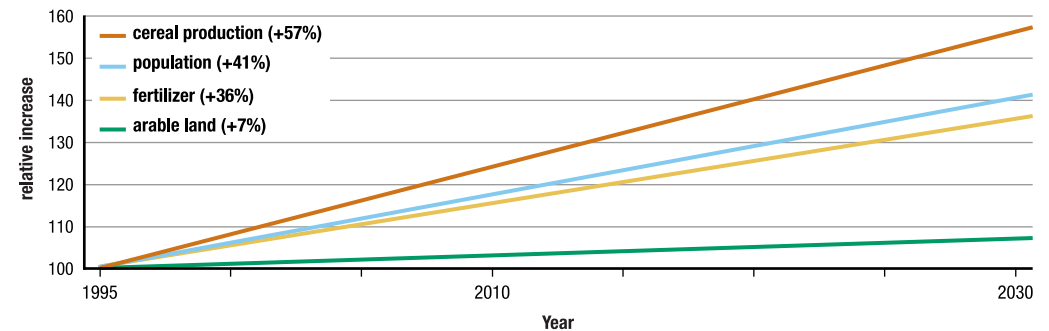


**DELIVERING QUALITY TO YOUR FOOD**  
The Benefits of Mineral Fertilizers



**Global trends: Development of cereal production, world population, fertilizer use and arable land**

Source: FAO; Towards 2015/30; Technical interim report 4/2000.

It is only with the use of mineral fertilizers that the continuously growing world population can be fed.

**NOT ENOUGH FOOD WITHOUT PLANT NUTRIENTS****Plants need nutrients in order to grow and produce good quality food.**

**Macro-nutrients** (nitrogen, phosphorus and potassium) are the main constituents of the plant's tissues and essential components in its metabolism:

- Nitrogen primarily contributes to fuel the plant's growth.
- Phosphorus promotes root growth, improves the quality of the grain and accelerates its ripening.
- Potassium helps plants resist hardiness, water stress, pests and diseases.

**Secondary and Micro-nutrients** (sulphur, calcium, magnesium, iron, copper, boron, zinc or manganese) are essential for the plant's physiology.

*There is a direct relationship between the crop's yield and the amount of nutrients available.*

With agricultural systems where no external nutrients (organic or inorganic) are supplied to the soil, crop yield is determined by natural soil

fertility, which tends to decrease after each harvest. But in modern agriculture, soil fertility must be maintained at a high level in order to maximize the land's productive capacity. Therefore, those nutrients taken up by the plants, and then removed with the harvest, must be replenished.

Nutrients are obtained from the soil and its minerals. These nutrients can be **organic**, deriving from crop residues or manures, or **inorganic**, namely mineral nutrients. A soil deficiency of a certain nutrient can be compensated by applying an organic or inorganic fertilizer. Since plants can only uptake the mineral form of a nutrient, the organic form needs to be mineralized in the soil. Therefore, the type of fertilizer applied makes no difference to the plant because it takes up the nutrient in the same way, via the root of the plant and as ions in the soil solution.

The optimal nutrient requirement is what a plant needs for optimal growth. Like all living organisms, plants need a balanced diet: a good balance of nutrients. Different crops have different nutritional requirements. For instance, potato tubers take up more potassium than cereals, and cereals have a higher need for nitrogen.

The uptake efficiency of plants also plays a role: potatoes are characterized by a small root system, which makes them less efficient when taking up phosphorus than plants with a more developed root system. This means that the amount of phosphorus in the soil needs to be higher for potatoes than for other crops.

**Primary fertilizer use by farmers in Great Britain and the N-P-K ratios of these applications.**

Actual Nutrient Applications (kg/ha)			
CROP	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Winter Wheat	197	69	80
Maincrop Potatoes	172	141	235
Sugar beet	12	82	129
Oil Seed	201	71	77

Source: DEFRA

Plants need a good balance of nutrients and different crops have different requirements.



Nitrogen fertilizers.



Phosphate rock.



Potassium salts. (Potash)

**Mineral Fertilizers Supply Natural Nutrients**

Nature provides minerals which contain the essential nutrients for plants. These minerals also serve as raw material to produce mineral fertilizers:

**Phosphate (P)** rock, as apatite, is one such mineral. But the solubility of raw phosphate is low and thus provides little phosphate to plants. This low solubility can be improved by a chemical process, from which phosphate fertilizers are manufactured.

**Potassium (K)** salts are extracted, ground and purified, and used to manufacture potassium fertilizers.

**Nitrogen (N)** is rarely found in mineral form, but is rather extracted from the air and fixed in a chemical process.

**Organic Sources of Nutrients**

The term organic fertilizer applies to farmyard manure, crop residues, etc., including some exogenous (from outside the farm) sources of organic materials such as compost and sewage sludge from municipalities or certain industries. When these materials decompose, they release nutrients in mineral form, which are then taken up by plants.

