Assiut Journal of Agricultural Sciences 54 (3) 2023 (107-118) Website: http://ajas.journals.ekb.eg/
ISSN: 1110-0486 / EISSN: 2356-9840 E-mail: ajas@aun.edu.eg

(Original Article)

Reducing Environmental Pollution through Biotechnology Fertilization in Pomegranate Orchards

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DOI: 10.21608/ajas.2023.212566.1259

Abstract

This study was processed at the experimental orchards, Agriculture of Faculty, Assiut University, Egypt, to survey impact of nitrogen fertilizers at different sources on Manfalouty pomegranate trees growth, yield and fruit quality in 2020 and 2021seasons. The research design was randomized complete block of eight treatments with three replications.

The results findings as follow

Amending the advised of nitrogen dosage as twice (mineral-N plus organic or bio-form) or three sources of nitrogen fertilization were used: mineral-N, organic-N and bio-N form (mineral plus organic and bio-form) materially raised the shoot length, leaf surface, chlorophyll, leaf content of N, P and K comparing to mineral-N source only (control). All amending treatments materially raised the yield/tree, commercial fruit % and materially reduced the percentage of fruit cracking and sunburn comparable to use control. Amending with any triple form (organic + bio + mineral) materically amended the fruit traits due to raising the fruit weight, arils percentage, soluble solid contents, sugar and contents of anthocyanin and vitamin C and reducing the acidity and tannins contents comparing to use control treatment.

It is obvious from the obtained data that the interest of organic and bio manures for pomegranates forms, where this is desired to amend the trees growth and nutritional status and production quality and then the package yield. Moreover, these amending reduce the production cost and ecological contamination.

Keywords: *Maturation, Biotechnology, Pomegranate, Yield, Pollution.*

Introduction

Pomegranate trees are among the most important commercial fruit trees economically and biologically. They are bearing the conditions of environmental stress, whether the dryness and salinity of soil. In additional, it tolerant the climate stress in terms high or low temperature. Moreover, all parts of pomegranates have great economic importance. They can use as fresh fruits, manufacturing or carful and resistance to some diseases. These importance effects and uses because they contain important nutrients and substances. In addition, they contain antioxidants

Received: 24 May 2023/ Accepted: 18 June 2023/ Published online: 1 July 2023

that have a beneficial effect on treatment or the vitality and activity of cell and tissues (Paranjpe, 2001; Michel *et al*., 2005; Martins *et al*., 2006 and Ephraim and Robert, 2007).

Overall pomegranate farms area was rating to be around 0.5% of overall fruit acreage in Egypt (76924 fed.). Assiut Governorate is counted leading reproducer of pomegranate Egyptian due to M.A.L.R. (2020). Newly, there has been a raising request of pomegranate to enough the demand local and the export markets.

Vegetative growth, yield and fruit traits of pomegranate trees materially influence due to N fertilizers used (Hunter *et al*., 2011 and Srivastava and Malhotra, 2017).

Nitrogen is a very important and essential nutrient for all plants and trees. It is responsible for the amino acids' formation, chlorophyll and natural hormones. Several research had shown that its shortage is accompanied by signs of lack of growth, lowest yield and poor of fruit quality (Marschner, 2012).

Nitrogen fertilization capacity down poor field and normal irrigation cases ranges around 30 to 40 (Saharawat, 1979). Nitrogen lack by leaching, volatilization, denitrification is representing one of the major serious problems of the Egyptian lands. Therefore, attention must be paid to add nitrogen from sources that reduce this loss as a solution this problem. In general, the best solution is to pay attention to fertilization technology to reduce easily soluble chemical fertilizers. These management reduce production biological harmful damage.

From here, attention must be paid to modern methods of fertilization. These modern methods represented by composting methods and good horticultural practices. In addition, use organic and bio-manures through biotechnology increases fertilizer efficiency. These modern methods lead to an increase in vegetative growth and yield with upgrading the fruit quality (Aseri *et al*., 2008; Mosa *et al*., 2014; El-Salhy *et al*., 2015 and Amin *et al*., 2017).

Production of horticultural crops linked for alteration of system and the evaluation of modern technologies associated integrated nutrient arrangement training. Where to add of organic manures is a productive style that averts or largely prevents the artificial chemical manures used. Bio-manures, that involve phosphate-solubilizing bacteria (PSBs), solidarity and non-solidarity, N_2-fixing bacteria and arbuscular mycorrhizal (AM) fungi. Amending with organic and bio-manures on increasing growth and yield that obtained momentum in new years in order to highest value and dangerous impact of chemical manures (Khanizadeh *et al*., 1995 and Aseri *et al*., 2008).

