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Response of Williams Banana to Different Rates of Nitrogen and Potassium Fertilizers

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Abstract: During two successive crop cycles of Williams banana cultivar, grown under El-Gharbia Governorate conditions, on 2002/2003 (second ratoon) and 2003/2004 (third ratoon) were subjected to study the effect of the recommended dose of Nitrogen and potassium fertilizers added in different parts intervals through out the growing season. The obtained results revealed that, treatment No. 2(T2) which include the following intervals, (50 gm N/plant on April, 50 gm N/plant on May, 50 gm N/plant on June, 70 gm N/plant on July, 80 gm N/plant on August, 90 gm N/plant on September and 100 gm N/plant on October + (100 gm K/plant on April, 133.5 gm K/plant on June, 167 gm K/plant on August and 199.5 gm K/plant on October gave the highest values of : length of pseudostem and its circumference number of green leaves and leaf area. Also, this treatment caused earlier bunch shooting, bunch harvesting as well as; cropping cycle.The highest bunch weight, number of hands/bunch and number of fingers/bunch with best finger quality (weight, length and diameter) were recorded by plants received (T2) during both seasons. It is worthy to decide that the best results with regard to growth,. Leaf nutritional status, yield and fruit quality were obtained by plant received (T2), in both seasons.

Key words: Williams banana, nitrogen, potassium, yield, fruit quality.

INTRODUCTION

Banana is considered as one of the most important tropical fruit crops grown in the world. Because of increasing the economic importance of banana in Egypt, a high increase in banana cultivation area, specially that of new reclaimed soils. Many Egyptian growers introduce some banana cultivars characteristic by high yield production with high fruit quality. Further more, the Egyptian consumers considered Banana fruits as a good source of energy i.e. high starch content, and vitamins of A, B and C.

These new cultivars consider with the development of fertilizers program, include the rates and doses intervals, as well as, time of addition from such elements through out the growth season. This investigation tended to increase the efficiency use of the recommended fertilization rates of both nitrogen and potassium, which partitioned in different does added in some intervals during the vegetative growth season; i.e. before flowering or bunch shooting.

Many investigators suggested that the optimum amount required from nitrogen or potassium for banana plants differed, according to soil and variety[1] . Potassium was also found to have an active role in the uptake and translocation of nitrogen since deficiency in potassium depressed the nitrogen absorption[2-4].

On the other hand, potassium is required in greater amounts for banana as mentioned by many researchers. Its deficiency apparently decreased growth, number of green leaves and yield of banana plants[1,3,5,6].

The aim of this study was to investigate the response of Williams banana plants to the recommended rates of nitrogen and potassium fertilizers divided into intervals rates added through the growing season.

MATERIALS AND METHODS

This experiment was carried out during two successive seasons of 2002/2003 (second ratoon) and 2003/2004 (third ratoon of Williams banana cv. Grown in a private orchard located at El-Gharbia Governorate, Egypt.

All plants were spaced at 3.5x3.5 m apart and irrigated with surface irrigation system, received the traditional horticultural practices, except that of fertilization. The experiment was set in completely randomized block design with five replicates each contained 3 mats.

This experiment included four treatments; each obtained 500 gm N/plant/year (as ammonium sulphate

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Table 1: Nitrogen and potassium fertilizers distributions during the growing season of Williams banana.

Treatments		Months April	May	June	July	Aug.	Sept.	Oct.	Total
T1	N* (gm/plant)	071.40	71.40	071.40	71.40	071.40	71.40	071.40	499.80
Control	K**(gm/plant)	150.00	00.00	150.00	00.00	150.00	00.00	150.00	600.00
T2	N*(gm/plant)	050.00	50.00	060.00	70.00	080.00	90.00	100.00	500.00
	K**(gm/plant)	100.00	00.00	133.50	00.00	167.00	00.00	199.50	600.00
T3	N*(gm/plant)	050.00	60.00	070.00	80.00	080.00	80.00	080.00	500.00
	K**(gm/plant)	100.00	00.00	140.00	00.00	180.00	00.00	180.00	600.00
T4	N*(gm/plant)	050.00	70.00	080.00	90.00	090.00	70.00	050.00	500.00
	K**(gm/plant)	180.00	00.00	160.00	00.00	140.00	00.00	120.00	600.00

