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Effect of Some Anti-transpirant to Reduce Amount of Irrigation Water Added to the Banana cv."Grand Nain" in Sandy Soil

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IN a field experiment on a banana cv. "Grand Nain" plants during two consecutive seasons 2012/2013 (the first ratoon plants) & 2013/2014 (second ratoon plants) in sandy soil to study the spraying anti-transpiration response (potassium silicate- aluminium silicate - Green Miracle - Glycerol) to reduce amount of irrigation water rates 10, 20 , 30 % of recommended amount of water (10000 m^3/fed/year). Spraying on vegetative growth six times starting from the month of May to October (once a month) at a concentration of 6%. In the control treatment plants received only 10000 m^3 of water /Fed/ year and no spraying antitranspirant

Growth parameter, bunch weight and bunch characteristics of Grand Nain banana significantly varied in response to spray some anti-transpirant and reduce amount of irrigation water. The highest values for these parameters were obtained from the treatments use anti-transpirants as compared with untreated control. Potassium silicate and Aluminium silicate were the most effect treatments followed by Green Miracle while Glycerol was the least effect. Anti-transpirant decreased significantly the transpiration rate with the control (un-treated). Aluminium silicate and Glycerol treatments had the lowest values of transpiration rate comparing with the check treatment. The better values of yield/fed and water utilization efficiency were obtained from plants receiving of water 8000 m^3/fed/year treatment (reduce by 20% rate of recommended amount of water) and spray anti-transpirant as compared with plants receiving of water 10000 m^3/fed/year and control. According to the results obtained in this experiment it can be concluded that using anti-transpirant (Potassium silicate - Aluminium silicate) agent led to reduction by 20% of recommended amount of water added using anti-transpration agent improving water use efficiency by reducing leaf transpiration rate, decrease leaf water loss and increased assimilation area of Grand Nain banana plant in sandy soil.

Keywords: Banana, Anti transpirant agent, Potassium silicate, Aluminium silicate, Green Miracle, Glycerol, Assimilation area, Water utilization efficiency, Yield.

Water is the most important factor for life function of the plants, the amount of it within the plant tissues has a great effect on vegetative growth and productivity. One of the most important problems limiting the production of banana especially under the new reclaimed sandy soil is the deficiency of water. The supply of water for use in agriculture is becoming increasing limited (Salvin *et al.,* 2000 and Ibrahim *et al.,* 2012). High temperatures increase evaporation rate and consequently the amount of needed water by banana plants, especially when planted at new reclaimed area with low water supply. Under subtropical conditions like Egypt, using antitranspirants may reduce transpiration rate from the plant , consequently the amount of used water improving water use efficiency (Makus, 1997 and Singh *et al.,* 1999).

The great benefits of various antitraspirants for improving flowering, checking fruit drop as well as improving quantitive yield of different fruit trees have fascinated pomologists and promoted much of the modern researches in this direction (Glenn *et al.,* 2003, Abd El-Kader *et al.,* 2006, Wand *et al.,* 2006, Saleh, El-Ashry, 2006 and Aly-Mahmoud *et al.,* 2010). The beneficial of these antitranspirants on increasing plant water potential and stimulating cell division and growth characters could result in enhancing growth of fruits.

Many plants, particularly monocotyledonous species (*Musa* sp.), contain large amounts of Si (up to 10% of dry mass). In spite of the high Si accumulation in plants (its amount may equal concentration of macronutrients), until now it has not been considered as an essential element for higher plants. Many reports have shown that silicon may play a very important role in increasing plant resistance to noxious environmental factors. Hence, Si is recognized as a beneficial element for plants growing under biotic and abiotic stresses. The main form of Si which is available and easily taken up by plants is monosilicic acid (H_4SiO_4). These beneficial effects may result from better and more efficient osmoregulation, improved plant water status, reduction in water loss by transpiration, maintenance of adequate supply of essential nutrients, restriction in toxic ions uptake and efficient functioning of ant ioxidative mechanisms. Silicon can also modulate plants′ metabolism and alter physiological activities, particularly in plants subjected to stress conditions. Silicon sources like potassium silicate is considered as an important beneficial element as it helps in growth and development of plant.

