417
Arab Univ
J. Agric. Sci.,
Ain Shams Univ.,
Cairo, 15(2), 417-429, 2007

EVALUATION OF CHLORIDE FORM AS A PARTIAL SOURCE FOR POTASSIUM FERTIGATION OF BANANA PLANTS GROWN ON A SANDY SOIL

[36]

Fikry[1], O.Kh.; H.E. Abu-Hussin[1] and A.A. Ibrahim[1]
1- Soils Department, Faculty of Agriculture, Ain Shams University, Shoubra Elkhiema, Cairo, Egypt

Keywords: Potassium chloride (KCl), Fertigation, Banana plants, Fruit yield, Nutritional status, Chloride accumulation, Sandy soil

ABSTRACT

A field experiment was carried out in sandy soil to elucidate the possibility of using chloride form as a partial source for potassium in fertigation of banana plants grown on a sandy soil. Growth, fruit yield and quality as well as plant nutritional status and Cl accumulation within both plant leaves and rhizosphere beside an economical elucidation were taken in to consideration to accomplish such evaluation. Eleven gradual increasing KCl: KNO_3 (0:100 - 100:0) ratios were applied with maintaining the concentration of all macro and micro nutrients except Cl constant. Obtained data indicated that increasing Cl existence didn't adversely affect plant growth under this experiment. Treatments of 10:90 followed by 50:50 as well as 70:30 followed by 80:20 and either 90:10 or 10:90 (KCl:KNO_3) were most stimulating treatments for increasing pseudo stem diameter and leaves number, respectively. Although total fruit yield bunch as well as number and length of fingers are less sensitive to increasing KCl:KNO_3 ratio, number of hands/bunch and diameters of fingers were significantly and positively affected by increasing KCl existence. Treatment of 80:20 KCl:KNO_3 was the most significant superior one for all measured fruit yield parameters. Although Cl content increased significantly in banana leaves and root surrounding area with increasing Cl existence in the fertigation solutions, recorded contents seemed to be in safe ranges whereas no chloride necroses symptoms were appeared at banana leaves. Contents of N, P and K as well as Cl in plant leaves were significantly, although in fluctuating manner, affected by increasing chloride occurrence in fertigation solution. The encountered response of N, P and K contents seemed to be not only a resultant of increasing Cl occurrence in the root media but also as a reflection to changing the N form (NH_4 and urea) compensating N-NO_3 decline in the fertigation solutions having high Cl concentrations. The relatively high supplements of Cl (80:20 followed by 70:30 KCl: KNO_3) recorded the highest economical net return. It could be concluded that KCl can be perfectly used in fertigating banana plants grown on sandy soils. To increase safety of using chloride under such conditions, more work could be suggested particularly what concerns with calculating irrigation and leaching water requirements to prevent chloride accumulation in the root zone.

INTRODUCTION

Although potassium (K) hasn't been reported yet to play a direct role in plant cell structure, it is considered as a fundamental macro nutrient in plant nutrition. Plants generally and banana trees particularly require high amounts of K to assure synthesis, transportation and accumulation of sugars and subsequently allowing fruit fill and yield accumulation. Such High demands increase when the cultivated soil is poor in K as known for the sandy soils **(Lopez and Espinosa, 1998).** The most common sources of potassium for fertigation

(Received June 26, 2007)
(Accepted July 9, 2007)

