مجلة جامعة بخت الرضا العلمية العدد الحادي عشر يونيو 2014م [ISSN 1858-6139]
University of Bakht Alruda Scientific Journal Issue No. 11 June 2014

Effect of N, P and K Fertilization on Fruit Shelf Life, Total Soluble Solids and Ripening of Banana Fruit (*Musa sp*)

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المستخلص

أجريت هذه التجربة بحقل بحوث ومعمل المعهد القومي لتنمية الصادرات البستانية لدراسة تأثير مستويات التسميد النيتروجينى والفوسفورى والبوتاسى على فترة بقاء الثمرة والمواد الصلبة الذائبة الكلية وعدد الأيام للنضج والتغير في اللون ودرجة الصلابة للثمار في صنف الموز "هجين ويليامز"، شملت المعاملات خمسة مستويات من النتروجين (0 ، 69 ، 138 ، 207 و276جم نيتروجين للوحدة الإنتاجية/سنة) ، ومستويين من البوتاسيوم (0 ،41 للوحدة الإنتاجية/سنة) ، ومستويين من الفوسفور (0 ،20 للوحدة الإنتاجية/سنة) ، صممت المعاملات باستخدام القطاعات العشوائية الكاملة بثلاث مكررات، أوضحت الدراسة استجابة معنوية لإضافة تركيبه من النيتروجين والبوتاسيوم أدت إلى إطالة فترة بقاء الثمرة كما نتج من إضافة البوتاسيوم زيادة معنوية في مستوى المواد الصلبة الذائبة ، وأوضحت الدراسة عدم وجود فروق معنوية في عدد الأيام للنضج والتغير في اللون والصلابة لتأثير المعاملات قيد الدراسة بالمستويات المختلفة .

ABSTRACT

Field and laboratory experiments were conducted at the National Institute for the Promotion of Horticultural Exports (NIPHE) research farm and laboratory to determine the effect of N, P and K levels on fruit shelf life and T.S.S, number of days to maturity, fruit firmness and color change of banana crop "Williams Hybrid" cultivar. Treatments consisted of 5 N levels (0, 69, 138, 207 and 276 g N mat-1 year-1), 2 P levels (0 and 20g K mat-1 year-1) and 2 K levels (0 and 41g K mat-1 year-1). The treatments were arranged in a randomized complete block design with 3 replications. Application of K in combination with N resulted in longer fruit shelf life and improved Total soluble solids (TSS). There were no effect of N, P and K on number of days to maturity, fruit firmness and color change in all treatments.

INTRODUCTION

Banana and plantain represent the largest fruit crop produced in the world. They are cultivated in 130 countries, mainly in the tropical and

subtropical regions of the southern hemisphere. The annual production of banana is over 81.2 million tons (FAO, 2008).

Nitrogen is required in large quantities for bananas because they are quick growing herbaceous plants which yield "heavy" crops within a short period of time. Nitrogen was reported to affect yield and fruit quality (Williams et al., 1980). Elkhidir et al (2009) reported a negative relationship between TSS and N rate in William banana fruit.

K was found to improve banana fruit quality as reflected in reducing, non-reducing and total sugars (Gowen, 1995).

Banana fruits with a long fruit shelf life are more suitable for export because they can reach distant international markets and distributed to retail stores while they are still firm and green before the commencement of ripening or degradation in quality(Elkhidir et al 2009).Therefore, the objective of this study was to determine the effect of different rates of N,P and K on fruit shelf life , TSS, and
number of day to maturity of banana cultivar "William's Hybrid" .

MATERIALS AND METHODS

Site

Field experiments were conducted at the National Institute for the Promotion of Horticultural Exports (NIPHE) research farm at Hantoub, on the east bank of the Blue Nile (lat. 140 5' N and long. 330 4' E). The area lies within the arid climate of summer rains and relatively cools winter.

Treatments

The banana cultivar “William” was used in this study. Treatment consisted of five nitrogen level , 2 potassium levels and 2 Phosphorus levels. Nitrogen in the form of urea was applied at the rates of 0, 69, 138, 207 and 276g N $mat^{-1}year^{-1}$at four equal doses. Phosphorus in the form of triple superphosphate was applied at the rates of 0 and 20 g P mat-1 year-1 in a single dose at sowing. Potassium in the form of $K_2 SO_4$ was applied at the rates of 0 and 41 g K $mat^{-1}year^{-1}$ in a single dose at sowing.

Treatments were arranged in a randomized complete block design with three replications. Plot size was 6 x 6 m. Each plot consisted of four plants.

