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DEVELOPMENT OF NEW GENERATION FERTILIZERS FOR HORTICULTURE AND FIELD CROPS

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Abstract

It has become very essential for the fertilizer manufacturers, Agronomists, and Soil Chemists to improve their practices and products for providing food security by increased agriculture production/yield. Fertilizer management is one of the most important factors to promote growth and yield of crop plants. They are usually applied either via the soil, for uptake by plant roots, or by foliar feeding through leaves. The three major plants nutrients, (N, P and K) the secondary plant nutrients (Ca, S, Mg) and trace elements (Zn, Fe, Cu, Mn, B and Mo) (Anonymous, 2007a) play a vital and key role in increasing the crop yield. Keeping in view the situation National Fertilizer Corporation, Institute of Engineering and Fertilizer Research (NFC IE&FR) Faisalabad has developed new generation fertilizers, NPK+Trace elements (TE). These are crop specific. The different grades of NPK+Trace elements are completely water soluble, used in fertigation, drip irrigation, foliar application or any other modern technique of fertilizer application. These fertilizers have very significant effect both on quality and yield of the field and horticultural crops. This paper will provide data regarding different grades of NPKs'+TE with their properties and salient features.

INTRODUCTION

Agriculture systems in Pakistan seek to maximize the yield and quality of agriculture products. A prerequisite for achieving this object is an optimal and balance nutrient supply that demarks the tuning of plant nutrient supply. Uptake of fertilizer nutrient provided in soil always remains a problem. The availability of all the nutrients as per requirement of plant is the key source to increase the productivity depending upon deficiency of nutrients based on soil and plant analysis. Every farmer's desire is to produce the maximum crop yield from his land. It is imperative for farmers to pay close attention to nutrient management and incorporate the concept of balanced plant nutrition into their farming techniques, to provide the deficient plant nutrient quickly.

NFC Institute of Engineering and Fertilizer Research (IE&FR) developed special fertilizers, which are completely water soluble and solid in nature having balanced nutrients along with complete range of micronutrients. The major advantage is their demonstrated convenience in handling, processing and application that fertilizer under scores their selection by agronomists and farmers over conventional fertilizers. As these fertilizers are completely water-soluble they must be applied at least every 1-2 weeks and can be applied as often as every watering. The main

benefit of these products is that these can be used in fertigation irrigation or for foliar fertilization as a supplement to normal application of fertilizers. *Foliar spray will not replace regular programme of root feeding but this technique will supply valuable supplementary nutrients to plants quickly and efficiently.* The products developed could easily be used in green houses and for foliar fertilizer on fruits, vegetables, field crops and nursery ornamentals.

BACK GROUND INFORMATION

Different grades of completely water-soluble fertilizers (NPKs+TE) were developed and manufactured in bulk and supplied to different progressive farmers. The detail of experimental products and their properties is given below:-

a) Development of High Phosphate Fertilizer (15-30-15+TE)

Grade of Product

NPK + TE = 15-30-15+TE

Characteristics of 15-30-15+TE

- This product is recommended when higher phosphorus levels are required during the early stages of crop growth.
- It is used in Green Houses, field crops Cotton, Rice, Potatoes, Peanut, grains etc., and in orchards i.e. citrus, apples, peaches, pears, apricots, and grapes.

b) Development of All Purpose Fertilizer (16-16-16+TE)

Grade of Product

NPK+TE = 16-16-16+TE

Characteristics of 16-16-16+TE

- It is all-purpose fertilizer.
- It is ideal for use on most situations where soil condition is unknown (Anonymous, 2007b)
- It is compatible with all other completely water soluble fertilizer (Anonymous, 2007b)
- It is ideal for bedding plant growers.
- Due to its high water solubility it is recommended as foliar feed to correct nutrient deficiencies in various agricultural crops and horticultural crops i.e. citrus, grapes and strawberries etc.