Green Miracle is a new-generation, reflective type of anti-transpirant cum anti-stress product. It is based on long chain fatty alcohol non-edible vegetable oil. Green Miracle functions primarily on the principle of reflecting the sun's rays. Applied as a foliar spray, it forms a thin glassy film-coat, which reflects

incident light more than it would occur under normal conditions. This prevents the thermic effect of light on plant tissues. It effectively reduces the water loss from the plant surface through reflecting greater amount of incident light than it would occur under normal condition. (Nermeen and Emad, 2011) found that, glycerol treatment showed the lowest leaf weight reduction rate, as well as water loss rate, which obviously reflected on extending leaf vase life.

The purpose of this study was to investigate the effect of some under different water regime on vegetative growth, bunch characteristics, yield, water utilization efficiency and transpiration rate of Grand Nain banana plant.

Materials and Methods

This work was carried out at the sandy soil of Khatatabe region, Egypt, through the two successive seasons 2012/2013 (first ratoon plants) and 2013/2014 (second ratoon plants) of Grand Nain cultivar, Giant Cavendish AAA sub-group. Mother plant were planted at 3.0X3.5 m. apart in March 2011 and three suckers were selected per each mat (hole) and the others were removed. The experimental soil in texture and fertility characteristics of the soil in which the experiment was carried according to mechanical and chemical analysis is given in Table 1.

TABLE 1. **Soil characteristics of the banana plantation at the start of the experiment.**

Properties	Value
Clay %	8.00
Silt %	6.00
Fine sand %	30.50
Coarse sand %	55.50
Texture	Sandy
PH	8.2
EC	0.84
Ca Co_3%	0.63
Na mg/L	3.11
K mg/L	0.10
Ca mg/L	1.24
Mg mg/L	0.86
HCo_3 mg/L	3.01
Cl mg/L	1.53
So_4 mg/L	0.63

The plants were received compost at the rate of 60m^3/fed./year applied in the soil root zone during the first week of December and the recommended fertilizer NPK (800, 100, 1000 N, P_2O_5, K_2O actual g/plant) in the forms (ammonium nitrate 33.5 N%, phosphoric acid 80% and potassium sulphate 48%

(K_2O) following Ibrahim (2003)). The drip irrigation with two lines per single and promising micro-flapper emitters with discharge 4 Littre/hour. The selected plants received all agriculture practices usually used in banana plantation except irrigation rate (water regime). The present study included the following treatments from the four antitranspirants (Green Miracle, potassium silicate, Glycerol and Aluminum silicate) spray and the check treatment (foliar application) were as follows:

- Spraying with water only (check treatment).
- Spraying with 6% Aluminium silicate ($AL_2Si_2O_5$ $(OH)_4$) as a metabolic agent (Kaolin powder supplier),
- Spraying with 6% Potassium silicate (K_2 Si_{O3}) at 6 ml/litre (potassium liquid silicon) the product contained 26.6% K_2O and 10.4% Si_{O3}.
- Spraying with 6% Green Miracl.
- Spraying with 6% Glycerol.

Each treatment contained three replicates. Every treatment sprayed six time *i.e.* April, May, Jun, July, Aug. and Sep. for each season (foliar application) and reduce amount of applied water (10, 20, 30%) from optimum water quantity (10000 m^3./Fed./year) recommended by Ibrahim *et al.*, (2012) (Table 2).

TABLE 2. Scheme of irrigation water frequency.