to horticultural crops as banana trees are potassium chloride (KCl), potassium sulfate (K_2SO_4) and potassium nitrate (KNO_3). Suitability of K fertilizer is usually limited by its price, solubility, accompanying anion and ease of use. Potassium nitrate although acceptable in theory, is scarcely ever used as a sole K source due to its high cost per K unit and liability to lose by leaching. Potassium sulfate, however, has less cost compared to potassium nitrate but scarcely ever used also in fertigation due to its low solubility and capability of admixing with Ca and Mg fertilizers and usually causes emitter clogging. On contrast, KCl is not only the cheapest source for K fertigation, but also the most soluble one (34% at 20 C°) compared to 31% and 11% for KNO_3 and K_2SO_4, respectively and has the highest K content (62% K_2O compared to 46% and 48% for KNO_3 and K_2SO_4, respectively (**Wolf *et al* 1985**). Chloride is an essential plant nutrients involved in several processes taking place in the plant bioactivities including osmotic regulation, photosynthesis by evolution of oxygen in plant system, enzyme activation and transportation of other plant nutrients, plant development, lodging prevention and disease suppression (**Freeman *et al* 2006).** On the other hand, the most negative critical disadvantage for KCl use in fertigation is the chloride toxicity particularly for sensitive and relatively sensitive plants like banana ones (**Marschner, 1995).**

Therefore, the main aim of this study was to evaluate the gradual increase in using KCl as compensate for KNO_3 in the fertigation solutions used for banana plants grown on a sandy soil. Such evaluation was designed to be accomplished via evaluation of plant growth, fruit yield and nutritional status of banana plants as well as chloride ion accumulation in both plant leaves and rhizosphere.

MATERIALS AND METHODS

This field experiment was conducted during the banana production season of 2005-2006 in a sandy soil at the south El-Tahreer Provenance (110 km North West of Cairo). The plant spacing was 3.5 m between each two rows and 3 m between each two mats to allow 400 mats/ fed The experiment area was divided into 33 rows (10 mats/raw) containing 25 suckers/ row for the first ratoon plant (2 or 3 suckers per each mat). Each three rows represented three replicates for each treatment. The experimental rows were arranged in the field according to the complete randomized design (CRD) Fertigation treatments were applied at the following 11 combination ratios of K-KCl, K-KNO_3. The ratios were 0:100, 10:90, 20:80, 30:70, 40:60, 50:50, 60:40, 70:30, 80:20, 90:10 and 100:0 relative to 100% of K requirement during the growth season. Solutions of indicated treatments contained finally 0, 9, 18, 27, 36, 45, 54, 63, 72, 81, and 90 mg Cl/l, respectively. All banana plants under investigation received irrigation water containing sum of 380kg N/fed, 54kg P_2O_5/fed and 634 kg K_2O/fed throw the whole growth season. To maintain N concentration constant in all designed treatment solutions, $CaNO_3$, NH_4NO_3 as well as Urea were included particularly when Cl existence increased. Soil samples were collected from the surface and subsurface layers (0-30 and 30-60cm, respectively) at the start of the experiment and subjected to determination of some physical and chemical properties according to **Jackson (1973)** as shown in **Table (1)**. Another soil sampling was done at the end of growth season to evaluate chloride accumulation in the root zone. Samples of plant leaves samples were collected at flowering stage and oven dried at 70 C° to be then milled and wet digested using H_2SO_4-H_2O_2 method (**Cottenie *et al* 1982).** Contents of N, P and K were measured in the obtained digests according to (**Cottenie *et al* 1982).** Number of leaves and pseudostem diameters of treated banana plants were recorded monthly to express growth status as described by **Deolankar and Firake (2001)**. At harvest, bunch weight, number of hands/ bunch, number of fingers/ hand as well as diameter and length of fingers were recorded to express production and quality of fruit yield.

RESULTS AND DISCUSSION

Accumulated changes in the diameter of pseudo stems and number of leaves during the growth season of banana plants were calculated as a response of increasing Cl concentration in the fertigation solutions **Table (2)**. Data show that increasing KCl up till 50 % of K requirements (50: 50 KCl: KNO_3) did not only increase significantly the diameter of pseudo stems but also accelerated the response from the beginning of growth season particularly at June month; treatments of 70:30 and 90:10 KCl:KNO_3 ratio had also a similar trend. Using KNO_3 or KCl alone as a sole source for K fertigation proved to be significantly inferior for growth of banana stems. A similar trend was also encountered for the response of number of leaves where superiority was

Table 1. Some Characteristics of cultivated soil.