Grade

Total available Nitrogen	=	16% (minimum)
Total available P ₂ O ₅	=	16% (minimum)
Total potash as K ₂ O	=	16% (minimum)

Chelated Micronutrient

Zn	=	500 ppm
Fe	=	1000 ppm
Cu	=	500 ppm
Mn	=	500 ppm
B	=	200 ppm
Mo	=	50 ppm

c) Development of Urea Phosphate

Urea phosphate has been known a chemical compound since long. It is the crystalline additive compound of urea and phosphoric acid. Phosphoric acid present in the compound is not neutralized being addition compound. Upon dissolution in water, urea phosphate decomposes into urea and phosphoric acid. Water solution is acidic and pH of 1% water solution is 1.8. In Finland, the urea phosphate was developed which is used for horticultural purposes in water-saving irrigation systems (Anonymous, 2000). Due to its attractive grade and acidic nature it is used in horticulture and it provides the main nutrients required: Nitrogen and phosphorus. Because urea phosphate is fully water soluble, it can be used in drip and other irrigation methods. Due to its acidity it is particularly effective in areas where the soil is alkaline (Anonymous, 2000). It is also used as raw material for the manufacture of water-soluble NPK fertilizer (Anonymous, 2000).

Analysis Results

Physical condition	=	Free flowing
State	=	Crystalline solid
Colour	=	White
Organic Nitrogen	=	16% (minimum)
Total water soluble P ₂ O ₅	=	44% (minimum)
pH (1%)	=	1.8
CRH (Critical Relative Humidity)	=	66-70%
Grade	=	16-44-0

Agronomic Evaluation

Tennessee valley Authority (TVA) USA has been studying the product and agronomic characteristics of urea phosphate of the various granules and fluid fertilizers that can be produced from it. According to their findings,

- The acidic nature of Urea phosphate improves nitrogen use efficiency as compared with urea alone.
- The acidity of urea phosphate improves nitrogen use efficiency by permitting incorporation of the fertilizer near the seed row; ammonia toxicity is not a problem under most conditions (Glenn, 1984).

NFC Institute of Engineering and Fertilizer Research (IE&FR) developed his own method for its preparation. The sample was provided to potatoes growers as a starter. The feed back results are very much encouraging. Agronomic data collection is under progress.

d) Development of Urea Nitrate

Urea nitrate is a crystalline additive compound of urea and nitric acid. Nitric acid present in the urea nitrate is not neutralized one because of being addition compound like of urea phosphate (Anwar-ul-Haq et al., 1992).

Characteristics of Urea Nitrate

Total Nitrogen	=	34% Minimum
pH (1%)	=	1.8
CRH (Critical Relative Humidity)	=	65-70%
Grade of Product	=	34-0-0

- Urea nitrate could be used to make up the deficiency of nitrogen in fields and horticultural crops.
- This product could be used in green houses.
- It could be used in the formulation of acidic fertilizer.

Advantages of Completely Water Soluble NPKS+TE

- Due to high water solubility these can be applied through all types of irrigation systems.
- Along with NPK, they provide chelated micronutrients, which are available to plants under alkaline conditions.
- They do not contain harmful/undesirable elements to damage plant roots.
- Pesticides can also be mixed with these formulations.
- Process for preparation of all mentioned acidic fertilizers is indigenous, with minimum energy consumption and hence they can be commercialized with out any difficulty.
- The economics of these processes is independent of sulphuric acid.
- No by-product and therefore, no disposal problem access.

e) Development of VC-10

Pakistan is facing the serious problem of water logging and salinity. Gypsum is used for reclamation of sodic soils:sulphuric acid is used as soil reclamation for the calcareous soils and for irrigation water having high bicarbonates but the hazards to personnel have restricted its use. Gypsum is normally recommended as soil reclamation, which is slow reactive in nature and also contains carbonates, which is not good for alkaline soil health.

