

Customized Fertilizers: Concept and Application

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ABSTRACT

The rising need to produce food while the soil fertility is decreasing calls for proper management practices regarding nutrients. While conventional fertilizers are important for increased yield in crop plants, these have poor nutrient-use efficiency, nutrient imbalance and cause environmental degradation. Customized fertilizers are now available as a solution that offers nutrients depending on soil composition and crop needs. This type of fertilizer incorporates macro-nutrients, secondary nutrients and micro-nutrients in appropriate amounts to increase the efficiency of nutrients. Customized fertilizers are important for precision agriculture and reduce the risks of nutrient leaching and emission of greenhouse gases. This paper explains the idea of customized fertilizers along with their significance, manufacture, application and benefits.

INTRODUCTION

The issue that confronts global agriculture is producing more food without affecting environmental sustainability. Nutrient fertilizers have made great contributions in improving the yields of crops, being responsible for 40% of yield improvement globally (Zhang *et al.* 2015).

However, conventional fertilizers based on standardized approaches have failed to take into account the differences in soils and different nutritional needs of various crops.

Commercial fertilizers like urea, diammonium phosphate, and muriate of potash provide macro-nutrients but do not consider the

provision of secondary and micro-nutrients. The provision of nutrients together with ineffective application techniques results in nutrient losses due to leaching, volatilization, and runoffs. This means that nutrient use efficiencies are extremely low, with nitrogen having an average efficiency of 30–35% worldwide (Zhang *et al.* 2015). It calls for a shift to improved fertilization approaches like customizing fertilizers.

Concept of Customized Fertilizers

Customized fertilizers are multicomponent nutrients, which cater to the nutritional needs of crops according to the fertility levels of the soil, climatic conditions and cropping system (Majumdar and Prakash. 2018). These nutrients are prepared based on the soil test method and yield-based method of fertilization for precise nutrient management.

Contrary to regular fertilizers, customized fertilizers comprise a balanced mix of macronutrients, secondary nutrients and micronutrients, thus providing a complete spectrum of plant nutrition. These fertilizers are in granular, liquid and water-soluble forms. Being site-specific, they help address soil variation issues through efficient use of nutrients.

Need for Customized Fertilizers

The rationale behind customized fertilizers lies in the declining fertility status of soils, reduced organic carbon levels, and the presence of multi-nutrient deficiencies in agricultural soils. Application of regular fertilizer techniques results in an imbalance of nutrients, leading to poor crop productivity.

Site-specific nutrient management refers to the management of nutrients according to the requirements of specific crops and soils. Customized fertilizers provide the desired response by synchronizing nutrient supply

with nutrient absorption of the crops (Majumdar and Prakash. 2018).

Manufacturing Process

Different manufacturing processes are adopted in the making of customized fertilizers. The processes include chemical granulation, bulk blending, steam granulation and fluid fertilizer manufacturing process. In the chemical granulation process, fertilizer granules are formed due to the chemical reaction of the materials involved. Bulk blending is a cheap and simple process that combines fertilizers in certain proportions.

In the steam granulation process, the fertilizer granules are made consistently. On the other hand, fluid fertilizers are either in the form of liquids or suspensions, which are mainly used in fertigation and foliar application. These are some of the processes aimed at ensuring an even nutrient composition and distribution (Havlin *et al.* 2014).

Application Methods

The customized fertilizers can be applied through basal application, top dressing, fertigation and foliar spray depending on what type of crops requires the fertilizer. Nutrient supply is ensured by the basal application at the time when the nutrient requirement is high. Top dressing provides nutrients in the right growth period.

Fertigation is the application of the fertilizer via the irrigation process for effective nutrient distribution. Foliar application helps in the quick correction of nutrient deficiency in plants. These strategies enhance nutrient uptake and overall crop performance (Majumdar and Prakash. 2018).

Nutrient Interactions

Customized fertilizers are useful in regulating nutrient interactions in the soil-plant system.

Nutrient synergism in the form of nitrogen-Phosphorus interaction or nitrogen-Sulphur interaction increases the absorption of nutrients by plants.

However, nutrient antagonism like the reduction of Zinc by excess Phosphorus or interference with Magnesium absorption by excess Potassium may have adverse effects on the productivity of the crop. Proper nutrient formulation is key in overcoming the problem (Havlin *et al.* 2014).

Advantages of Customized Fertilizers

Some of the benefits associated with customized fertilizers include increased efficiency in nutrient utilization, better nutrient balance, increased crop productivity and better-quality crops (Zhang *et al.* 2015). The fertilizers eliminate the need to introduce other nutrients in addition to reducing costs.

They reduce the impact on the environment through loss of nutrients and their compatibility with precision agriculture techniques.

Challenges in Adoption

Although customized fertilizers have numerous advantages, there are certain limitations, such as high production costs, complicated production procedures and the need for exact soil analysis, among others. Some of these limitations include limited availability in certain areas and policy-related difficulties.

Increased farmer awareness, easy access, and favourable policy measures are vital for

addressing these limitations and increasing the application of customized fertilizers (Majumdar and Prakash. 2018).

CONCLUSION

The introduction of customized fertilizers represents a major step forward in relation to proper nutrient management. Their capability to offer an appropriate and efficient source of nutrients ensures optimal yields while protecting the environment from pollution. The integration with the principles of site-specific nutrient management and precision agriculture may prove useful in promoting sustainability. Increased awareness, technological advancements and favourable policies will play a key role in promoting customization.

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