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Beneficial Effects of Minimizing Nitrogen Fertilization on Fruiting of Manfalouty Pomegranate Trees

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Abstract:

This study was carried out at the Experimental Orchard, Faculty of Agriculture, Assiut University, Egypt, to investigate the response of Manfalouty pomegranate trees for Azotin (bio-fertilizer) and Enciaben (slow release-N fertilizers) during 2013 and 2014 seasons. The experiment was arranged in a complete randomized block design with six treatments and three replications, each one tree.

The results of this study showed that all studied fertilization treatments significantly increased the leaf area as well as percentage of N, P and K in leaves compared to use the recommended dose of nitrogen (RDN) as fast mineral nitrogen source only. No significant differences on these traits due to use slow release-N fertilizer at any dose as well as 60% of RDN as two or three forms. All studied fertilization treatments studied significant increasing the yield/tree and decrease the fruit splitting percentage compared to use (RDN) as fast mineral-N source only. The maximum yield/tree and least fruit splitting percentage were recorded on the trees that fertilized by three different fertilization source (three forms). Fertilization with the slow release dose, two forms (mineral plus bio) or three forms (mineral plus bio and slow release) significantly improved the fruit quality in terms of increasing the fruit weight, pulp % and total soluble solids % as well as sugar, vitamin C and anthocyanin contents and decreasing the total acidity and tannin content compared to use the RDN as release mineral-N source. Hence, the cost wise evaluation of the application of these N sources is in favour of 60% RDN at either two, three forms or slow release-N.

It is evident from the obtained results that such fertilization programs are very important for the production of pomegranate fruits since it improves the fruit quality and packable yield and reduces the production costs and environmental pollution.

Keywords: Bio-fertilization, slow release, pomegranate, yield, nutrient status, environmental, pollution, fruit quality.

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Introduction:

The pomegranate (*Punica granatum* L.) is an ancient fruit that has been widely consumed in various cultures for thousands of years. It is an economically important commercial fruit plant species belonging to family punicaceae. Pomegranate trees has many desired characteristics, i.e. tolerant drought, hard winter and can thrive well under desert conditions, as well as grown in many tropical and subtropical countries. Pomegranates is a good source of carbohydrate, minerals and antioxidants. It has been used for controlling diarrhea, hyperacidity, tuberculosis, leprosy, abdominal pain and fever. Due to its multipurpose uses it is also known as "Dadima: in Ayurveda (Paranjpe, 2001) and as "superfruit" in the global functional food industry (Martins *et al*., 2006). Pomegranate juice contains antioxidants such as soluble polyphenols, tannins, anthocyanins and may have antiotherasclerotic properties (Michel *et al*., 2005) and can be used as a remedy of cancer and chronic inflammation (Ephraim and Robert, 2007).

The total area of pomegranate trees was estimated to be about 0.5% of the total fruit acreage in Egypt (4746 feddans). Assiut Governorate is considered the main producer of Egyptian pomegranate according to statistics of the Ministry of Agriculture, 2012.

Fertilization especially with nitrogen is one of the important management tools for increasing crop yield. Nitrogen (N) is known to be one of the most major elements for plant nutrition and development. It plays an important role as a constituent of all proteins, nucleic acids and enzymes. Nitrogen fertilization effects depending on the nutrient status of the cultivated soil, as well as applied amount, sources and methods of N applications (Yagodin, 1990).

In recent years, production of horticultural crops has undergone significant changes due to development of innovative technologies including integrated nutrient management practices involving bio-fertilizers, which include phosphate-solubilizing bacteria (PSBs), symbiotic and non-symibotic, N_2-fixing bacteria and arbuscular mycorrhizal (AM) fungi. Bio-fertilizers enhance the plant growth and yield and has gained momentum because of higher cost and hazardous effect of chemical fertilizers. Nitrogen-fixing bacteria and arbuscular mycorrhizal fungi significantly enhance the growth and production of various fruit trees (Khanizadeh *et al*., 1995 and Aseri *et al*., 2008) besides improving the microbiological activity in the rhizosphere (Kohler *et al*., 2007). Bio-fertilizer improve growth and fruit quality of pomegranate (Abo-Taleb, Safia *et al*., 1999; Wadee, 2007; Aseri *et al*., 2008 and El-Salhy *et al*., 2013).

