Effect of Gibberellin and Urea Foliar Spray on Blooming, Fruiting and Fruit Quality of Mango Trees cv. Fagri Kalan.

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Abstract: *This study was conducted during two consecutive seasons of 2013 and 2014 on nine years old Fagri Kalan mango trees grown at private orchard at El Tall El Kbeer region, Ismailia Governorate Egypt. This work aimed to study the effect of foliar sprays with urea at 2, 2.5 and 3 %, GA3 at 50, 75 and 100 ppm and application dates i.e. October 25th and November 15th on blooming, fruiting and fruit quality. Results showed that urea treatment surpassed GA3 in delaying blooming date especially 3% urea treatment. Moreover, application date effects indicated that foliar sprays of the tested urea and GA3 related blooming date effect enhanced the studied delaying blooming. Consequently, it is preferable to spray Fagri Kalan mango trees with urea at 3% at November 15th to enhance fruiting and fruit quality.*
Keyword*: Mango; Fagri Kalan cv.; urea; GA3; blooming; application dates; yield; fruit quality.*

I. Introduction

Mango (*Mangifera indica* L.) belongs to Anacardiaceae family is known as the king of fruits in many countries (Purseglove, 1972). Mango is successful commercial fruit in tropical and subtropical regions (Millington 1984). Flowering period of mango tree is related to weather patterns and environmental conditions (Whiley, 1985 and Chacko 1991). Litz (1997) found that warm periods in winter may enhance early flowering that damaged by subsequent cold temperature. Moreover, early flowering, which happened in winter before the natural flowering in spring time, when the temperature is low causes many problems such as reduction of hermaphrodite flowers (Sukhvibul et al., 1999), pollen viability, germination and pollen tube growth (Shu et al., 1989 and Issarakraisila et al., 1992) increased embryos abortion (Lakshminarayana and Aguilar, 1975). Such adversable affects lead to poor fruit (Singh et al 2005).In addition, blooming delay is necessary to enhance mango trees to flowering in the optimum which reflected in better fruit set, fruit drop reduction and higher yield

The inhibition of flowering by gibbrellin is normally associated with stimulation of vegetative growth, GA3 promoted delay of flowers emergence until March (Kachur et al., 1972). Moreover, Shawky et al., (1978) found that GA3 at 50 ppm delayed time of flower bud opening. Also GA3 can be delay the early flowering (Singh, 1991). Sedgley, (1990) and Nuñez-Elisea, (1994) stated that GA3 inhibited flowering. Muhammad Azam et al. (2007) observed that high doses of GA3 300 ppm delayed panicle emergence. Vázquez-Valdivia et al., 2009 stated that the feasibility to delay 'Ataulfo' mango flowers with GA3 applications. GA3 plays an important role in delaying mango flowering 2, 17, 19 days depending on GA3 concentration and application time (Singh, 2009). GA3 delayed panicle emergence and full bloom (Samra et al., 2010), Zaeneldeen (2014) showed that spray GA3delay flowering of "Succary Abiad" mango.

Moreover, GA3 application date can delay the early flowering by autumn GA3 sprays (Singh, 1991). GA3 application during winter caused a four week delay in mango flowering (Sedgley, 1990 and Nuñez-Elisea., 1994). Sánchez-Sánchez et al. 2004 indicated that spraying mango trees "Keitt" by gibberellic acid in September-November-January and July- September-November-January inhibited floral budding of trees.

Many investigations used GA3 to increase fruit set percentage, induced higher fruit retention, improved yield, enhanced number of fruits per tree, exerted effect on fruit quality and enhanced fruit chemical properties (Muarya and Singh, 1981; Rajput and Singh, 1983; Moti-Singh et al., 1987; Rajput and Singh., 1989; Sharma et al., 1990; Singh et al., 1991; Anila and Radha, 2003; Singh et al., 2005; Singh 2009; Samra et al., 2010; Nkansah et al., 2012 Zaeneldeen, 2014 and El Gammal et al., 2015).

Furthermore, early flowering can be corrected by urea sprays (Shawky et al., 1978). Urea delayed panicle emergence and full bloom (Samra et al., 2010), Zaeneldeen (2014) showed that urea spray led to delay tree flowering. Spraying urea before flower bud differentiation in Mid November delayed flowering time of mango trees (Shawky et al., 1978)

In addition, urea sprays was reported to be an effective tool for increasing fruit set, fruit retention, produced higher number of fruit per tree, improve increase tree yield and improved fruit quality by (Rajput and Tiwari 1975; Rajput and Singh, 1989; Singh et al., 1991; Yeshitela et al., 2005; Samra et al., 2010; Wahdan et al., 2011; Sarker and Rahim, 2013 and Zaeneldeen 2014).

Therefore, the purpose of this work is to evaluate the effect of GA3, urea foliar spray and application dates i.e in winter prior to flowers opening in spring and the reflection on fruiting and fruit quality of Fagri Kalan cv. mango trees

II. Material and Methods

This experiment was conducted throughout two successive seasons of 2013 and 2014 on mango trees cv. "Fagri Kalan" grafted onto seedling rootsock. The trees were planted in a private orchard at El Tall El Kbeer region, Ismailia Governorate. The trees were nine years old at the initiation of experiment, planted at spacing 5X5 m in sandy soil, similar in vigor, size and watered with drip irrigation system. Fertilization program and other horticulture practices were the same for all trees. Physical and chemical properties of the experimental soil are shown in Table, 1

Table, 1. Physical and chemical analysis of the Experimental soil.