Replacement the chemical manure with organic and bio-manure count on the rotation plants and animal wastes. The use of organic and bio manures raises land productivity and facilitate absorption nutrients. In addition, it is considered are the best to avoid all forms of environment pollution arising from pollution tradition form way master (Miller et al., 1990 and Yagodin, 1990; Abd-Ella *et al*., 2010 and El-Salhy *et al*., 2015). Several previous studies have shown the magnitude of using

organic and bio-fertilizers on recovering the pomegranate trees vegetative growth, yield and fruit quality (Wardee, 2007; Aseri *et al*., 2008; El-Salhy *et al*., 2015; Amin *et al*., 2017 and El-Salhy *et al*., 2022).

So, the research was aforethought to survey influence of organic and bio-manuring on Manfalouty pomegranate trees growth and yielding as an attempt to increase fertilization efficiency and reduce environmental pollution.

Materials and Methods

This research performed in the two sequential of 2020 and 2021 seasons on pomegranate of Manfalouty trees implanted at the research farm of Faculty of Agriculture, Assiut University, Assiut Governorate, Egypt. Soil texture is clay, and its estates shows in Table (1), according to Wilde *et al*. (1985).

Table 1. Some physiochemical soil characteristics (0-90 cm deep) of the research site.

Soil estate	Rate	Soil estate	Rate
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
Water saturation (%)	26.29	DTPA extractable Fe (ppm)	13.14
Field capacity, FC (%)	48.43	DTPA extractable Mn (ppm)	15.16
pH (1-2.5)	8.22	DTPA extractable Zn (ppm)	2.35
EC (ds m^{-1})	2.69	DTPA extractable Cu (ppm)	2.4
$CaCO_3$ (%)	3.66		

They are intact and does not show any symptoms of deficiency of nutrient or diseases. They selected and divided for implementation of this study twenty-four trees, 40 years. The selected trees received the same horticulture practices excepted fertilization treatments. Eight fertilization treatments were arranged as follows:

1-Adding the recommended nitrogen dosage (RND) at 500 g N/tree as chemical source (control).

2-Adding RND at 75% chemical-N and 25% out of RND as organic source (humic acid).

3-Adding RND at 50% chemical and 50% organic (humic acid).

4-Adding RND at 75% chemical and 25% bio (yeast).

5-Adding RND at 50% chemical and 50% bio-form (yeast).

6-Adding RND at 25% chemical plus 50% organic and 25% bio.

7-Adding RND at 25% chemical plus 25% organic and 50% bio.

8-Adding RND at 25% chemical plus 37.5% organic and 37.5% bio.

The study design as a randomized block (CRB) with three recurrences of treatment, tree each one complete. Humic acid 60% N apply once at beginning of the winter seasons. Yeast as a bio-fertilizer was stimulated before applying by using sugar solution at 5% and was applied in two similar doses at start of growth

and after month. Using mixing of yeast and wet sand pre applied at ring surround the tree trunk, then immediately irrigated. Mineral-N source (NH_4NO_3) was applying thrice times at March, May and August.

The next traits were amounted through two years.

A- Growth attributes

Four shoots of similar growth and distribution over four growth directions were chosen in April to measure the next vegetative growth attributes:

1- Length of shoot (cm).

2- Area of leaf (cm^2), was estimated as according to Ahmed and Morsy (1999).

3- Content of leaf chlorophyll was measured using chlorophyll meter (Minolta SPAD 502 plus).

B- Nutritional status of leaves

For nutrients (N, P & K) estimation, 50 leaves were taken randomly from non-fruiting shoot in September every season. The leaf sample was processed and digested according to (Wilde *et al*., 1985). Then estimated nitrogen by the micro-Kjeldahl methods (Bremner and Mulvaney, 1982), phosphorus and potassium by calorimetrically and flame photometer, respectively (Jackson, 1958).

C- Yield

Fruit was harvested and the heinous fruits was separated to count the percentage of sound splitting and sunburning fruits.

D- Fruit quality

Ten fruits were taken randomly of replicate in order to evaluate the physical traits as weight of fruit and arils %. Also, the juice chemical traits as soluble solids and reducing sugar contents and total acidity and vitamin C were estimated due to A.O.A.C. methods (1985). Additionally, the juice anthocyanin content calculated due to Rabino and Mancinelli (1986).