The nitrogen fertilizer efficiency under field and surface irrigation conditions rarely exceeds 50% and it ranges between 30 and 40% (Saharawat, 1979). The loss of nitrogen by leaching, volatilization, denitrification is considered the most important problem in the Egyptian soils. Thus, the management of N applied sources is required to solve this problem.

The loss of nitrogen via leaching through drainage water may be reduced to some extent by using the slow release-N fertilizers that could regulate the release of their own N as the plant needs. During the last decades, several controlled-release fertilizers were developed mainly to improve the efficiency of nitrogen used by the fruit trees (Miller *et al*., 1990). Application of controlled-release fertilizers seem to be very effective on improving the growth and productivity of most fruit trees. This is attributed to the continuous amendment of N during all growth and fruit development stages as well as release their own N at a longer period and at the critical date of fruit development (Koo, 1988; Wang and Alva, 1996 and El-Salhy *et al*., 2013).

So, this study aims to investigate the response of Manfalouty pomegranate trees to the applicate of bio and slow release N fertilizers.

Materials and Methods:

This study was carried out during the two successive seasons of 2013 and 2014 on Manfalouty pomegranate trees grown at the Experimental Orchard of Faculty of Agriculture, Assiut University, Egypt, where the soil has a clay texture. The properties of the experimental soil were presented in Table (1), according to Wilde *et al*. (1985).

Table (1): Some physical and chemical properties of soil of the experimental site.

Soil property	Value	Soil property	Value
Sand (%)	15.43	Organic matter (%)	1.32
Silt (%)	33.22	Total nitrogen (%)	0.16
Clay (%)	51.35	$NaHCO_3$-extractable P (ppm)	21.6
Texture grade	Clay	NH_4OAC-extractable K (ppm)	401.3
Field capacity, FC (%)	48.43	DTPA extractable Fe (ppm)	13.14
pH (1-2.5)	8.22	DTPA extractable Mn (ppm)	15.16
EC (ds m^{-1})	2.69	DTPA extractable Zn (ppm)	2.35
$CaCO_3$ (%)	3.66	DTPA extractable Cu (ppm)	2.4

Eighteen healthy trees with no visual nutrient deficiency symptoms were chosen and devoted for carrying out this experiment. The chosen trees were divided into six groups. Each group had three trees and subjected to the following treatments:

T_1-Applying the recommended nitrogen dose (RDN) at 600 g N/tree as mineral source (1.8 kg ammonium nitrate 33.3 N/tree, check treatment, control).

T_2-Applying 100% of RDN as slow release (1.5 kg Enciaben 40% N/tree).

T_3-Applying 80% of RDN as slow release (1.2 kg Enciaben 40% N/tree).

T_4-Applying 60% of RDN as slow (0.9 kg Enciaben 40% N/tree).

T_5-Applying 60% of RDN as 10% mineral and 50% bio (300 gm Azotin, tree two forms).

T_6-Applying 60% of RDN as 10% mineral plus 25% bio (150 gm Azotin) and 25% slow release tree (three forms).

The experiment was set up as a complete randomized block design with three replications per treatment, one tree each. The slow release-N fertilizer (Enciaben) was added once during the spring growth at the first week of March. Azotin was added in two equal batches at growth start and one month later. Azotin as a bio-fertilize that contains nitrogen fixation *Paenifacullus polymxa* was brought fresh. It used by mixing it with moist sand before the application, added in soil holes around the trunk of the tree and then, directly irrigated after covering the holes with soil. Ammonium nitrate (33.3% N) as a mineral source was splitted into three equal batches and added at the first week of March, May and August. Other horticultural practices were carried out as recommended.

The following parameters were measured during the two growth seasons.

A- Vegetative growth and leaf nutrient status:

Four main branches which were nearly uniform in growth, diameter and foliage density and distribution around the periphery of each tree were chosen and labeled in April. In the autumn growth cycle, the following vegetative characteristics were measured, shoot length (cm), leaf number/shoot and leaf area (cm^2) according to Ahmed and Morsy (1999).

Samples of fifty mature leaves were randomly selected from the non fruiting spring shoots on mid September to determine N, P and K in leaves using the digestion with a mixture of sulfuric acid and hydrogen peroxide. Nitrogen was measured by the micro-kjeldahl methods, phosphorus was determined colorimetricaly, and potassium was determined using flame photometer in the digest solutions described by Champan and Pratt (1975), Bremner and Mulvaney (1985) and Wilde *et al.* (1985).