Soil Depth (cm)	Texture Class	Organic matter (%)	$CaCO_3$	PH Soil past	E.C. (dSm^{-1})	Soluble cations (mequiv./l)				soluble anions (mequiv./l)			
						Ca^{2+}	K^+	Na^+	Mg^{2+}	Cl^-	SO_4^{2-}	HCO_3^-	CO_3^{2-}
0-30	Sand	0.21	5.95	7.6	0.71	3.12	0.09	2.62	1.12	4.08	1.53	1.34	--
30-60	Sand	0.20	3.89	7.7	0.79	3.07	0.20	3.31	1.32	3.76	3.32	0.82	--

This study was designed as a factorial experiment with two factors arranged in a randomized complete block design with three replicates for each treatment and each replicate was represented by two trees. The first factor consisted of seven spray treatments i.e. Control "tap water", GA at 50, 75 and 100 ppm and urea at 2%, 2.5%, and 3%. The second one involved two application dates of the tested treatments, the first date was done at October, 25th and the second date was done at November 15th, meanwhile, the control trees were sprayed with tap water at the two previously mentioned dates. Tween-20 was added at 0.1% as a surfactant to spray solution including the control "tap water". Spraying was carried out using compression sprayers (5L solution/tree) at the previously mentioned dates.

The following parameters were measured for both seasons.

2.1. Flowering
2.1.1. Period (days) from spray to flowering.

This was recorded when 5-10% of the terminal buds reached the burst stage. Average periods (in days) from spraying date till the beginning flowering stage were calculated and number of flowering (days) delay relative to control was counted according to (Shawky et al., 1978)

2.2. Tree fruiting parameters
2.2.1. Fruit set and fruit retention.

Number of fruitlets per panicle was counted after 15 days of full bloom to determine the initial number of set fruitlets per panicle. The initial fruit set was calculated as a percentage. After recording the initial fruit set, number of fruits per panicle was recorded at mature stage (a week before harvest). The percentage of retained fruits at harvest time was calculated.

2.2.2. Number of fruits/tree and Yield kg/tree

In each season, at harvest time (October, 3rd), number of fruits per each treated tree was counted and reported then yield (kg/tree) was weighed and recorded.

2.3. Fruit quality parameters

Five ripen fruits were taken at harvest from each treated tree for determination of the following physical and chemical properties i.e. fruit weight (g), fruit length (cm), fruit width (cm) and seed weight (g). Total soluble solids (T.S.S.) determined by Hand refractometer. Percentage of total acidity as g citric acid /100 g F.Wt., total sugars %, and ascorbic acid (mg ascorbic acid/100 ml juice) according to A.O.A.C. (1995).

Statistical analysis

The obtained data in 2013 and 2014 seasons were subjected to analysis of variance according to Clarke and Kempson (1997). Means were differentiated using Range test at the 0.05 level (Duncan, 1955)

□ □ □ Results and Discussion

3.1. Flowering
3.3.1. Flower bud opening date.

Table, 2 showed that all the treatments at all concentrations affected on the date of the beginning of flowering.

Furthermore, urea at 3% recorded the date of flower bud opening on 9 Mar. in the first season at two application date (Oct., 25th and Nov., 15th) and recorded date of flower bud opening on (Feb 26th., and Mar., 6th) in second season at both application (Oct., 25th and Nov., 15th), compared with control (Feb., 19th and Feb., 18th) and (Feb., 15th and Feb., 17th) in both seasons, respectively.

Table, 2. Effect of urea, GA₃ and application date on date of flower bud opening of Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	date of flower bud opening			
	Application date			
	Oct., 25th	Nov.,15th	Oct., 25th	Nov.,15th
	2013		2014	
Control "tap water"	19 - Feb.	18- Feb.	15- Feb.	17- Feb.
GA at 50 ppm	27 - Feb.	27- Feb.	23- Feb.	27- Feb.
GA at 75 ppm	01 - Mar.	05- Mar.	24- Feb.	28- Feb.
GA at 100 ppm	03- Mar.	06- Mar.	23- Feb.	27- Feb.
Urea at 2%	06- Mar.	06- Mar.	24- Feb.	28- Feb.
Urea at 2.5%	07- Mar.	06- Mar.	24- Feb.	04- Mar.
Urea at 3%	09- Mar.	09- Mar.	26- Feb.	06- Mar.

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.3.2. Periods (days) from spraying till blooming

To establish clear and better comparison between the tested treatments, it is preferable to add 21 days for Nov., 15th application date to be equal with Oct., 25th application date. Consequently, Table, 3 demonstrates that GA3 and urea treatments delaying flowering date and longer period to begin blooming as compared with the control in both seasons. In this respect urea sprays caused flowering (134.0 and 128.5 days) in the first and second seasons, respectively.