Soil depth (cm)	Texture grade	Saturation Percentage (SP %)	pH 1:2.5 suspend	ECe dS/m (1:5 ext.)	CaCO$_3$ %	Organic matter %
0-30	Sandy	19.5	7.59	0.51	1.13	0.35
30-60	Sandy	18.6	7.47	0.46	1.09	0.28

	soluble cations (meq/l) (1:5 ext.)				soluble anions (meq/l) (1:5 ext.)			
	Ca^{++}	Mg	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	SO_4^{--}	CL^{-}
0-30	1.20	0.15	2.00	1.85	ND	0.96	3.84	0.40
30-60	1.16	0.12	1.75	1.67	ND	0.88	3.52	0.30

ND: Not Detected

Table 2. Effect of KCL:KNO_3 combination ratio on accumulated changes in banana pseudo stem diameters and Leaves number during growth season and their regression indices

a) Accumulated changes in pseudo stem diameters in (cm).

KCl:KNO_3	Months - Days						Mean PSD	
	Apr-0	May-30	Jun-60	Jul-90	Aug-120	Sept-150	mean	*RC%
0:100	0.0	3.0	6.2	10.2	14.2	14.2	7.9_{G}	100
10:90	0.0	3.7	16.2	21.4	26.7	26.7	15.8_{C}	198
20:80	0.0	4.0	11.0	12.1	13.2	13.2	8.9_{F}	112
30:70	0.0	4.3	12.5	14.3	0.0	16.1	7.9_{G}	99
40:60	0.0	3.3	6.3	9.2	12.0	12.0	7.1_{H}	90
50:50	0.0	5.0	20.2	22.7	25.2	26.2	16.5_{A}	208
60:40	0.0	3.7	10.3	12.1	14.0	14.0	9.0_{F}	113
70:30	0.0	6.7	18.0	21.4	24.8	24.8	16.0_{B}	201
80:20	0.0	5.3	14.0	14.7	15.3	15.3	10.8_{E}	136
90:10	0.0	8.3	20.2	21.4	22.7	23.3	16.0_{B}	201
100:0	0.0	4.7	10.8	15.8	20.7	20.7	12.1_{D}	152

* RC%=relative change as calculated as a percentage of that of 0:100 KCl: KNO_3 treatment.

- Values having the same letters within a column are not significantly different at 5% confidence level.

Cont. Table 2.

b) Accumulated changes in leaves number

$KCl:KNO_3$	Months - Days						Mean LN	
	Apr-0	May-30	Jun-60	Jul-90	Aug-120	Sept-150	mean	*RC%
0:100	0.0	2.3	6.3	11.0	15.7	15.7	8.5 E	100
10:90	0.0	3.3	8.3	12.3	16.3	16.3	9.4 B	111
20:80	0.0	3.0	8.0	11.3	14.7	14.7	8.6 D	101
30:70	0.0	3.0	8.0	12.0	16.0	16.0	9.2 C	108
40:60	0.0	3.3	8.3	11.0	13.7	13.7	8.3 F	98
50:50	0.0	3.0	8.0	12.0	16.0	16.0	9.2 C	108
60:40	0.0	3.0	8.0	11.2	14.3	14.3	8.5 E	100
70:30	0.0	3.0	8.0	12.7	17.3	17.3	9.7 A	114
80:20	0.0	3.3	8.3	12.3	16.3	16.3	9.4 B	111
90:10	0.0	3.3	8.3	12.3	16.3	16.3	9.4 B	111
100:0	0.0	3.3	8.3	10.8	13.3	14.0	8.3 F	98

* RC%=relative content as calculated as a percentage of that of 0:100 KCl: KNO_3 treatment.
-Values having the same letters within a column are not significantly different at 5% confidence level.

