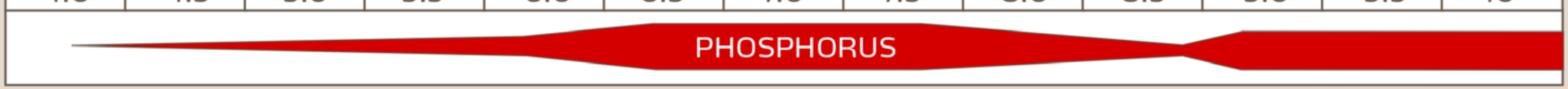
Main Period of Phosphorus Requirement

Vegetative Growth	Flowering to Fruit/Seed/Tuber Set	Fruit/Grain/Tuber Fill

High requirement · Low requirement

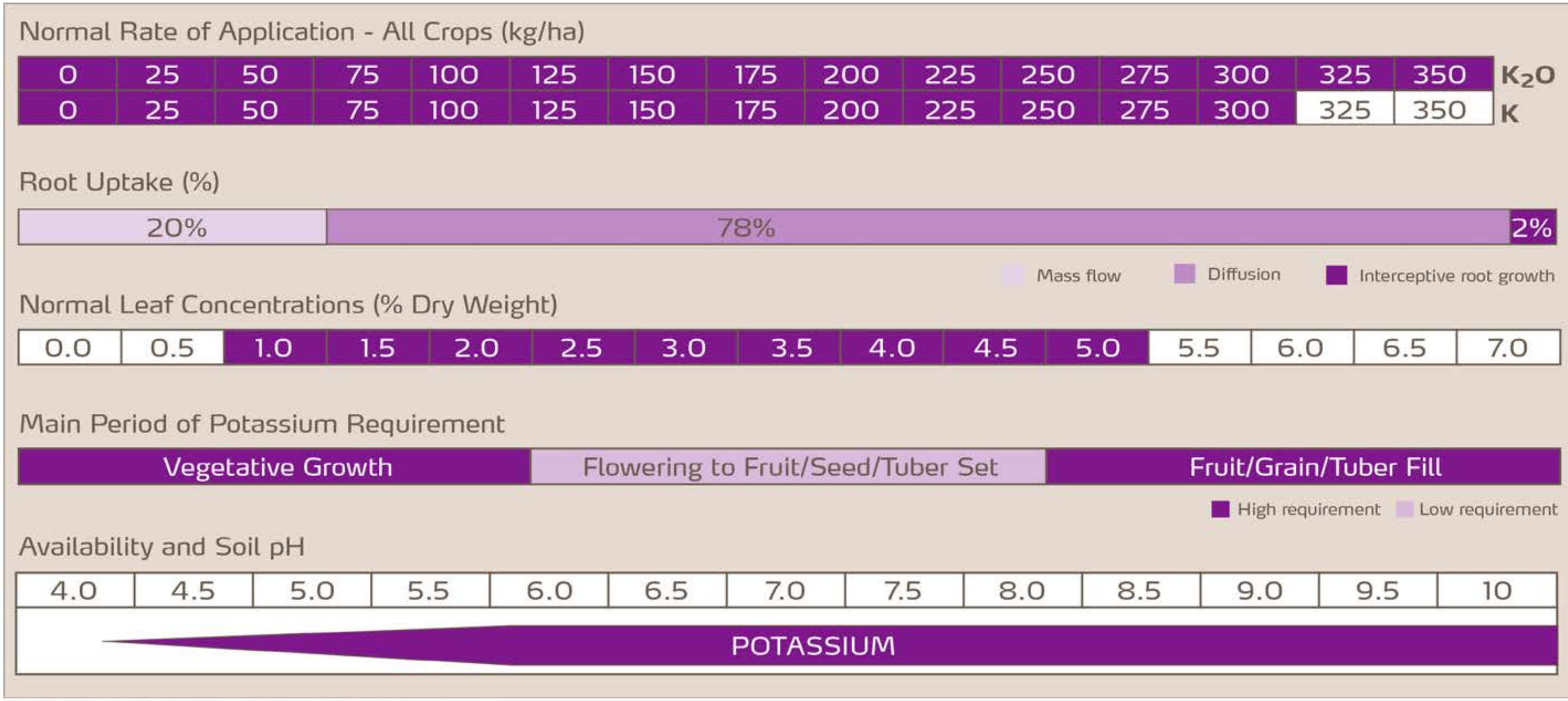
Availability and Soil pH

4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10



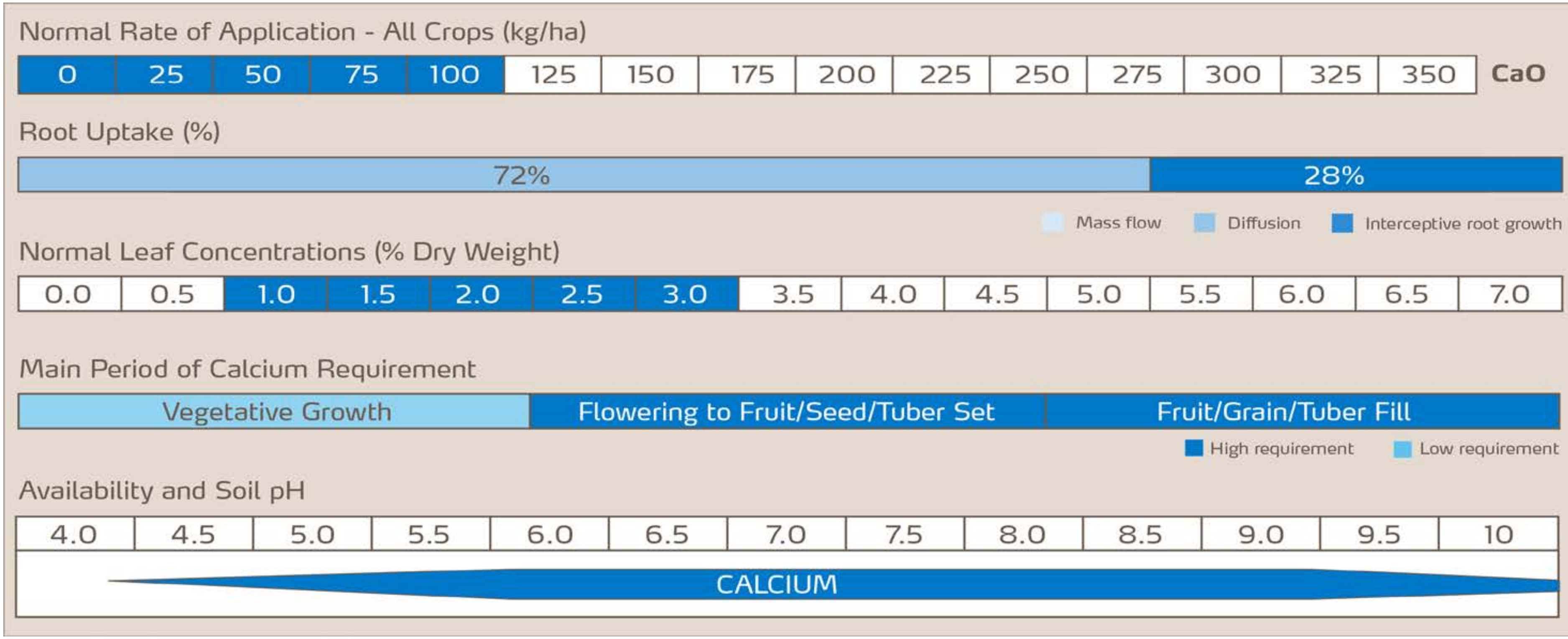
- ❖ **P uptake is improved in the presence of ammonium**