Furthermore, application date produced insignificant effect on number of days from treatment spray to reach blooming in both seasons of study.

In addition the interaction data reveal that urea spray at 3% whether applied on Oct., 25th or Nov.0 15th induced blooming later than all tested interactions including the control. Moreover, GA3 at 50 ppm treatment applied on Oct., 25th or Nov., 15th particularly in the first season induced the least positive effect on delaying blooming. Other tested combinations gave more or less an intermediate values in this respect.

Table, 3. Effect of urea, GA₃ and application date on number of days from application date to begging flower of Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	Number of days from application date to begging flower							
	Application date							
	Oct., 25th	Nov.,15th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Nov.,15th	Mean
	2013				2014			
Control "tap water"	117 f	*116 f	95	**116.5 E**	114 g	*115 d	94	**114.5 D**
GA at 50 ppm	125 e	*125 e	104	**125.0 D**	122 b	*125 bc	104	**123.5 C**
GA at 75 ppm	126 de	*130 bc	10 9	**128.0C**	123 b	*126 b	105	**124.5 C**
GA at 100 ppm	128 cd	*131 bc	110	**129.5 B**	122 b	*125 bc	104	**123.5 C**
Urea at 2%	131 bc	*130 bc	109	**130.5 B**	123 b	*126 b	105	**124.5 C**
Urea at 2.5%	132 ab	*131 bc	110	**131.0 B**	123 b	*130 a	109	**126.5 B**
Urea at 3%	134 a	*134 a	113	**134.0 A**	125 a	*132 a	111	**128.5 A**
Mean	127.7 A	*128.1A	107.1		121.7 A	*125.5 A	104.4	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.
*The tested treatments are added 21 days for Nov., 15th application date to be equal with Oct., 25th.

3.3.3. Number of delayed days of blooming

Table, 4 shows that all tested GA3 and urea treatments retarded blooming date as compared with the control (the basic comparison) in both seasons. Briefly, urea spray at 3% treatment delayed blooming 17.5 and 14.0 days as compared with the control. Generally, urea treatments surpassed GA3 treatments in retarding blooming date.

On the other hand, Nov., 15th application date retarded blooming date than Oct., 25th in both seasons of study.

As for the interaction effect, Table 4 reveals that urea sprays at 3% applied on Nov., 15th followed by Oct., 25th application date and urea sprays at 2.5% applied in both tested application dates showed superiority in retarding blooming date. Other tested combinations scored in between values in this respect.

The effect of urea treatment may be due to the role of urea through depended in plant C: N ratio is associated with balance between reproductive and vegetative growth. Balance in vegetative and reproductive growth could be achieved by maintaining optimum nitrogen status in mango plants. Application of nitrogen in excess or at wrong time may develop undesirable vegetative growth while application at proper times may reduce irregular bearing in mango.

Gibberellin seems able to reduce number of potential floral buds, inhibiting the transition of meristematic apices from the vegetative to floral stage, when applied before floral differentiation (Oliveira and Browning, 1993 and Gonzales-Rossia et al., 2006).

GA3 has the potential control on growth and flowering process by the hydrolysis of starch and sucrose into fructose and glucose (Khan and Chaudhry, 2006), increasing the synthesis of IAA in plant tissues and involves synthesis acceleration of hydrolytic enzymes in aleurone cells (Addicott and Addicott (1982).

The results of affected GA3 on delayed flowering are emphasized by the finding of Samra et al., 2010; Singh, 1991; Sedgley, 1990; Nuñez-Elisea, 1994 and Zaeneldeen 2014.

Table, 4. Effect of urea, GA₃ and application date on number days delay of the begin flowering of Fagri Kalan mango trees (2013 and 2014 seasons).

Treatments	Number of delaying days of begging flower					
	Application date					
	Oct., 25ᵗʰ	Nov.,15ᵗʰ	Mean	Oct., 25ᵗʰ	Nov.,15ᵗʰ	Mean
	2013			2014		
Control "tap water"	0 h	0 h	**0 G**	0.0 fe	0.0 fe	**0.0 D**
GA at 50 ppm	8 q	9 f	**8.50 F**	8 e	10 cd	**9.0 C**
GA at 75 ppm	9 f	14 d	**11.5 E**	9 cd	11 c	**10.0 C**
GA at 100 ppm	11 e	15 c	**13.0 D**	8 e	10 cd	**9.0 C**
Urea at 2%	14 d	14 d	**14.0 C**	9 df	11c	**10.0 C**
Urea at 2.5%	15 c	15 c	**15.0 B**	9 de	15 b	**12.0 B**
Urea at 3%	17 b	18 a	**17.50 A**	11 c	17 a	**14.0 A**
Mean	10.57 B	12.14 A		7.71 B	10.61 A	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

The obtained results regarding the effect urea on delayed flowering go in line with those mentioned by Shawky et al., 1978; Samra et al., 2010 and Zaeneldeen 2014.

The obtained results of date application regarding their positive effect delayed floweing are in agreement with the findings of Shawky et al., 1978; Abou Rawash et al., 1983 and Sánchez-Sánchez et al. 2004.

