The Asian Journal of Horticulture, Vol. 3 No. 2 : 479-482 (December-2008)

A Review :

Potassium nutrition in banana

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Accepted : *November, 2008*

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Key words : Banana, Potassium

Banana being a surface feeder and a nutrient exhausting crop, it is of paramount importance to maintain a high degree of soil fertility in order to maintain the production at economic level over a long period. Large quantities of major nutrients especially potassium is necessary for proper growth, high yield and improved fruit quality of banana (Singh *et al.*, 1990). Potassium is required for the activation of over sixty enzymes involved in the formation of carbohydrates, translocation of sugars, various enzyme actions, yield, quality parameters, storage life of banana, the tolerance of certain diseases, mechanisms to overcome the abiotic stresses and several other functions. In this review, the literature pertaining to the effect of potassium on growth, development, dry matter production and distribution, yield, quality and interaction with other nutrients are discussed.

Potassium in banana nutrition :

Potassium is a key element in banana nutrition. It is the most abundant cation in tissues of banana (often up to 3-4 per cent of dry weight). Uptake studies showed that large amounts of potassium is absorbed during the later half of the vegetative phase (Lacoeuilhe, 1973) and have a special effects on the maturation process (Fox *et al.*, 1979). Potassium is found to regulate the transfer of nutrients to the xylem. Where potassium supply is low, the transfer of nitrogen, phosphorus, calcium, magnesium, sodium, manganese, copper and zinc across the xylem is restricted (Turner and Barkus, 1983), the exception being potassium itself, a constant proportion of which moves to the top of the plant irrespective of potassium supply. Knowing the importance of potassium, various proportion of K is recommended to banana by different workers. Fawcett (1921) recommended 1 : 2 : 4 NPK mixture, while Stephens (1945) recommended a NPK ratio 1 : 1 : 2 or 1 : 1 : 4 with annual dressing rate of one ton/ acre.

Potassium on growth and development:

Banana requires potassium in large quantities throughout its normal life upto flowering stage. The K application must follow the potential growth of the plant and would thereafter be increasing; during fruit filling stage, the need for K is substantial (Lacoeuilhe, 1973). The response to potash fertilization was spectacular and its deficiency caused retardation of root growth (Charpentier and Martin-Prevel, 1965). According to K application in the early stages recorded the maximum height, girth, number of leaves, leaf area and increased sucker growth. The study also revealed a close relationship between pseudostem height, girth and yield. Potassium increases drought tolerance in plants (Mengel and Kirkby, 1980) and is believed to increase resistance power of plants to diseases (Katyal and Chadha, 1961). It is inferred that K application extended the longevity of leaves (Israeli and Lahav, 1986). Role of potassium in advancing flowering and shortening the number of days for maturity in banana has been well documented by many workers (Lahav and Turner, 1983). In a trial with Dwarf Cavendish banana, EL-Khoreiby and Salem (1991) indicated that the height and basal circumference responded positively to the highest K application rate of 500 g K_2O / plant. At this rate the plants were more vigorous and there was greater leaf area. Baruah and Mohan (1991) observed highly significant effect of K on leaf area index and phyllochron. The best phyllochron (7.3) and the highest number of leaves (30.3) were recorded when 344 g K/plant/crop was applied at 3rd and 5th month after planting. Reduced leaf size, delay in floral initiation, reduced fruit number and hands/bunch and reduced fruit size were observed in plants receiving no potash (Baruah and Mohan, 1992). According to Lahav (1972), K starvation significantly reduced leaf area, longevity, pseudostem height and girth. Significant increases in pseudostem height, girth and sucker production were observed with increase in K nutrition in Robusta banana by Mustaffa (1996).