- ❖ **High P may reduce Fe uptake (rare occurrence)**
- ❖ **High P may reduce Cu uptake (mentioned in literature)**
- ❖ **High P reduces Zn availability in plant and vice-versa**

Potassium (K) summary



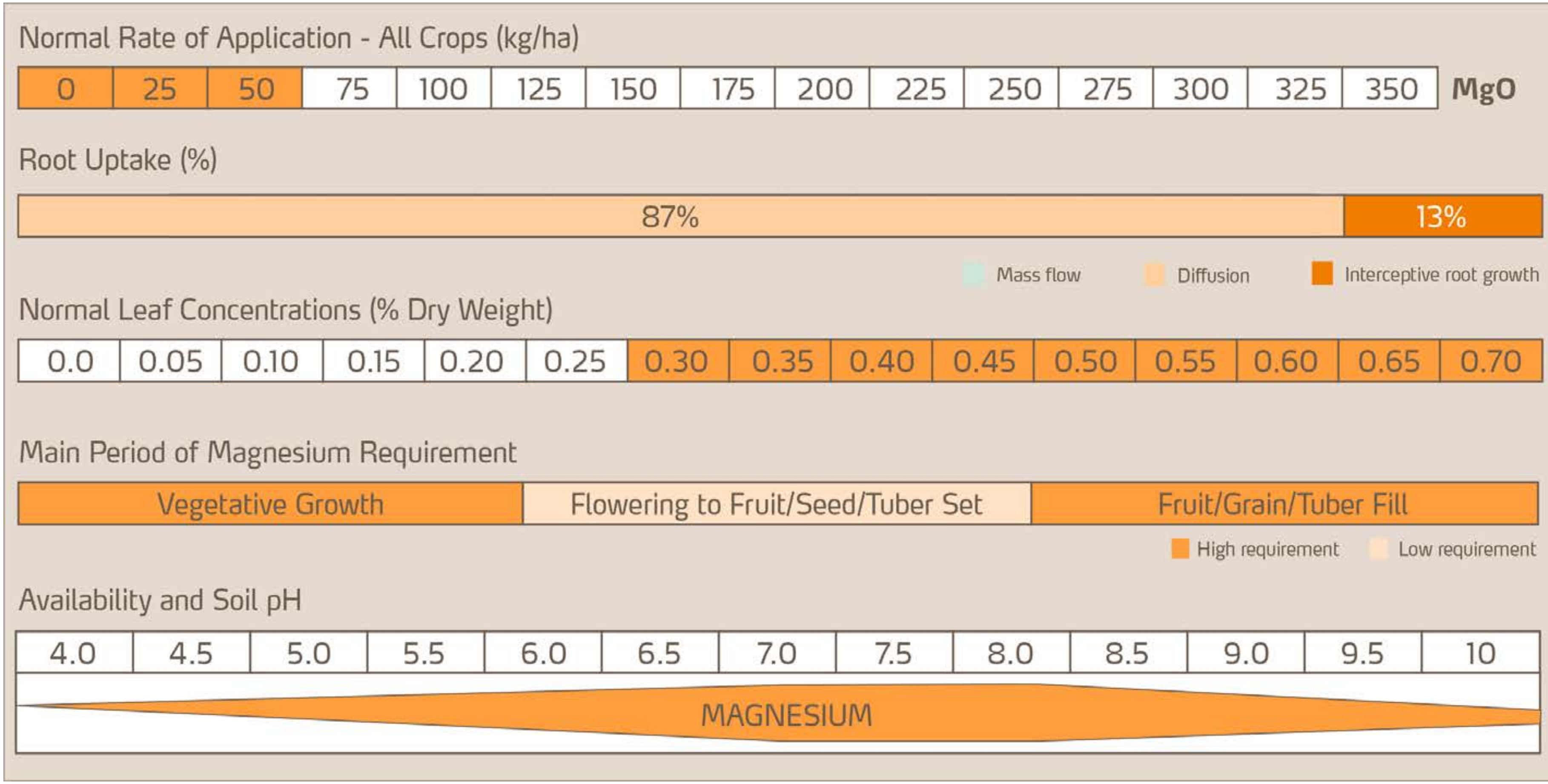
- ❖ **Potassium, calcium and magnesium all need to be balanced**
- ❖ **An excess of one will suppress the uptake of the others**
- ❖ **High ammonium-N will reduce K uptake**