Treatment / Months	10000 m^3/Fed/year	9000 m^3/Fed/year	8000 m^3/Fed/year	7000 m^3/Fed/year
Feb.	357.14	321.40	285.70	250.00
Mar.	642.85	578.50	514.20	450.00
Apr.	857.14	771.40	685.70	600.00
May.	928.50	835.71	742.80	650.00
Jun.	1071.40	964.20	857.10	750.00
July	1285.70	1157.10	1028.50	900.00
Aug.	1285.70	1157.10	1028.50	900.00
Sept.	1071.40	964.20	857.10	750.00
Oct.	1000.00	900.00	800.00	700.00
Nov.	714.20	642.80	571.40	500.00
Dec.	500.00	450.00	400.00	350.00
Jan.	285.70	257.14	228.57	200.00

The following parameter were used to evaluated the tested treatments (anti-transpirants and water regime treatments):

- *Vegetative growth:* morphological measurements were done at bunch shooting stage via the following parameters: pseudostem height (cm.), pseudostem circumference (cm.), leaf area and assimilation area/plant (m^2/ plant). Assimilation area was determined using the equation = leaf area X number of green leaves (Ibrahim, 1993).
- Bunch characteristics: At time of harvesting, the bunch, number of hands / bunch, number of finger / bunch, finger weight , were counted and recorded.
- Yield was calculated according to the following equations

Yield = Bunch weight (kg) X Number of plant / fed.

- Water utilization efficiency (W.U.E.) was measured. W.U.E. expressed as the amount of banana fruits in kg that could be produced from one cubic meter of water

$$\text{W.U.E.} = \frac{\text{Yield (kg/fed)}}{\text{Water regime (m}^3\text{/Fed)}} \text{ kg. fruits / one m}^3 \text{ water}$$

The method described by Ibrahim *et al.* (1988) and Ibrahim, (2003)

- Transpiration rat at shooting stage, leaf sample was taken from the middle of the third leaf from the top of each plant in different treatment were collected. The leaf petiole was immediately covered with a thin layer of Vaselene at the place of cutting rapidly weighed. On torsion balance sheltered from wind, they were then exposed in the open air under natural condition for two minutes and re-weighed. The decrease in weight corresponds to the water loss by transpiration during the period of exposure. Transpiration rate was determined as total water output / one hour in grams / square mm of leaf surface. following a method recommended by EL- Hefnawi (1986).
- *Statistical analysis:* Data were subjected to analysis of variance for factorial plot design in a randomized complete blocks (Snedecor & Cochran, 1980). The mean were compared by using the method of New least significant differences (New L.S.D. at 0.05) described by Waller & Duncan (1969).

Results and Discussion

Effect of spraying anti-transpirant agents on the vegetative growth of Grand Nain banana plants at bunch shooting stage

It is evident from the data in Table 3 that spraying the four anti-transpirants significantly vegetative growth parameters (pseudostem height, pseudostem circumference, leaf area, and assimilation area) comparing with the control (check) treatment. Application of potassium silicate, Aluminium silicate, Green Miracle, Glycerol in ascending order was significantly very effective in enhancing the vegetative growth parameter in both tested seasons. The best results with regard to pseadostem height (259.41 & 272.75 cm), pseudostem circumference (78.03 & 74.41 cm) leaf area (1.87 & 1.90 m^2/ leaf) assimilation area (23.60 & 26.03m^2/ plant) were obtained with using potassium silicate at 6% treatment. While, the lowest values to pseudostem height (240.25 & 255.25 cm) pseudostem circumference (69.74 & 70.75 cm) leaf area (1.41 & 1.58 m^2/ leaf) assimilation area (16.07 & 17.80 m^2/ plant) were recorded on untreated treatments (spraying water).

Data in Table 3 also showed that all growth parameters of Grand Nain banana were significantly by increasing the amount of applied water. The highest values of the vegetative growth parameters were obtained under the high rate water regime (10000 m^3/fed/year).

TABLE 3. Vegetative growth parameters of Grand Nain banana plants at bunch shooting stage as affected by spraying of some anti-transpirant and water regime during two studies seasons (2012/2013 & 2013/12014).

1 – Pseudostem height (cm).

