

Research Application Summary

The effect of super phosphate and planting density on mini-tuber production from true potato seed

Mutetwa, M.¹, Shoko, M.D.¹ & Mtaita, T.A.¹

¹Faculty of Agriculture and Natural Resources, Africa University, Box 1320, Old Mutare, Zimbabwe
corresponding author: munashoko@yahoo.co.uk

Abstract

Improving tuber seed quality and availability is institutionally complex in the tropics and sub-tropics. The main objective of this work was to evaluate the effect of superphosphate and plant density on mini-tuber production from true potato seed. The enhancement of all growth variables was due to P availability in the soil allowing plants to develop without restrictions as rates increased. Days to maturity, shoot P, tuber dry matter, shoot dry matter and specific gravity showed significant responses to superphosphate. Phosphorus showed significant yield increases with increase in application rates. Yield also increased significantly by weight with decreased planting spacings adopted.

Key words: Nursery, phosphorus, seedling tuber, *Solanum tuberosum*, yield

Résumé

Améliorer la qualité et la disponibilité des semences de tubercules est institutionnellement complexe dans les régions tropicales et sub-tropicales. L'objectif principal de ce travail était d'évaluer l'effet de superphosphate et de la densité des plantes sur la production de mini-tubercules à partir de semences de pomme de terre. La mise en valeur de toutes les variables de croissance était attribuable à la disponibilité du phosphore dans le sol permettant aux plantes de se développer sans restriction comme les taux augmentaient. Les jours de maturité, de P de pousse, de la matière sèche des tubercules, de matière sèche de pousse et de la gravité spécifique ont montré des réponses significatives au superphosphate. Le phosphore a montré des augmentations de rendement importantes avec l'augmentation des taux d'application. Le rendement aussi a augmenté considérablement en poids par des espacements décroissants de plantes adoptés.

Mots clés: Pépinière, phosphore, semis de tubercules, *Solanum tuberosum*, rendement

Background

Phosphorus is essential in many plant functions and is needed in a stable supply in order to avoid disruptions in plant growth. Application of P fertilizers is recommended to potato crops so as to initiate tuber formation, increase the yield, quality and set of tubers (Marchner, 1995; Jenkins and Ali, 2000). Planting density strongly affect yield, both by number and by weight, and more tubers and yield per square meter are expected in higher planting densities (Karafyllidis *et al.*, 1997). This work was carried out to determine the effect of planting densities and phosphorus application rates on production of mini-tubers from true potato seed.

Literature Summary

Poor potato (*Solanum tuberosum*.L) tuber seed quality is often cited as the most important factor limiting potato productivity in developing countries (Aldana, 2005). Moreover, formal certified seed tuber production is limited and faces technical, economical and managerial problems (Wooster and Hussain, 1995). Potato crop being vegetatively propagated is vulnerable to both pathological and physiological problems. One solution to potato seed problem could be the use of true potato seed (TPS) instead of conventional propagation from seed tubers (Schmiediche, 1997). True Potato Seed (TPS) is a captivating technology that offers farmers an option to overcome the expensive conventional, and weakness of clonally propagated tubers as a source of planting material (Chilver *et al.*, 1997).

Study Description

The experiments were conducted at Africa University Farm (AU) in Mutare, Zimbabwe located at 18° 53' S, 32° 36' E and 1104m asl. Average day length is 14 hours in summer to 11 hours in winter. Rainfall averages 800-1000 mm per year and temperature mean maximum are from 18°C (July) to 32°C (October). Hot summer is between September and December. The soil at AU farm is a red sandy clay loam, Fersiallitic 5E soil under Zimbabwe soil classification system (Nyamapfene, 1991).

A split-plot design with 4 phosphorus levels [0, 30, 60 and 90 kg P/ha] as the main plot factor and 3 planting density [15x30, 15x40 and 20x40 cm] as subplot factors was used. Each treatment was replicated three times. Seeds were planted in speedling trays and manually transplanted after five weeks from planting. Individual treatment plots were of a gross size 1.5x 2m. Rainfall was supplemented by light irrigations. The entire phosphate fertilizer treatments were applied as basal fertilizer.