Calcium (Ca) summary



- **Calcium, potassium and magnesium all need to be balanced**
- **An excess of one will suppress the uptake of the others**
- **High ammonium-N will reduce Ca uptake**
- **Ca and P will react to form an insoluble compound**
- **Ca and S will react to form gypsum**
- **B will improve the uptake and translocation of Ca**

Magnesium (Mg) summary

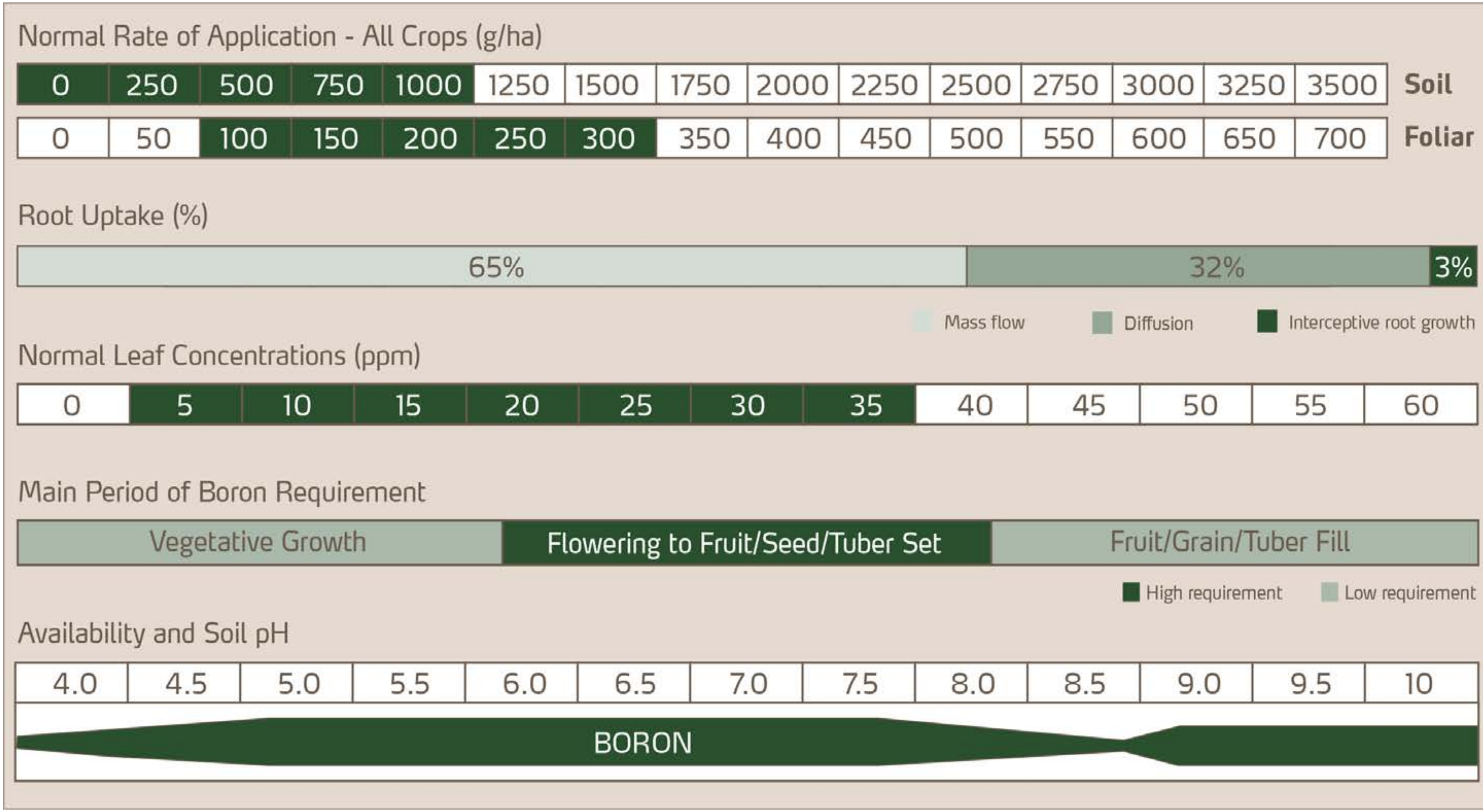


- **Magnesium, calcium and potassium all need to be balanced**
- **An excess of one will suppress the uptake of the others**
- **High ammonium-N will reduce Mg uptake**

