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Research Application Summary

Influence of arbuscular mycorrhiza fungi inoculation on growth of sweet potato varieties in Nairobi county, Kenya

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Abstract

Sweet potato is an important food security crop cultivated mostly under temperate and mild tropical climatic conditions. The crop is vegetatively propagated using vines. However, its productivity in Kenya is lower than its genetic potential due to poor soil fertility. The productivity is constrained by phosphorus limitation in most agro-ecosystems. Phosphorus is one of the most important plant nutrients in sweet potato production but it is limiting in the tropical African soils. However, one of the feasible options is the use of arbuscular mycorrhizal fungi inoculant that enhances phosphorus and moisture uptake. A field experiment was therefore conducted in Peri urban area of Nairobi County to investigate the influence of arbuscular mycorrhiza fungi inoculation on growth of sweet potato varieties, during the long rains of 2017.The experiment was laid out in a Randomized Completely Block Design (RCRD) with two factors (two sweet potato x two mycorrhiza inoculation –plus or minus) and the treatments were replicated three times. Data on plant growth (vine length and number of primary stems) were collected and later analyzed using Genstat statistical software 15th edition and means separated by Tukeys 95% confidence level. The study results indicated that there were significance (Pd”0.05) differences amongst the sweet potato varieties and inoculation with AMF, leading to better performance in inoculation. Overall, mycorrhiza inoculation increased sweet potato growth. The study therefore recommends that farmers should be encouraged to use bio-fertilizers when planting their crops to realize better yields.

Key words: Arbuscular mycorrhiza fungi, inoculation, Kenya, phosphorus, sweet potatoes

Résumé

La patate douce est une culture de sécurité alimentaire importante, cultivée principalement dans des conditions climatiques tropicales tempérées et douces. La culture est multipliée par voie végétative à l’aide de vignes. Cependant, sa productivité au Kenya est inférieure à son potentiel génétique en raison de la faible fertilité des sols. La productivité est limitée par la limitation du phosphore dans la plupart des agro-écosystèmes. Le phosphore est l’un des nutriments végétaux les plus importants dans la production de patates douces, mais il est limitant dans les sols tropicaux africains. Cependant, l’une des options réalisables est l’utilisation d’un inoculant de champignons mycorhiziens arbusculaires qui améliore l’absorption du phosphore et de l’humidité. Une expérience sur le terrain a donc été menée dans la zone périurbaine du comté de Nairobi pour étudier l'influence de l'inoculation des mycorhizes à arbuscules sur la croissance des variétés de patates douces, pendant les longues pluies de 2017. avec deux facteurs (deux patates douces x deux inoculations de mycorhizes - plus ou moins) et les traitements ont été répétés trois fois. Les données sur la croissance des plantes (longueur de la vigne et nombre de tiges primaires) ont été collectées puis analysées à l'aide du logiciel statistique Genstat 15eme édition et les moyennes séparées par un niveau de confiance de 95% de Tukeys. Les résultats de l'étude ont indiqué qu'il y avait des différences significatives (Pd ”0,05) entre les variétés de patates douces et l'inoculation avec l'AMF, conduisant à une meilleure performance de l'inoculation. Dans l'ensemble, l'inoculation de mycorhizes a augmenté la croissance de la patate douce. L'étude recommande donc d'encourager les agriculteurs à utiliser des bio-engrais lors de la plantation de leurs cultures pour obtenir de meilleurs rendements.

Mots clés : Champignons mycorhiziens arbusculaires, inoculation, Kenya, phosphore, patates douces

Introduction

Sweet potato (*Ipomoea batatas* (L.) Lam.) belong to the botanical family Convolvulaceae (morning glory family) and it is a perennial crop that is usually grown annually (Ukom*et al*., 2011). It is considered an important, versatile and underutilized food security crop. It is highly nutritive, and it outranks most carbohydrate foods in terms of vitamin, mineral, dietary fibre and protein content (Mukhopadhyay *et al*., 2011). It is the seventh most essential food crop - after wheat, rice, maize, potato, barley and cassava with over 105 hundred million metric tonnes of foodstuffs in the globe annually (FAO, 2011).In Kenya sweet potato growing is mainly concentrated in western Kenya in counties such as Kakamega, Siaya, Bungoma, Homa Bay, Busia, Kisii and, to a small extent, at the Coast and in Central regions (ROSPOGO, 2012). However, its production is very low; one of the constraints in its production being poor levels of soil available phosphorus. For instance, sweet potato production level in Kenya averages 9.5 t ha^{-1} in Kenya (FAOSTAT, 2009) against a potential of 20-50 t ha^{-1} (Traynor, 2005) of marketable roots depending on cultivar and environment. This is because most of the phosphorus supplied to the soils to meet phosphorus demand of the plant is converted into unavailable forms due to the soil high phosphate sorption capacity. Currently soil microorganisms such as arbuscular mycorrhiza fungi are in use since they have the ability to enhance phosphorus uptake by plants. Their associations with plants are widespread throughout the plant kingdom and they form associations with most agricultural crops where they are important for sustainable crop production in many different climates, soils and types of agricultural practice (Hart and Trevors, 2005). The current farm management practices and soil degradation have affected AMF communities both qualitatively and quantitatively. Therefore, the objectives of this study wa to study the influence of arbuscular mycorrhiza fungi inoculation on growth and yield of sweet potato varieties in Kenya.

