Influence of Foliar Application of some Nutrient (Fertifol Misr) and Gibberellic Acid on Fruit Set, Yield, Fruit Quality and Leaf Composition of "Anna" Apple Trees Grown in Sandy Soil

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Abstract: The effect of Fertifol Misr (N, P, K, Mg zn, Fe, Mu, Cu, Mo & B) and gibberellic acid on fruit set, drop percentage, yield, fruit quality and leaf chemical composition on "Anna" Apple trees were studied during 2007 and 2008 seasons. Results showed that, fruit set%, drop%,, yield, leaf minerals & chlorophyll contents as well as physical and chemical characters of the fruit were positively effected by single or combined application of Fertifol Misr and gibberellic acid compared to unspraying .There was a slight promotion on such characters with increasing Fertifol Misr concentration from 1.5 – 2.5 g/l. The best results with regard to yield and fruit quality were obtained due to spraying "Anna" apple trees three times with a mixture containing Fertifol Misr at 2.5 g/l and gibberellic acid at 20ppm. [Journal of American Science. 2010;6(12):202-208]. (ISSN: 1545-1003).

Key words: Anna apple, foliar application, nutrients, gibberellic acid.

1. Introduction:

Anna apple (Malus domestica, Borkh) is a low chilling cultivar spreading in many tropic and subtropics area including Egypt. It is considered as one of the most important commercial cultivars planted in Egypt. The adaptation of proper fertilization program is one of the important cultural techniques that greatly promote and enhance the growth and fruit quality. No doubt that the application of soil fertilizers together with foliar feeding solution would probably be of great help in this respect. Amending the apple tree with their requirements from different nutrients via leaves was accompanied by on obvious improvement in both yield and quality of fruit. Many investigations studied the effect of spraying macro and micronutrients an growth, yield and fruit quality. Such as nitrogen, phosphorus, potassium &magnesium (Abd Ela, 1991, Akl, et al., 1993a & 1993b , and Gobara 2001). However zinc (Nijjar 1985 and Kabeel et al., 1998) Cupper and iron (Mohamed et al 1991); boron (Hanson 1991a); manganese (El Shazly, 1999) were highly effective in improving, nutritional status yield and quality of different pear and apple trees.

For instance, Plant growth, flowering fruit quality and yield were improved in apple by gibberellic acid application (El – Fakharany et al. (1995); Makarem & Mokhtar 1996).

The aim of this study was to test the effect of spraying some macro and micronutrient as (Fertifol Misr) and gibberellic acid on fruit set, yield, fruit quality and leaf chemical composition of Anna apple trees.

2. Materials and Methods:

This investigation was carried out during 2007 and 2008 seasons on 12-years old apple trees (Malus domestica, Borkh) budded) on MM 106 rootstock, planted at 3.5x3.5 meters apart and grown in a sandy soil under drip irrigation system in a private orchard located at El-Khatatba, Minufiya governorate, Egypt. Cross pollination was secured by planting Dorset Golden and Ein Shemir as pollinizers which were distributed in the whole orchard.

Soil analysis was carried out according to wiled et. al, (1985) data shown in Table (1). The experiment included six treatments as follows; Control (foliar sprayed with water).

Table (1) Physical and chemical properties of the tested soil.

Character	Volume
Particle size distribution	
Sand %	83.16
Silt %	15.11
clay %	1.73
Texture	Sandy
pH (1:2.5 extract)	7.50
Ec. (mmohs/cm 1:2.5) extract	0.65
Organic Mater %	0.75
Total Ca Co3 %	4.01
Available macro- nutrient	
Total N %	0.058
Available P (ppm,olsen)	5.33
Available K (ppm, ammonium acetate)	178 .06
Soluble cations meal 1, 1:5 soil water extract	
Mg++ ppm	
B (hot water extractable)	1.53
	o.16
DTPA extractable micro nutrieties ppm.	
Fe	1.99
Zn	1.30
Mn	1.00
Cu	2.89