Sulfur (S) summary

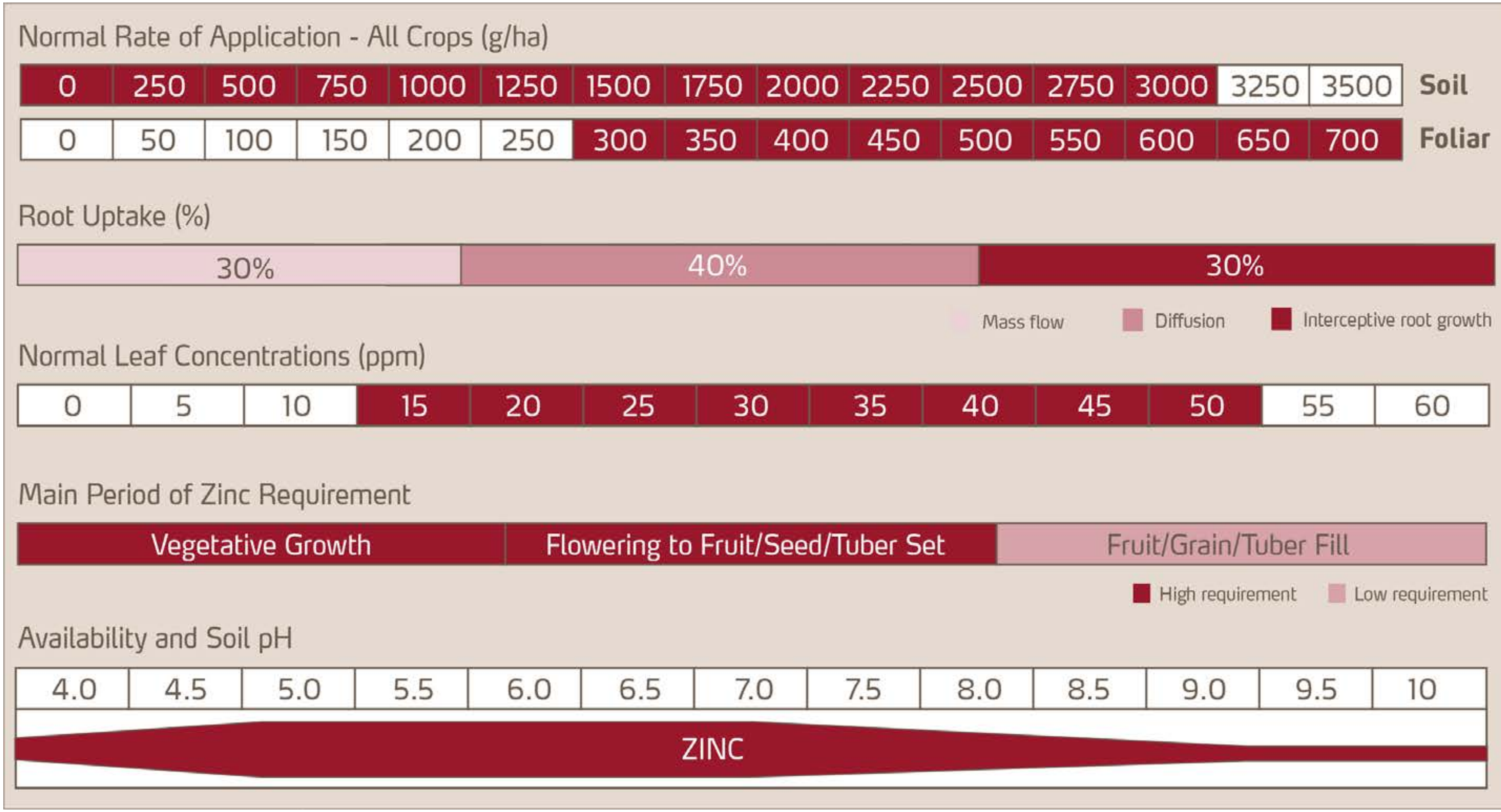
- ❖ **High S levels in soil will inhibit uptake of selenium**
- ❖ **This may effect animal health**

Boron (B) summary



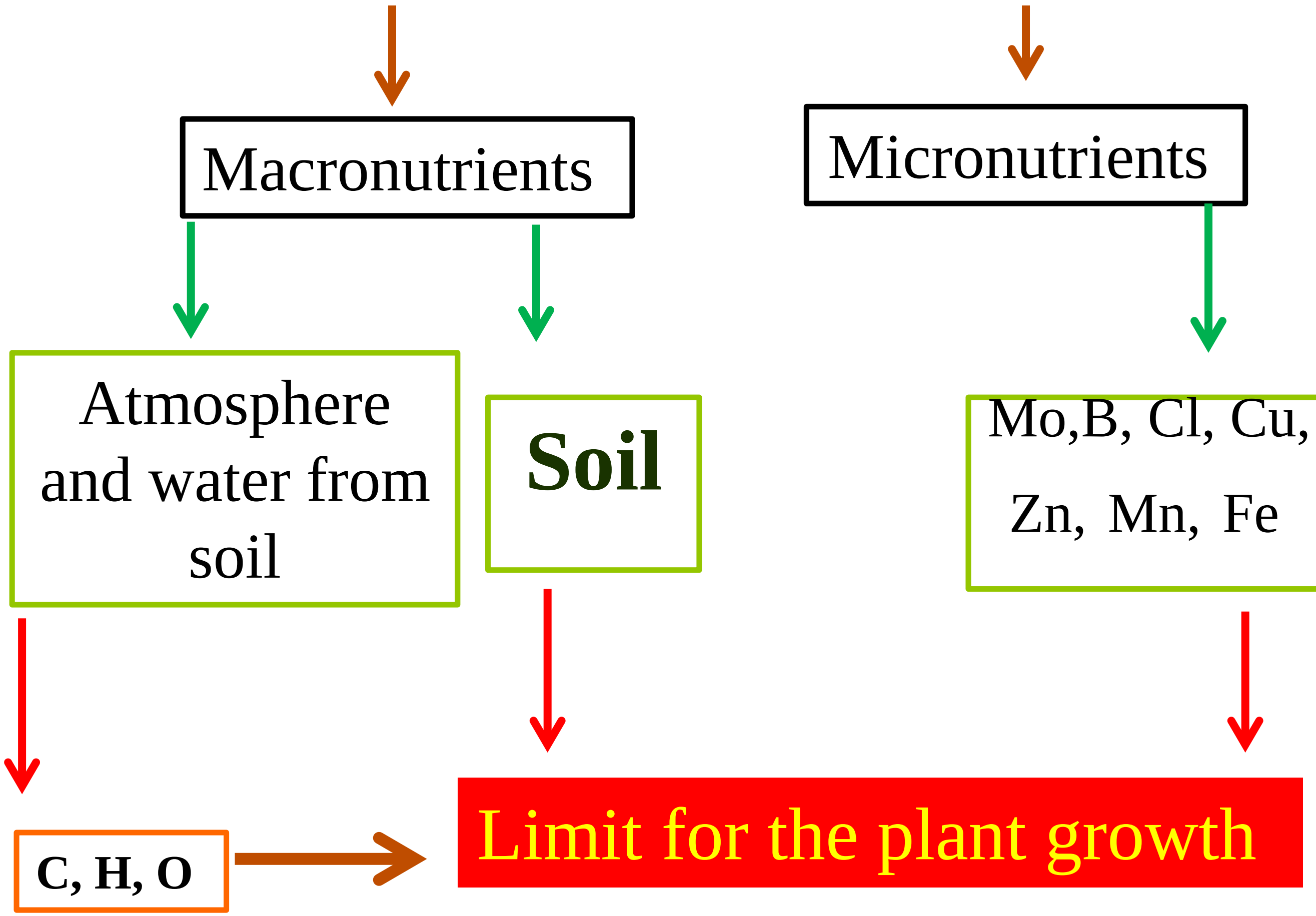
❖ **Boron is critical for uptake and transport of Ca in the plant**