Gained data were statistically analyzed according to Gomez and Gomez (1984) and Mead *et al*. (1993) using the New L.S.D. values at 5% to determine the worthy of distinction between various treatment average.

Results

1- Influence of nitrogen manuring on growth and nutritional status

Current data in Tables (2 & 3) exhibited the influence of various sources of nitrogen manuration on length of shoot, leaf area, total chlorophyll and percentage leaf N, P and K in 2020 and 2021 seasons. It is clear that the results take the same direction in the two seasons.

Table 2. Influence of biotechnology fertilization on shoot length and leaf traits of Manfalouty pomegranate trees in season of 2020 and 2021

Characteristics Treatment		Length shoot (cm)			Area leaf (cm^2)			Chlorophyll SAPD		
		2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
Recommended	**T_1**	73.26	74.87	**74.07**	6.36	6.92	**6.64**	56.89	54.18	**55.19**
75% min + 25% humic acid	**T_2**	78.18	80.34	**79.26**	7.08	7.71	**7.40**	58.85	57.45	**58.15**
50 min + 50% humic acid	**T_3**	77.91	79.51	**78.71**	6.99	7.58	**7.29**	59.11	57.51	**58.31**
75 min + 25 yeast	**T_4**	78.33	80.15	**79.24**	6.83	7.43	**7.13**	58.83	57.16	**58.00**
75 min + 50 yeast	**T_5**	79.11	81.50	**80.31**	6.78	7.40	**7.09**	58.90	57.39	**58.15**
25 min + 50 hum + 25 yeast	**T_6**	79.96	80.96	**80.46**	7.78	8.45	**8.12**	62.13	60.74	**61.44**
75 min + 25 hum + 50 yeast	**T_7**	80.25	82.11	**81.18**	8.11	8.86	**8.49**	62.78	60.89	**61.84**
25 min + 37.5 of hum. + yeast	**T_8**	80.81	81.34	**81.08**	8.23	8.73	**8.48**	63.12	60.32	**61.72**
New LSD 5%		**4.38**	**4.15**		**0.38**	**0.42**		**2.15**	**2.52**	

Table 3. Influence of biotechnology fertilization on leaf N, P and K of Manfalouty pomegranate trees in season of 2020 and 2021

Characteristics Treatment	Leaf-N %			Leaf-P %			Leaf-K %		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	1.46	1.53	**1.50**	0.201	0.205	**0.203**	1.18	1.25	**1.22**
T_2	1.51	1.63	**1.57**	0.216	0.228	**0.222**	1.25	1.35	**1.30**
T_3	1.55	1.68	**1.62**	0.225	0.231	**0.228**	1.29	1.38	**1.36**
T_4	1.59	1.72	**1.66**	0.231	0.241	**0.236**	1.33	1.42	**1.38**
T_5	1.59	1.71	**1.65**	0.228	0.243	**0.236**	1.31	1.41	**1.36**
T_6	1.69	1.81	**1.75**	0.242	0.250	**0.246**	1.42	1.46	**1.44**
T_7	1.71	1.80	**1.76**	0.240	0.258	**0.249**	1.41	1.48	**1.45**
T_8	1.66	1.80	**1.73**	0.235	0.261	**0.248**	1.37	1.46	**1.42**
New LSD 5%	**0.06**	**0.06**		**0.011**	**0.018**		**0.05**	**0.06**	

Data declared that the all vegetative attributes and leaf-N, P and K percentage materially influenced due to use different sources of nitrogen manuration comparing with using the RND as mineral-N alone. All manuring treatments materially raised length of shoot, area of leaf and the percentage of chlorophyll and leaf-N, P and K comparison with use mineral-N alone (T1). Moreover, adding the RND as triple form at 25% mineral-N plus 25% organic and 50% bio (T7) gave the maximum shoot and leaf traits than twice form or check treatment (T1). Highest vegetative attributes reading recorded of trees manured by mixture manure from mineral-N, organic and bio (T6, T7 & T8). No significant various on these attributes due to manured with thrice form whatever 25% mineral-N plus 50% organic and 25% bio (T6) or 25% mineral plus 50% organic and 25% bio-form (T7) or 37.5% mineral-plus 37.5% organic and 50% bio (T8). No significant various for manuring by double form at 75% mineral plus 25% organic (T2) comparison to any twice form (T3, T4 or T5).

The percentage of increasing of leaf area (22.29, 27.86 & 27.71%), chlorophyll (11.33, 12.05 & 11.83%) for average of the two seasons) due to T6, T7 and T8 compared control (T1), respectively. Conforming increasing percentage of N% were (16.67, 17.33 & 15.33%, respectively.