* Nitrogen fertilizer was added as Ammonium sulphate (20.50%).
** Potassium fertilizer was added as potassium sulphate (48.00%).
Treatment No. 1 (T1), (control).
Treatment No. 2 (T2).
Treatment No. 3 (T3).
Treatment No. 4 (T4).

20.5%) and 600 gm K/plant/year (as potassium sulphate 48%), which added at the following doses intervals shown in (Table 1). These treatments as follows:

- T1 (control) [500 gm N/plant/year added at 7 equal doses added monthly, form the beginning of April until October, and potassium sulphate (600 gm K/plant/year added at four equal batches on April, June, August and October.
- T2 500 gm, N/plant/year added at 7interval doses gradually increased from April until October and 600 gm K/.plant /year) added at four interval doses gradually increased at April, June, August and October.
- T3 500 gm N/plant/year added at 7 doses, three of them gradually increased from April until June after which four equal doses until October,. Meanwhile, 600 gm K/plant/year two of them at increasing doses added on April and June, after that two equal doses were added at August and October.
- T4 500 gm N/plant/year added at 7 doses, three doses from April Until June and July increased gradually, followed by three decreasing doses form August to October. Meantime, 600 gm K/plant/year added at 4 doses decreased gradually form April, June August and October.

The following parameters were studies:

Vegetative Characters: Data on the vegetative characteristics included pseudostem length and its circumference diameter in (cm), number of green leaves per plant at bunch shooting and leaf area (m^2) using the third full sized leaves according to Murry[7] and calculated as follows:

Leaf area (m^2) = length x width x 0.8

Flowering: Periods to bunch shooting, period from bunch shooting to bunch harvesting and cropping cycle were recorded for each treatment.

Leaf mineral contents: Leaf samples were taken from the third upper leaf from the top of the plant after bunch shooting in September of each season. A sample of 10x10 cm from the middle part of the leaf blade was used as recommended by Hewitt[2] and adapted by Abou-Aziz[1]. As for N, P and K determinations were estimated according to A.O.A.C.[8].

Bunch characteristics: The following bunch characters were studied at harvest: bunch weight (Kg), number of hands/bunch and number of fingers/bunch was estimated and recorded.

Fruit Quality:

- Physical properties: included the following measurements: weight (gm), length and diameter of finger (cm) were estimated.
- Chemical properties: total soluble solids (T.S.S), total sugar, total titratabel acidity and ascorbic acid content were determined according to A.O.A.C. [8], as well as, T.S.S /acid ratio was calculated.
- Statistical analysis: All the obtained data were tabulated and statistically analyzed according to Sendecor[9] using L.S.D test at 0.05 level.

RESULTS AND DISCUSSION

Vegetative growth characteristics: Data in Table (2) clearly showed that treatment No.2 include an increased

Table 2: Effect of nitrogen and potassium fertilizer distribution on Vegetative growth of Williams banana during 2002/2003 and 2003/2004 seasons.

	Pseudostem length (cm)		Pseudostem circumference (cm)		Number of green leaves		Leaf length (cm)		Leaf width (cm)		Leaf area (m^2)	
Treatments	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
T1 control	272	277	82.0	83.0	11.6	11.7	242	256	88	99	1.7	2.0
T2	308	318	97.7	98.0	13.6	13.9	269	285	99	112	2.1	2.6
T3	288	290	89.7	90.3	12.5	12.6	260	272	93	10.5	1.9	2.3
T4	276	279	83.0	85.0	11.6	11.8	245	260	90	100	1.7	2.1
LSD 5%	6.8	6.6	3.8	4.1	0.7	0.5	9.9	6.2	4.5	4.9	0.2	0.2

in pseudostem for length and circumference, number of green leaves, as well as, leaf area when compared with treatment (T1) control, during both seasons. This increase was over come that obtained from T3, for both seasons.