Zinc (Zn) summary



- ❖ **High soil P levels increases Zn adsorption in the soil**

Nutrients for plant growth

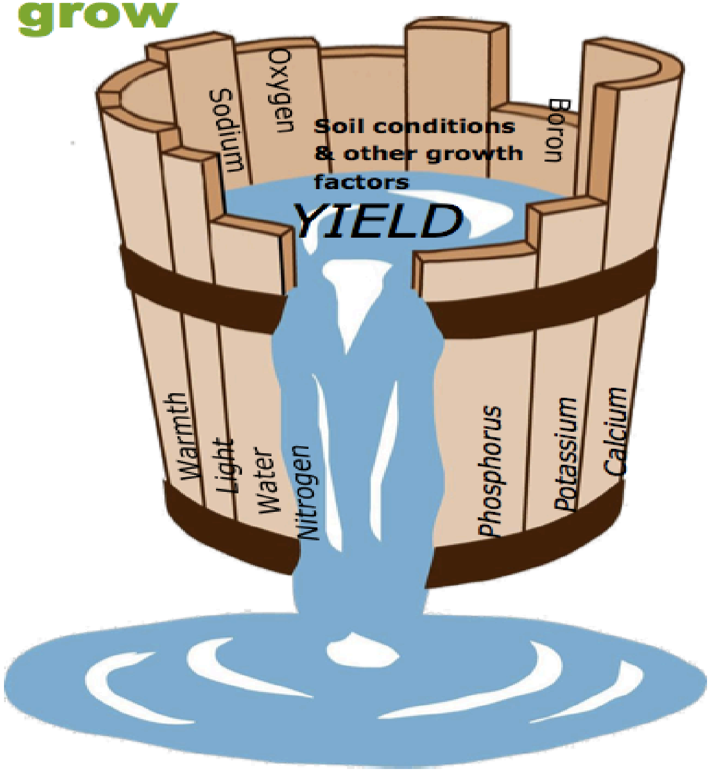


Balanced fertilizer application

Plants need nutrients to grow

Nutrient behavior

- Nutrients have specific and essential functions in plant metabolisms
- They cannot replace each other, and lack of any one nutrient limits crop growth



Fertilizer management:

R4: *Right type, Right rate, Right time, Right method*

Nutrient Fertilizers Characteristics: Organic & mineral

Characteristics	Organic fertilizer	Mineral fertilizer
Nutrient source	Crop residues and animal manures	Nitrogen from the air and minerals from the soil
Nutrient concentration	Low concentration	High concentration
Nutrient availability	Variable	Immediately available for the crop
Quality	Often inconsistent	Traceable and consistent