Cont. Table 2.

c) Simple regression indices for pseudo stem diameters (PSD) and leaves numbers (LN) of banana plants

$KCl:KNO_3$	Pseudo stem diameter in cm (SD)			Leaves number (LN)		
	Intercept	Slope	R^2	Intercept	Slope	R^2
0:100	6.6	7.04	0.96	3.8	3.51	0.97
10:90	11.4	13.61	0.92	3.0	3.56	0.96
20:80	2.6	3.19	0.95	2.6	3.19	0.95
30:70	7.9	11.00	0.62	3.1	3.51	0.96
40:60	4.0	5.78	0.96	1.9	2.91	0.94
50:50	6.6	12.78	0.86	3.1	3.51	0.96
60:40	2.4	3.11	0.95	2.4	3.11	0.95
70:30	5.2	11.94	0.89	3.7	3.84	0.96
80:20	0.0	7.07	0.77	3.0	3.56	0.96
90:10	0.4	10.59	0.80	3.0	3.56	0.96
100:0	8.0	10.19	0.96	1.9	2.93	0.95

PSD = f (growth period in months) LN = f (growth period in months) significantly recorded for the treatment of 70:30 followed by 80:20 and 90:10. Obtained results were in agreement with those obtained by **Johnes and Vimpany (1999)** who reported that using KCl in banana fertigation didn't cause negative effects but, to some extent, encouraged plant growth particularly under stressed water regimes and concluded that Cl may enhance water use efficiency by banana plants.

Obtained superiority of some KCl treatments was proved through calculating the regression coefficients for the response of both pseudo stem diameters and leaves number. Although leaves number proved to be less sensitive than stem diameter to increasing KCl:KNO_3 ratio, 10:90 followed by 50:50 and 70:30 as well as 70:30 followed by 80:20 and either 90:10 or 10:90 ratios were most stimulating treatments for increasing stem diameter and leaves number, respectively.

As response of fruit yield was regarded obtained data **(Table, 3)** indicated that bunch weight as well as number and length of fingers were less sensitive to increasing KCl: KNO_3 ratio. Number of hands/bunch and diameter of fingers were significantly more positively sensitive to increasing KCl existence. Treatment of 80:20 KCl: KNO3 proved to be the most significant superior one for all measured yield parameters. These findings were not surprised where in a previous study for strawberry plants under same conditions carried out by **Ibrahim *et al* (2004)** revealed that increasing KCl: NO_3 uptill 50 days 70:30 in the fertigation solutions did not substantially inhibit but relatively increased growth and fruit yield of strawberry plants. Of course, as well known, due to the high salt and chloride sensitivity of strawberry, compared to banana plants, the encountered tolerance of banana plants to increasing chloride existence seemed to be reasonable and logic. Similar patterns for the effect of KCl fertigation on yield of some crops were previously obtained by several authors; some of which are **Ibrahim, 1992** for tomato plants; **Ibrahim *et al* 1995** for strawberry plants. Such positive action encountered for chloride may be attributed to enhancement of water upward movement within plants which, of course, plays an important role in translocating the assimilated nutrients within plant tissues resulting in a good distribution of the assimilates particularly sugars and other carbohydrates to fruits to cause finally good filling of yield banana bunches.

Data in **Table (4)** show the response of N, P and K as well as Cl contents to increasing ratio of KCl: KNO_3 in fertigation solutions. In this concern, P content in banana leaves was stimulated significantly as the Cl existence in the nutrient solution increased. The ratio of 70:30 followed by 80:20 KCl:KNO_3 was the most superior one; opposite to that, high and relatively high NO_3 existence in the fertigation solution significantly diminished P content in the banana leaves. This, in fact, was not unexpected due to what is well known about the competition phenomena where phosphate ions were found repeatedly to be competed by NO_3^- and Cl^- ions, while and NO_3^- ions are the most competing **(Marschner, 1995).** Incorporating NH_4 ions in fertigation solutions containing reltively high Cl concentrations appeared some sort of synergism phenomenon in activation of P uptake. Other explanation to this pattern may be related to the positive role of Cl^- ions in enhancing the transpiration upward stream within plant xylem, **(Imas and Magen, 2004).**

