

# Importance of Potassium in Banana

Banana is harvested in over five million hectares worldwide with close to 107 million tons produced in 2013 globally, of which 18 million tons came from about 881,000 hectares in Southeast Asia (FAOSTAT, 2015). Average yield worldwide is 21 t/ha.

Bananas require large quantities of nitrogen (N), phosphorus (P), and potassium (K) in order to obtain high yields (Yao *et al.*, 2009). Total nutrient uptake per ton of whole bunches of banana (Cavendish) ranged from 4-7 kg N, 0.9-1.6 kg P<sub>2</sub>O<sub>5</sub> and 18-30 kg K<sub>2</sub>O (Wichmann, 1992; Ganeshamurthy *et al.*, 2011). Nutrient levels in field studies indicate high K requirements compared to N or P (Table 1), with significant accumulation of K in fruit and plant tissues (Table 2).

Potassium is important in catalyzing critical reactions such as respiration, photosynthesis, chlorophyll formation, and water regulation (Mengel and Kirkby, 1987). Potassium is critical in water relations and in transport and accumulation of sugars in the plant (Mengel, 1997). With adequate K, bananas increase in vigor and disease resistance, improve fruit weight, and increase the number of fingers per bunch, and as well as weight and diameter of the middle fruit (Atim *et al.*, 2013, Silva *et al.*, 2013, Garcia *et al.*, 1980). In addition, K stimulates earlier fruit shooting and shortens time to fruit maturity. Potassium also improves the storage quality of bananas.

In the soil, K is prone to losses as it is very mobile. Likewise, in the plant, K moves to the growing parts. When there is insufficient amount of K, deficiency is manifested in the older leaves of the plant, exhibited by an orange-yellow chlorosis of the leaves with brown patches. The midrib of the leaf curls so the tip of the leaf points to the base of the plant showing eventual death of the leaf tissue (Lahav, 1972; Murray, 1960). Potassium deficiency leads to deformation of bunches (short, stunted), with fewer fingers per hand and poor fruit filling (Turner and Bull, 1970). As K deficiency affects translocation of sugars and starch, fruit quality is poor (Lopez and Espinosa, 1998, Vadivelu and Shanmugavelu, 1978). Several studies (Okumu *et al.*, 2011; Nyombi *et al.*, 2010; Silva *et al.*, 2013; Memon *et al.*, 2010, Taulya, 2013) have shown that K is important in increasing banana yield and fruit quality, and improved fertilizer practices have been developed in many banana-growing countries (Memon *et al.*, 2010; Lopez and Espinosa, 1998; Nyombi *et al.*, 2010). Balanced nutrient management addresses the amount of nutrients removed in the harvested fruit, the nutrients existing in the soil, and nutrient losses (leaching, erosion, volatilization, denitrification).

The application of rather large amounts of nutrients required for high yields with marketable quality should follow 4R Nutrient Stewardship concepts (Yao *et al.*, 2015). Soil and plant tissue analyses aid in determining nutrient deficiencies and critical values (Delvaux *et al.*, 1987). Lahav and Turner (1983) set plant tissue critical values of 2.6% for N, 0.2% for P, and 3.0% for K (based on analysis of the leaf blade of the third leaf from the top of a fully grown banana). Soil exchangeable critical K values were low in soils with low base saturation (0.2 meq 100<sup>-1</sup> g, Dabin and Leneuf, 1960) and high in soils highly saturated with Mg and Ca (1.0-1.2 meq 100<sup>-1</sup> g, Turner *et al.*, 1989; 1.5 meq 100<sup>-1</sup> g, Delvaux *et al.*, 1987).

*Table 1. Nutrient levels in single banana plants from field experiments and in lysimeter studies at final bunch harvest. (Adapted from Turner and Barkus, 1983).*

| Location            | N                     | P    | K   | Dry weight            |
|---------------------|-----------------------|------|-----|-----------------------|
|                     | g plant <sup>-1</sup> |      |     | g plant <sup>-1</sup> |
| Trinidad Cul de Sac | 53                    | 6.6  | 91  | 5.12                  |
| St. Lucia Winban    | 44                    | 9.5  | 155 | 5.52                  |
| St. Lucia Roseau    | 86                    | 10.1 | 160 | 8.22                  |
| St. Lucia           | 59                    | 11.7 | 93  | 6.76                  |
| St. Vincent         | 68                    | 7.6  | 157 | 6.53                  |
| Grenada             | 132                   | 19.2 | 422 | 15.21                 |
| Lysimeters          | 83                    | 16.3 | 276 | 9.25                  |

*Table 2. Distribution and nutrient concentration of Cavendish banana in a lysimeter study with balanced amounts of nutrients applied. (Adapted from Turner and Barkus, 1983).*

| Nutrient                               | Roots | Pseudostem, corm, sucker and stalk | Leaves | Trash | Fruit |
|--|-------|------------------------------------|--------|-------|-------|
| <u>Proportional distribution (%)</u>   |       |                                    |        |       |       |
| N                                      | 11.9  | 32.1                               | 7.5    | 22.9  | 25.6  |
| P                                      | 10.0  | 43.7                               | 5.0    | 20.8  | 20.5  |
| K                                      | 5.4   | 43.2                               | 3.8    | 11.9  | 35.7  |
| <u>Concentration in dry matter (%)</u> |       |                                    |        |       |       |
| N                                      | 0.96  | 0.97                               | 1.28   | 1.02  | 1.49  |
| P                                      | 0.10  | 0.21                               | 0.14   | 0.14  | 0.16  |
| K                                      | 0.83  | 2.12                               | 1.02   | 0.84  | 2.79  |

#### References:

Refer to the last printed page of this diary for sources.