B- Yield and its components:

Fruit were harvested at once at the second week of October due to the recommended maturity standard according to El-Salhy (1985) and then:

- Yield (kg/tree).
- The percentage of fruit splitting was estimated.

C- Fruit quality:

Samples of 10 fruits were randomly taken at harvest time from each tree to determine the fruit quality. The fruit weight, fruit pulp % and the chemical fruit quality such as total soluble solids, titratable acidity (expressed as g citric acid/100 ml juice), V.C. contents as (mg/100 ml juice) and sugar contents, as well as, hydrolysable tannin and total anthocyanin contents were determined according to A.O.A.C. methods (1985).

The obtained data were statistically analyzed according to Gomez and Gomez (1984) and Mead *et al.* (1993) using the L.S.D. test to define the significance of the differences among various treatment means.

Results:

1- Effect of different nitrogen fertilization sources on vegetative growth:

Data presented in Tables (2 & 3) showed the effect of different sources of nitrogen fertilization on shoot length, number of leaf/shoot and leaf area (cm^2) as well as the percentage of N, P, K in leaves during 2013 and 2014 seasons. It is obvious from the data that the results showed similar trend during the two studied seasons.

Data showed that the fertilization treatments significantly increased the number and area of leaves compared to applying the recommended nitrogen dose as mineral source (check treatment, T_1). Using the recommended dose of nitrogen (RDN) as 10% mineral-N plus 50% bio-form (two forms, T_5) or 10% mineral-N plus 25% bio and 25% slow release (three forms, T_6) significantly decreased the shoot length compared to using RDN as 100% slow release-N (T_2) No significant differences on shoot length due to use any studied fertilization treatments compared to check treatment.

Moreover, using either slow release, two forms or three forms significantly increased the percentage of N, P and K in leaves compared to use RDN as mineral source only (T_1). No significant differences on these vegetative parameters could be observed due to use slow release-N at any doses (T_2, T_3 or T_4), as well as 60% of RDN as two forms (T_5) or three forms (T_6).

The increment percentage of leaf area was 13.11, 11.93, 8.24, 9.72 and 16.34% as an av. of the two studied seasons due to T_2, T_3, T_4, T_5 and T_6 as compared with the control (T_1), respectively. Whereas, the increment percentage of N%, P% and K% caused by T_2, T_3, T_4, T_5 and T_6 compared to T_1 were 15.72, 13.84, 9.43, 19.50 & 25.15%, 22.73, 27.27, 36.36, 59.09 & 40.91% and 4.80, 4.80, 5.60, 6.40 and 7.20% as an av. of the two studied seasons, respectively. The maximum values of vegetative traits were detected on Manfalouty pomegranate trees fertilized with 60% RDN as three forms 10% mineral plus 25% slow release-N plus and 25% bio-form (T_6). Therefore, fertilizing with mixed fertilization treatments or slow release significantly increased the total leaf surface area, nutritional status and vegetative vigour of trees. These results emphasized the impotance of using the three fertilization forms or 60% of recommended nitrogen dose on improving the tree nutrient status and vigour than to use mineral-N fertilizer only. In addition, it minimized the production costs and environmental pollution which can be occurred by excess of chemical fertilizers.

2- Effect of different nitrogen fertilization sources on yield

Data in Table (4) showed that fertilizing the trees by combination of mineral-N with slow release-N as well as mineral-N plus slow release and bio-form (three fertilization forms, T_6) or mineral plus bio-form slow release (two forms, T_5) at 60% out of RDN significantly increased the yield/tree. On the other hand, these fertilization treatments significantly decreased the fruit splitting percentage compared to mineral-N source only (check treatment, T_1).

The recorded yield/tree was 72.9, 92.6, 91.3, 90.1, 101.2 and 110.1 kg/tree as an av. of the two studied seasons, due to T_1 to T_6, respectively. The increment percentage of yield/tree was 27.02, 25.24, 23.59, 38.82 and 51.03% as an av. of the two studied seasons due to T_2, T_3, T_4, T_5 and T_6 compared to T_1, respectively. On other hand, the fruit splitting percentage attained 12.90, 9.16, 6.63, 6.27, 6.51 and 5.67% as an av. the two studied seasons due to T_1, T_2, T_3, T_4, T_5 and T_6, respectively. The decrement percentage of fruit splitting due to fertilization treatments under fertilization as mineral-N source only (T_1) attained 28.99, 48.60, 51.39, 49.53 and 56.05% as an av. the two studied seasons due to T_2, T_3, T_4, T_5 and T_6, respectively.