Contents of N and K, however, showed patterns could be as expected dependent not only on the level of Cl^- in the nutrient solution but, to large extent, on the form of the fertigated N where NH_4 and/or urea N-forms were incorporated in the irrigation solutions to compensate KNO_3 decreasing as the Cl existence increased. In other words, at low Cl existence (high NO_3 existence), N and K contents in plant leaves were significantly high compared to treatments containing high Cl existence (low NO_3 presence meaning high NH_4 occupation). The highest existence of NO_3 and Cl was inferior to nutrient content particularly K and P in case of 100% NO_3 as well as N in case of 100%Cl. In fact, such fluctuated patterns may be related again to the physiological influences of the fed-N form. Form of NO_3 usually increases pH of rhizosphere via extrusion of OH^- ions which decline the uptake of phosphorus and potassium **(Marschner, 1995).**

Opposite to the fluctuated response of N, K and to some extent P and Cl contents in banana leaves increased gradually and significantly as Cl existence in fertigation solutions increased. Although high ratio of KCl:KNO_3 treatments resulted in relatively high contents of Cl, it seemed to be still in the normal range. It is worthy to mention that no leaf tip burns were observed on banana plants throw the whole growth season. Concerning Cl accumulation in plant root zone of banana as affected by different KCl:KNO_3 combination ratios, data in **Table (5)** showed significant Cl accumulation in the both tested layers with increasing Cl concentrations in irrigation water. This increase was more pronounced in the surface soil

Table 3. The effect of KCl:KNO_3 combination ratio on some fruit yield parameters of banana plants

KCl:KNO_3	Bunch weight		Hand No		Finger No		Finger diameter		Finger length	
	Kg/bunch	*RC%	/ bunch	*RC%	/ bunch	*RC%	/cm	*RC%	/cm	*RC%
0:100	18.3 $_B$	100	9.00 $_{CD}$	100	18.3 $_B$	100	3.32 $_{DEF}$	100	19.6 $_B$	100
10:90	18.5 $_B$	101	9.33 $_{BCD}$	104	18.3 $_B$	100	3.24 $_{EF}$	97	19.7 $_B$	101
20:80	18.8 $_B$	103	8.33 $_D$	93	19.7 $_{AB}$	107	3.39 $_{CDEF}$	102	19.8 $_B$	101
30:70	18.5 $_B$	101	9.67 $_{BC}$	107	19.2 $_{AB}$	105	3.29 $_{DEF}$	99	19.9 $_B$	102
40:60	19.0 $_B$	104	10.00 $_{ABC}$	111	17.3 $_B$	95	3.43 $_{BCDEF}$	103	20.7 $_{AB}$	106
50:50	18.5 $_B$	101	9.00 $_{CD}$	100	18.3 $_B$	100	3.10 $_F$	93	20.5 $_{AB}$	105
60:40	20.0 $_{AB}$	109	10.00 $_{ABC}$	111	17.7 $_B$	96	3.82 $_{AB}$	115	20.5 $_{AB}$	105
70:30	21.3 $_{AB}$	116	10.00 $_{ABC}$	111	17.5 $_B$	95	3.74 $_{ABC}$	112	22.5 $_{AB}$	115
80:20	24.3 $_A$	133	11.00 $_A$	122	21.2 $_A$	115	3.85 $_A$	116	23.5 $_A$	120
90:10	18.3 $_B$	100	10.33 $_{AB}$	115	19.3 $_{AB}$	105	3.57 $_{ABCDE}$	107	21.2 $_{AB}$	108
100:0	18.7 $_B$	102	9.67 $_{BC}$	107	19.5 $_{AB}$	106	3.64 $_{ABCD}$	110	21.2 $_{AB}$	109

* RC%= relative change as calculated as a percentage of that of 0:100 KCl: KNO_3 treatment.
- Values having the same letters within a column are not significantly different at 5% confidence level.