3.2. Tree fruiting
3.2.1. Fruit set (%)

Table, 5 illustrates that all tested treatments enhanced fruit set percentage as compared with control treatment in both seasons. Briefly, Urea at 3% ppm treatment scored 20.75 and 20.90% as compared with 13.60 and 14.20 for control treatment in the 2013 and 2014 seasons, respectively.

Moreover, application date results showed that Nov., 15ᵗʰ application date enhanced fruit set percentage and scored 18.55 and 18.18% against 17.21 and 17.81% kg/tree for control treatment in the October15ᵗʰ application date in the first and the second seasons, respectively.

On the other hand, the interaction between the two tested factors indicated that combination of Urea at 3% treatment applied in the Nov., 15ᵗʰ induced higher positive effect on fruit set percentage and scored 21.00 and 21.00 % as compared with 13.20 and 14.00 % for control treatment in the 2013 and 2014 seasons, respectively. Other combinations gave an intermediate values in this concern.

Table. 5. Effect of urea, GA3 and application date on fruit set percentage of Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	Fruit set (%)					
	Application date					
	Oct., 25ᵗʰ	Nov.,15ᵗʰ	Mean	Oct., 25ᵗʰ	Nov.,15ᵗʰ	Mean
	2013			2014		
Control "tap water"	13.20 k	14.00 j	**13.60 E**	14.00 l	14.40 k	**14.20 F**
GA at 50 ppm	15.00 i	17.60 f	**16.30 D**	16.00 j	17.20 h	**16.60 E**
GA at 75 ppm	17.00 g	19.50 d	**18.25 C**	17.80 g	19.00 e	**18.40 D**
GA at 100 ppm	19.00 e	20.80 ab	**19.90 B**	19.40 d	18.40 f	**18.90 C**
Urea at 2%	16.00 h	17.00 g	**16.50 D**	16.70 i	16.76 i	**16.73 E**
Urea at 2.5%	19.80 cd	20.00 c	**19.90 B**	20.00 c	20.50 b	**20.25 B**
Ureaat 3%	20.50 b	21.00 a	**20.75 A**	20.80 ab	21.00 a	**20.90 A**
Mean	17.21 B	18.55 A		17.81 B	18.18 A	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.2.2. Fruit retention (%)

Table, 6 reveals that all tested treatments exerted higher enhancing effect on fruit retention percentage as compared with the control treatment in both seasons. Generally, urea 3% and Urea 2.5% treatments in the first season and urea 3% treatment in the second seasons proved to be the superior treatments in this respect.

Furthermore, application date had no effect on retained fruit percentage in first season. Application date on second time Nov., 15ᵗʰ exerted pronounced positive effect on fruit retention than Oct., 25ᵗʰ application date the second season.

On the other hand, the interaction between the two tested factors indicated that combinations of 3% treatment applied in Mid-November higher induced positive effect on fruit retained percentage as compared with the control. Other combinations gave an intermediate values in this respect.

Table, 6. Effect of urea, GA3 and application date on fruit retention percentage of Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	Fruit retention (%)					
	Application date					
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	0.90 f	0.92 f	**0.91 D**	0.87 k	0.86 k	**0.86 F**
GA at 50 ppm	1.02 e	1.04 de	**1.03 C**	0.95 j	0.98 i	**0.95 E**
GA at 75 ppm	1.05 de	1.05 de	**1.05 C**	1.02 h	1.08 g	**1.05 D**
GA at 100 ppm	1.10 bcde	1.12abcd	**1.11 B**	1.10 f	1.14 de	**1.20 C**
Urea at 2%	1.08 cde	1.09bcde	**1.08 BC**	1.00 f	1.13 e	**1.11 C**
Urea at 2.5%	1.16 abc	1.17 ab	**1.16 A**	1.15 cd	1.16 c	**1.15 B**
Ureaat 3%	1.19 a	1.20 a	**1.19 A**	1.18 b	1.20 a	**1.90 A**
Mean	**1.07 A**	**1.08 A**		**1.03 B**	**1.07 A**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.2.3. Number of fruits/tree

Table, 7 shows that all tested treatments increased number of fruits per tree as compared with the control treatment in both seasons. Generally, urea at 3% gave higher positive effect on number of fruits per tree and proved to be the superior treatment in this concern.

Moreover, application date results showed that Nov., 15th application effect surpassed tested in inducing higher values in this respect in both seasons.

In addition, the interaction between the two tested factors showed that combination of 3% treatment applied in the Nov., 15th scored 44.26 and 39.68 fruits/tree against 30.54 and 23.58 fruits/tree for control treatment in the first and the second seasons respectively. Other combinations gave an intermediate values in this concern.