The maximum yield/tree was recorded on the trees that fertilized by three different fertilization source (T_6). Therefore, it was clear that fertilization using mixture of three sources (slow release + bio + mineral), or two forms (bio + mineral) as well as, slow release-N fertilizer have beneficial effects on the pomegranate yield.

3- Effect of different nitrogen fertilization sources on fruit quality:

It is noticed from the obtained data presented in Tables (4, 5 and 6) that the fertilization with any two form (mineral, plus bio), three sources (slow release + bio + mineral) or slow release-N fertilizer significantly improved the fruit quality in terms of increasing the fruit weight, pulp fruit percentage and total soluble solids as well as sugar, vitamin C and anthocyanin contents and decreasing the total acidity and tannin content compared to use the recommended nitrogen dose (RDN) as the release (mineral-N) source. No significant differences in these traits due to fertilize as either slow release at any doses (T_2, T_3 or T_4) as well as mixture of the two forms, T_5 or three forms, T_6 at 60% of the RDN. Using mixture of the three sources gave the highest values of most studied traits. The recorded fruit weight was 336.9, 392.0, 388.7, 382.2, 411.8 and 426.9 gm as an av. the studied seasons) due to T_1 to T_6, respectively. The corresponding TSS, vitamin C and anthocyanin contents were 15.75, 16.35, 16.50, 16.80, 16.75 & 17.05%, 24.79, 29.10, 29.73, 31.09, 31.53 and 30.80% mg/100 and 54.15, 58.60, 61.00, 62.10, 66.90, 67.90 mg/L as an av. the two studied seasons, respectively. The increment percentage in fruit weight was 16.36, 15.38, 13.45, 22.23 and 26.71% as an av. the two studied seasons due to T_2, T_3, T_4, T_5 and T_6 over the control, respectively. In addition, the corresponding increment percentages of TSS%, V.C and anthocanyin contents were 3.81, 4.46, 6.67, 6.53 & 8.25, 17.38, 19.92, 25.41, 27.19 & 28.28 and 8.22, 12.65, 14.68, 23.55 & 25.39% as an av. the two studied seasons, respectively.

Also, using the three form (T_6) recorded the lowest titratable acidity and tannins contents. The obtained titratable acidity percentage and tannins contents were 1.55, 1.31, 1.31, 1.30, 1.22 & 1.20% and 2.54, 2.15, 2.09, 2.01, 1.95 & 1.93 mg/gm dry weight as an av. the two studied seasons due to T_1, T_2, T_3, T_4, T_5 and T_6, respectively. The corresponding decrement percentage of titratable acidity and tannins contents due to T_2, T_3, T_4, T_5 and T_6 compared to check treatment (T_1) attained 15.48, 15.48, 16.13, 21.29 & 22.58% and 15.35, 17.72, 20.87, 23.23 & 24.01% as an av. the two seasons, respectively.

Hence, the cost wise evaluation of the application of these N sources is in favour of 60% RDN at either two forms, three forms or slow release-N source. Such fertilization programs are very important for the production of pomegranate fruits, because the improve in the fruit quality induce an increase in packable yield. In addition, such fertilization treatments reduce the cost of production and environmental pollution.

Table (2): Effect of different nitrogen fertilization sources on some vegetative growth traits of Manfalouty pomegranate trees during 2013 and 2014 seasons.

Characteristics / Treatment	Shoot length (cm)			No. of leaf/shoot			Leaf area (cm^2)		
	2013	**2014**	**Mean**	**2013**	**2014**	**Mean**	**2013**	**2014**	**Mean**
T_1	61.29	63.57	62.43	74.28	76.49	75.39	6.40	7.17	6.79
T_2	63.46	65.53	64.50	80.90	83.11	82.01	7.13	8.22	7.68
T_3	62.59	64.48	63.54	79.30	81.38	80.34	7.07	8.13	7.60
T_4	61.55	63.80	62.68	78.87	81.15	80.01	6.87	7.84	7.35
T_5	59.94	62.11	61.03	76.98	79.55	78.26	6.81	8.08	7.45
T_6	60.22	62.68	61.45	77.42	80.11	78.76	7.42	8.38	7.90
L.S.D. 5%	**2.31**	**2.77**	**-**	**2.61**	**2.82**	**-**	**0.31**	**0.28**	**-**

T_1- Applying the recommended nitrogen dose (RDN) at 600 g N/tree as mineral source (1.8 kg Ammonium nitrate 33.3 N, check treatment, control).