Table 4. The effect of KCl:KNO_3 combination ratio on some nutrient contents in banana leaves lamina and its relative to 0/100=100

KCl:KNO_3	N		P		K		Cl	
	%	*RC%	%	*RC%	%	*RC%	%	*RC%
0:100	3.44 BC	100	0.23 EF	100	3.29 G	100	0.86 G	100
10:90	4.11 A	119	0.23 E	103	4.01 ABC	122	1.01 F	117
20:80	3.07 DE	89	0.30 C	132	4.19 A	128	1.04 EF	121
30:70	3.70 B	107	0.30 C	133	4.16 AB	127	1.10 DE	128
40:60	4.16 A	121	0.22 F	95	3.78 DE	115	1.13 D	131
50:50	3.24 CD	94	0.20 G	88	3.98 BC	121	1.20 C	139
60:40	2.86 E	83	0.29 C	129	3.60 EF	110	1.19 C	139
70:30	3.62 B	105	0.36 A	158	3.44 FG	105	1.25 BC	144
80:20	3.08 DE	89	0.35 B	152	3.96 CD	121	1.30 B	150
90:10	3.57 BC	104	0.30 C	133	3.98 BC	121	1.44 A	167
100:0	2.51 F	73	0.25 D	110	3.72 E	113	1.44 A	167
average	3.40		0.28		3.83		1.18	

*RC%=relative content was calculated as a percentage of that of 0:100 KCl: KNO_3 treatment.

- Values having the same letters within a column are not significantly different at 5% confidence level

Table 5. The effect of $KCl:KNO_3$ combination ratio on chloride accumulation in different soil layers in meq/l

$KCl:KNO_3$	0-30 cm depth			30-60 cm depth		
	Cl^- meq/l	**RC %	accumulation %*	Cl^- meq/l	**RC %	accumulation %*
0:100	0.42 F	100	5.00	0.33 F	100	10.00
10:90	0.48 EF	114	20.00	0.36 EF	109	20.00
20:80	0.60 DE	143	50.00	0.39 EF	118	30.00
30:70	0.63 DE	150	57.50	0.42 DEF	127	40.00
40:60	0.66 D	157	65.00	0.48 CDEF	145	60.00
50:50	0.72 CD	171	80.00	0.51 BCDE	155	70.00
60:40	0.73 CD	175	82.50	0.51 BCDE	155	70.00
70:30	0.74 BCD	177	85.00	0.57 ABCD	173	90.00
80:20	0.87 ABC	207	117.50	0.64 ABC	193	113.33
90:10	0.90 AB	214	125.00	0.65 AB	198	116.67
100:0	0.93 A	221	132.50	0.68 A	205	126.67

* accumulation % = ((Cl after harvest- Cl before cultivation)/Cl before cultivation)*100.
** RC%=relative content as calculated as a percentage of that of 0:100 KCl: KNO_3 treatment.
- Values having the same letters within a column are not significantly different at 5% confidence level.

layer. Such increments in Cl accumulation particularly at the 0-30 soil layer (the most active layer for banana roots, **Robinson and Alberts, 1989)** may suggest some defects in the adopted system particularly what concerns with calculation and scheduling water requirements (irrigation and leaching). An additional work seemed to be required in this concern to prevent building up of Cl ions throughout the cultivated soil profiles.

Finally and to make the results more trust particularly for plant growers, a simple economical evaluation was carried out to fertilization costs during the 1st ratoon of banana plants as shown in the **Table (6).** Such evaluation showed that the fertilization cost of the 1st ratoon of banana plants in LE /fed during growth season decreased markedly and gradually with increasing KCl:KNO_3 ratio in the fertigation system. The maximum decrease in fertilization cost reached 56-60% of the initial fertilization cost (100%NO_3). The highest net return was recorded to the treatment of 80:20 followed by 70:30 KCl:KNO_3 ratios.