Decomposition or mineralization is a microbiological process whose speed largely depends on the temperature at which it occurs. It is therefore difficult to predict when exactly nutrients become available to the crop.

Organic or Atmospheric nitrogen is not available to plants as such – it must first be converted to ammonium or nitrate for plants to use it– hence the use of mineral fertilizers. However, leguminous plants (beans, peas) are capable of capturing atmospheric nitrogen by using bacteria called Rhizobium, which help them convert the nitrogen into ammonium. The so-called *rhizobacteria* are found in nodules located on the roots of the leguminous plants and live in symbiosis with them. Once fixed, the nitrogen is released by the bacteria as ammonium and, thus, made available for the leguminous plant to use for their growth.



The N-Tester enables the farmer to read the nitrogen status of a crop from the green color of its leaves.



Mineral fertilizers used with modern spreading equipment facilitates the precise application of nutrients for the plants at the right time.



Nutrient application adapted to the crop's needs optimizes the quality of the harvest.



### Applying Nutrients to Meet the Crop's Needs

Nutrients must be applied in the right quantity –meeting the needs of the crop– and at the right time. This is easier when the nutrients are already supplemented in mineral form and, therefore, directly available for the plant:

Organic fertilizer needs to undergo a process of mineralization for the plant to be able to take up the nutrients. This process is slow and irregular. Equally, not all the nutrients become available in mineral form at the same time, which then also makes it difficult to supply the correct amount.

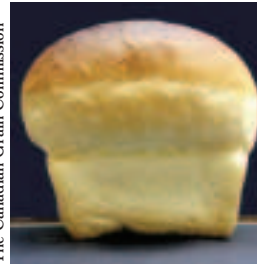
With mineral fertilizers, unlike the organic, the amount and composition of nutrients can be exactly adapted and timed to the crop's requirements and the nutrients are directly available to the plants since they do not have to undergo the process of mineralization.

In this respect, the use of mineral fertilizers facilitates plant nutrition notably. Excessive use of fertilizers, whether mineral or organic, can potentially pollute the environment. Before defining an application rate for mineral fertilizers, one should take into account the supply of other

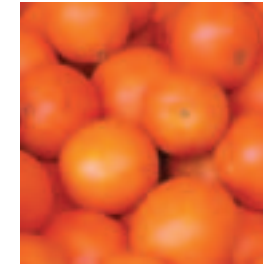
sources such as organic fertilizers or soil reserve. Good Fertilization Practices recommend first applying the organic source of nutrients available on the farm, and then using mineral fertilizer to complete the nutrient supply. New developments, including Precision Farming, enable farmers to determine the nutrient requirements of a plant on a particular site with much greater accuracy. In this way, mineral fertilizers facilitate the dosage and are therefore more crop-friendly and environment-friendly.



The Canadian Grain Commission



A correct dressing of nitrogen to wheat can produce high quality bread, rich in proteins.



Potassium gives juicier and meatier citrus fruits.



With calcium, potatoes have a greater resistance to disorders.

## THE BENEFITS OF MINERAL FERTILIZERS

### Mineral fertilizers ensure food of the highest nutritional quality

**Nutrients are necessary to produce good, wholesome, high-quality food. Mineral fertilizers play an important role to achieve this. Furthermore, as main constituents of food, plant nutrients have a direct impact on human health.**

#### Fertilizers for a High Nutritional Value:

Crop nutrition has a major influence over food quality, one of today's major concerns of the consumer. There is no doubt that a balanced fertilization has a positive effect on crop quality. A high availability of nitrogen thus results in higher protein content, and scientists have recently found that it also boosts vitamin content.

For example, only with an appropriate dosage of nitrogen can wheat offer enough proteins to make bread healthy and nutritious. Wheat carrying low protein content cannot provide a rounded, fully-formed loaf of bread, since the dough tends not to rise and thus becomes dense. It is thanks to correct nitrogen dressing that protein content in wheat is increased, quality features in dough are enhanced and, finally, high quality bread can be baked. Such high quality bread delivers an optimal diet in proteins to the consumer.

A deficiency in nitrogen can truly affect crop quality: in Denmark, for instance, due to strict limitations on the use of nitrogen, the quality of Danish wheat deteriorated to such an extent that in 1999 farmers were no longer able to produce sufficient quality wheat for the domestic market. Formerly a quality wheat exporting country, Denmark has now become a net importer.