Table,7. Effect of urea, GA$_3$ and application date on numbers of fruit Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	Numbers of fruit tree					
	Application date					
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	30.54 l	31.18 i	**30.86 F**	23.58 n	24.56 m	**24.07 G**
GA at 50 ppm	35.36 k	36.99 j	**36.17 E**	29.33 l	29.48 k	**29.40 F**
GA at 75 ppm	39.44 i	40.27f	**39.85 D**	30.20 j	30.76 i	**30.48 E**
GA at 100 ppm	40.87 e	42.30 c	**41.58 B**	36.41 d	37.99 b	**37.20 B**
Urea at 2%	39.63 h	39.77 b	**39.70 D**	31.33 h	31.75 g	**31.54 D**
Urea at 2.5%	39.95 g	41.65 d	**40.80 C**	32.92 f	35.62 e	**34.27 C**
Ureaat 3%	43.13 b	44.26 a	**43.59 A**	36.52 b	39.68 a	**38.10 A**
Mean	**38.41 B**	**39.48 A**		**3.47 B**	**32.83 A**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.2.4. Yield (kg/tree)

Table, 8 illustrates that all tested treatments induced high positive effect on yield as compared with the control treatment in both seasons. Generally, urea at 3% proved to be the superior treatment and recorded 17.87 and 16.75 kg as compared with 11.46 and 9.63 kg in the first and second seasons, respectively.

Moreover, application date results showed Nov., 15th application exerted higher pronounced positive on yield (kg/tree) than Oct., 25th application date in both seasons.

Furthermore, the interaction between the two tested factors showed that combinations of Urea 3% treatment applied in Nov., 15th induced high positive effect on yield (kg/tree) as compared with the control treatment in this respect. Other combinations exerted an intermediate values in this sphere.

The enhanced effect of GA3 treatment on fruit set, fruit retention, number of fruits per tree and yield (kg/tree) may be due to the role of GA3 through multiplying and lengthily the meristem cells (Sarkar and Ghosh, 2005).

The obtained results regarding the effect of GA3 of affected many investigations can be used on increased fruit set percentage are reported earlier by (Rajput and Singh (1983); Rajput and Singh (1989); Singh (2009) and Zaeneldeen 2014), fruit retention (Rajput and Singh, 1989, Singh et al., 1991, Zaeneldeen 2014), number of fruits per tree (Sharma et al., 1990, Zaeneldeen 2014), yield (Singh et al., 1991, Rajput and Singh, 1989 Samra et al., 2010 Zaeneldeen 2014).

The obtained results of urea regarding their positive effect on fruit set are in harmony with the findings of Rajput and Singh (1983); Rajput and Singh (1989); Singh (2009) and Zaeneldeen 2014) and obtained results of fruit retention are agreement with these of Rajput and Singh (1989); Singh et al., (1991) and Zaeneldeen (2014). Similar results of these were obtained on number fruit/tree were reported by (Sharma et al., 1990, Zaeneldeen 2014), number of fruits per tree and these results are agreement (Singh et al., 1991, Rajput and Singh, 1989 Samra et al., 2010 and Zaeneldeen 2014) improving yield.

Table, 8. Effect of urea, GA$_3$ and application date on yield (kg/tree) of Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	Yield (kg/tree)					
	Application date					
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	11.43 j	11.50 j	11.46 F	9.47 l	9.80 k	**9.63 G**
GA at 50 ppm	13.50 i	14.03 h	13.76 E	11.80 j	12.00 j	**11.90 F**
GA at 75 ppm	15.13g	15.70 f	15.41 D	12.40 i	12.80 h	**12.60 E**
GA at 100 ppm	16.16 d	16.90 c	16.53 B	13.30 g	13.40 g	**13.35 D**
Urea at 2%	15.93e	16.00 e	15.96 C	14.00 f	15.00 e	**14.50 C**
Urea at 2.5%	16.20 d	17.03 c	16.61 B	15.70 d	16.30 b	**16.00 B**
Ureaat 3%	17.50 b	18.23 a	17.87 A	16.00 c	17.50 a	**16.75 A**
Mean	15.12 B	15.62 A		13.23 B	13.82 A	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

The obtained results of GA3 regarding acid positive effect on fruit set came in line with the finding of Rajput and Tiwari 1975 and Rajput and Singh, 1989), enhancing effect on retained fruit percentage (Rajput and Singh, 1989; Singh et al., 1991 and Wahdan et al., 2011), positive effect on number of fruit per tree (Sarker and Rahim, 2013, Samra et al., 2010) and improving tree yield (Yeshitela et al., 2005 Samra et al., 2010, Sarker and Rahim, 2013 and Zaeneldeen 2014).

3.3. Fruit quality
3.3.1. Fruit weight (g)
Table, 9 indicates that all tested treatments increased fruit weight as compared with control treatment in both seasons. Generally, Urea 3% treatment produced the heaviest fruits (430.15 and 439.50 g) against (382.53 and 398.90 g) for control in the 2013 and 2014 seasons respectively.

Furthermore, application date results showed that the Mid-November application surpassed the other one in improving fruit weight in both seasons.

Moreover, the interaction between the two tested factors indicated that combination of Urea at 3% treatment applied in the Nov., 15th record the higher values of fruit weight (431.20 and 441.0 g) against (380.20 and 398.60 g) for control treatment applied in the first application date in 2013 and 2014 seasons respectively. Other tested combinations gave an intermediate values in this sphere.

