Response of a Traditional Sweetpotato (*Ipomoea batatas* [L.]) Variety to Fertilization in Leyte, Philippines

Luz G. Asio[1], Nemesio V. Tamayo[2], Nenita E. dela Cruz[3]

[1]Visayas State University, Department of Agronomy, Philippines, [2]Central Luzon State University, Department of Crop Science, Philippines
[3]Central Luzon State University, Department of Soil Science, Philippines
Corresponding author Email: luz.asio@vsu.edu.ph

INTRODUCTION

Sweetpotato (SP) is among the major root crops in the tropics. It provides livelihood and food security to the millions of people living and farming in fragile uplands in the Philippines (Roa, 2007). In recent years, SP has received increased interest as a health food and a climate change-resilient crop ideal for typhoon-prone areas. Little crop physiological and mineral nutrition research has yet been done on traditional SP varieties.

OBJECTIVE

To evaluate the response of the traditional SP variety *Siete Flores* to NPK fertilization.

MATERIALS AND METHODS

Study site elevation: 5-10 m asl in Baybay, Leyte, Philippines. Climate: 2,800 mm annual rainfall and 25-29^{oC} air temperature. Soil: sandy loam Inceptisol with pH of 5.8, 3.4 % organic matter (low), 0.21% total N (sufficient), 19 mg kg^{-1} Bray P (high) and 0.94 cmol kg^{-1} exchangeable K (high).

Separate N, P and K experiments were laid out in RCBD with 3 replications. Treatments were: N experiment: T1=0, T2=40, T3=80, T4=120, T5=160, T6=200, & T7=240 kg N ha^{-1}; P experiment: T1=0, T2=20, T3=40, T4=60, T5=80, T6=120 kg P_2O_5 ha^{-1}; K experiment: T1=0, T2=30, T3=60, T4=90, T5=120, T6=160, T7=200, T8=240 & T9=280 kg K_2O ha^{-1}.

Treatments were based on the recommended fertilizer rate 40-40-60 kg ha^{-1} N, P_2O_5, and K_2O. For N levels blanket applications in all plots of 40 & 60 kg ha^{-1} P_2O_5 & K_2O, respectively; 40 & 60 kg ha^{-1} N and K_2O for P levels; 40 and 40 kg ha^{-1} N and P_2O_5 for K levels. Split application (at planting & 6 WAP) was done for N and K while P was applied at planting.

Agronomic and yield parameters were gathered. Plant samples were analyzed for crude protein, total carbohydrates, crude fiber and nutrient analyses.

Experiment 1= 510 m^2 (N Levels) | Experiment 2= 435 m^2 (P Levels) | Experiment 3= 660 m^2 (K Levels)

Total Experiment area = 1, 605 m^2

Fig 1. Stand of the NPK experiments at 4 months after planting

RESULTS AND DISCUSSIONS

General Observation

The traditional SP variety matured only after six months (modern high yielding varieties can be harvested after only three to four months). It responded to NPK fertilization particularly in terms of herbage production indicating the low root yielding characteristic of the variety.

Herbage and Root Yield Response to NPK

Levels of N increased the herbage and root yields of SP (Fig. 2). Herbage production was very high relative to root yield resulting in low harvest index (HI) of 0.10 to 0.20. N application encourages vine growth than storage root formation (Marschner, 1995). Harvest index of the crop varies between 0.11 to 0.85 when harvested during 12 to 24 weeks (Ravi and Saravanan, 2012).

Fig. 3 shows that levels of P increased the herbage and root yield of SP. 20 to 40 kg ha-1 P_2O_5 were better than the control in terms of the two parameters. P fertilization encourages root formation in sweetpotato (Akinjoba, 2014). HI ranged from 0.13 to 0.18, closely similar to HI from the N experiment.

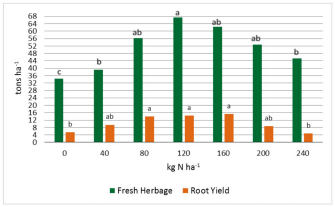

Fig. 2. Fresh herbage and root yield of traditional SP variety with N application levels

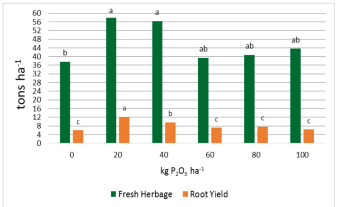

Fig. 3. Fresh herbage and root yield of traditional SP variety with P application levels

K levels increased herbage yield relative to the control (Fig. 4). Highest fresh herbage yield was obtained at 120 kg ha^{-1} K_2O. Higher K levels were not different from each other (suggesting luxury consumption). Previous studies have shown that K is the most important nutrient in SP production (Lebot, 2009) because K increases root growth and improves drought resistance.