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	250.00	274.00	278.33	264.00	275.00	268.26	264.00	279.00	289.00	276.00	280.00	277.60
9000 m^3/fed/year	234.00	259.00	261.66	247.00	262.00	252.73	251.00	270.00	278.00	270.00	275.00	268.80
8000 m^3/fed/year	223.00	253.00	256.66	243.33	253.33	245.86	245.00	268.00	270.00	266.00	268.00	265.40
7000 m^3/fed/year	214.00	234.00	241.00	230.00	246.66	233.13	225.00	247.00	254.00	243.00	252.00	244.20
AV.	230.25	255.00	259.41	246.08	259.24		246.25	266.00	272.75	263.75	267.50	
New L.S.D at 0.05 Water quantity	5.75						6.78					
Anti-transpirant	4.95						5.45					
Interaction	6.89						7.0					

2 - Pseudostem circumference (cm)

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	77.00	84.00	89.66	85.33	88.00	84.79	74.00	80.00	82.00	79.00	80.00	80.00
9000 m^3/fed/year	72.33	75.50	78.16	72.16	75.16	74.66	70.00	74.00	77.66	74.00	75.00	74.93
8000 m^3/fed/year	64.66	73.66	75.33	69.66	69.00	70.46	67.00	71.00	72.00	70.00	72.00	71.00
7000 m^3/fed/year	60.00	69.33	69.00	62.00	60.83	64.23	60.00	61.00	66.00	61.00	62.00	62.00
AV.	68.49	75.62	78.03	72.28	78.24		67.75	71.50	74.41	71.00	72.25	
New L.S.D at 0.05 Water quantity	3.04						3.55					
Anti-transpirant	2.87						N.S					
Interaction	3.95						4.12					

3 - Leaf area (m^2 /leaf)

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	1.56	1.95	2.11	1.81	2.02	1.89	1.65	2.05	2.12	1.89	2.12	1.96
9000 m^3/fed/year	1.35	1.75	1.89	1.53	1.73	1.65	1.59	1.88	1.97	1.81	1.94	1.84
8000 m^3/fed/year	1.24	1.61	1.79	1.46	1.64	1.55	1.40	1.77	1.84	1.67	1.81	1.72
7000 m^3/fed/year	1.09	1.18	1.28	1.34	1.52	1.36	1.20	1.56	1.66	1.43	1.56	1.48
AV.	1.31	1.62	1.87	1.53	1.73		1.48	1.81	1.90	1.70	1.86	
New L.S.D at 0.05 Water quantity	0.14						0.13					
Anti-transpirant	0.11						0.1 0					
Interaction	0.15						0.16					

4 - Assimilation area (m^2/plant)

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	19.57	28.27	29.52	25.15	28.68	26.23	21.32	27.32	29.31	26.46	29.80	26.840
9000 m^3/fed/year	17.56	23.45	26.46	21.73	23.70	22.38	19.52	25.06	28.52	25.34	25.22	25.53
8000 m^3/fed/year	14.74	21.67	21.48	19.79	20.33	17.80	16.65	21.82	25.97	22.26	21.72	21.8
7000 m^3/fed/year	12.42	14.80	16.96	15.99	16.80	13.79	12.72	18.72	20.33	17.16	18.72	18.33
AV.	16.07	22.58	23.60	20.66	22.37		17.80	23.23	26.030	22.80	24.36	
New L.S.D at 0.05 Water quantity	2.44						2.34					
Anti-transpirant	1.66						1.77					
Interaction	2.56						2.68					

Effect of interaction between spraying of some anti-transpirantion and reduce of amount water