From the above mentioned results, it could be noted that banana plants responded positively to fertigation with different combinations ratios of K-KCl:K-KNO_3 from both economical and biological aspects. Therefore, it could be concluded that fertigation with low price and high water soluble KCl as a main source of potassium requirements is recommended for banana plants grown on sandy soils and irrigated with water low in salinity and chloride content without any sever effects on banana crop yield and quality.

Table 6. Fertilization cost of in LE per faddan - season as affected by different KCL/KNO_3 combination ratios and relative to 0/100=100

KCl/KNO3	Fertilization cost in LE/F-S		Product price LE/F-S	
ratios	LE/f-s	%	Yield price	*Net return
0/100	8675	100	18300	9625
10/90	8292	96	18500	10208
20/80	7909	91	18800	10891
30/70	7526	87	18500	10974
40/60	7143	82	19000	11857
50/50	6760	78	18500	11740
60/40	6376	74	20000	13624
70/30	5993	69	21300	15307
80/20	5610	65	24300	18690
90/10	5227	60	18300	13073
100/0	4844	56	18700	13856

*Net return = yield price – fertilization cost.

REFERENCES

Cottenie, A. ; M. Verloo ; L. Kieken ; G. Velghe and R. Comerlynch (1982). Chemical Analysis of Plants and Soils. Fac. Agric., State Univ., Gent, Belgium.

Deolankar, K. P. and N. N. Firake. 2001. Effect of water soluble fertilizers on growth and yield of banana. **J. Maharashtra Agric.Univ., 26:333-334**.

Freeman, K.W.; K. Girma; J. Mosali; R.K. Teal; K.L. Martin and W.R. Raun (2006). Response of winter wheat to chloride fertilization in sandy loam soils. Communic. **Soil Sci. Plant Analysis 37:1947-1955**.

Ibrahim, A. (1992). Effects of irrigation with acidified water on emitter clogging, nutrients content and fruit yield of fertigated tomato. **Egypt. J. Appl. Sci., 7: 835-844.**

Ibrahim, A.; A.H. Khater and M.H. Mahmoud (1995). Liquid compound fertilizers and fertigation of some horticultural crops. International Society for Horticultural Sciences. **Symposium on Strategies for Market Oriented Greenhouse Production, pp. 31-43.** Held in Alexandria, Egypt, March 11-15, 1995 .

Ibrahim, A.; T. Abdel-Latif; Sh. Gawish and A. Elnagar. (2004). Response of strawberry plants to fertigation with different K-KCl / K-KNO_3 combination ratios. **Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 12: 469 – 480.**

Imas, P. and H. Magen. (2004). Chloride, an essential micronutrient in crop management. **IFA International Symposium on Micronutrients, pp.1-13.** New Delhi, India.

Jackson, M.I. (1973). Soil Chemical Analysis. pp. 18-38. Prentice Hall, New Delhi, India.

Johnes, G.G. and I.A. Vimpany (1999). Effect of high rates of potassium chloride fertilizer on banana leaf conductance, plant growth, nutrient concentration and root death under contrasting watering regimes. **Austr. J. Agric. Res., 39: 211-219.**

Lopez, A. and J. Espinsa (1998). Banana Response to Potassium. **Better Crops International. 2: 1-10.**

Marschner, H. (1995). Mineral Nutrition of Higher Plants. 2^{nd} **Ed. pp. 24-37.** Academic Press Inc., London.

Robinson, J.C. and A.J. Alberts (1989). Seasonal variation in the crop water-use coefficient of banana (cultivar *Williams*) in the subtropics. **Scienta Hortic., 40: 215-225.**

Wolf, B.; J. Fleming and J. Batchelor (1985). Fluid Fertilizer Manual. pp. 43-55. National Fertilizer Solutions Association, Peoria, Il.

