

RESPONSE OF MANFALOUTY POMEGRANATE TREES GROWN IN SANDY RECLAIMED SOILS TO DIFFERENT LEVELS OF NITROGEN, PHOSPHORUS AND POTASSIUM

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Abstract: The present study was carried out in a private farm (El-Assuity Valley) Assuit Governorate, Egypt, during two successive seasons (2003 and 2004) to investigate the response of pomegranate (Manfalouty cv.) trees to different rates of nitrogen (400 and 800 g/tree), Phosphorus (150 and 300 g/tree) and potassium (250, 500 and 750 g/tree) fertilizers through the possible combinations between the investigated fertilizers rates. Generally, the obtained data showed that, the highest values of perfect flowers percentage was recorded at the beginning of flowering season (April 18th), while, the lowest values was recorded at the end of flowering season (June 1st). In this respect, the highest value was recorded when N:P:K fertilizers were applied at 800:300:750 g/tree/year.

It is clear that, initial fruit set was significantly higher at flowering dates before full bloom, while, the lowest values were recorded at the end of flowering season. However, the

pronounced effect on initial fruit set was mostly referred to N, P and K fertilization treatments. N:P:K at 400:300:500g/tree/year, was the most effective treatment. In addition, application of nitrogen at 800, phosphorus at 150 and potassium at 250 or 500 g/tree/year gave the highest yield, least fruit splitting and improved of fruit quality. However, the lowest acidity % and the highest ratio of T.S.S./acid were obtained from N, P, K at the rates of 400, 300 and 175 or 800, 150 and 250 g/tree/year.

In addition, application of nitrogen at 400 g, phosphorus at 300g and potassium at 500 or 750 g gave the best results concerning the commercial fruit yield.

As a conclusion, a combination of N:P:K fertilizers at 800:150:250 or 500g/tree/ year can be recommended for pomegranate (Manfalouty cv.) fertilization programme, to increase fruit yield/tree, improve fruit quality and decrease fruit splitting % .

Key words: pomegranate, sandy reclaimed, nitrogen, phosphorus, potassium

Introduction

The pomegranate (*Punica granatum* L.) is native from Iran to the Himalayas in northern India and cultivated over the whole Mediterranean region since ancient times. This tree can tolerate heat, wind drought, calcareous, salinity and alkaline soils and resistance to many diseases (Hayes 1970). Nutritionally, the pomegranate is used as medicine for thousands of years. It is considered to be one of the most popular fruit crops in Egypt. Assiut is considered the leader governorate in area and production because it has the suitable weather for growing and fruiting. Recently, there has been an increasing demand for pomegranate to satisfy for local requirements as well as the foreign markets to European and Arab countries.

Pomegranate growers believe that, the trees can be successfully grown under any agricultural conditions without any special fertilization program. Nitrogen is being one of the most important nutrient elements plays an important role in plant nutrient. Consequently, importance of nitrogen in the structure and metabolism of the plant leads to the necessity of having enough nitrogen supply in the soil (Hussein and Hussein, 1972). In addition, Phosphorus is a macronutrient that is used in the sugar phosphates that store energy

and is also necessary in the production of wood and fruits (Worley, 1983). Potassium is the second mineral nutrient required in large amounts by plant. Moreover, it plays an important role in enzyme activation, protein synthesis, photosynthesis, cation-anion balance, osmoregulation and cell wall stabilization, which reflected on plant growth and fruit production (Marschner, 1995). Some literatures has been done on the response of pomegranate to various fertilizers (Hussein and Hussein, 1972; Abd-Elal *et al.*, 1975; El-Kassas, 1988, Abd-Allah, 1992 and Nijjar, 1985). Accordingly, fertilization with N, P, K and their possible combinations are important factors which control the successful growth and the productivity of pomegranate trees.

Thus, the aim of the present study is to investigate the effect of different doses of NPK fertilizers on yield and fruit quality of Manfalouty pomegranate cultivar.

Materials and Methods

This investigation was carried out during two successive years of 2003 and 2004 on Manfalouty pomegranate cultivar grown at El-Assiuty Valley, Assiut governorate. The pomegranate orchard established on sandy soil under drip irrigation system. The experimental soil analysis are presented in Table (1):

Table (1): The experimental soil analysis .

Soil properties	Soil texture			Chemical properties					
	Sand %	Silt %	Clay %	PH (1:1)	Ec (1:1)	CaCo3 %	Total (N)%	Available (P) ppm	Exchangeable (K)meg/100 g soil
Value *	94.6	4.2	1.2	8.4	2.6	12.4	0.045	4.2	0.236

Each Value represents the mean of 3 replicates

The trees were 8 years old and planted at 5X5 meter apart. The trees were healthy and received the regular horticultural managements as recommended. Concerning of fertilization and apart from the treatments, only farmyard manure was applied to all trees at the rate of

40 Kg/tree during mid winter.

The experiment was executed on 120 trees. 10 uniform trees from each treatment (one tree/replicate).