Data in Table 3 represented that all the possible interaction were statistically significant, which indicate a high degree of interdependence between the studied factors under study. The highest values for vegetative growth parameter in both seasons resulted from 100% water regime (100000 m^3/fed/year + anti-tranpirant and 80% water regime (8000 m^3/fed/year + anti-transpiration treatment while the lowest of water regime (7000 m^3/fed/year from the water regime) + non anti-transpirant application. Show that the spraying the anti-transpirants namely potassium silicate, Aluminium silicate, Green Miracle and Glycerol at 6% and reduce of amount applied water 20% had no significant effect on vegetative growth parameter comparing with the check treatment (sprays of water + 100% of amount applied water treatment). So, we can say that used anti-transpirants agents reduce the amount of using water by 20% from water regime. These results were true during the two seasons. These results are in agreement with those obtained by Aly – Mahmoud *et al.* (2010) and Abd El-Kader *et al.*, (2006), who found that foliar sprays of anti-transpirants on Williams banana increased growth parameters. Silicon sources (K_2SiO_3 and $AL_2Si_2O_5$ $(OH)_4$ are considered as an important beneficial element helping growth and development of plants Davenport *et al.* (1974).

Effect of spraying anti-transpirantion agents on the bunch characteristics of Grand Nain banana plants

Data in Table 4 showed that in both seasons, all foliar application significantly increased the bunch characteristics (bunch weight, number of hands / bunch , number of fingers / bunch and finer weight) of treated plants, as compared to the control, the best results were obtained from potassium silicate at 6% treatment and Aluminium silicate at 6% comparing with control, the greatest number of bunch weight (25.69 & 27.07 kg/plant), number of hand / bunch (11.97 & 11.08 hand /bunch) and number of finger / bunch (183.00 & 191.50 finger/bunch) and finger weight (132.01 & 136.77 gm) as compared with untreated control (18.58 & 18.92 kg/bunch), (9.70 & 9.30 hand/bunch), (160.25 & 169.50 finger /bunch) (116.25 & 114.74 gm/finger) in both tested season respectively.

It is clear from the data in Table 4 that bunch characteristics (bunch weight, number of hands/bunch and number of fingers/bunch) were significant increased by increasing the amount of applied water.

Effect of interaction between the two main factors

The interaction between anti-transpirants and the amount of applied irrigation water added was statistically significant regarding bunch characteristic with values being incremented as water added was also increased .except for the comparison between 9000 m^3/fed/year + spraying of anti-transpirant, and 8000 m^3/fed/year + spraying of anti-transpirant and control 10000 m^3/fed/year+ un-treated)) in both seasons.

TABLE 4. Bunch characteristics of Grand Nain banana plants as affected by spraying of some anti-transpirant and water regime during two studies seasons (2012/2013 & 2013/12014).

1 - Bunch weight (kg)

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon (R1)						Second ratoon (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	21.31	28.32	31.30	26.69	29.42	27.60	23.16	30.56	32.70	29.05	31.42	29.37
9000 m^3/fed/year	20.50	25.00	27.11	23.85	25.84	24.25	20.95	26.41	28.90	25.71	27.60	25.89
8000 m^3/fed/year	17.85	22.65	24.80	21.10	22.70	21.82	17.59	23.40	25.50	23.00	24.82	22.84
7000 m^3/fed/year	14.68	17.24	19.56		18.29	17.47	13.99	19.81	21.20	19.03	21.48	19.10
AV.	18.58	23.30	25.69	22.31	24.06		18.92	25.04	27.07	24.19	26.33	
New L.S.D at 0.05 Water quantity (regime)												
Anti-transpirant	1.45						1.56					
Interaction	1.21 1.54						1.2 1.67					

2 - No. of hand /bunch

Anti-transpirant Treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	11.90	13.20	14.10	13.05	13.50	13.15	11.30	11.60	12.50	11.45	11.90	11.75
9000 m^3/fed/year	9.60	10.97	12.10	10.78	11.35	10.94	10.00	10.37	11.50	10.18	10.75	10.56
8000 m^3/fed/year	9.20	9.72	11.30	9.46	10.25	9.98	8.60	9.12	10.70	9.86	10.65	9.78
7000 m^3/fed/year	8.10	8.67	10.40	8.38	9.25	8.96	7.50	8.07	9.80	7.78	8.65	8.36
AV.	9.70	10.64	11.97	10.41	11.08		9.35	9.79	11.08	9.56	10.48	
New L.S.D at 0.05 Water quantity												
Anti-transpirant	1.33						1.27					
Interaction	NS NS						NS NS					