T_2- Applying 100% out of RDN as slow release-N (1.5 kg Enciaben 40% N/tree).

T_3- Applying 80% out of RDN as slow release-N (1.2 kg Enciaben 40% /tree).

T_4- Applying 60% out of RDN as slow release-N (0.9 kg Enciaben 40% N/tree)

T_5- Applying 60% out of RDN as 10% mineral plus 50% bio-form (300 gm Azotin), two forms.

T_6- Applying 60% out of RDN as 10% mineral, 25% slow release-N and 25% bio-form (three forms).

Table (3): Effect of different nitrogen fertilization sources on the percentage of N, P and K in the leaves of Manfalouty pomegranate trees during 2013 and 2014 seasons.

Characteristics / Treatment	Leaf N %			Leaf P %			Leaf K %		
	2013	**2014**	**Mean**	**2013**	**2014**	**Mean**	**2013**	**2014**	**Mean**
T_1	1.55	1.62	1.59	0.21	0.23	0.22	1.24	1.26	1.25
T_2	1.79	1.88	1.84	0.25	0.28	0.27	1.29	1.32	1.31
T_3	1.75	1.86	1.81	0.25	0.30	0.28	1.30	1.32	1.31
T_4	1.69	1.78	1.74	0.29	0.31	0.30	1.30	1.33	1.32
T_5	1.84	1.96	1.90	0.33	0.36	0.35	1.31	1.34	1.33
T_6	1.93	2.05	1.99	0.30	0.32	0.31	1.32	1.35	1.34
L.S.D. 5%	**0.08**	**0.11**	**--**	**0.02**	**0.02**	**--**	**0.04**	**0.05**	**--**

Table (4): Effect of different nitrogen fertilization sources on the yield/tree (kg) and fruit splitting (%) as well as fruit weight (g) and fruit pulp (%) of Manfalouty pomegranate trees during 2013 and 2014 seasons.

Characteristics / Treatment	Yield/tree (kg)			Fruit splitting			Fruit weight (g)			Fruit pulp (%)		
	2013	2014	Mean	2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
T_1	67.5	78.3	72.9	13.68	12.12	12.90	324.6	349.2	336.9	56.15	58.52	57.34
T_2	86.0	99.1	92.6	9.45	8.86	9.16	385.7	398.3	392.0	60.40	63.00	61.70
T_3	83.3	98.8	91.3	6.57	6.68	6.63	381.7	395.7	388.7	59.85	61.97	60.91
T_4	81.5	98.6	90.1	6.15	6.39	6.27	373.8	390.5	382.2	59.31	61.86	60.59
T_5	91.5	110.8	101.2	6.48	6.54	6.51	398.2	425.4	411.8	61.08	64.18	62.63
T_6	101.8	118.4	110.1	5.46	5.88	5.67	417.1	436.6	426.9	62.10	64.50	63.30
LSD 5%	**4.81**	**5.23**	**-**	**1.13**	**0.86**	**-**	**15.18**	**16.86**	**-**	**2.89**	**3.18**	**-**

Table (5): Effect of different nitrogen fertilization sources on total soluble solids (TSS%), titratable acidity (%) and reducing sugars of Manfalouty pomegranate fruit juice during 2013 and 2014 seasons.

Characteristics / Treatment	TSS%			Titratable acidity (%)			Reducing (%)		
	2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
T_1	15.30	16.20	15.75	1.59	1.50	1.55	10.91	10.82	10.87
T_2	16.00	16.70	16.35	1.34	1.28	1.31	11.42	11.19	11.31
T_3	16.00	17.00	16.50	1.30	1.32	1.31	11.64	11.80	11.72
T_4	16.40	17.20	16.80	1.27	1.22	1.30	12.25	11.73	11.99
T_5	16.40	17.10	16.75	1.24	1.20	1.22	12.51	13.00	12.76
T_6	16.80	17.30	17.05	1.23	1.16	1.20	12.74	13.14	12.94
L.S.D. 5%	**0.48**	**0.39**	**-**	**0.08**	**0.11**	**-**	**0.43**	**0.32**	**-**

Table (6): Effect of different nitrogen fertilization sources on vitamin C, tannin and anthocyanin contents of Manfalouty pomegranate fruit juice during 2013 and 2014 seasons.