The increase in both treatments No.2 (T2) and (T3), were significantly than those of T1 (control) and T4. Meanwhile, treatment No. 4 (T4), generally, tended to give an increase in the vegetative growth parameters, which developed by the control plants however; such increase was insignificant, for both seasons.

In addition, the maximum values were detected on Williams banana plants received T2, followed by T3 and T4, respectively.

In case of T1 (control) resulted in the minimum values, during both seasons. The present results were, generally, in line with those found by Saad[10] and Mostofa[11,12].

The positive action of N and K on the biosynthesis of both cell division and cell enlargement could explain the present results. In this respect the present results are in coincidence with those obtained by Mayaz[13], Srinivas[14], Saad[10], Reddy[15] and Mostafa[12].

Flowering: It is clear from the date in Table (3) that Williams banana plants received T2 caused earlier bunch shooting by 10 day, bunch harvesting by 8 days, and cropping cycle by 7 days than control (T1), while T3 and T4, came after, in both seasons.

The data presented in Table (3) indicated that during both seasons, the control (T1) had the higher number of days to reach bunch shooting, bunch harvest and cropping cycle.

The shortest time to bunch shooting, bunch harvesting and cropping cycle recorded by Williams banana plants received T2, in both experimental seasons. These findings supported by the results obtained by Mostafa[11,12].

Leaf mineral contents: Data presented in Table (3) indicate that leaf N% was affected significantly by different treatments under this investigation. The highest N% in leaf was recorded by plants received T2. Also, the minimum value of N% in leaf resulted by plants received control (treatments No.1, in both experimental seasons. Leaf phosphorus percentage was not affected significantly by the different treatments, in both seasons. Meanwhile, leaf potassium percentage was affected significantly by the different treatments, in the two seasons. The highest K% was recorded by T2, while the lowest K% recorded by treatment No.1, in both seasons. These results are in harmony with those of Saad[10] and Soliman[16].

Bunch character: Data in Table (4) indicated that Williams banana plants received treatment No.2 (T2) developed a significantly increase in bunch weight, number of hands/bunch and number of fingers/bunch followed by T3 when compared with T1 (control), during the two experimental seasons. Treatments No.2 (T2) produced the highest bunch weight reached about 32.7 Kg and 33.3 Kg for both seasons, respectively.

The minimum values for bunch weight were recorded in Williams banana plants received T1 (control). The values were 26.3 Kg in the first season and 27.0 Kg in the second one.

This increase in bunch weight of Williams banana was attributed to the increase in both number of hands/bunch and number of fingers/bunch. Also, T2 produced the highest number of hands/bunch reached about 12.6 and 13.0 hands/bunch in both seasons, respectively, meantime followed by treatment No.3 (T3) and finally by T1 (control).

Number of fingers/bunch also differed significantly among the treatments as shown in Table (4). The highest number of fingers/bunch reached about 178 and 181 in plants received T2 in the first and second seasons, respectively, while (T3) was followed.

The beneficial influence of N and K on the yield might be attributed to their positive effect on growth and nutritional status of such plants, which could be rendered in increasing such biosynthesis, developed such good results.

Fruit quality:

A) Physical properties: Data in Table (4) cleared that Williams banana plants received T2 produced significantly large weight of finger, longest finger and finger diameter than the other treatment. This result was

Table 3: Effect of nitrogen and potassium fertilizer distribution on time to bunch shooting, time to bunch harvest, cropping cycle and leaf mineral percentage of Williams banana during 2002/2003 and 2003/2004 seasons.