Thus, each treatment consists of 10 replicates.

Table (2): The experiment involved the following treatments:

No.	Treatment	Yearly doses (g) for each tree		
1	N ₁ P ₁ K ₁	400	150	250
2	N ₁ P ₁ K ₂	400	150	500
3	N ₁ P ₁ K ₃	400	150	750
4	N ₁ P ₂ K ₁	400	300	250
5	N ₁ P ₂ K ₂	400	300	500
6	N ₁ P ₂ K ₃	400	300	750
7	N ₂ P ₁ K ₁	800	150	250
8	N ₂ P ₁ K ₂	800	150	500
9	N ₂ P ₁ K ₃	800	150	750
10	N ₂ P ₂ K ₁	800	300	250
11	N ₂ P ₂ K ₂	800	300	500
12	N ₂ P ₂ K ₃	800	300	750

Accordingly, there were 12 treatments (10 trees each) consisted of nitrogen, phosphorus and potassium fertilizers in different combinations. The previous treatments presented in Table (2) were fractionated from the beginning of January till the end of September. Nitrogen fertilizer was applied as ammonium nitrate (33.3 % N), phosphorus as phosphoric acid (80.5 % P₂O₅) and potassium as potassium sulphate (48.0 % K₂O).

The effect of the previous treatments on flowering, fruit setting, yield and some physical and chemical fruit properties were studied as follows:

Two main uniform vigorous branches in two constant directions were tagged. All perfect flowers were weekly counted along the flowering season from April 18th till June 1st. Thus, the percentage of perfect (complete) flowers were periodically estimated relative to the total produced number at the end of flowering season.

The number of perfect flowers which set fruits was also counted every day and labeled to determine the seasonal trend or the density of initial fruit set after 7 days of the emergency of perfect flowers and finally relative to total number of such complete flowers at the end of flowering season.

At harvest time, fruits were

picked on October 1st and 3rd during the first and second seasons, respectively. Fruits per tree were counted and weighted to estimate the yield as number of fruits and Kg/tree, as well as, the commercial fruit yield (kg/tree), commercial and non-commercial fruit number were estimated. Finally, the cracked fruits were sorted and counted, then the percentage of fruit splitting relative to the total number of fruits was calculated. A sample of 10 fruits of each tree were randomly taken and directly transported to the laboratory for determining physical properties, chemical properties of juice were determined according to A.O.A.C. (1975).

The experimental treatments were arranged in a randomized complete blocks design (RCBD). Data recorded in both seasons were selected to analysis of variance according to Snedecor and Cochran (1972). Means were compared using the LSD test at 5%.

Results and Discussion

A) Flowering and fruit setting:-

1) Perfect flowers percentage:

The combined effect of two rates of N, P with 3 rates of K on percentage of perfect flowers relative to the total flowers at the end of flowering season is shown in Table (3).

Concerning the effect of the studied dates, the highest values of

perfect flowers % was recorded at the beginning of flowering season (April 25th), while the lowest value was recorded at the end of flowering season (June 1st). Regarding the effect of NPK fertilizer treatments, the highest value was recorded when N P K fertilizer was applied at 800:300:750 g/tree/year. These results are in harmony with El-Kassas (1988) and Abd-Allah (1992).

2) Initial fruit set relative to the total female flowers:

Data in Table (4) clearly show the effect of different levels of nitrogen, phosphorus and potassium fertilization and flowering dates. It is clear that, initial fruit set was significantly higher at the studied flowering dates before full bloom, while, the lowest values were recorded at the end of flowering season. However, the pronounced effect on initial fruit set was mostly referred to N, P and K fertilization treatments. In this respect, N:P:K at 800:150:750g/tree/year, respectively, were the most effective treatment. These results were confirmed by Hayes (1970), El-Sese (1988) and Abd-Allah (1992). They noted that early stage of flowering season produced more than (70.80%) while, the later periods of flowering produced the lower percentage of flowering seasons.

B)Yield components and fruit quality :-

1) Yield (weight and fruits number /tree) and fruit weight:

Table (5) shows the effect of different treatments on total number of fruits/tree, yield weight (kg/tree) and fruit weight (g) of Manfalouty pomegranate cultivar during 2003 and 2004 seasons and the averages of both seasons.