- Foliar spray with Fertifol Misr at 1.5 g/l. This product was purchased from El Delta Company for fertilizers and chemical Al industrial.
- Foliar spray with Fertifol Misr 2.5 g./l .
- Foliar spray with gibberellic acid at 20 ppm.
- Foliar spary with Fertifol Misr at 1.5 g/l + gibberellic acid at 20 ppm.
- Foliar spray with Fertifol Misr at 2.5 g/l + gibberellic acid at 20 ppm.
- Fertifol Misr consists of (25 % N 16% P , 12% K, 0.25% Mg, 300 ppm zn, 1900 ppm Mn, 850 ppm cu, 100 ppm Mo & 200 ppm .

Fifty four healthy tress and nearly uniform in growth vigour and fruiting were selected. All trees had received regularly the same common cultural practices already give to the tree. Selected trees were sprayed 3 times at full bloom, after fruit set (fruit diameters 3 cm) and four weeks after fruit set. Foliar sprays were applied using a hand pressure sprayer. Triton B emulsifier at the rate of o.2% was used as surface to each tree received 8l of spraying solution, each treatment was surrounded with two rows as guard trees. The treatments were arranged in a completely randomized blocks design with three replicates for each treatment and three trees per each replicate. The following parameters were determined in the two seasons of the study.

1- Fruit set and fruit drop percentage.

Two main branches from two direction (east and west) of each tree were chosen and tagged in March of the two experimental seasons the number of flowers was recorded and them set fruits on the selected branches were counted for calculation the percentage of fruit set (divided number of fruits per branch/ Total number of flowers per branch x100).

Pre-harvest fruit drop was calculation by counting the number of dropping fruit from the 4th week of May till the commercial harvesting time under the experimental conditions (3rd week in June), then expressed as a percent from the whole number of fruits existed on the tree at the 4th week of May.

2-Yield per tree.

Yield was pressed in weight (Kg) and number of fruits per tree was recorded at harvest time (3rd week of June).

3-Fruit quality.

Fruit sample consisting of twenty fruits were randomly taken at harvest time from each replicate for the determination of both physical and chemical characteristics.

3-1. Physical characteristics:

Fruit weight (g), fruit length (cm), fruit diameter (cm) and fruit firmness (16/ inch) which was measured by fruit pressure tester on the two opposite sides of the fruit.

3-2.Fruit chemical characteristics

Total soluble solids were determined using a hand refractometer, percentage of titratable acidity in fruit juice was determined according to A.O.AC., (1995), total soluble solid / total acidity ratio were calculated and total sugar in the fruit pulp tissues were also determined by phenol sulfuric method according to (Dubois et al., 1956).

4-Leaf chemical composition.

Samples at twenty leaves from the middle part of the shoots (according to Chuntanaparb and Cummings, 1981) were randomly selected from each replicate (at the 2nd week of June to measure their area (cm2) and to determined their content N%, P %, K %, Mg % and Fe, Zn, Mn, Cu at ppm (according to Wilde et al., 1985). Determinations were carried out on dry weight basis. A leaf portion from each sample was kept fresh for chlorophyll determination, chlorophyll a and b (mg/l) was determined according the methods of Arnon (1949).

Statistical analysis was done according to Mead et.al. (1993) using the new L.S.D. test for comparing between means of different treatments.

3. Results and Discussion:

1-Fruit set and fruit drop percentage

Data presented in Table (2) show clearly that all treatments used significantly increased fruit set percent than the untreated trees during both seasons under this study. The data also indicated that the effect of Fertifol Misr 2.5 g/l + GA3 at 20 ppm application was more pronounced than other used treatments or the control. These results were true in both seasons. These results may be attributed the use of plant hormones, i.e. G A3 could lead to an increase in fruit set for deciduous trees (Makarem and Mokhtar, 1996). Similar results were obtained by Awad and Atawia (1995), Khabeel et al., (1998); Gobara (1998) and El Seging and Khalil (2000).