Table, 9. Effect of urea, GA$_3$ and application date on fruit weight (g) percentage of Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	Fruit weight (g)					
	Application date					
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	380.20 m	384.87 l	**382.53 G**	398.60 k	399.20 k	**398.90 G**
GA at 50 ppm	388.40 k	391.70 j	**390.05 F**	402.20 j	407.00 j	**404.60 F**
GA at 75 ppm	392.80 j	399.80 i	**396.30 E**	410.50 h	416.00 g	**413.25 E**
GA at 100 ppm	412.20 f	413.70 e	**412.95 C**	421.00 f	425.25 e	**423.12 C**
Urea at 2%	406.30 h	409.50 g	**407.90 D**	421.20 f	4.22.00 f	**421.60 D**
Urea at 2.5%	421.10d	425.50c	**423.30 B**	429.00 d	431.20 c	**430.10 B**
Ureaat 3%	429.10 b	431.20 a	**430.15 A**	438.00b	441.00 a	**439.50 A**
Mean	404.96 B	407.37 A		414.21 B	420.09 A	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.3.2. Fruit length (cm)
Table, 10 illustrates that all tested treatments induced high positive effect on fruit length as compared with the control treatment in both seasons. Generally, 3% urea treatment high positive effect on fruit length than other tested treatments in this concern.

Moreover, application date effects showed that Nov., 15th application date exerted pronounced positive effect on fruit length than Oct., 25th in 2013 and 2014 seasons.

Furthermore, the interaction between the two tested factors showed that combinations of 3% urea treatment applied in Nov., 15th in 2013 and 2014 seasons gave higher positive values of fruit length as compared with the control treatment. Other combinations exerted an intermediate values in this sphere.

Table, 10. Effect of urea, GA$_3$ and application date on fruit length (cm) percentage of Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	Fruit length					
	Application date					
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	7.70 f	9.40 e	**8.55 D**	7.72 j	9.41 i	**8.56 E**
GA at 50 ppm	9.70 de	9.86 de	**9.78 D**	9.71 h	9.85 h	**9.78 D**
GA at 75 ppm	9.90 de	10.43cde	**10.16CD**	9.88 h	10.44 g	**10.16 D**
GA at 100 ppm	11.13 bcd	11.66 bc	**11.39BC**	11.48 d	11.64 cd	**11.56 C**
Urea at 2%	10.80 bcde	10.83bcde	**11.81CD**	10.81 f	11.14 e	**10.97 C**
Urea at 2.5%	11.86 bc	12.36 ab	**12.11AB**	11.85 c	12.35 b	**12.10 B**
Ureaat 3%	12.40 ab	13.76 a	**13.08 A**	12.38 b	13.77 a	**13.07 A**
Mean	**10.49 B**	**11.18 A**		**10.54 B**	**11.22 A**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.3.3. Fruit width (cm)

Table, 11 shows that all tested treatments induced higher positive effect on fruit width as compared with the control treatment in both seasons. Generally, 3% urea treatment exerted higher positive effect and record 8.98 and 8.99 cm against fruit width 5.64 and 5.65 cm for control in 2013 and 2014 seasons, respectively.

Moreover, application date results showed that Nov., 15th application date exerted higher positive effect on fruit width than Oct., 25th date in 2013 and 2014 seasons.

Furthermore, the interaction between the two tested factors indicated that combinations of 3% urea treatment applied in Mid-Nov date gave high positive effect on fruit width as compared with the control treatment in this respect. Other combinations exerted an intermediate values in this respect.

Table,11. Effect of urea, GA$_3$ and application date on fruit width (cm) of Fagri Kalan mango trees during 2013 and 2014 seasons.

Treatments	Fruit width					
	Application date					
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	5.63 d	5.66 d	**5.64 D**	5.64 m	5.67 l	**5.65 G**
GA at 20 ppm	6.36 cd	6.93 bc	**6.64 D**	6.39 k	6.92 j	**6.65 F**
GA at 40 ppm	7.06 bc	7.20 bc	**7.13 CD**	7.25 g	7.27 f	**7.26 D**
GA at 40 ppm	7.26 b	7.43 b	**7.34 B**	7.28 f	7.44 e	**7.36 C**
Urea at 400 ppm	7.26 b	7.26 b	**7.26 BC**	7.08 i	7.19 h	**7.13 E**
Urea at 800 ppm	7.50 b	7.66 b	**7.58 AB**	7.51 d	7.69 c	**7.60 B**
Ureaat 25 ppm	8.63 a	9.33 a	**8.98 A**	8.65 b	9.34 a	**8.99 A**
Mean	**7.10 B**	**7.35 A**		**7.11 B**	**7.36 A**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.3.4. Seed weight (g)

Table, 12 reveals that all tested treatments exerted higher values of seed weight as compared with the control treatment in both seasons. Generally, 3% urea scored the highest value in this respect.

Furthermore, application date results showed that Nov., 15th application date induced higher positive values than other tested one in both seasons.

On the other hand, the interaction between the two tested factors indicated that combinations of 3% urea treatment applied in Mid-Nov. date gave scored higher values of seed weight as compared with the control. Other combinations gave an intermediate values in this respect.

3.3.5. T.S.S. (%)

Table, 13 indicates that all tested treatments gave high positive effect on T.S.S as compared with control treatment in both seasons. Generally, urea 3% treatment enhancing T.S.S and recorded 22.16 and 21.90 % against 19.60 and 20.50 % for control in the both seasons, respectively.