Data presented in such Table indicated that N₂P₁K₃, N₂P₁K₂ and N₂P₁K₁ treatments gave the highest yield expressed as no. of fruits/tree or kg./tree in the two years of study. The averages were 285.00, 273.75 & 268.75 fruits/tree and 73.81, 69.51 & 68.49 kg./tree, respectively. However the treatment of N₁P₁K₁ resulted in the lowest values of no. of fruits/tree and yield (43.26 kg./tree). It was also observed that, the highest rates of N and K with lower P rate were the most effective treatments in increasing the yield of pomegranate tree. The tabulated data in Table (5) also indicated that, fruit weight of pomegranate greatly affected by different rates of fertilization in the two studied seasons. The most effective treatments that included higher levels of phosphorus. Moreover, the treatments that gave the highest yield resulted in the lightest fruits. In this respect, N₂P₂K₂ and N₂P₂K₃ treatments produced significantly the heaviest fruits (277.88 & 275.38), in both seasons, respectively. However the lowest average of fruit weight, however,

was recorded from $N_2P_2K_1$ treatment which averaged 240.38g. These results were confirmed by El-Kassas (1988); Hussein and Hussein (1972) and Abd-Allah (1992) on Manfalouty pomegranate trees. They reported that increasing N and P levels increased fresh weight per fruit of Manfalouty pomegranate. On the other hand, the Division of Agricultural Sciences (1977) in California stated that excessive N applications caused excessive vegetative growth and reduce fruit production.

2) Commercial, non-commercial yield and fruit splitting:

The effect of fertilization treatments on the percentage of commercial, non-commercial and fruit splitting % is shown in Table (6).

The percentage of commercial fruit number/tree and/or commercial fruit yield (kg/tree) % was decreased as the rate of applied nitrogen was increased from 400 g/tree to 800 g/tree. On the other hand, the higher rate of phosphorus and potassium combined with the lower rate of nitrogen gave the highest percentage of commercial fruit and lowest percentage of non-commercial fruits. In this respect, both $N_1P_2K_3$ and $N_1P_2K_2$ fertilization treatments exerted statistically the best results. They recorded 65.57 and 63.83% commercial fruit yield (kg/tree). On the other hand, the higher rate of nitrogen with lower rate of P and K

induced the least percentage of commercial fruits. In this respect, $N_2P_1K_1$ and $N_2P_1K_2$ treatments achieved the least percentage of commercial fruits (46.65 and 48.25%, respectively). Nevertheless, as for the percentage of fruit number/tree, it is clearly noticed that the data took the same trend of commercial fruit yield. In this concern, trees which were subjected to $N_1P_2K_3$ and $N_1P_2K_2$ treatments recorded the best results (62.25 and 60.0%, respectively). While, the reverse was true with the treated trees with $N_2P_1K_1$ and $N_2P_1K_2$ which exhibited the lowest percentage of fruit number/tree (46.63 and 48.25%, respectively).

Moreover, $N_2P_1K_1$ and $N_2P_1K_2$ treatments that gave the lowest percentage of commercial fruit, gave in the contrary the highest percentage of non-commercial fruits, they recorded 40.76 and 38.08%, respectively. On the other hand, the highest values of commercial fruits % were detected by the pomegranate trees received $N_1P_2K_2$ and $N_1P_2K_3$ treatments, while the reverse was true for non-commercial fruits (22.33 and 20.63%), respectively.

The abovementioned results were confirmed by Abd-Allah (1992) who found that the percentage of commercial or good quality fruits was significantly decreased as the rate of applied nitrogen was increased. As well it increased as

the rate of phosphorus and/or potassium was increased. Hussein and Hussein (1972) reported that when the rate of applied N was increased the commercial fruits were increased.

In respect of fruit splitting %, data presented in such Table (6) indicated that, $N_2P_2K_1$, $N_2P_1K_1$ and $N_2P_1K_3$ treatments gave the least percentage of fruit splitting in both seasons. They recorded 11.61, 12.61 and 13.18%, respectively. Meanwhile, the highest percentage of fruit splitting was markedly coupled with pomegranate trees subjected to $N_1P_2K_1$, $N_1P_2K_2$ and $N_1P_2K_3$ treatments which averaged 18.66, 17.68 & 17.13, respectively.

These results were in line with those reported by Abd-Allah (1992) on Manfalouty pomegranate cultivar. He found that, the percentage of fruit splitting significantly decreased as the rate of N fertilization increased.

3) Fruit quality:

I-TSS, acidity and TSS/acid ratio:

Data presented in Table (7) show the effect of different treatments on the percentage of total soluble solids, acidity and TSS/acid ratio of Manfalouty pomegranate cultivar during 2003 and 2004 seasons as well as average of the two studied seasons.