Characteristics / Treatment	V.C (mg/100 ml)			Tannin (mg/gm dry weight)			Anthoycanin (mg/L)		
	2013	2014	Mean	2013	2014	Mean	2013	2014	Mean
T_1	24.38	25.21	24.99	2.96	2.11	2.54	55.6	52.7	54.15
T_2	28.96	29.24	29.10	2.42	1.88	2.15	59.3	57.9	58.60
T_3	29.35	30.11	29.73	2.33	1.85	2.09	61.2	60.8	61.00
T_4	30.82	31.35	31.09	2.26	1.76	2.01	62.8	61.3	62.10
T_5	31.45	31.60	31.53	2.19	1.71	1.95	67.4	66.3	66.90
T_6	31.63	31.97	31.80	2.18	1.68	1.93	69.1	66.8	67.90
L.S.D. 5%	**1.26**	**1.12**	**-**	**0.11**	**0.09**	**-**	**1.98**	**2.19**	**-**

Discussion:

Fertilization is one of the important management tools in increasing crop productivity. Nitrogen is a necessary element for chlorophyll, protoplasm, protein and nucleic acid synthesis (Nijjar, 1985), so that its application induce an increase in the growth traits due to the increase of the cell number and its size. Major compensation to overcome the low fertility of soil is to use chemical fertilizers that become an expensive item for orchard management and environmental pollution. Using organic and bio-fertilizers are considered a promising alternative for chemical fertilizers, as well as, their safety for soil, human, animals and environment (Verna, 1990 and El-Salhy *et al*., 2010).

The important role of bio-fertilizers is facilitating the fixation of atmospheric N, activating the availability and uptake of nutrients and reducing the incidence of soil born plant diseases. As well as, accelerating carbohydrate and protein synthesis and movement which aids in encouraging cell division and the development of meristemic tissues; Subba Rao (1984) and Kannaiyan (2002).

All these effects improve vegetative vigour, nutritional status of trees inducing an increase of nutrient uptake and synthesis of total carbohydrates and proteins. As well as, maintaining a good balance between total carbohydrates and N in favour of improving floral bud induction and fertility coefficient. Moreover, it hastened the maturation and improved fruit quality.

The above mentioned findings in accordance with those obtained by Khanizadeh *et al*. (1995), Abo-Taleb-Safia *et al*. (1999),Wadee (2007), Kohler *et al*. (2007), Aseri *et al*. (2008) and El-Salhy *et al*. (2013). They concluded that application of bio-fertilizer along with mineral-N source were effective for improving growth aspects, yield and fruit quality.

In addition, the application of the slow release of nitrogen reduces the loss of nitrogen by leaching, volatilization, denitrification as well as mobility. It also regulates the release of own–N over a long period of time for the plants need. Moreover, it remains the highest values of residual N in the soil due to their low activity index, and substantially improves the soil properties and vegetative growth traits compared to the fast release (mineral) N application which gives the lowest values of available N left in the soil. Using slow release of N fertilizers was very effective on improving growth characteristics compared to using the fast release ones i.e. ammonium nitrate. In addition, when using slow release-N fertilizers, the applications frequency could be reduced to 50% without reducing the optimum leaf N content. Soluble (fast release) N fertilizers were generally more readily available but they had shorter residual effects on leaves and soil than the slow release-N ones. Slow release increases the efficiency use of fertilizers, control the release of nutrients, hence improves the soil fertility and the growth, vigour and productivity of trees (Koo, 1988; Mikkelesen *et al*., 1994; El-Salhy *et al*., 2013 and Mir *et al*., 2014).

Similarly, using slow release and bio-fertilization had a positive action on improving growth vigour and nutrient status in favour of improving the flower formation as well as its important action on maintaining a good balance between total carbohydrates and nitrogen in favour of improving the floral bud formation and initiation aids of the flowers to retention. Thus, the aforementioned points resulted in an increase in the number of fruits per trees.