3 - No. of finger /bunch

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	176.00	188.00	200.00	183.00	193.00	188.00	180.00	200.00	208.00	189.00	204.00	196.20
9000 m^3/fed/year	168.00	176.00	188.00	176.00	181.00	177.80	175.00	185.00	193.00	183.00	193.00	185.80
8000 m^3/fed/year	159.00	172.00	182.00	170.00	172.00	171.00	168.00	179.00	190.00	179.00	178.00	184.20
7000 m^3/fed/year	138.00	149.00	162.00	153.00	155.00	151.40	155.00	165.00	175.00	170.00	173.00	167.60
AV.	160.25	170.25	183.00	170.25	175.25		169.50	182.25	191.50	180.25	193.75	
New L.S.D at 0.05 Water quantity	5.77						5.0					
Anti-transpirant	4.34						4.65					
Interaction	5.99						5.77					

4- Finger weight (gm)

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	125.33	142.69	149.00	137.67	144.67	139.87	127.00	145.33	150.00	142.50	146.67	142.30
9000 m^3/fed/year	115.00	130.00	136.23	127.00	134.50	128.54	118.33	134.67	146.00	132.33	135.25	133.31
8000 m^3/fed/year	109.13	125.95	131.33	116.00	128.50	122.18	113.67	128.00	133.11	123.00	131.50	125.85
7000 m^3/fed/year	95.57	105.67	111.50	105.33	108.33	105.28	99.97	111.00	118.00	110.00	115.50	110.69
AV.	116.25	126.07	132.01	121.50	129.00		114.74	129.75	136.77	139.20	132.23	
New L.S.D at 0.05 Water quantity	5.08						6.07					
Anti-transpirant	5.33						5.12					
Interaction	6.58						6.27					

Effect of some anti-transpirantion agents on yield of Grand Nain banana plant

It is clear from the data in Table 5 that spraying the four anti-transpirantion significantly improved yield comparing with check treatment. Application of potassium silicate, Aluminium silicate, Green Miracle and Glycerol in asscending order was significantly very effective in enhancing the yield. The best results with regard to yield were obtained with using silicon treatments potassium silicate (26.20 & 28.02 ton/fed), Aluminium silicate (24.72 & 27.23 ton/fed), Green Miracle (23.96 & 25.78 ton/fed), Glycerol (22.79 & 24.79 ton/fed) comparing with yield (21.65 & 21.29 ton/fed) produced by untreated plant during both seasons, respectively.

Effect of interactions between the amount of applied irrigation and spraying the anti-transpirant agent

The interaction between anti-transpirants and the amount of applied irrigation water added was statistically significant regarding yield with values being incremented as water added was also increased. except for the comparison between 9000 m^3 /fed/year (reduce by 10%) + spraying of anti-transpirant , 8000 m^3 /fed/year (reduce by 20%) + spraying of anti-transpirant and control (10000 m^3/fed/year + un-treated) were statistically insignificant in both tested seasons. These results are in harmony with those obtained by Glenn *et al.* (2003), Aly-Mahmoud *et al.* (,2010) and Nesreen *et al.* (2011).

Effect of spraying the anti-transpirants on water utilization efficiency (kg. fruits / one m3 water) of Grand Nain banana plant

That WUE showed a variable response in respect to the different treatments *i.e.* anti-transpirant and amount of applied water (irrigation). Anyhow, using anti-transpirant improved water use efficiency. All foliar application, anti-transpirant treatments (potassium silicate, Green Miracle, Aluminium silicate, Glycerol) in descending order was significantl in enhancing water use efficiency in the first season and Aluminium silicate, potassium silicate, Green Miracle, Glycerol in the second season,comparing with WUE produced by untreated plants during both seasons.