Furthermore, application timing effects showed that the Mid-Novmber time effect surpassed other ones in both seasons.

Moreover, the interaction between the two tested factors indicated that combination of Urea at 3% treatment applied in the Nov., 15th recorded the higher values of TSS 22.60 and 22.20 % against 19.20 and 20.50 % for the control treatment in the first date in both seasons, respectively. Other combinations gave an intermediate values in this respect.

Table,12. Effect of urea, GA$_3$ and application date on seed weight (g) of Fagri Kalan mango trees during 2013 and 2014 seasons).

| Treatments | Seed weight | | | | | |
| | Application date | | | | | |
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	49.31 a	45.73 cde	**47.52 A**	50.87 a	46.95 cde	**48.91 A**
GA at 50 ppm	48.41 ab	46.58 bcd	**47.49 A**	49.63 ab	46.80 cdef	**48.21 AB**
GA at 75 ppm	47.17 abc	46.38 bcd	**46.77 AB**	48.39 bc	46.50 cdef	**47.44 BC**
GA at 100 ppm	46.47 bcd	44.51 def	**45.49 BC**	47.58cd	45.34 efg	**46.46 CD**
Urea at 2%	47.38 abc	43.65 ef	**45.51 BC**	46.42 def	44.87 fg	45.64DE
Urea at 2.5%	45.20 cdef	43.01 f	**44.10 C**	45.73 defg	44.09 g	**44.91 E**
Ureaat 3%	44.52 def	43.18 f	**43.85 C**	45.56 efg	43.92 g	**44.74 E**
Mean	**46.92 A**	**44.72 B**		**47.74 A**	**45.49 B**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

Table, 13. Effect of urea, GA$_3$ and application date on T.S.S of Fagri Kalan mango trees during 2013 and 2014 seasons.

| Treatments | TSS | | | | | |
| | Application date | | | | | |
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	19.20 g	**20.00 f**	19.60 D	20.50 e	20.00 f	**20.25 E**
GA at 50 ppm	20.80 e	**21.33 cd**	21.06 C	19.60 g	20.40 e	**20.00 E**
GA at 75 ppm	21.20 de	**21.80 b**	21.50 B	19.90 fg	20.50 e	**20.20 E**
GA at 100 ppm	21.00 de	**22.00 b**	21.50 B	20.50 e	21.70 bc	**21.10 C**
Urea at 2%	20.80 e	**22.10 b**	21.45 B	20.70 de	21.00 d	**20.85 D**
Urea at 2.5%	21.00 de	**22.10b**	21.55 B	21.00 d	22.00 ab	**21.50 B**
Ureaat 3%	21.73 bc	**22.60 a**	22.16 A	21.61c	22.20 a	**21.90 A**
Mean	**20.81 B**	**21.70 A**		**20.54 B**	**21.11 A**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.3.6. Acidity (%)

Table, 14 illustrates that all tested treatments exerted high reductive effect on fruit acidity (%) as compared with control in both seasons. GA3 at 100 ppm treatment in first season gave higher values of fruit acidity than other tested treatments. In the second season GA3 at 100 ppm and urea at 3% gave scored higher value in this respect. Other tested treatments showed insignificant effect in this sphere.

Furthermore, application date showed no significant effect in this concern in the first season. Meanwhile, the second date Nov., 15th gave higher values than Oct., 25th application date in the second season.

Furthermore, the interaction between the two tested factors indicated that combinations of GA3 at 100 ppm treatment applied Nov., 15th induced high reductive effect on fruit acidity as compared with the control in first season. Most tested treatments recorded higher acidity in both tested application dates compared with GA3 at 50 ppm and control treatments applied in Oct., 25th in the second season.

Table, 14. Effect of urea, GA$_3$ and application date on fruit acidity content of Fagri Kalan mango trees during2013 and 2014 seasons).

| Treatments | Fruit acidity (%) | | | | | |
| | Application date | | | | | |
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	0.29 c	0.30 bc	**0.29 C**	0. 27 b	0.29 a	**0.28 C**
GA at 50 ppm	0.30 bc	0.30 bc	**0.30 BC**	0.27 b	0.30 a	**0.28 C**
GA at 75 ppm	0.30 bc	0.31 ab	**0.31 ABC**	0.29 a	0.30 a	**0.29 BC**
GA at 100 ppm	0.31 ab	0.32 a	**0.32 A**	0.30 a	0.30 a	**0.30 A**
Urea at 2%	0.30 bc	0.30 bc	**0.30 BC**	0.29 a	029 a	**0.29 BC**
Urea at 2.5%	0.30 ab	0.31 bc	**0.31 ABC**	0.29 a	0.30 a	**0.29 BC**
Ureaat 3%	0.31 ab	0.31 ab	**0.31 ABC**	0.30 a	0.30 a	**0.30 A**
Mean	**0.30 A**	**0.31 A**		**0.28 B**	**0.29 A**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.3.7. Fruit total sugars content

Table, 15 illustrates that all tested treatments exerted high positive effect on fruit total sugar (%) as compared with control treatment in both seasons. Moreover in the first season, all urea treatments GA at 100 ppm and GA at 75 ppm increased fruit total sugar (%) and recorded 11.79, 11.62, 11.77, 11.71 and 11.80 % respectively against 11.46 and 10.93% for GA at 50 ppm and control respectively. In 2014 season, urea at 3% increased fruit total sugars content and recorded 12.35% against 10.80% for control.