2- Influence of nitrogen manuring sources on yield

Data in Tables (4) confirmed that manured the trees with double form or triple form materially raised yield and commercial fruit percentage comparison to with applying RND mineral-N alone (control, T1). Conversely these manuring applying materially reduced percentages of fruit cracking and fruit sunburn comparison with control.

Table 4. Influence of biotechnology fertilization on yield components of Manfalouty pomegranate trees in season of 2020 and 2021

Characteristics / Treatment	Yield/tree (kg)			Cracking fruit %			Commercial fruit %		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	80.8	94.6	**87.7**	15.11	16.35	15.73	60.61	61.14	60.88
T_2	98.9	118.5	**108.7**	9.86	8.81	9.34	74.90	77.41	76.16
T_3	101.3	120.3	**110.8**	8.36	7.45	7.91	77.53	79.94	78.74
T_4	103.1	122.8	**113.0**	9.33	8.21	8.77	74.78	77.96	76.37
T_5	108.3	127.4	**117.9**	6.68	6.13	6.41	79.83	81.77	80.80
T_6	110.3	130.5	**120.4**	6.79	6.25	6.52	80.26	82.00	81.13
T_7	114.8	135.2	**125.0**	6.83	6.12	6.48	80.35	82.02	81.19
T_8	112.6	133.8	**123.2**	6.59	6.00	6.30	80.98	82.72	81.85
New LSD 5%	**6.81**	**7.39**		0.93	1.12		3.85	4.28	

The obtained yield/tree was 87.7, 108.7, 110.8, 113.0, 117.9, 120.4, 125.0 & 123.2 kg/tree) and commercial fruit percentage (60.88, 76.16, 78.74, 76.37, 80.80, 81.13, 81.19 & 81.85% as average of the two seasons) due to T1 to T8, respectively.

Increasing percentage of yield/tree and commercial fruit percentage were attained (37.29, 42.53 & 40.48) and (33.26, 33.36 & 34.44%) due to use thrice form (T6, T7 and T8) compared to T1, respectively. Also, the percentage of fruit cracking and fruit sunburn were (15.73, 9.34, 7.91, 8.77, 6.41, 6.52, 6.48 & 6.30) and (23.40, 14.26, 13.36, 14.86, 12.80, 12.35, 12.34 & 11.86% as av. of two seasons) due to T1 to T8, respectively.

The highest yield/tree and least heinous percentage of fruits were found of trees that applied by three various manures source as 25% mineral plus 75% organic and bio-form (T6, T7 & T8). Hence, it is obvious the manuring by a combined of three sources manures have useful influences effects for production of pomegranate.

3- Influence of nitrogen manuring sources on fruit traits

It is observed from the results in Tables (5, 6 & 7) that the manuring with any double form or triple sources manuring materially progressed the fruit traits as raising the weight of fruit, percentage of arils and their contents of soluble solids, reducing sugar, anthocyanin and V.C and reducing contents of acidity and tannins

comparison with use (RND) as mineral-N only. No material variations in these attributes due to manure by either mineral plus organic or mixture of the three sources. Adding combination of the three sources had the maximum rates of most studied traits. The obtained weight of fruit was 361.7, 401.1, 407.2, 413.2, 416.9, 434.6, 442.3 & 444.9 g as av. of the two seasons for T1 to T8, respectively. The identical TSS and vitamin C contents were 14.85, 15.74, 15.63, 15.84, 15.95, 15.97, 15.83 & 15.80% and 24.25, 28.27, 28.91, 29.24, 29.23, 30.73, 30.56 & 30.76 mg/100g as av. of two seasons, respectively. The increasing percentage in fruit weight was (20.15, 22.28 & 23.00% as an av. of the two seasons due to use triple form (T6, T7 & T8) over the control, respectively. Moreover, the identical increasing percentages of TSS% and V.C contents were 8.23, 6.59 & 7.18 and 27.05, 27.20 & 27.90% as an av. of the two studied seasons, respectively.