Regarding fruit drop data reported in Table (2) that spraying Fertifol Misr (N, P, K, Mg., Zn, Fe, Mn, Cu, Mo & B) alone or combined with GA3 was very effective in reducing pre-harvest fruit drop of Anna apple trees compared with the control. The differences between treated and untreated trees was significant. The minimum drop value was presented in Anna apple trees sprayed with Fertifol Misr at 2.5 / L + G A3 at 20 ppm. Similar results were observed in both seasons Zn, Cu, B, K and Fe were responsible

for building and moving carbohydrate from leaves to fruits and encourage the biosynthesis of cellulose which positively streng them the cell wall.

In addition, Zn and B Played an important role in biosyntheses and moving of the natural aux in namely IAA to the pedicels of fruits (Nijjar, 1985) . These results are in harmony with those found by Gill et al (1994) who worked on Zn, Cu, K and Fe.

2-Number of fruit and yield porter.

It is clear from the data in Table (3) that foliar application of Fertifol Misr single or combined with GA3 increased number of fruits per tree compared with the control. Such as increasing effect on fruits number per tree was almost similar to that yield per tree. The same table revealed that trees sprayed with Fertifol Misr at 2.5 g/l plus GA3 at 20 ppm resulted in the highest values of fruit number and yield in both seasons. These results agree with obtained by Bach et.al. (1995) on grapes and Awad & Atwaia (1995) on pears. They all stated that foliar sprays of Fe, Zn and Mn increased the total yield of studied fruit trees. Also Makarem & Mokhtar (1996) and El-Seigny & Khalil (2000) mentioned that foliar spray of GA3 increased the fruit set and fruit weight one.

3-Fruit quality

It is clear from the data in Table (4) that quality of Anna apple trees was positively affected by application of Fertifol Misr (macro and micronutrients) and GA3 either single on in combinations compared with unsprayed. The promotion on fruit quality due to applications of these materials appeared in terms of increasing fruit weight, T.S.S., total sugar content and in decreasing total acidity. The promotion on fruit quality was associated with increasing (Fertifol Misr) concentration. Single application with beneficial in enhancing fruit quality than using GA3 alone. The highest significant value of fruit quality was from trees treated with Fertifol Misr (N, P, K, Mg, Zn, Fe, Mn, Cu, Mo and B) at 2.5g/l plus GA3 at 20 ppm in both seasons. The improving of fruit quality in response to application of nutrients was supported by Ranvir and M'sra (1980) , Saraswathi et al., 1998, Zhao et al., (1999), Ahmed and Morsy, (2001); Younes-Randa (2002) and Fawzi and Abd Al-moneim (2004).Concerning the effect of gibberellic acid on fruit quality was emphasized by the results of Awad and Atawia (1995), Ibrahim et al., (1994), Kabeel et al., (1998) , El Shazly (1999), El Hammady et al., (2000) and El-Seginy and Khalil (2000).

4-Leaf aria and leaf chemical composition.

It is obvious from Table (5) that all tested treatments caused high significantly increased leaf area as compared with the control. Moreover, trees sprayed with Fertifol Misr at 2.5 g/l plus GA3 at 20 ppm was only the treatment that induced the highly significant effect on leaf area. Regarding leaf chlorophyll content data presented in Table (5) show that chlorophyll a and b content showed significant increase due to all tested treatments compared with the control. The same table revealed that trees sprayed with (Fertifol Misr) at 2.5 g/l plus GA3 at 20 ppm resulted in the higher values of leaf chlorophyll content. In general, the observe increase in the concentration of nitrogen, magnesium and iron in the leaves of Anna apple trees sprayed with Fertifol Misr and GA3 might help in interpretation the results obtained. The participation of nitrogen and magnesium in the structure and the integrity of the chlorophyll molecules together play indispensable role with iron in chlorophyll synthesis are well documented by numerous physiologists. Such as Bidwell (1979) and Faust (1989) they reported that over 10-20% of leaf magnesium and more than 80% of the iron content of green leaves are located in the chlorophyll. Concerning leaf macro and micronutrients contents, It is clear from the data in Table (6) that sprays Fertifol Misr (N, P, Mg, Zn, Fe, Mn, Cu, Mo and B) either alone or combined with GA3 significantly improved leaf status of these nutrients compared with control. Improved effect of nutrient, on N, K and Mg in the leaves was confirmed by the results of Abo-Shelbaya (1988), Intrighliolo et. al., (1991), Sheo and Singh (1999) and Lovatt (1999). The reduction in leaf p content might be due to the antagonism between Fe and P (Nawar 1991).