Research Application Significant differences were recorded between SDM and P levels (Table 1). There was an increase in SDM with increase in P fertilization rates. Increases of 27.66%, 115.00% and 242.76% were noted for 30 kg P ha⁻¹, 60 kg P ha⁻¹ and 90 kg P ha⁻¹ treatments relative to the control. Significant (P<0.05) differences in above ground dry matter were also recorded as a result of varying plant density.

Table 1. Means of solanum potato agronomic characteristics and postharvest parameters as affected by plant spacing and P fertilizer rate.

Treatment	Maturity (days)	Shoot P (%)	TDMB (%)	SDMB (%)	Specific gravity	Tuber P
P Levels^(P)						
P _{0kg/Ha}	4.556a	0.033d	25.290c	19.270b	1.075d	0.026
P _{30kg/Ha}	4.111a	0.071c	25.800bc	24.600b	1.079c	0.039
P _{60kg/Ha}	3.333b	0.114b	27.310b	41.430b	1.084b	0.048
P _{90kg/Ha}	2.556c	0.136a	29.690a	66.050a	1.089a	0.043
LSD _(0.05)	0.4576	0.015	1.832	1.712	0.001	0.001
Density^(D)						
High	3.750	0.083z	26.320z	33.010z	1.079z	0.040
Medium	3.417	0.089yz	26.350z	39.300y	1.082y	0.044
Low	3.750	0.094y	28.400y	41.200y	1.083y	0.032
LSD _(0.05)	0.009	0.008	0.655	2.966	0.001	0.003

Recommendation Results of this study have shown that, the use of low plant density can significantly increase yield per unit area. Planting density strongly effect yield by weight than by numbers. It can also be concluded that by increasing the planting density the percentages of the small size tubers produced are increased. Foliar P concentration increases with increased P fertilization and at lower P application rates shoot P concentration can be increased by zinc fertilization. Based on these findings P nutrition appears to play a role in regulating tuber set, but the effect of P may be inconsistent due to interactions with the multiple factors affecting tuber initiation.

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References Aldana, M.E. 2005. Effect of phosphorus and potassium fertility on fruit quality and growth of tabasco pepper (*Capsicum frutescens*) in hydroponic culture. M.Sc Thesis, Graduate faculty of the Louisiana State University and Agricultural and Mechanical College.

- Chilver, R., El-Bedewy and Rizk, A. 1997. True potato seed: Research, diffusion and outcomes in Egypt. CIP, Lima, Peru. pp. 1-28.
- Jenkins, .D. and Ali, H. 2000. Phosphate supply and progeny tuber numbers in potato crops. *Ann. appl. Biol.* 136:41-46.
- Karafyllidis, D.I., Georgakis, D.N., Stavropoulos, N.I., Nianiou, E.X. and Vezyroglou, IA.1997. Effect of planting density and size of potato seed-minitubers on their yielding capacity. *Acta Hort.* 462:943-950.
- Marchner, H. 1995. Mineral nutrition of higher plants. Second edition. Academic Press Inc, Sand Diego.
- Nyamapfene, K. 1991. The soils of Zimababwe. Nehanda Publishers, Zimbabwe.
- Patel, B.T., Barad, A.V., Chaudhari, S.M., Patel, C.K. and Patel, R.N. 2002. Standardization of spacing for seed tuberlet production from TPS under nursery beds in Gujrat. *J. Indian Potato Assoc.* 29(3-4):143-146.
- Schmiediche, P. 1997. Overview of CIP work in East and Southeast Asia and the Pacific. International Potato Center Program Report 19995-1996. pp. 15-18.
- Wooster, P. and Hussain, A. 1995. National potato seed strategy document. Pak Swiss Potato Development Project, PARC, Islamabad, Pakistan. 20 pp.