NFC Institute of Engineering and Fertilizer Research (IE&FR) carried out series of experiments to handle sulphuric acid safely. Results revealed that a new liquid soil reclaiming agent could be developed which is based on sulphuric acid and organic-N.

This liquid fertilizer can greatly reduce the corrosive action on human tissue without neutralizing any of the acidity of sulphuric acid. It is based on sulphuric acid and urea. The chemical bonding of these compounds results in a product with excellent properties, which can offer the grower a tool that can be used as an acidifying amendment, as well as, a nitrogen fertilizer (Anonymous, 2001). Characteristics of product are given below:-

Physical Properties

Matter state	=	Liquid
Density	=	1.6-1.7
pH	=	Less than 1
<input type="checkbox"/> Corrosive nature		
<input type="checkbox"/> Tolerable to human tissues. A mild skin irritation may occur after prolonged skin contact		
<input type="checkbox"/> Harmful if contact with a cut or sore on skin		

Chemical Analysis

pH	=	Less than 1
Organic-Nitrogen	=	8-10%
Sulphur	=	28-30%

Safety

- Use plenty of water to flush the effected area.
- Protect eyes with goggles. Contact to doctor at the earliest.
- Recommended to wear rubber protection equipment i.e., foot wear, gloves etc.

Pleasing Benefits of VC-10

- VC-10 is acidifying amendment, as well as a nitrogen fertilizer.
- VC-10 virtually climate the corrosive action on human tissues with minimal neutralizing of acidity of sulphur based acid (Anonymous, 2001).
- It is recognized as a fast, effective soil reclaiming agent for sodic soils.
- It reacts immediately with no free time in the soil.
- It can be broadcasted on the soil as a pre-plant application, injected as a side dressing application, water run and can be used in drip irrigation systems.
- It can readily mix with phosphoric acid and liquid zinc sulphate etc.
- It can be used to control high bicarbonates/carbonates in irrigation water (Anonymous, 2001).

Agronomic Interests

VC-10 adjust the high water pH and high bi-carbonates, thereby adjusting the soil pH and eliminating toxic Sodium level and high salts in soil. The regular application of VC-10 will bring the water alkalinity down to a more acceptable average pH of between 6.5 and 6.8. By lowering the water pH, the soil pH falls accordingly, and the nutrients bound at high pH range in the soil become soluble (Anonymous, 2001).

Demand of VC-10

VC-10 is highly acidic and also provides spoon feeding of nitrogen. Keeping in view the importance of VC-10, it was introduced to progressive farmers. They requested for its supply (5.3 tonnes). VC-10 was prepared at Lab. Scale and supplied to different progressive farmers for field trials. The results so far achieved are very encouraging.

Economics

Completely water soluble fertilizers are normally used for drip irrigation/foiar application, quantity of these fertilizer used is very low as compared to normal commercial fertilizers. So, it can be easily used for the specific crops. Results of agronomic studies are under progress on potatoes, sugarcane, mango, citrus etc.

REFERENCES

- Anonymous. 2007a. Wikipedia, the free Encyclopedia. URL: <http://en.wikipedia.org/wiki/fertilizer>, date of visit: February 20, 2007.
- Anonymous. 2007b. Plantco Inc. Ontario Canada. Plantex Soluble Fertilizer Concentrate.
- Anonymous. 2000. Kemira News 1/2000, Kemira Oy, Helsinki Finland. <http://www.kemira.com>, pp.35.
- Glenn, M.B. 1984. Urea phosphate fertilizer technology work shop Alabama, April 17-18, 1984.
- Anwar-ul-Haq, M., A. Ishtiaq, Niazi, M.T., Arif. M. and Mahmood, K. 1992. A study on some acidic fertilizers. Proceedings of the 4th National Congress of Soil Science, Islamabad, May 24-26, 1992, pp:459-462.
- Anonymous. 2001. Fertilizer International No. 381, March/April 2001. British Sulphur Publishing. URL: <http://www.britishsulphur.com>.