	Time to bunch shooting days		Time to bunch harvesting		Cropping cycle days		Nitrogen %		Phosphorus %		Potassium %	
Treatments	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
1	415	411	117	113	532	523	2.4	2.5	0.20	0.21	3.2	3.4
2	405	403	110	107	515	510	2.9	2.9	0.21	0.22	3.8	3.9
3	410	409	114	112	523	521	2.6	2.7	0.21	0.22	3.5	3.6
4	413	410	115	112	528	522	2.6	2.6	0.21	0.21	3.5	3.7
LSD 5%	3.0	4.0	2.9	3.5	5.1	4.5	0.1	0.1	NS	NS	0.2	0.2

Table (4): Effect of nitrogen and potassium fertilizer distribution on bunch and finger properties of Williams banana during 2002/2003 and 2003/2004 seasons.

	Bunch weight (kg)		No. of hands per bunch		No. of fingers per bunch		Finger weight (gm)		Finger length (cm)		Finger diameter (cm)	
Treatments	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
1	26.3	27.0	10.9	11.3	164	165	160.7	163.7	19.0	19.2	3.3	3.4
2	32.7	33.3	12.6	13.0	178	181	183.8	184.1	20.8	20.9	3.6	3.7
3	29.0	30.0	11.2	12.0	175	176	165.7	170.9	19.9	19.9	3.3	3.5
4	26.7	27.6	11.0	11.3	167	163	159.4	169.2	19.2	19.5	3.2	3.5
LSD 5%	2.9	1.6	0.3	0.7	10.5	7.3	9.9	12.0	0.4	0.5	0.2	0.2

Table 5: Effect of nitrogen and potassium fertilizer distribution on finger properties of Williams banana during 2002/2003 and 2003/2004 seasons.

	Total soluble solids (%)		Acidity (%)		TSS/acid ratio		Total sugars (%)		Ascorbic acid (mg 100 G^{1}gm)	
Treatments	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
1	18.2	15.5	0.32	0.31	56.9	59.7	16.4	16.4	16.6	14.9
2	19.6	19.9	0.30	0.32	64.6	62.9	17.6	17.3	17.4	16.2
3	18.8	19.1	0.32	0.32	58.1	60.2	17.1	17.0	16.8	16.0
4	19.0	19.2	0.31	0.33	62.0	58.1	17.0	16.8	16.8	16.0
LSD 5%	0.4	0.2	NS	NS	2.4	NS	0.18	0.2	0.3	0.3

followed by T3, in both seasons.

The present influence of N and K were attributed to their positive action on the biosynthesis of proteins and carbohydrates[17].

B) Chemical properties: Data in Table (5) showed that the total soluble solid was significantly higher in plants received T2 compared with T1 (control), as well as, other treatments, in the two seasons.

Acidity did not significantly affect among the different treatments, in both seasons. The values were ranged between 0.30-0.33%, while TSS/acid ratio was affected significantly in the first season, however, it was insignificant during the second season.

Data presented on total sugar, the obtained results indicate that the highest value was 17.6 and 17.3% in T2 during the first and second season, respectively. The lowest values were (16.4 and 16.0% recorded by plants received T1 (control); in both experimental season.

Data on ascorbic acid content showed significant differences among different treatments, in both seasons. The highest ascorbic acid content in fruit pulp recorded by plants received T2 in the two seasons, while the minimum value recorded by T1 (control) in the first and second season, respectively. These results were agreement with those obtained by Nalina[18].

As a conclusion of such study , the obtained data prevail that the partitioning of the recommended dose of both the nitrogen and potassium fertilization, into different parts, which increased in their amounts by developing the growth phase of Williams banana plants till the beginning of the productive phase; i.e. starting the flowering and bunch shooting stage. The increase of the efficiency use of a certain dose of such fertilization program in a proper dose and time gave the best vegetative growth rendered in a high production with best quality for Williams banana cultivar grown under Egyptian conditions.

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