Table 5. Influence of biotechnology fertilization on sunburn %, fruit weight (g) and arils % of Manfalouty pomegranate trees in season of 2020 and 2021

Characteristics Treatment	Sunburn %			Fruit weight (g)			Arils %		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	24.28	22.51	23.40	345.8	377.6	361.7	55.13	56.29	55.71
T_2	15.24	13.28	14.26	383.5	418.7	401.1	60.46	62.35	61.41
T_3	14.11	12.61	13.36	389.2	425.2	407.2	61.11	63.12	62.12
T_4	15.89	13.83	14.86	395.1	431.3	413.2	60.73	62.41	61.57
T_5	13.49	12.10	12.80	398.2	435.5	416.9	61.52	63.56	62.54
T_6	12.95	11.75	12.35	419.5	449.6	434.6	61.78	63.40	62.59
T_7	12.82	11.86	12.34	428.3	456.3	442.3	61.83	63.85	62.84
T_8	12.43	11.28	11.86	431.3	458.5	444.9	62.11	64.11	63.11
New LSD 5%	1.63	1.49		21.83	23.11		3.11	3.85	

Table 6. Influence of biotechnology fertilization on TSS, reducing and anthocyanin of Manfalouty pomegranate trees in season of 2020 and 2021

Characteristics Treatment	TSS %			Reducing %			Anthocyanin mg/100g		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	14.51	14.18	14.85	12.69	13.10	12.90	43.38	45.63	44.51
T_2	15.33	16.14	15.74	13.49	14.35	13.92	49.75	53.81	51.78
T_3	15.16	16.10	15.63	13.34	14.10	13.72	48.96	52.80	50.88
T_4	15.43	16.25	15.84	13.55	14.10	13.83	50.22	54.38	52.30
T_5	15.48	16.51	15.95	13.56	14.48	14.02	49.83	53.18	51.51
T_6	15.50	16.43	15.97	13.74	14.50	14.12	51.20	54.96	53.08
T_7	15.38	16.18	15.83	13.61	14.20	13.91	49.54	53.65	51.60
T_8	15.33	16.27	15.80	13.48	14.31	13.90	51.71	55.10	53.41
New LSD 5%	0.58	0.46		0.43	0.38		2.11	1.99	

Table 7. Influence of biotechnology fertilization on V.C, acidity % and tannins % of Manfalouty pomegranate trees in season of 2020 and 2021

Characteristics	V.C			Acidity %			Tannins %		
Treatment	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
T_1	23.95	24.55	24.25	1.58	1.53	1.56	2.68	2.35	2.52
T_2	27.71	28.83	28.27	1.33	1.26	1.30	2.16	1.86	2.01
T_3	28.33	29.49	28.91	1.27	1.21	1.24	2.08	1.77	1.93
T_4	28.62	29.86	29.24	1.28	1.23	1.26	2.10	1.81	1.96
T_5	28.81	29.65	29.23	1.26	1.21	1.24	2.06	1.75	1.91
T_6	30.26	31.19	30.73	1.24	1.18	1.21	2.04	1.78	1.91
T_7	29.88	31.23	30.56	1.22	1.18	1.20	1.98	1.75	1.87
T_8	30.11	31.40	30.76	1.22	1.17	1.20	1.89	1.72	1.81
New LSD 5%	1.41	1.29		0.11	0.10		0.08	0.10	

Therefore, this fertilization program is very important and necessary to raise the production and improve the fruits properties. These improving cause an increase in their price and thus an increase economic return.

In addition, using this program leads to reduce in production costs and environmental pollution resulting from frequent use of chemical fertilizers.

Discussion

Nitrogen is considered one of the most material nutrients for trees as it as component 1-5% of the curt matter. It is also the basal unity components of much organic components such as acids, protein and enzymes. Nitrogen has the most influential compound on soil fertility (Marschner, 2012). Therefore, it must be added in large quantities and repetitions that could be costly matter for farm practices and environmental pollution. Therefore, modern technologies which build on utilize biological manuring must be utilized for decreasing utilize of mineral nitrogen manures and their integrity of soil, animals, human and environment (Verma, 1990; Amin *et al*., 2017 and El-Salhy *et al*., 2022).

Utilizing biological manures induce positive impacts such as promoting the bio-activity, raising the absorption nutrients and increasing the fertilization efficiency. They also, promotes of the trees nutritional status and formation of carbohydrates and proteins that induces equilibrium among nutrients and the carbohydrates of synthesis in plant (Subba Rao, 1984 and Kannaiyan, 2002). Humic acid could be helping to reduce the rate of soil fertilizers need, enhance nutrient efficiency, replace synthetic plant growth regulators, improve yield and fruit quality. Also, using humic acid had many beneficial effects on growth and nutrient soil status of trees with less negative effects on the environment (Kok and Bal, 2016 and Popescu and Popescu, 2018). In addition, yeast has risen content of mineral, especially N, P and K, proteins, vitamin B and cytokinin. Also, it was releasing CO_2 that promotes net photosynthesis. Moreover, the importance of yeast, and known produces of organic acid, and their high survival rate under extremist soil cases in transformation of rock phosphates and insoluble carbonate induce raises in ready phosphorus, Fe and other micro-nutrients (Vassileva *et al*., 2000).