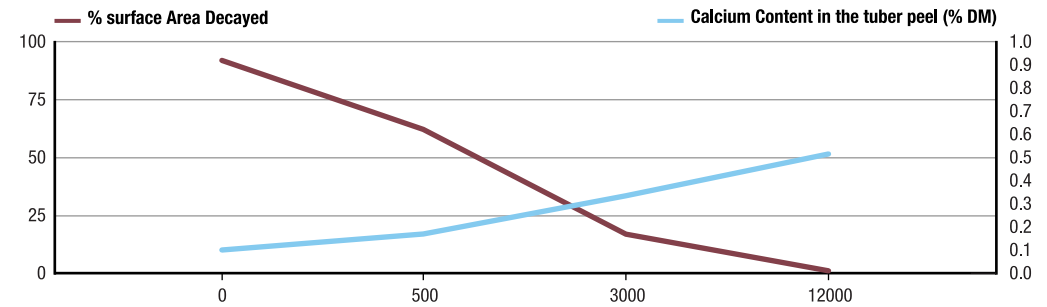
#### Fertilizers for Tempting and Appetizing Food

It is a well known fact that fertilizers can significantly limit, even avoid, defects or crop disorders in specialty fruit and vegetables, and improve their appearance:

**Potassium** not only saves citrus fruits from their common defects (i.e. plugging and creasing), but also contributes to making the fruit meatier and juicier. Potassium is also essential for producing high quality potatoes that do not blacken after cooking.

**Calcium** is a key element to preserve potatoes from various disorders such as scabs, internal rust spot or soft rot. Calcium gives early potatoes a strong and smooth skin finish, as well as a greater resistance to diseases. An important aspect for the consumer is that calcium helps to avoid potato rotting whilst stored at home. (See graph on next page)

### Calcium and soft rot



REF: MCGUIRE & KELMAN

Thanks to mineral fertilizers, an increased content of calcium in the tuber enhances the potatoe's resistance against diseases such as soft rot or decay.



### Fertilizers for Tasty and Scented Food:

The organoleptic (sensory) qualities of specialty produce or crops can be significantly improved by monitoring the application of some particular nutrients in a precise way (exact quantities at the right period of the crop's growth):

**Potassium** is known to increase the sugar content in grapes and, therefore, the richness of the must. The fermentation process in wine cannot provide full aroma or fragrance unless nitrogen has been applied to the vine. If the content in nitrogen is too low, the grape will not develop enough amino-acids for the yeast fermentation to develop successfully. A correct application of nitrogen after flowering enhances the fermentation and helps develop a richer and pronounced bouquet in the wine.

**Nitrogen** is also necessary to grow tasty and juicy tomatoes. It enhances sugar and acid content of the tomato and prevents it from becoming mealy.

**Potassium** generally increases the acidity of fruits and the application of iron optimizes the acid ratio in citruses, one of the essential quality criteria for this crop.

Turnips, radishes and mustard, for instance, are tastier with a correct application of sulphur.

Such precise application of nutrients, in small and defined quantities, at a precise period of time, is not only possible but best achieved when using mineral fertilizers.

It is sometimes claimed that food produced organically (commercialized as "Bio" products) is of better quality than food produced with conventional methods. Up to now, however, extensive research has never found objective evidence of significant differences between the two types of products. Moreover, in terms of fertilization, plants take up the mineral form of nutrients anyhow, whether taken from organic or mineral fertilizers.



## Mineral Fertilizers for a Healthy Diet

Most of these mineral nutrients are also essential elements of the human body. When correctly supplied to the crops, nutrient content in food satisfies our nutritional needs and has a positive impact on our health:

- Nitrogen positively influences the production of vitamins, especially vitamin C. More essentially, our own DNA is based on proteins, which are essentially generated from nitrogen.
- Phosphorus, an essential component of the metabolism for transporting energy in the body, also influences the synthesis of vitamin D and is a key element for the transport of calcium in the body. However, a lack of phosphorus does not only affect our bone structure, but also affects our appetite, growth and fertility.
- Potassium helps maintain nerve impulses, muscle activity, heartbeat and blood pressure.

- Calcium, the essential constituent of the bones, also plays a key role, together with potassium, in transmitting nerve impulses.
- Magnesium has a beneficial effect on circulatory distress and cardiac infarction.
- Sulfur is a nutrient that helps prevent cancer.

For more than a century, modern fertilizer practices have contributed to increasing the quantity and quality of crops and, thus, to the supply of food worldwide. Mineral fertilizers have made this possible and are essential for providing high quality food to the world's fast growing population. Without mineral fertilizers, agricultural soil today would not be fertile enough for crops to grow strong, healthy and abundant.

EFMA has adopted the International Fertilizer Industry Association's motto "Fertilizer Feeds the World" to underline its concern with food shortage insecurity and malnutrition and to communicate the achievements made in addressing these concerns. Likewise, and to also underline the Fertilizer industry's efforts to ensure food quality, EFMA would like to expand this motto:

*"Fertilizer Feeds the World Better...  
...by Delivering Quality to your Food".*



**Photographs facilitated by**

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