Effect of interactions between the two main factors concerning WUE

The highest values for WUE in both tested seasons were recorded in the treatment 8000 m^3/fed/year + spraying of potassium silicate. The same trend was found by Liang *et al.* (2002) who reported that water consumption was less for the anti-transpiration treated plants.amd also by Bora & Malhur (1998) and

Yancey (2005) that reported that anti-transpirant agent improved water use efficiency, by reducing leaf transpiration rate and decrease leaf water loss.

Effect of spraying the anti-transpirants on transpiration rate of Grand Nain banana plants:

As shown in Table 7, rate of transpiration as effected by anti-transpiration agents. Data in both seasons, indicate that the application of anti-transpirant decreased significantly the transpiration rate comparing with the control. Aluminium silicate and Glycerol treatments have the lowest value of transpiration rate the two experimental seasons. Data in Table (7 show that rate of transpiration tended to increase as the water regime was increased. In other words, positive correlation was found between transpiration rate and water quantity.

Effect of interactions between the two main factors

The interaction between transpiration rate and spraying anti-transpirant and amount of water applied was significant (Table 7). These results are in agreement with those reported by El-Hefnawi (1986), Nomir (1994 the transpiration rate increases to lessen the reduction of photosynthesis by water stress from the data obtained in this experiment it could be concluded that anti-transpirant agents like (potassium silicate, aluminium silicate, Green Miracle, Glycerol can be used as a tool for reducing plant water loss, which could be resulted from reducing the transpiration rate improved the water use efficiency and reducing the amount of applied water irrigation by 20%.

TABLE 5. Yield (Ton/ Fed) of Grand Nain banana plants as affected by spraying of some anti-transpirant and water regime during two studies seasons (2012/2013 & 2013/12014).

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	22.00	28.15	31.00	26.35	29.36	27.37	23.50	30.61	32.97	28.85	31.56	29.90
9000 m^3/fed/year	20.75	25.81	27.82	24.23	26.42	24.80	22.34	27.05	29.63	26.28	28.36	27.13
8000 m^3/fed/year	19.73	23.91	25.50	22.21	24.00	23.07	21.64	24.70	27.00	24.00	26.40	24.74
7000 m^3/fed/year	16.14	17.99	20.51	18.37	19.11	18.42	17.68	20.79	22.50	20.03	22.62	20.59
AV.	21.65	23.96	26.20	22.79	24.72		21.29	25.78	28.02	24.79	27.23	
New L.S.D at 0.05 Water quantity	2.44						2.57					
Anti-transpirant	1.68						1.87					
Interaction	2.57						2.64					

TABLE 6. Water utilization efficiency (kg. fruits / one m3 water) of Grand Nain banana plants as affected by spraying of some anti-transpirant and water regime during two studies seasons (2012/2013 & 2013/12014).

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	2.20	2.81	3.10	2.63	2.93	2.73	2.30	3.06	3.29	2.88	3.15	2.95
9000 m^3/fed/year	2.30	2.86	3.09	2.69	2.93	2.78	2.40	3.00	3.22	2.92	3.15	2.93
8000 m^3/fed/year	2.46	2.98	3.18	2.77	3.00	2.88	2.70	3.08	3.30	3.00	3.30	3.07
7000 m^3/fed/year	2.30	2.57	2.93	2.62	2.73	2.63	2.52	2.97	3.20	2.86	3.20	2.95
AV.	2.31	2.84	3.11	2.71	2.78		2.48	3.02	3.25	2.91	3.28	
New L.S.D at 0.05 Water quantity	0.21						0.24					
Anti-transpirant	0.14						0.16					
Interaction	0.31						0.37					

TABLE 7. Transpiration rate in leaves (mg H2O / gm-F.w/h) of Grand Nain banana plants as affected by spraying of some anti-transpirant and water regime during two studies seasons (2012/2013&2013/12014).