The results regarding the effect of gibberellic acid on leaf mineral contents are in agreement with those obtained by Addicot and Addicot (1982). In addition the increase of plant nutrient status resulted from spraying different solution might by due to quick absorption via leaves and the limited loss of the nutrients when they were sprayed (Marschner, 1995).

The data of the present study also revealed that with respect to sprayed by Fertifol Misr had apparently higher levels of Fe, Zn, Mn and Cu than the control. These results are in line with those reported by Hilail (1993) Awad and Atawia (1995); Kabeel at al., (1998), El Seiginy and Khalil (2000) and El-Shobaky at al., (2001) who worked on deciduous fruit trees.

Table (2): Effect of foliar spray with Fertifol Misr and GA_3 on fruit set and fruit strop percentages of Anna apple trees (2007& 2008 Seasons)

Treatments	Fruit set %		Fruit drop %		No. of fruit/ tree		Yield/ tree Kg.	
	2007	2008	2007	2008	2007	2008	2007	2008
T_1 – Control	15.30	16.90	54.30	51.33	136.30	143.00	10.81	12.07
T_2 – Fertifol Misr at 1.5 g/l	15.80	18.10	51.31	47.11	142.00	151.00	13.25	15.29
T_3 – Fertifol Misr at 2.5 g/l	16.30	18.93	48.30	44.30	148.31	165.51	14.54	18.04
T_4 – GA3 at 20 ppm	17.33	19.50	46.03	41.11	156.16	175.11	15.51	19.29
T_5 – Fertifol Misr at 1.5 g/l + GA3 at 20 ppm	17.83	20.31	41.33	39.16	165.31	180.03	18.35	20.89
T_6 – Fertifol Misr at 2.5 g/l + GA3 at 20 ppm	18.33	21.36	39.12	38.10	171.10	193.31	19.85	23.39
New L. S. D. at 5%	1.80	3.63	6.53	6.73	16.01	28.03	5.06	6.11

Table (3), Effect of foliar spray with Fertifol Misr and GA_3 on physical properties of Anna apple trees (2007& 2008 seasons).

Treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		Fruit firmness ($lb/inch^2$)	
	2007	2008	2007	2008	2007	2008	2007	2008
T_1 – Control	79.31	85.00	4.21	4.41	4.81	4.90	11.62	11.81
T_2 – Fertifol Misr at 1.5 g/l	93.31	101.30	4.32	4.71	4.90	5.30	11.93	12.03
T_3 – Fertifol Misr at 2.5 g/l	98.03	109.00	4.61	4.41	5.30	5.63	12.23	12.43
T_4 – GA3 at 20 ppm	91.30	93.21	4.60	4.85	5.20	5.30	12.11	12.33
T_5 – Fertifol Misr at 1.5 g/l, GA3 at 20 ppm	111.00	116.01	5.10	5.32	5.61	5.83	12.58	12.71
T_6 – Fertifol Misr at 2.5 g/l, GA3 at 20 ppm	116.00	121.01	5.30	5.51	5.831	6.11	12.63	12.85
New L. S. D. at 5%	16.31	16.31	0.19	0.18	0.16	0.23	0.63	0.58

Table (4), Effect of foliar spray with Fertifol Misr and GA_3 on chemical properties of Anna apple trees (2007& 2008 seasons)