Methodology

Field research was conducted in Peri-urban areas of Nairobi County in Central Kenya from July to November 2017. The experiment was laid out in a Randomized Completely Block Design (RCRD) with two factors. The first factor was variety, while the second was AMF inoculation. Data on sweet potato growth parameters (vine length and number of primary stems) were collected monthly after planting up to the 5th month. The collected data were stored and managed in Microsoft excel 2007. Data were then subjected to analysis of variance (ANOVA) using GenStat statistical software 15^{th}

edition at 5% level of significance, and the treatment means were compared using Tukey's Least Significance difference method.

Results and discussion

The effects of mycorrhiza inoculation on growth parameters (vine length and number of primary stems) of sweet potatoes are presented in Table 1. Interaction of sweet potatoes with AMF significantly ($P<0.05$) affected their vine length from the fourth week up to the twentieth week. The lowest vine length (47.34 cm) recorded was from Bungoma variety without inoculation, while the highest vine length (79.53 cm) recorded was from Kemb 10 variety inoculated with arbuscular mycorrhiza fungi (Table 1).

Table 1. Effects sweet potatoes interaction with arbuscular mycorrhizal fungi on sweet potato vine length

Varieties	Mycorrhiza	Vine length		
		Week 4	Week 12	Week 20
Kemb 10	Negative	12.86b	36.69b	69.97a
Bungoma	Negative	15.09ab	32.78b	47.34b
Kemb 10	Positive	17.23ab	45.38a	79.53a
Bungoma	Positive	17.76a	38.82ab	50.36b
$LSD_{0.05}$		3.47	6.44	7.64

Mycorrhiza inoculation had no significant effects on the number of primary stems at week four. However, from the twelfth week, arbuscular mycorrhiza inoculation effect became significant. For instance, at 20 weeks after transplanting, uninoculated Kemb 10 had the lowest number of primary stems (5.46) while Bungoma inoculated with AMF had the highest number (6.98) (Table 2). Irrespective of mycorrhizal inoculation, Kemb 10 was superior in vine length (Table 1) while inoculation with mycorrhizae improved number of primary branches in both cultivars mith. Bungoma inoculated with mycorrhiza had significantly higher number of primary stems compared with Kemb 10 at 20 Weeks after planting (WAP) without mycorrhiza (Table 2).

The significance of inoculation with mycorrhiza was therefore evident with Bungoma variety. The present results are in-line with the findings by Jarande *et al*. (2006) who stated that arbuscular mycorrhiza fungi treatments resulted in higher values on growth parameters, including plant height and number of seeds per plant. The findings are also in agreement with those of Hani (2009) who reported significant effects of bio-fertilizer on plant height. Previous studies also show positive effects of mycorrhiza on plant growth (Cekic *et al*., 2012). Arbuscular mycorrhiza fungi are known to enhance the capacity of host plants to mine mineral nutrients such as phosphorus from the soil and their ability to extract water from soil. In addition, arbuscular mycorrhiza fungi are reported to provide protection against pathogens and nematodes attacks.

Conclusion

From the result, arbuscular mycorrhiza fungi application had positive effect on sweet potato growth.

Table 2. Effects sweet potatoes interaction with arbuscular mycorrhiza fungi on the number of primary stems of sweet potato

Varieties	Mycorrhiza		Primary stems	
		Week 4	Week 12	Week 20
Kemb 10	Negative	1a	3.96b	5.46b
Kemb 10	Positive	1a	4.68ab	6.60ab
Bungoma	Negative	1a	4.48ab	6.62ab
Bungoma	Positive	1a	4.94a	6.98a
LSD0.05		NS	0.69	0.87

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