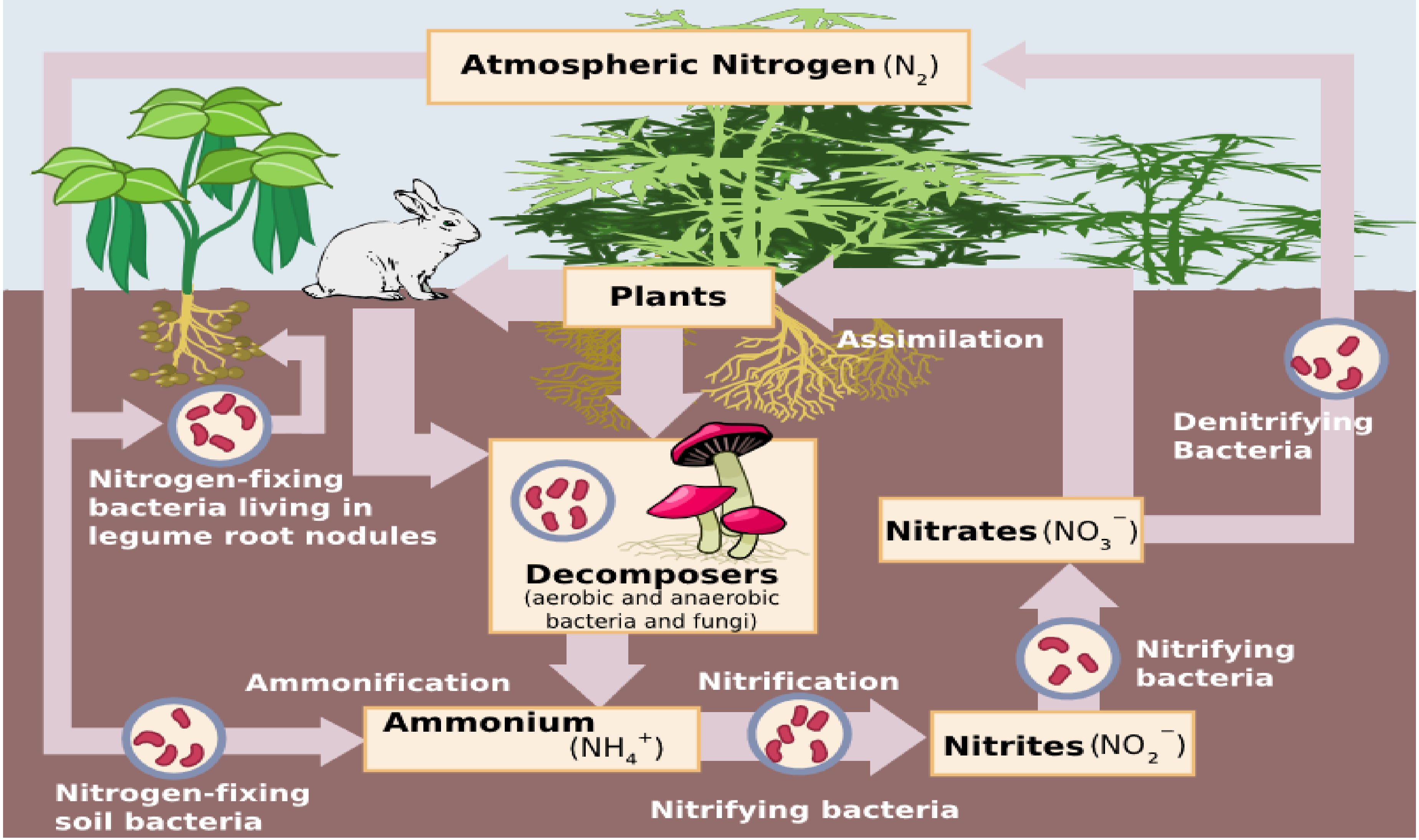
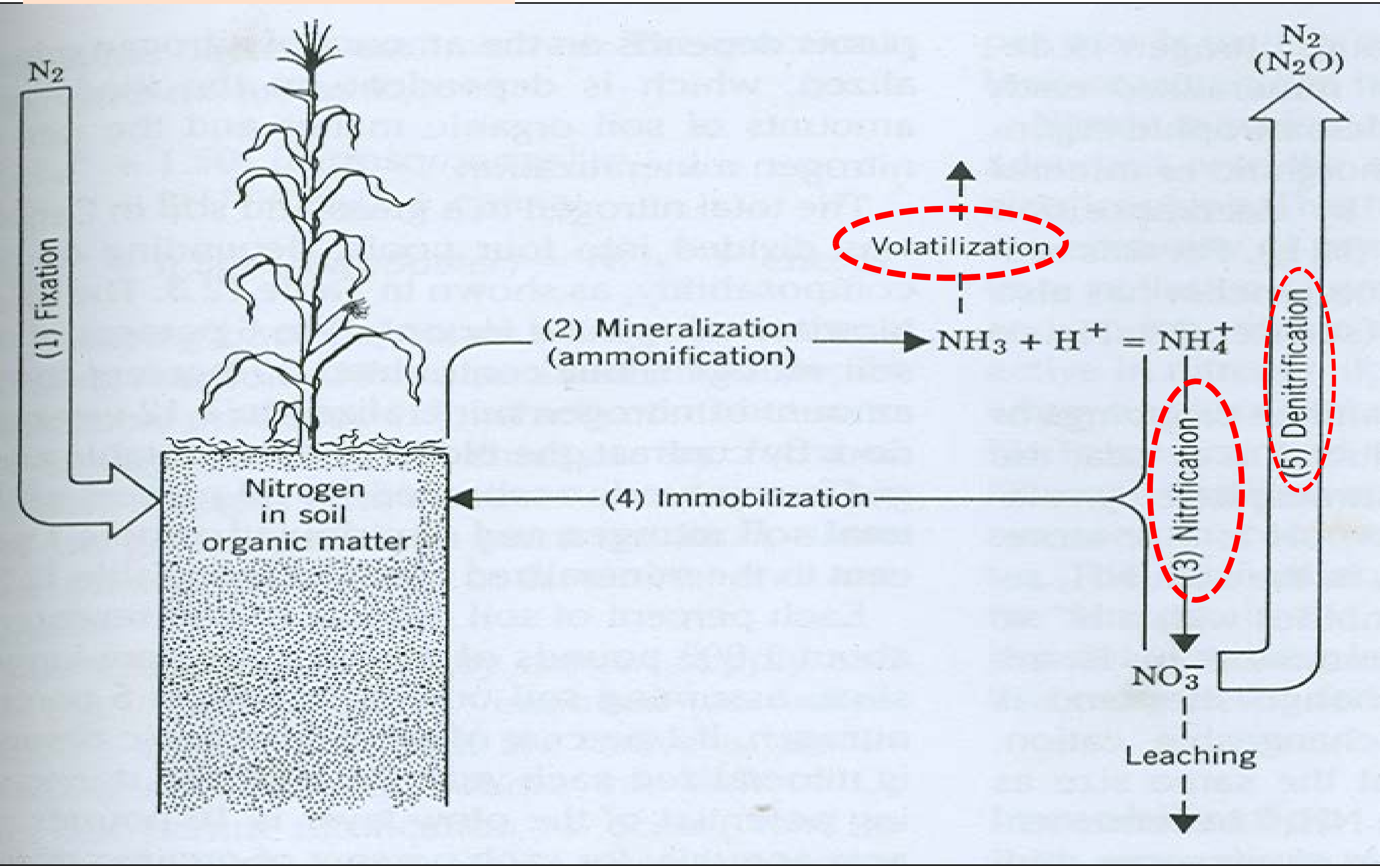


Diagram of the Nitrogen Cycle:

Abiotic nitrogen fixation has been omitted.