Dry matter production (DMP) and distribution :

Murray (1961) observed that a low level of potassium restricted the growth of leaves resulting in reduced leaf area and photosynthetic efficiency, thereby reducing the total dry matter production of the plant. Vadivel (1976) found that increasing the K_2O level did not correspondingly increase the DMP. Mahadevan (1988) explained at higher K_2O levels, the leaf dry matter was substantially utilized for bunch formation.

Effect of potassium on yield and yield parameters of banana :

The results of many experiments showed that adequate supply of K fertilizers increased the bunch weight and its components of banana as indicated below:

Potassium on fruit quality :

Application of K_2O exerted marked effect on nearly every feature of fruit quality. With an increase in potash levels, total soluble solids, reducing and non-reducing sugars, total sugars, ascorbic acid and sugar-acid ratio of the fruits increased, while acidity decreased (Vadivel and Shanmugavelu, 1978).

Critical levels of nutrients :

Information on the concentration of nutrients in plant tissues is useful in determining the nutrient status of the plant and provides diagnosis of toxicity as well as deficiency in the plant. Based on NPK concentrations of 3rd, 5th and 7th leaf, Hewitt (1955) suggested that 3rd leaf should be sampled to estimate nutrient status. He also found that 2.6 per cent N, 0.45 per cent P_2O_5 and 3.3 per cent K_2O were the critical concentrations and that no increase in yield could be obtained by additional applications of P_2O_5 and K_2O over and above the critical levels.

Interaction between potassium and other nutrients :

Increase or decrease of one element may substantially increase or decrease the other element. Antagonism and synergism among nutrient elements in banana is reported to have affected growth and development of banana considerably. The main cations examined are potassium, calcium and magnesium and many other antagonisms and synergisms have been documented in the Table 1:

Turner (1969) found that excess of Ca and/or Mg in the soil prevented uptake of K by the plant and thus, K

Cultivar	Quantity of K_2O (g/plant)	Effect	Yield (M.T/ha)	Authority
Robusta	336	Increased bunch weight	-	Singh *et al.* (1977)
Poovan and Vayal Vazhai	350	Increased bunch yield	-	Nanjan *et al.* (1980)
Palayankodan	350	Increased yield	-	Sheela (1982)
Dwarf Cavendish	200	Increased yield	-	Yadav *et al.* (1988)
Robusta	300	Increased bunch yield	55% more than control	Mustaffa (1996)
Rasthali	400	Increased yield	33.3	Mahalakshmi and Sathiya moorthy (1999)
Grand Naine	800	Increased bunch weight, number of hands and fingers/bunch	-	Saad and Atawia (1999)
Nendran	450	Increased bunch weight	10.33 kg/plant	Jeyabaskaran *et al.* (2001)
Williams	800	Increased bunch weight	-	Attia *et al.* (2001)

Cultivar	Quantity of K_2O (g/plant)	Quality	Reference
Robusta	330	Increased reducing, non-reducing total sugar, sugar/acid ratio and reduced acidity	Vadivel and Shanmugavelu (1978)
Hill banana	400	Increased TSS, ascorbic acid, reduced acidity	Mustaffa (1988)
Williams	800	Increased TSS, reducing and non-reducing sugars	Attia *et al.* (2001)

Table 1 : Effect of deficiencies on the concentration of other nutrients in banana leaves

	Deficient element							
	N	P	K	Ca	Mg	Mn	Zn	S
N	-		-		+0			+0
P	+	-	-	+	-	0	+	+
K	+		-	+	+0	0	-	
Ca	-		+	-	+0	+	-	+
Mg	+	-	+	+	-	+		0
Mn			-		+	-		
Cu			+	0				
Zn			0-		0		0	
Fe		-						
Na		-	0					
Cl			+					

+: Increase -: Decrease 0: No effect

was low while Ca and Mg were high. According to Lahav (1973) antagonism exists between K and Mg, K and Ca, K and N and also K and Na. But a synergistic relationship was observed between K and P. An adequate supply of K enhanced NH_4-utilization, thus improving crop yields (Hagin *et al*., 1990).

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