

Fertilizers



1

Fertilizer

- Any organic or inorganic material of natural or synthetic origin which is added to a soil to supply elements essential to the growth of plants

2

(FAO press release, April 1990):
Nutrient Depletion

- *The loss of soil fertility in many developing countries poses an immediate threat to food production and could result in a catastrophe no less serious than from other forms of environmental degradation”.*

3

(FAO press release, April 1990):
Nutrient Depletion

- *“Agricultural soils lose their fertility by plant nutrient depletion and, in some cases, plant nutrient exhaustion.....a real and immediate threat to food security and to the lives and livelihoods of millions of people. The loss of fertility reduces yields and affects water holding capacity, leading to greater vulnerability to drought.”*

4

The Essential Nutrients

Element	Chemical symbol	Importance to Plant
Nitrogen	N	Major or Primary Nutrients
Phosphorus	P	
Potassium	K	
Sulphur	S	Secondary Nutrients
Calcium	Ca	
Magnesium	Mg	

5

The Essential Nutrients

Element	Chemical symbol	Importance to Plant
Iron	Fe	Micro nutrients
Manganese	Mn	
Zinc	Zn	
Boron	B	
Copper	Cu	
Molybdenum	Mo	
Chlorine	Cl	

6

The Essential Nutrients

- Apart from boron, plants take up nutrients in the form of ions. Nitrogen is taken up as ammonium (NH_4^+) and nitrate (NO_3^-) (with nitrate the preferred N-form taken up by plants), potassium as potassium ions (K^+) and phosphorus mainly as phosphates (H_2PO_4^- and HPO_4^{2-}).
- Boron is taken up mainly as boric acid (H_3BO_3) rather than as a charged ion.

7

Fertilizer declarations

- Fertilizer declarations do not always reflect the form in which a nutrient is taken up by plants, or the form that is present in the fertilizer. For example, potassium often is declared as K_2O and phosphorus as P_2O_5 though these are neither present in fertilizers nor taken up by plants.

8

The Numbers on the Fertilizer Bag

- On a fertilizer bag, you will find three or four numbers with hyphens separating them.
- The numbers indicate, in order, the percentage of nitrogen (N), phosphorus (P), potassium or potash (K), and sulfur (S) - the letters in parentheses are the chemical symbols for the elements.

9

Percentage of N P K S

- Here are some common fertilizers and the proportion of the elements they contain.

Fertilizer	N	P	K	S
11-48-0	11%	48%	0%	0%
16-20-0-14	16%	20%	0%	14%
34-0-0	34%	0%	0%	0%

10

Major nutrients (N, P, K)

- So, a 25-kg bag of 16-20-0-14 would provide ($16/100 \times 25 =$) 4 kg of nitrogen, ($20/100 \times 25 =$) 5 kg of phosphorus, no potash, and ($14/100 \times 25 =$) 3.5 kg of sulfur.
- A 25 kg. bag of 34- 0-0 would supply $34/100 \times 25 =$) 8.5 kg of nitrogen but no other elements.
- A "complete" fertilizer contains nitrogen, phosphorus, and potash.
- If one of these three elements is missing, the fertilizer is not "complete."

11

Major Nutrient: Nitrogen

- Nitrogen is the nutrient with the greatest influence on crop yield through the effect on chlorophyll and protein production
- Nitrogen is needed for the green, leafy, vegetative growth of plants.
- When an element is lacking, the plant will show deficiency symptoms.
- Deficiency symptoms for nitrogen include an overall pale yellow color of the leaves, and plants which are dwarfed or stunted.

12

Major Nutrient: Nitrogen

Nitrogen

- Intensifies the green colour (chlorophyll).
- Increases leaf size.
- Increases growth rate.
- Increases final yield.
- Increases protein content.

13

The most common nitrogen fertilizers are:

- NP/NPK Complex fertilizers: 5 - 30% N
- Ammonium Nitrate (AN) : 33.5 - 34.5% N
- Calcium Ammonium Nitrate (CAN) : 26 - 28% N
- Ammonium Sulphate (AS): 21% N
- Calcium Nitrate (CN) :15.5% N
- Urea (U): 46% N
- Urea Ammonium Nitrate Solution (UAN) :28 - 32% N

14

Major Nutrient: Nitrogen

- Too much nitrogen or a nitrogen imbalance can delay flowering, fruiting and seed set. The resultant growth is soft and succulent and may be more vulnerable to fungal and bacterial infection.
- As well, nitrogen can desiccate or "burn" the roots of plants if placed too close to seeds, seedlings or newly planted plants.

15

Major Nutrient: Phosphorus

- Phosphorus is said to promote root growth, root branching, stem growth, flowering, fruiting, seed formation, and maturation.
- When phosphorus is lacking, stems and foliage often have a red or purplish tinge.

16

Major Nutrient: Phosphorus

- This is particularly noticeable on tomatoes and maize. Deficiency signs are seen in new growth first.
- Phosphorus is very stable and non-mobile within the soil, so it is not easily leached by soil water.
- When used moderately, it may be placed fairly close to seeds and seedlings and will not "burn" or desiccate them.

17

The most common phosphate fertilizers are:

- NP/NPK Complex Fertilizers : 5 - 23% P_2O_5
- Diammonium Phosphate (DAP) : 46 - 53% P_2O_5
- Monoammonium Phosphate (MAP) : 48 - 55% P_2O_5
- Single Superphosphate (SSP): 16 - 20% P_2O_5
- Triple Superphosphate (TSP): 42 - 50% P_2O_5

18

Major Nutrient: Potash or Potassium

- Potassium enables the plant to more readily withstand "stress" such as drought, cold, heat and disease.
- It also stimulates flower color and promotes tuber formation and a strong root system.
- When potassium is lacking, leaves appear dry and scorched on the edges and have irregular yellowing. This is seen on older leaves first.