Treatments	T.S.S. %		Total acidity %		T.S.S./ acid ratio		Total sugar %	
	2007	2008	2007	2008	2007	2008	2007	2008
T_1 – Control	10.93	11.00	0.56	0.53	19.51	20.75	8.16	8.03
T_2 – Fertifol Misr at 1.5 g/l	11.05	11.43	0.53	0.51	20.85	22.41	8.28	8.31
T_3 – Fertifol Misr at 2.5 g/l	11.53	11.96	0.50	0.48	23.06	24.92	9.03	9.16
T_4 – GA3 at 20 ppm	11.50	12.36	0.46	0.45	25.00	27.47	9.18	9.35
T_5 – Fertifol Misr at 1.5 g/l, GA3 at 20 ppm	11.91	12.43	0.45	0.44	26.47	28.25	9.26	9.53
T_6 – Fertifol Misr at 2.5 g/l, GA3 at 20 ppm	12.36	12.63	0.44	0.42	28.09	30.03	9.31	9.63
New L. S. D. at 5%	0.53	0.73	0.04	0.05	3.31	3.63	0.55	0.75

Table (5), Effect of foliar spray with Fertifol Misr and GA_3 on leaf area and leaf chlorophyll content of Anna apple trees (2007& 2008 seasons)

Treatments	Leaf area cm^2		Leaf chlorophyll content (mg/l)			
			Chl. (a)		Chl. (b)	
	2007	2008	2007	2008	2007	2008
T_1 – Control	48.30	46.38	79.10	75.33	41.30	43.16
T_2 – Fertifol Misr at 1.5 g/l	53.10	51.12	110.30	112.30	58.10	57.30
T_3 – Fertifol Misr at 2.5 g/l	56.30	53.32	118.31	116.23	60.31	62.03
T_4 – GA3 at 20 ppm	56.10	55.12	81.00	79.11	39.11	41.10
T_5 – Fertifol Misr at 1.5 g/l, GA3 at 20 ppm	59.11	58.11	124.11	126.16	63.16	56.10
T_6 – Fertifol Misr at 2.5 g/l, GA3 at 20 ppm	66.18	63.31	126.00	130.10	65.31	69.16
New L. S. D. at 5%	2.10	3.10	10.30	11.26	6.16	7.31

Table (6), Effect of foliar spray with Fertifol Misr and GA_3 on Leaf mineral percentage (2007& 2008 seasons).

Treatments	N %		D %		K %		Mg %		Fe ppm		Zn ppm		Mn ppm		Cu ppm	
	07	08	07	08	07	08	07	08	07	08	07	08	07	08	07	08
T_1 – Control	1.63	1.68	0.23	0.25	1.38	1.36	0.30	0.33	86.00	99.03	21.31	23.12	17.00	18.00	26.00	28.01
T_2 – Fertifol Misr at 1.5 g/l	1.75	1.80	0.20	0.23	1.51	1.48	0.39	0.38	112.00	118.36	31.11	32.31	22.01	23.11	28.00	31.01
T_3 – Fertifol Misr at 2.5 g/l	1.93	1.98	0.18	0.22	1.56	1.53	0.45	0.46	115.33	123.01	36.10	38.10	24.31	26.30	30.00	33.03
T_4 – GA3 at 20 ppm	2.01	2.06	0.17	0.20	1.39	1.37	0.33	0.35	89.31	103.11	34.32	36.10	21.36	23.16	27.00	29.00
T_5 – Fertifol Misr at 1.5 g/l, GA3 at 20 ppm	2.26	2.31	0.18	0.23	1.57	1.54	0.47	0.48	116.03	134.11	39.16	41.16	29.33	30.00	31.00	35.16
T_6 – Fertifol Misr at 2.5 g/l, GA3 at 20 ppm	2.36	2.43	0.19	0.21	1.59	1.56	0.53	0.50	119.31	138.01	41.12	43.18	30.00	32.33	36.00	38.03
New L. S. D. at 5%	2.30	2.41	N.S	N.S	0.09	0.08	0.06	0.05	7.01	8.10	5.01	4.90	4.10	3.00	2.01	2.63

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