مجلة اتحاد الجامعات العربية
للعلـــــوم الزراعيـــــة
جامعة عين شمس ، القاهــرة
مجلد(١٥)، عدد (٢)، ٤١٧-٤٢٩، ٢٠٠٧

تقييم الكلوريد كمصدر جزئى لتسميد نباتات الموز بالبوتاسيوم خلال مياه الرى فى الأراضى الرملية

[٣٦]

عمر فكرى خطاب[١]- هاشم السيد أبوحسين[١]- أحمد عبدالفتاح أحمد[١]
١- قسم الأراضى - كلية الزراعة - جامعة عين شمس- شبرا الخيمة - القاهرة - مصر

أقيمت تجربة حقلية فى أرض رمليـــة لتوضـــيح إمكانية استخدام الكلوريد كمصدر جزئى للبوتاســيوم فى تسميد نباتات الموز من خلال مياه الرى. وقد تـــم تقييم النمو ومحصول الثمار والحالة الغذائية وكـــذلك التقييم الاقتصادى للحكم على المعـــاملات المختلفـــة. واشتملت هذه المعاملات على إحدى عشر نسبة مـــن (الكلوريد: النترات) كمصدر للبوتاسيوم مع المحافظة على تركيز جميع المغذيات الكبرى والصغرى ماعدا الكلوريد فى المحاليل التجريبية المختلفة.

وقد دلت النتائج المتحصل عليها على أن زيـــادة تركيز الكلوريد فى مياه الرى لم تؤثر سلبيا على نمو النباتات تحت ظروف هذه التجربة، وعلى العكس من ذلك فقد زاد قطر الساق الكاذبة للنباتات زيادة معنوية بزيادة نسبة كلوريد البوتاسيوم: نترات البوتاسيوم الى ٥٠:٥٠، بينما زاد عدد الأوراق زيادة معنوية بزيادة الكلوريد أكثر من ذلك خاصة فى المعاملات ٧٠:٣٠، ٨٠:٢٠.

أما بالنسبة لمحصول الثمار فقد كان وزن السباطة وعدد وطول أصابع المـــوز أقـــل حـــساسية لزيـــادة الكلوريد مقارنة بعدد الكفوف/سباطة وقطر الإصـــبع الذى أظهر زيادة معنوية بزيادة الكلوريد فى محلـــول الرى. وعموما فقد كانت المعاملة ٨٠:٢٠ (كلوريـــد البوتاسيوم:نترات البوتاسيوم) أفضل المعاملات لمعظم قياسات النمو ومحصول الثمار. أما عن الحالة الغذائية للنباتات المعاملة فلم تظهر استجابة واضـــحة لزيـــادة الكلوريد حيث كانت الاستجابة متذبذبة بـــالرغم مـــن حدوث تأثير إيجابى فـــى امتـــصاص البوتاســـيوم و الفوسفـــات والنيتروجين فـــى بعـــض المعامـــــلات ذات التركيزات العاليـــة نـــسبيـــاً مـــن الكلوريـــد . وعلى العكس من ذلك فقد كانـــت اســـتجابة تـــراكم الكلوريـــد فى كل من النبـــات ومنطقـــــة انتـــشار الجذور واضحة ومعنوية بالرغم من عـــدم ظهـــور أعراض سمية الكلوريد على النبـــات (حـــروق قمـــم الأوراق). وقد أظهـــر التقييـــــم الاقتـــصـــــادى أن المعاملـــة ٨٠:٢٠ (كلوريـــد البوتاســـيوم: نتـــرات البوتاسيوم) لها أفضل عائد إقتصادى . وقـــد أكـــدت الدراسة إمكانية الاستخدام الآمن للكلوريـــد كمـــصدر جزئى لتسميد نبات الموز بالبوتاسيوم تحت ظـــروف هذه التجربة مع الأخذ فى الاعتبار اجراء دراســـات أخرى خاصة فيما يتعلق بحساب المقننـــات المائيـــة والغسيلية لمنع تراكم الكلوريد فى القطاع الأرضـــى على المدى الطويل.

تحكيـــم: أ.د محمد أحمد مصطفى
أ.د محمد نبيل حجـــازى