Anti-transpirant treatment / Water quantity m^3/fed/year	First ratoon plant (R1)						Second ratoon plant (R2)					
	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.	Un-treated	Green Miracle 6%	Potassium silicate 6%	Glycerol 6%	Aluminium silicate (Kaolin) 6%	AV.
10000 m^3/fed/year	9.86	5.22	3.30	5.14	2.44	5.19	8.74	6.24	3.94	5.14	2.59	5.33
9000 m^3/fed/year	5.01	4.35	3.82	4.17	3.53	4.37	4.23	3.84	2.82	3.25	1.94	3.21
8000 m^3/fed/year	3.25	2.28	2.36	1.63	1.61	1.82	2.94	3.29	2.45	1.82	1.73	2.44
7000 m^3/fed/year	2.79	1.54	1.39	1.01	0.42	1.43	1.67	1.24	1.39	1.23	1.00	1.30
AV.	5.22	3.34	2.71	2.98	2.00		4.39	3.65	2.65	2.86	1.81	
New L.S.D at 0.05 Water quantity												
Anti-transpirant	1.44						0.88					
Interaction	1.23 1.54						0.75 0.99					

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تأثير الرش ببعض مضادات النتح لخفض كمية مياه الرى المضافة للموز صنف " جراندنان " فى الأراضى الرملية

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فى تجربة حقلية على نباتات الموز صنف " جراندنان " خلال موسمين متتاليين ٢٠١٣/٢٠١٢ (نباتات الخلفة الاولى) و ٢٠١٤/٢٠١٣ (نباتات الخلفة الثانية) فى الأراضى الرملية لدراسة استجابة الرش بمضادات النتح (سليكات البوتاسيوم – سليكات الألومنيوم – جرين مريكل - جليسرول) لخفض كمية مياه الرى بمعدل ١٠ ، ٢٠ ، ٣٠ ٪ من كمية المياه الموصى بها (١٠٠٠٠م^{٣}/فدان/سنة) تم الرش بمضادات النتح على النمو الخضرى ستة مرات ابتداء من شهر مايو الى اكتوبر (مرة كل شهر) بتركيز ٦٪ و معاملة الكنترول بدون رش بمضادات النتح وتم ريها بمعدل ١٠٠٠٠م / فدان / سنة (الكنترول).

تأثرت الصفات الخضرية ووزن السوباطة وصفات السوباطات معنويا للموز الجراندنان تبعا لأستجابتها للرش بمضادات النتح و خفض كمية مياه الرى المضافة. تحصل على أعلى القيم من النباتات المعاملة بمضادات النتح بالمقارنة بالنباتات الغير معاملة (الكنترول) فى هذا المجال معاملة سيلكات البوتاسيوم وسيلكات الألومنيوم الأكثر تأثيرا يليه جرين مريكل و كان الجليسرول الأقل تأثيراً ، كذلك فان مضادات النتح قللت معنويا معدل النتح عن الكنترول (الغير معاملة) و كانت معاملات سيلكات الألومنيوم والجليسرول أقل القيم فى معدل النتح بالمقارنة بالكنترول . وتحصل على أفضل القيم للمحصول و كفاءة ماء الرى من النباتات التى رويت بمعدل ٨٠٠٠ م^{٣} / فدان/سنة (خفض كمية مياه الرى بمعدل ٢٠٪ عن الكمية الموصى بها) و المرشوشة بمضادات النتح بالمقارنة بالنباتات الغير معاملة بمضادات النتح و التى تم ريها بمعدل ١٠٠٠٠ م^{٣} / فدان / سنة (الكنترول).

عموما من النتائج المتحصل عليها يمكن التوصية باستخدام مضادات النتح (سليكات البوتاسيوم – سليكات الألومنيوم) التى تؤدى إلى خفض كمية المياه بنسبة ٢٠ ٪ من كمية مياة الرى الموصى بها. و استخدام مضادات النتح يحسن من كفاءة استخدام المياه عن طريق خفض معدل نتح الورقة و يقلل من فقد الماء من الاوراق وزيادة المساحة الفعالة الورقية لنبات الموز الجراند نان فى الارض الرملية.