## References:

### **Importance of Potassium in Banana**

Atim, M., F. Beed, G. Tusiime, L. Tripathi, and P. van Asten. 2013. High potassium, calcium, and nitrogen application reduce susceptibility to banana *Xanthomonas* wilt caused by *Xanthomonas campestris* pv. *musacearum*. *Plant Dis.* 97:123-130.

Dabin, B. and N. Leneuf. 1960. Les sols de bananeraies en Cote d'Ivoire. [The soils of banana plantations in Ivory Coast]. *Fruits* 15:117-127.

Delvaux, B., A. Lassoudiere, X. Perrier, and J. Marchal. 1987. A methodology for the study of soil-plant cultivation technique relations - Results for banana-growing in Cameroon, pp. 351-357. In: Galindo, J.J. (ed.) ACORBAT 85. *Memorias VII Reunion.*

Food and Agriculture Organization of the United Nations, FAOSTAT database (FAOSTAT, 2015), available at <http://faostat3.fao.org/download/Q/QC/E>.

Ganeshamurthy, A.N., G.C. Satisha and P. Patil. 2011. Potassium nutrition on yield and quality of fruit crops with special emphasis on banana and grapes. *Karnataka J. Agric. Sci.* 24:29-38.

Garcia, R., R. Guijarro, and B. Diaz. 1980. Changes in the nutritional status of banana due to the effect of potassium, on red soils in Cuba: their relations with yield and with the control in fertilizing. *Potash Review* 10:1-7.

Lahav, E. 1972. Effect of different amounts of potassium on the growth of the banana. *Tropical Agriculture, Trinidad* 49:321-335.

Lahav, E. and D.W. Turner. 1983. Fertilizing for High Yield—Banana. *International Potash Institute, Bulletin no. 7, Berne, Switzerland*, p. 62.

Lopez, A. and J. Espinosa. 1998. Banana response to potassium. *Better Crops International*, 12:3-5.

Memon, N., K.S. Memon, R. Anwar, A. Ahmad, and M. Nafees. 2010. Status and response to improved NPK fertilization practices in banana. *Pak. J. Bot.* 42:2369-2381.

Mengel, K. 1997. Food security in the WANA region, the essential need for balanced fertilization. pp. 157-174. In: Johnston, A.E. (ed.) *Proceedings of the Regional Workshop of the International Potash Institute held at Bomova, Izmir, Turkey, 26-30 May 1997, IPI, Bern, Switzerland.*

Mengel, K. and E.A. Kirkby. 1987. *Principles of Plant Nutrition*. 4th Edition. *International Potash Institute, IPI, Bern, Switzerland*, pp. 685.

Murray, D.B. 1960. The effect of deficiencies of the major nutrients on growth and leaf analysis of the banana. *Tropical Agriculture, Trinidad* 37:97-106.

Nyombi, K., P.J.A. van Asten, M. Corbeels, G. Taulya, P.A. Leffelaar, and K.E. Giller. 2010. Mineral fertilizer response and nutrient use efficiencies of East African highland banana (*Musa* spp., AAA-EAHB, cv. Kisansa). *Field Crops Research* 117:38-50.

Okumu, M.O., P.J.A. van Asten, E. Kahangi, S.H. Okech, J. Jefwa, and B. Vanlauwe. 2011. Production gradients in smallholder banana (cv. Giant Cavendish) farms in Central Kenya. *Sci. Hortic.* 127:475-481.

Qaim, M. 1999. A socioeconomic outlook on tissue culture technology in Kenyan banana production. *Biotechnol. Dev. Monit.* 40:18-22.

Silva, I.P., J.T.A. Silva, P.J. Pinho, A.L. Rodas, and J.G. Carvalho. 2013. Vegetative development and yield of the banana cv. 'Prata Anã' as a function of magnesium and potassium fertilization. *Idesia (Chile)* 31:83-88.

Taulya, G. 2013. East African highland bananas (*Musa* spp. AAA-EA) 'worry' more about potassium deficiency than drought stress. *Field Crops Research* 151:45-55.

Turner, D.W. and B. Barkus. 1983. The uptake and distribution of mineral nutrients in the banana in response to the supply of K, Mg and Mn. *Fertilizer Research* 4:89-99.

Turner, D.W. and J.H. Bull. 1970. Some fertilizer problems with bananas. *Agricultural Gazette NSW* 81: 365-367.

Turner, D.W., C. Korawis, and A.D. Robson. 1989. Soil analysis and its relationship with leaf analysis and banana yield with special reference to a study at Carnarvon, Western Australia. *Fruits* 44:193-203.

Vadivelu, E. and K.G. Shanmugavelu. 1978. Effect of increasing rates of potash on the quality of banana cv. Robusta. *Potash Review* 24:1-4.

Wichmann, W. 1992. *World Fertilizer Use Manual*. International Fertilizer Industry Association, Paris, France.

Yao, L., G. Li, B. Yang and S. Tu. 2009. Optimal fertilization of banana for high yield, quality and nutrient use efficiency. *Better Crops* 93:10-15.

Yao, L., G. Li, and S. Tu. 2015. 4R nutrient management for banana in China. *Better Crops* 99:11-13.