Nitrogen losses



Leaching

Volatilization

Fertilizer

Biological Fixation

astes

Resi-dues

Mineralization

Organic Matter

Immobilization

Nitrification

Crop Uptake

NO_3^-

Dentrification

- The nitrate ion has a negative charge and does not attach to the negatively charged soil particles.
- Rainfall or irrigation will leach the nitrate in the soil solution down through the soil profile.
- Nitrate leaching occurs most often in the spring with higher rainfall and slow crop growth

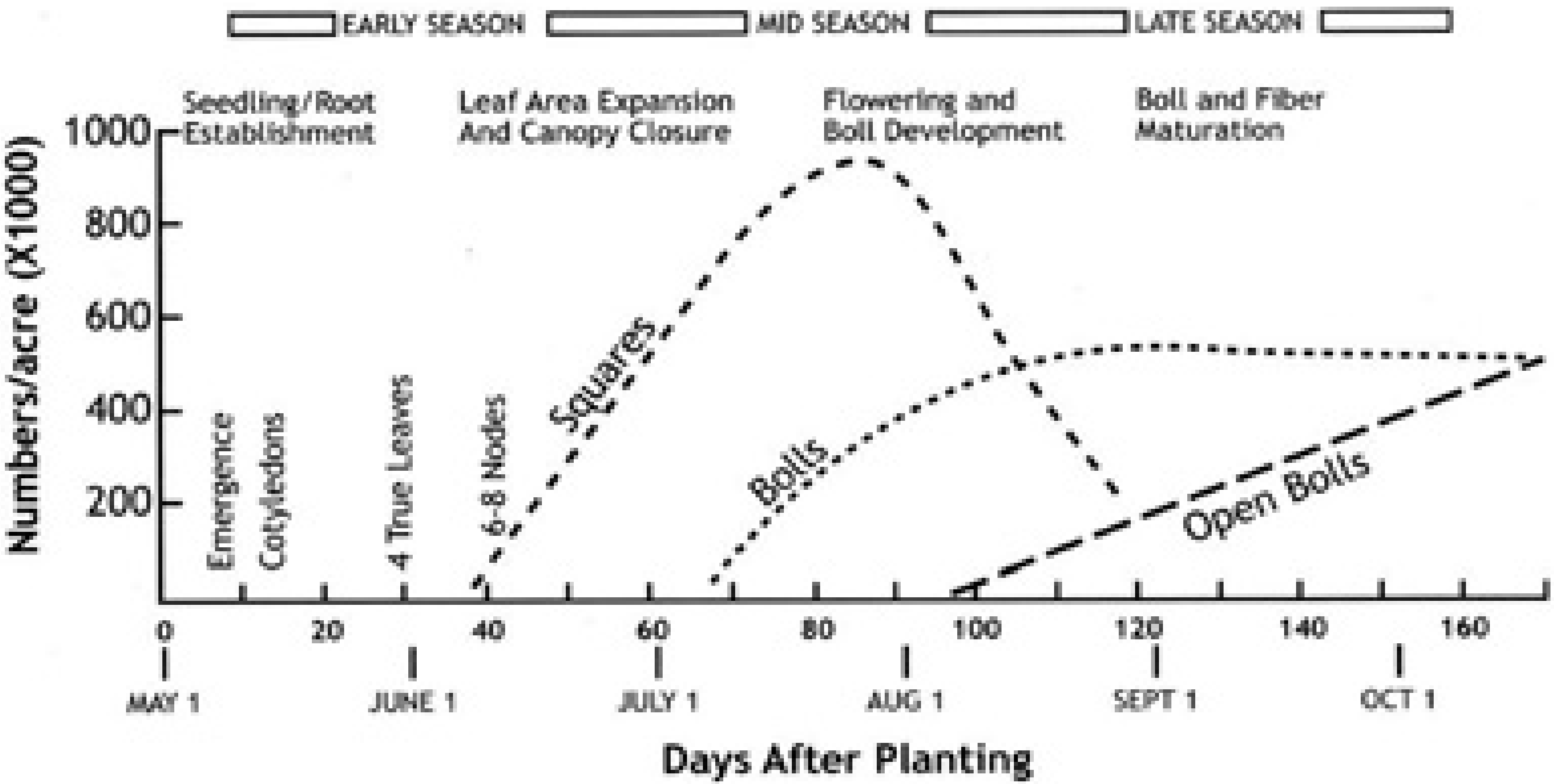


Figure . Seasonal development of cotton with a May 1 planting date, showing typical production patterns of squares, bolls and open bolls.

(Oosterhuis, 1990, with permission ASA)