Nutritional Quality of Sweetpotato

NPK fertilization did not affect the nutritional quality of SP (crude protein, total carbohydrates and crude fiber). Average crude fiber was 20% indicating that this variety can be promoted as a health food. Sugar content ranged from 2.55 to 7.29 % while the starch content ranged from 49.11 to 62.49 %.

Optimum NPK Fertilization Levels

Optimum fertilizer rate is reached when rate of change in yield per change in fertilizer amount is equal to the ratio of the cost of 1 kg fertilizer to the price of 1-ton tuber (Neeteson and Wadman, 1987). Thus, calculated optimum fertilizer (Table 1) were: N is 118 kg ha^{-1}, P_2O_5 of 38 kg ha^{-1}, & 90 K_2O kg h^{-1}.

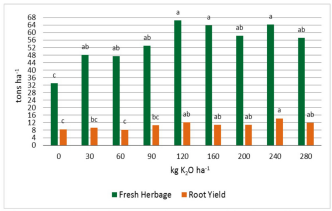

Fig 4. Fresh herbage and root yield of traditional SP variety with K application levels

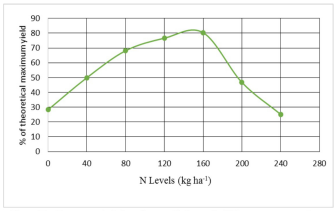

Fig. 5. Root yield of traditional SP expressed as percent of theoretical maximum yield as affected by N levels

Table 1. Yield response function of traditional SP and optimum NPK rates

Variables	Quadratic Equation	Optimum NPK rates (kg ha^{-1})	Philippine Recommended Rate (kg ha^{-1})
N	$y = 4.8931 + 0.1673x - 0.0007x^2$ $R^2 = 0.9433$	118	40
P	$y = 7.7182 + 0.0922x - 0.0011x^2$ $R^2 = 0.3713$	38	40
K	$y = 8.2766 + 0.0265x - 4E\text{-}05x^2$ $R^2 = 0.6597$	90	60

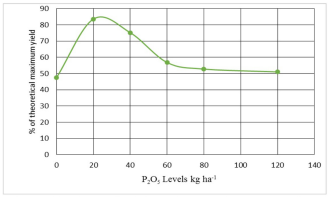

Fig. 6. Root yield of traditional SP expressed as percent of theoretical maximum yield as affected by P levels

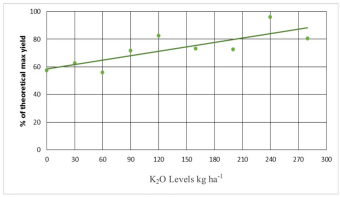

Fig. 7. Root yield of traditional SP expressed as percent of theoretical maximum yield as affected by K levels

Unlike for N and P_2O_5, optimum rate for K_2O could not be determined using the equation. The root yield increased with increasing rates of K suggesting luxury consumption. From the response curve, the optimum rate was determined as 90 kg ha^{-1} capable of producing about 10 t ha^{-1} root yield (70 % of the maximum yield).

Fig. 8. The traditional variety of SP studied

The study found that 30% of theoretical maximum yield of SP calculated using Mitscherlich-Bray equation (Sonar & Babhulkar, 2002) was produced by the inherent soil N, 50% by the inherent soil P and 60% by the inherent soil K.

CONCLUSIONS

- NPK application increased the herbage and root yield of the traditional SP.
- The traditional variety has low harvest index and matured in 6 months.
- NPK fertilization did not affect the nutritional quality of the SP tuber
- The blanket fertilizer recommendation in the Philippines is not valid.
- The inherent soil fertility contributes greatly to SP yield and thus should be considered in formulating fertilizer recommendations.

ACKNOWLEDGEMENT

The first author thanks the ASTHRDP-NSC doctoral scholarship granted by the Department of Science and Technology of the Philippines.

LITERATURE CITED

Akinjoba U. 2014. Int. J. Manures and Fertility 3: 558-560; Lebot V. 2009. Crop production in Horticulture. CABI, Wallingford; Marschner, H. 1995. Mineral nutrition of higher plants. 2nd ed. Academic Press, London; Neeteson J.J. and W.P. Wadman. 1987. Fertilizer Research 12: 37-52; Ravi V. and R. Saravana. 2012. In: Global Science Books. Pp: 17-29; Roa J. R. 2007. PhD Dissertation. Wageningen; Sonar K.R. and V.P. Babhulkar. 2002. Comm. Soil Sci. Plant Anal. 33: 15-18.