19

Major Nutrient: Potash or Potassium

Potassium:

- Encourages healthy growth.
- Renders crops more resistant to drought and disease.
- Improves the quality of the produce.
- Potassium is a particularly important nutrient for
 - potatoes,
 - sugar beet,
 - tomatoes, bush and
 - tree fruits.

20

The most common Potassium fertilizers are:

- NP/NPK Complex Fertilizers : 5 - 30% K_2O
- Potassium Chloride (MOP): 60 - 62% K_2O
- Potassium Sulphate (SOP): 50% K_2O
- Potassium Nitrate : 46% K_2O

21

Secondary Nutrient: Sulfur

- Sulfur is essential to plant growth and metabolism. It contributes to the unique taste and flavor of cabbage, broccoli, Brussels sprouts, cauliflower, and other members of the mustard family.
- Plants that do not have enough sulfur are stunted, thin-stemmed and spindly. The younger leaves are light green or yellow. Fruit and seed maturity may be delayed when sulfur is lacking.
- Various forms of sulfur may be added to basic soils to acidify them (or lower the pH).

22

The most common sulphur fertilizers are:

- NP/NPK Complex NPK: 2 - 10% S
- Ammonium Sulphate (AS): 24% S
- Gypsum: 18% S
- Potassium Sulphate: 18% S

23

Secondary Nutrient: Calcium (Ca)

- Calcium is required for plant growth, cell division and elongation. Root and shoot tips and storage organs are affected by calcium deficiency as it is part of cell membranes. Calcium is also vital for pollen growth.
- Calcium is of particular importance to horticultural crops. An adequate calcium supply to the leaves and fruits is required to prevent disorders during crop growth, handling and storage.

24

Secondary Nutrient: Calcium (Ca)

- Whilst some calcium is applied to crops as a nutrient, most is added to the soil as lime to correct soil acidity.
- Most crops grow best between pH 6 and 7 of soil acidity.
- Most common source of calcium as a fertilizer is Calcium Nitrate (CN 19% Ca).

25

Micro- nutrients or trace elements

- There are also micro- nutrients or trace elements, which are needed by plants in very, very small amounts.
- If these are missing, the plants will not be able to complete their life cycle.
- Among these micro-nutrients are iron, zinc copper, manganese, and magnesium.

26

Micro- nutrients or trace elements

- Boron deficiency is widely recognized and gives rise to disorders in several important root crops and vegetables. These disorders can make the product not easily sold.
- Manganese deficiency is particularly prevalent on organic soils with high pH content. The symptoms of manganese deficiency include yellowing of the leaves and sometimes grey specks on leaves.
- Deficiencies of iron, copper, zinc and molybdenum are widespread in semi arid and in calcareous soils (A soil containing accumulations of calcium and magnesium).

27

Quality of fertilizer

The quality of fertilizer refers to:

- Its bulk density
- The nutrient content.
- Its moisture content.
- The particle strength.
- Whether or not the fertilizer is free flowing.
- Particle size distribution.

28

Bulk density:

- The bulk density is the weight of a given volume of fertilizer.
- This affects the time needed to spread fertilizer.
- The lower the bulk density the less fertilizer can be held in the spreader hopper.
- Consistency in bulk density is also important to maintain spreading accuracy.

29

Nutrient content:

- When a customer purchases fertilizer, the nutrient content i.e. NPK, should be as declared.
- With some cheap, low quality products, this is not always the case. In other words, the customer does not get what he/she pays for.

30

Moisture content

- A high moisture content can cause caking.
- Caking means that the fertilizer has hardened into lump.
- Caked fertilizer is difficult to use and can cause spreading problems.
- This can lead to a reduction in yield and crop quality.

31

Particle strength

- A material that has a low particle strength is more likely to be crushed and turned into dust.
- This will cause problems with storage, wasted fertilizer, lost time, poor spreading and lost profit.

32

Free flowing fertilizer

- A free flowing fertilizer will be easier to spread and will give a predictable spread pattern.

Particle size distribution

- The particle size distribution affects both the evenness of spreading and the maximum spreading width.
- There should be little dust that can block spreaders.

33

Can fertilizers affect the environment?

- More nutrient is applied than the crop needs, either over the whole field or over part of a field (due, for example, to uneven spreading).
- A deficiency in one nutrient is left uncorrected leading to unbalanced nutrition and poor utilisation of other nutrients.
- Nutrients supplied by manures are not taken into account when applying fertilizer.
- Leaching of nitrate into aquifers or surface waters.
- Loss of phosphorus-enriched soil particles to surface waters that can cause eutrophication.
- Loss of ammonia or nitrogen oxides to the air by volatilisation or denitrification.

34

When used correctly fertilizers improve and protect the environment in several ways:

- Improved productivity from cropped land avoids the need to destroy further areas of natural forest and grassland.
- Sustained green crop growth essential for maintenance of the atmosphere.
- Reduced losses of soil due to wind or water erosion.

35

When used correctly fertilizers improve and protect the environment in several ways:

- Improved crop rooting systems which can make better use of both the soils nutrient supply and applied fertilizers. This reduces the risk of nutrients entering ground water.
- Land reclamation and safe disposal of degradable wastes is improved by fertilizers encouraging active crop growth.

36