Furthermore, Nov., 15th application date showed that the second time effect enhancing total sugar and scored 11.99 and 11.01 % against 11.17 and 11.99 % for other ones in 2013 and 2014 seasons, respectively.

Moreover, the interaction between the two tested factors showed that combination of 3% at urea treatment applied in Nov., 15th increased fruit total sugars content and scored 12.20 and 12.62 % against 11.80 and 11.80 % for control treatment in conducted Oct., 25th in the 2013 and the 2014 seasons, respectively. Other combinations gave an intermediate values in this sphere.

Table, 15. Effect of urea, GA3 and application date **on total sugar of Fagri Kalan mango trees during 2013 and 2014 seasons.**

Treatments	Fruit total sugar (%)					
	Application date					
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	10.40 e	11.47abcd	**10.93 B**	10.12 d	11.61 abc	**10.86 B**
GA at 50 ppm	10.89 de	12.03 abc	**11.46 AB**	11.80 ab	11.96 abc	**11.88 AB**
GA at 75 ppm	11.80 abc	11.80 abc	**11.80 A**	10.55 bcd	12.01 ab	**11.28 AB**
GA at 100 ppm	11.15 cde	12.27 a	**11.71 A**	10.34 cd	12.08 ab	**11.21 AB**
Urea at 2%	11.41 abcd	12.13 a	**11.77 A**	11.11abcd	12.01 ab	**11.56 AB**
Urea at 2.5%	11.18 bcde	12.07 ab	**11.62 A**	11.17 ab	12.04 ab	**11.60 AB**
Urea at 3%	11.38 abcd	12.20a	**11.79 A**	12.09 ab	12.62 a	**12.35 A**
Mean	**11.17 B**	**11.99 A**		**11.02 B**	**12.05 A**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

3.3.8. Fruit ascorbic acid content (mg/100 ml juice)

Table, 16 reveals that all tested treatments increased fruit ascorbic acid content as compared with control treatment in both seasons. Generally, urea at 3% treatment proved to be the superior treatment and scored 24.79 and 26.79 mg/100 ml juice against 21.91 and 23.80 mg/100 ml juice for control in the 2013 and 2014 seasons, respectively.

Furthermore, application date results showed that Nov., 15th application date effect surpassed tested application in enhancing fruit ascorbic acid content in both seasons.

Moreover, the interaction between the two tested factors indicated that combination of 3% urea treatment applied in Nov., 15th date gave the higher positive pronounced effect and scored 25.30 and 27.00 mg/100 ml juice against 21.73 and 21.10 mg/100 ml juice for control treatment in the first and the second seasons, respectively. Other combinations gave an intermediate values in this concern.

The obtained results of GA3 regarding its enhancing effect on fruit quality are in harmony with the findings of Muarya and Singh (1981); Rajput and Singh (1989); Sharma et al., (1990); Anila and Radha (2003); Nkansah et al., (2012) Zaeneldeen (2014) and El Gammal et al., (2015).

The obtained results of urea regarding its positive effect fruit quality are in harmony with the findings of Rajput and Tiwari (1975); Rajput and Singh (1989) and Sarker and Rahim (2013).

Table, 16. Effect of urea, GA₃ and application date on ascorbic acid of Fagri Kalan mango trees during2013 and 2014 seasons.

Treatments	Ascorbic acid (mg/100 ml juice)					
	Application date					
	Oct., 25th	Nov.,15th	Mean	Oct., 25th	Nov.,15th	Mean
	2013			2014		
Control "tap water"	21.73 j	22.09 i	**21.91 G**	21.10 m	23.80 j	**22.45 G**
GA at 50 ppm	23.90 g	23.90 f	**23.90 F**	22.20 l	24.20 h	**23.20 F**
GA at 75 ppm	23.04 h	23.99g	**23.51 E**	22.60 k	24.10 i	**23.35 E**
GA at 100 ppm	24.10 e	24.30d	**24.20 C**	25.30 f	26.00 e	**25.65 C**
Urea at 2%	24.15 e	24.18 b	**24.16 D**	25.00g	25.30 f	**25.15 D**
Urea at 2.5%	24.33 cd	24.36 c	**24.34 B**	26.10 d	26.27 c	**26.18 B**
Urea at 3%	24.28 d	25.30 a	**24.79 A**	26.40 b	27.00 a	**26.70 A**
Mean	**23.64 B**	**24.01 A**		**24.10 B**	**25.24 A**	

Means within each column or row followed by the same letter (s) are not significantly different at 5% level.

IV. Conclusion

Conclusively, urea at 3% treatment applied in the Nov., 15th delayed tree blooming and induced the highest positive effect on the fruiting and fruit quality traits of Fagri Kalan mango trees.

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