Shelf life

Determination of Shelf life was done on fruits harvested at the mature green stage (full three quarters) by determining the number of days from harvest till the fruits start to change from green to light green colour. The hands were washed with tap water to remove latex and dust, disinfected in a solution of commercial bleach chlorox of 5.25% sodium hypochlorite at a

concentration of 125 mg/l and then placed in polyethylene bags in a cold room calibrated at 14^0C. The Shelf life of the fruits was determined as the number of days required for the fruits to change to light green colour.

Fruit ripening

hands which changed to light green colour were dipped in a diluted Ethrel solution (2 ml/l) for two minutes and then placed in intact polyethylene bags and let to ripe

at room temperature. Fruit colour and firmness were measured every days till ripening.

Total soluble solids (TSS)

Total soluble solids (TSS) of ripe fruits were measured according to the procedure of Dadzie and Orchard (1997) according to which thirty grams of the pulp were blended with 90 ml water for two minutes and the juice TSS was measured using a hand refractometer.

RESULTS AND DISCUSSION

Fruit shelf life:

The main effect of N levels on Fruit shelf life is shown in table (1). Application of N resulted in a highly significant linear effect on banana shelf life. Application of N reduction of banana life. The lowest shelf life was obtained by application of 276 N g mat-1/ year-1. This finding is similar to Rbinson (1996) who stated that over supply of N resulted in the reduction of shelf life.

Application of K resulted in an increase of banana shelf life from 15.07 to 16.10 days. Similar results were reported by Geus (1973) who stated that K application improves storage life.

The effect of N and K fertilizer on shelf life of banana fruit is shown in table (2). Application of K in combination with N resulted a significant increase in shelf life. The highest values of shelf life were obtained with 41g K mat-1/ year-1 in combination with all N levels.

Total soluble solids (TSS)

Effects of N levels on TSS is shown in Table (3). Application of N resulted a highly significant linear effect on T.S.S. There was a negative relationship between TSS and N rate. Similar results were obtained by Gowen (1995) who reported that N affected fruit quality by reducing T.S.S.

Application of K resulted in an increase in banana fruit TSS from 12.9 to 13.77. Table (4) shows the effects of N and K fertilizers on banana fruit TSS. Application of K in combination with N resulted in a significant increase on banana TSS. The highest T.S.S value was obtained with application of 41g K and 0g N / mat-1/ year-1.
This finding is in agreement with Hassan et al. (1999) who reported that

N treatment (g/mat/year)	Fruit shelf life (days)

optimum potash dose increased T.S.S on banana fruit. Higher TSS content can be explained by the role of potassium which is involved in carbohydrate synthesis, breakdown and translocation and synthesis of protein and neutralization of physiologically important organic acids (Tisdale and Nelson 1966). Besides, K is involved in phloem loading and unloading of sucrose and amino acids and storage in the form of starch in developing fruits by activating the enzyme starch synthesis (Mengel and Kirkby,1987).

Fruit ripening

The results of treatment N, P and K showed not significant .This treatment were not
affected on fruit firmness and colour change during ripening in all treatments.

Conclusion

In conclusion, application K leads to long shelf life and best T.S.S on banana fruit. More research is needed to investigate the optimum K levels for "Williams Hybrid" banana fruit.

Table(1):Effects of N levels on fruit shelf life

0	16.17
69	15.83
138	15.67
207	15.42
276	14.83
Linear	**
Quadratic	N.S

** mean significance P≤0.01
N.S mean not significance

Table (2):Effects of N levels on Total soluble solids (TSS)

N treatments (g/mat/year)	TSS
0	14.13
69	13.50
138	13.29
207	13.25
276	12.50
Linear	**
Quadratic	N.S

** mean significance P≤0.01
N.S mean not significance

Table (3): Interactions effects of N and K on fruit shelf life

Fertilizer treatment (g/mat/year) K	N	Shelf life (days)
0	0	15.67a

69		15.67a
	138	15.67a
	207	14.17b
	276	14.17b
41	0	16.67a
	69	16.00a
	138	15.67a
	207	16.67a
	276	15.50a
	Significance level	*
	C.V%	10.62
	SE±	0.68

* means significance P≤0.05
Means within columns followed by the same letter are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

Table (4): Interactions effects of N and K on banana TSS:

Fertilizer treatment (g/mat/year) K	N	TSS
0	0	13.75 abc
	69	13.00 abc
	138	12.75 bcd
	207	12.75 bcd
	276	12.25 d
41	0	14.50 a
	69	14.00 ab
	138	13.83 abc
	207	13.75 abc
	276	12.75 bcd
	Significance level	*
	C.V%	8.97
	SE±	0.49

* indicates significance P≤0.05
Means within columns followed by the same letter are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

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