Moreover, the slow release-N and bio-fertilizers improve the nutrient status and the total leaf surface area of the trees which increase the synthesis of carbohydrates and proteins and consequently enhance cell division and enlargement leading to an increase in the fruit weight and fruit pulp percentage. Also, more available carbohydrates produced and translocated to the fruit can advance the fruit maturity and improve the fruit chemical attributes.

Such findings are of a good evidence for the importance of using the slow release as well as bio-fertilizers to increase the efficiency use of fertilizers, control the release of nutrients to trees and consequently improve the soil fertility (Mir *et al*., 2014) and tree nutrient status as well as produce the high yield with good fruit quality.

Conclusion:

Therefore, it could be concluded that using either two, three fertilization sources or the slow release-N at 60% of recommended dose of nitrogen improve the tree nutrients status, yield and fruit quality leading to an increase in the packable yield, as well as minimize the production costs and environmental pollution which could be occurred by excess of chemical fertilizers.

These advantages will eventually enable growers to obtain high yield with good fruit quality. Furthermore, using the slow release and bio-fertilization sources improve the soil fertility and reduces the added fertilizer requirements. Thus, the growers are able to produce organic farming products.

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التأثيرات المفيدة لتقليل التسميد النيتروجيني المعدني علي إثمار أشجار الرمان المنفلوطي

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الملخص:

أجري هذا البحث خلال موسمي ٢٠١٣ و ٢٠١٤ علي أشجار الرمان المنفلوطي بمزرعة كلية الزراعة – جامعة أسيوط – مصر بهدف دراسة تأثير الإستبدال الجزئي للأسمدة النيتروجينية المعدنية بالأسمدة بطيئة التحلل أو الأسمدة الحيوية علي النمو والحالة الغذائية والإثمار. وإشتملت المعاملات السمادية علي التسميد بسماد (الإنسيبابين) بطئ التحلل بمعدل ١٠٠ ، ٨٠ ، ٦٠% من الجرعة السمادية الموصي بها (٦٠٠ جم نيتروجين/شجرة/سنة– معاملة المقارنة) بالإضافة إلي ٦٠% في صورة ثنائية (١٠% معدني + ٥٠% حيوي) أو الثلاثية (١٠% معدني + ٢٥% حيوي + ٢٥% بطئ). وقد صممت التجربة بنظام القطاعات كاملة العشوائية والتي تحتوي علي ست معاملات وثلاثة مكررات لكل مكررة شجرة.

وقد أوضحت النتائج التالي:

- سبب التسميد بالأسمدة بطيئة التحلل أو الصورة الثنائية (١٠% معدني [نترات الأمونيوم] + ٥٠% حيوي [آزوتين]) أو الصورة الثلاثية (١٠% نترات أمونيوم [معدني] + ٢٥% آزوتين[حيوي] + ٢٥% إنسيابين [بطئ التحلل]) زيادة جوهرية في مساحة الورقة ومحتوي الأوراق من عناصر النيتروجين والفوسفور والبوتاسيوم (NPK) مقارنة بإستخدام التسميد بالأسمدة النيتروجينية المعدنية فقط (نترات الأمونيوم ٣٣,٣%).
- أدت جميع المعاملات السمادية إلي زيادة المحصول وتقليل نسبة تشقق الثمار وتحسين خصائص الثمار من حيث زيادة وزن الثمرة ونسبة اللب وزيادة محتواها من السكريات وفيتامين V.C والأنثوسيانين وقلة محتوي العصير من الحموضة والتانينات مقارنة بإستخدام نترات الأمونيوم كمصدر للنيتروجين.
- سجلت أفضل النتائج من حيث المحصول وخصائص الثمار بإستخدام ٦٠% من الجرعة السمادية سواء من الأسمدة بطئ التحلل أو الصورة الثنائية أو الصورة الثلاثية.

من نتائج هذه الدراسة يمكن التوصية بإستخدام ٦٠% من الجرعة السمادية الآزوتية الموصي بها في الصورة الثنائية أو الصورة الثلاثية أو بطئ التحلل حيث يؤدي ذلك إلي تحسين النمو الخضري والحالة الغذائية للأشجار مع إنتاج محصول عال وثمار جيدة علاوة علي تقليل تكاليف التسميد والتلوث البيئي الناشئ عن الأسمدة الآزوتية.