بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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MONA MAGHRABY

COMPARATIVE STUDY OF BEAN GROWTH BY USING TRADITIONAL AND NANO PHOSPHATE FERTILIZERS

By

TAREK AHMED MOHAMED ABD EL-BAKY

B.Sc. Agric. (Soils), Cairo University, 2012

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In Agric. Sci. (Soil Science)

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ABSTRACT

Recently, nanofertilizers are being tested as a new technology, either for soil or foliar applications, to improve food production and reduce environmental impact. Nano calcium phosphate (NCaP) was successfully synthesized, characterized and applied in this study. A pot experiment was carried out in two successive seasons in 2016 and 2017 on (*Phaseolus vulgaris* L.) plants to obtain the best phosphorus treatments. The results were applied in a field experiment during the 2018–2019 season. Single superphosphate (SSP) at 30 and 60 kg P_2O_5 fed^{-1} and NCaP at 10%, 20% and 30% from the recommended dose were applied to the soil. Foliar application involved both monoammonium phosphate (MAP) at one rate of 2.5 g L^{-1} and NCaP at 5% and 10% from the MAP rate. The results of all experiments showed that NCaP significantly increased the shoot and root dry weights and their nutrient contens in the yield components, the nutrient concentration and crude protein percentage in pods of the snap bean plants compared with traditional P. The greatest increase was obtained from a 20% NCaP soil application in combination with a 5% NCaP foliar application. The present study recommends using NCaP as an alternative source of P to mitigate the negative effects of traditional sources.

Keywords: snap bean; monoammonium phosphate; nano calcium phosphate fertilizer; foliar application

DEDICATION

I dedicate this work to whom my heart felt thanks; to my mother, my wife and my sons for their patience and help along the period of my post graduation, as well as to my father's soul , my brothers and my uncle for all the support they lovely offered.

With My GRATITUD AND LOVE

Tarek

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With My GRATITUD

Tarek

CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Agricultural land loses fertility as a result of human activity, which affects crop production and leads to starvation. One of the critical determinants of soil fertility is soil phosphorus availability Shi *et al*. (2017) Globally, more than 40% of soils suffer from low available phosphorus Vance *et al*. (2001), and according to some estimates, there will be no phosphorus reserve in the soil by the year 2050 Cordell *et al*. (2011). Plants absorb 15–20% of phosphate in fertilizer added to the soil, while 80–90% rapidly converts to low-available forms Hedley *et al*. (2005). The soil of Egypt suffers from phosphorus deficiency El-Agrodi *et al*. (2011) and applied phosphorus is retained in the soil due to many factors (i.e., clay minerals and high soil pH) Devau *et al*. (2010). Due to multiple problems associated with traditional phosphate fertilizers, nanofertilizers could be a suitable alternative. Nanofertilization relies on reducing bulk material to less than 100 nm to give a high surface area-to-volume ratio Montalvo *et al*. (2015). Nanofertilizers are more soluble and reactive relative to their traditional counterparts Janmohammadi *et al*. (2016), easy to disperse with high tolerance for soil fixation Naderi *et al*. (2013), easily absorbed by plants, and released slowly to provide nutrients over long periods Rameshaiah and Jpallavi (2015). Liu and Lal. (2015a) found nanohydroxyapatite to be such an alternative phosphate fertilizer, thereby showing that nanofertilizers help minimize the quantity of added fertilizer while reducing fertilizer loss and pollution due to agricultural malpractice Liu and Lal. (2015b), Tulasi *et al*. (2015), Singh *et al*. (2017) and Marzouk *et al*. (2019).In Egypt, the main sources of phosphorus are superphosphates and rock phosphates, but in recent years, water-soluble phosphorus fertilizers, such as

monoammonium phosphate (MAP) and monopotassium phosphate (MPK), have been used along with traditional sources, especially during production of short-life vegetables such as the snap bean. These sources have high solubility and are popular in several countries for their high phosphorus content and excellent physical properties Rosen *et al*. (2014). Essential plant nutrients are generally applied as a soil or foliar application to obtain maximum economic yields. For nutrients required in high quantities, soil application is more common and effective. However, under specific circumstances, foliar fertilization is more effective and economic; in intensified cultivation, it has become a necessary agrotechnical procedure.

Rane *et al*. (2014) reported that calcium phosphate nanoparticles supplemented calcium and phosphate, the essential macronutrients required for profuse root proliferation. Calcium phosphate nanoparticles may help in the formulation of new nano growth promoter and nanofertilizers for agricultural use. Therefore, it could potentially help in reduction of the quantity of fertilizer applied to crops and contributing to precision farming, as it reduces fertilizer wastage and in turn environmental pollution due to agricultural malpractices.

Phosphorus is a critical and essential nutrient that limits the growth and production of plants, especially legumes, by affecting nodule formation and, thus, N-fixation Liu *et al*. (2018). In sustainable agriculture, the importance of legumes is increasing because they enhance the physicochemical properties of soil, increase organic matter content by leaving major quantities of crop residue and decrease the amount of nitrogen fertilizer. Snap bean (*Phaseolus vulgaris* L.) is one of the most important leguminous vegetable crops in the world. In Egypt, it is important for local consumption and second only to potatoes in the export trade FAO "Statistical Pocket Book" (2018). It is a conventional food in the human diet, rich in protein, complex carbohydrates and vitamins, low in fat, and considered an important source of potassium, thiamine, selenium, molybdenum, folic acid and vitamin B6 Abd El-Hakim (2014). The snap bean is one of the more sensitive crops to different kinds of environmental stressors, so it was selected for this study Bargaz *et al*. (2016) This study used the calcium phosphate nanoparticles that supplemented calcium and