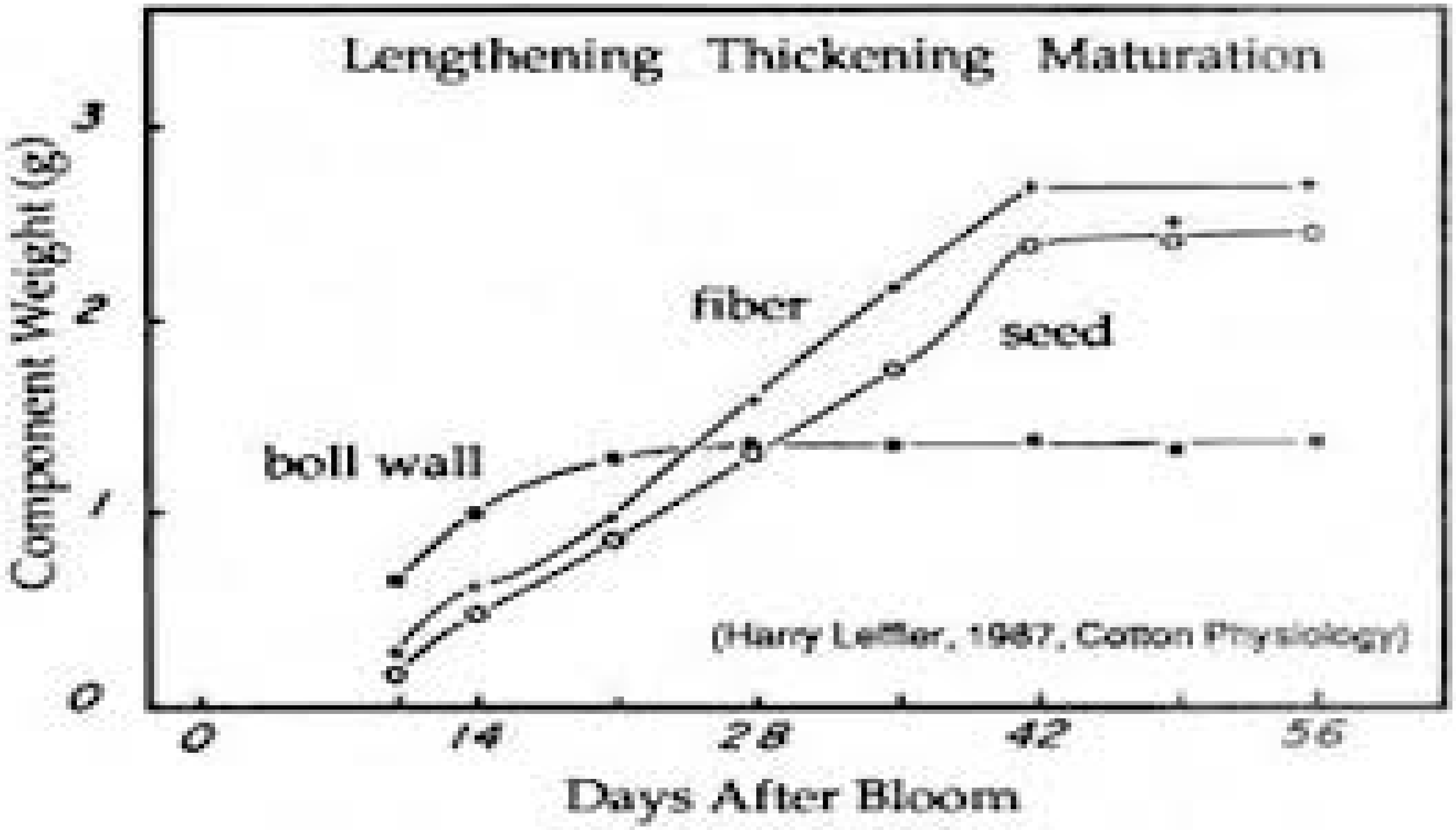
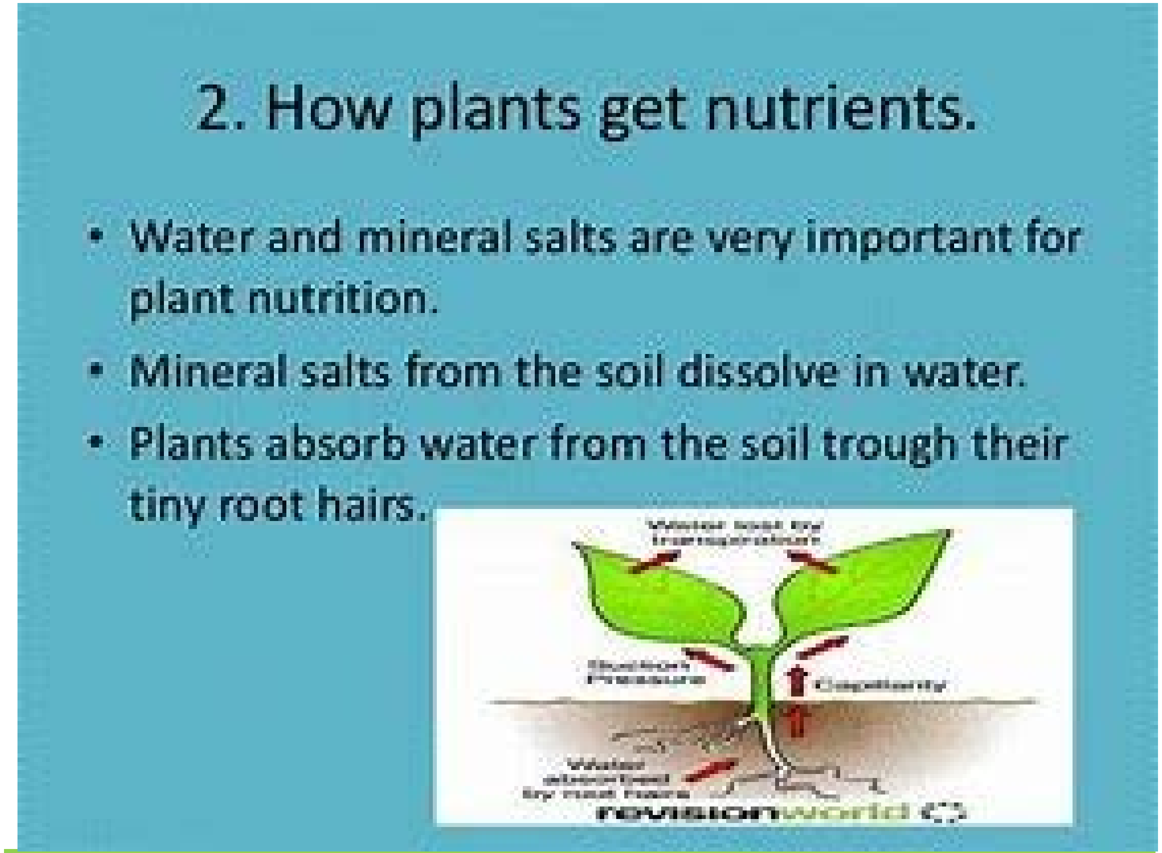


Fig. The boll develops rapidly after fertilization and reaches its full size within three weeks



Continue to calculate in applied of fertilizer rates