The data revealed that, the highest of TSS % was obtained

from $N_2P_1K_1$ and $N_2P_1K_2$ treatments, they recorded 16.85 and 16.60% as av. of both studied seasons, respectively. While $N_1P_2K_3$ treatment exhibited the lowest percentage (15.97). Also the data presented in such table indicated that, the lowest percentages of acidity were recorded when pomegranate trees (manfalouty cv.) were treated with $N_1P_2K_3$ and $N_2P_1K_1$ (1.064 and 1.054), respectively. Such previous treatments gave the highest ratio of TSS/acid. They gave, 15.056 and 16.013, respectively. These data were confirmed by Hussein and Hussein (1972), El-Kassas (1988) and Abd-Allah (1992).

II: Sugar contents:

The data presented in Table (8) indicated that, $N_2P_1K_1$, $N_2P_1K_2$ and $N_2P_1K_3$ exhibited the highest percentage of either reducing or total sugars. On the other hand, the highest percentage of non-reducing sugars was obtained from $N_2P_1K_1$ and $N_1P_1K_1$ treatments. The current data accordance with those reported by El-Kassas (1988) and Abd-Allah (1992).

The data of the present study indicated that the combinations of N, P and K at 800, 150 & 250 g/tree and 800, 150 & 500 g/tree gave the best results concerning yield and most of fruit quality characteristics as well as fruit splitting %.

On the other hand, N, P and K at

400, 300 and 500 or 750 gave the best results in respect of commercial and non-commercial yield.

As a conclusion, a combination of N:P:K fertilizers at 800:150:250 or 500g/tree/year can be recommended for pomegranate (Manfalouty cv.) fertilization programme, to increase fruit yield/tree, improve fruit quality and decrease fruit splitting %.

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إستجابة أشجار الرمان المنفلوطى المنزرع فى الأراضى الرملية المستصلحة لمستويات مختلفة من النيتروجين والفوسفور والبوتاسيوم

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أجريت هذه الدراسة فى إحدى المزارع الخاصة فى منطقة الوادى الأسيوطى (محافظة أسيوط) حيث الأرض رملية تروى بالتنقيط على أشجار رمان منفلوطى عمرها 8 سنوات مزروعة على مسافات غرس 5×5 متر خلال موسمى 2003، 2004. حيث تم تسميد هذه الأشجار بمعدلات مختلفة من الأسمدة الأزوتية والفوسفورية والبوتاسية .

وكانت المعدلات السنوية للشجرة هي:-

النيتروجين:- 800,400 جرام أزوت/ شجرة على مدار العام فى صورة نترات النشادر .

الفوسفور :- 300,150 جرام فوسفور(ف₂و₅) / شجرة على فى صورة حامض الفوسفوريك .

البوتاسيوم:-750,500,250 جرام بوتاسيوم(بو₂أ) / شجرة على فى صورة سلفات البوتاسيوم .

وكانت الإضافة فى شكل محاليل مع ماء الرى . وتم إجراء معاملات التسميد خلال الفترة من أول يناير وحتى نهاية سبتمبر من كل موسم وذلك لمعرفة تأثير هذه المعدلات على مواصفات التزهير والمحصول وجودة الثمار فى تجربة قطاعات كاملة العشوائية .

وقد أظهرت النتائج ما يلى :-

1- فى جميع المعاملات وجدت أعلى نسبة من الأزهار الخنثى والثمار العاقده فى الأسابيع الأولى من الإزهار الكامل وأقل نسبة من الأزهار الخنثى والثمار العاقده فى الأسابيع التى تلى الإزهار الكامل . كما أوضحت النتائج أن المعدل الأعلى من النيتروجين و الفوسفور والبوتاسيوم (800:300:750 جرام / شجرة) قد أعطى أعلى نسبة من الأزهار الخنثى مقارنة بباقى المعاملات .

2- إضافة النيتروجين بمعدل 800 جم والفوسفور بمعدل 150 جم والبوتاسيوم بمعدل 250 أو 500 جم قد أعطى أحسن النتائج بخصوص المحصول ومعظم خصائص جودة الثمار .

3-أدى إضافة النيتروجين بمعدل 400 جم والفوسفور بمعدل 300 جم والبوتاسيوم بمعدل 500 أو 750 جم إلى زيادة وزن الثمار وعدد الثمار التجارية مع قلة الحموضه .

وبناءً على ذلك :- فإنه للحصول على أفضل خصائص جوده مع قلة نسبة تشقق الثمار يفضل التسميد بإضافة النيتروجين بمعدل 800 جم والفوسفور بمعدل 150 جم والبوتاسيوم بمعدل 250 أو 500 جم/شجرة