Such effectives behold the most remarkable modulation of reclamation soil and promoting especially for Egyptian soils having alkaline and high pH are induce depressed in their ready nutrients. These stimulates of trees vegetative and nutritional status lead to rising uptake of nutrient and carbohydrates of formation and proteins. Also, maintaining a good equilibrium among total carbohydrates and N in favoritism of promoting floral bud induction and fertility coefficient. Moreover, it promoted the ripening and promoted fruit quality.

Organic manuring has many advantages i.e., raise the promoting of micro flora, soil structure soil aggregation, organic matter of soil, capacity of water holding, content of soil humus and the obtainable of maximum elements. This advantage led to raise the nutrients absorption, promote the formation of organic foods and cell division (Miller *et al*., 1990).

The favorable impactive of the biological manuring on the vegetative of growth trees were recorded by Nijjar (1985), Miller *et al*. (1990) and El-Salhy *et al*. (2015). Who pointed which using whatever organic-N only or alongside with mineral sources was functional on progressing trees growth traits comparing to utilize N totally as a mineral source.

The present study confirms the prominence of growth and yielding of pomegranate trees organic and bio-N manuring on. Nitrogen is demanded for common fruit growth. Using of mineral N manuring alone induce little size, low coloring and retired maturation. The opposite using triple form caused about 28% raise in leaf area 12% total chlorophyll and 16% in leaf-N content comparing to use mineral-N only. There more, utilizing triple form raised the yield around 40% and fruit weight around 23% and reduced the fruit rending percentage about 58% comparing to the control. Too, such amending raised the TSS and vitamin C of juice around 7% and 26% comparing with control, respectively. These findings are of writing by these reported with Aseri et al. (2008), Mosa *et al*. (2014), El-Salhy *et al*. (2015), Amin *et al*. (2017) and El-Salhy *et al*. (2022). Who exposed that there is a beneficial effect of due using biological manuring for pomegranate trees production.

Conclusion

Accordingly, it is possible to recommend the importance of fertilized in double or triple form. These forms cause the improvement of the nutritional status of the trees and raise the yield and promote the fruit traits. In addition, such treatments lead to an increase in the sold crop and an increase the economic return, which reduces the production cost and pollution of environmental resulting from the increased use the chemical fertilizers.

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تقليل تلوث البيئة من خلال تقليل التسميد المعدني في بساتين الرمان

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الملخص

أجريت هذه الدراسة خلال ثلاث مواسم 2020، 2021 بمزرعة كلية الزراعة – جامعة أسيوط مصر لدراسة تأثير إضافة خليط من الأسمدة العضوية والحيوية على النمو الخضري والحالة الغذائية والمحصول وخصائص ثمار أشجار الرمان المنفلوطي مقارنة بإضافة الأسمدة المعدنية فقط. حيث تم إضافة الأسمدة المعدنية على ثلاث دفعات (مارس – مايو – أغسطس) بينما أضيفت الأسمدة العضوية مرة واحدة خلال شهر ديسمبر والأسمدة الحيوية مرتين في بداية النمو وبعد شهر.

وقد أظهرت النتائج ما يلي

سبب استخدام الجرعة السمادية من خلال الصورة الثنائية (معدني + عضوي أو حيوي) والثلاثية (معدني + عضوي + حيوي) زيادة معنوية في طول الأفرع ومساحة الأوراق ومحتواها من الكلوروفيل والعناصر الغذائية مقارنة باستخدام الجرعة السمادية كلية من الأسمدة المعدنية. مما أدي إلي تحسين المساحة الكلية للأوراق والحالة الغذائية للأشجار.

أدت جميع المعاملات السمادية إلي زيادة المحصول بينما حدث نقص معنوي في نسبة تشقق الثمار ولسعة الشمس وبالتالي زيادة نسبة الثمار الجيدة الصالحة للتسويق مقارنة باستخدام الأسمدة المعدنية فقط. وسجل أعلي محصول وأقل نسبة للثمار الغير جيدة بالأشجار المسمدة بالصورة الثلاثية (25% معدني + 37,5% عضوي + 37,5% حيوي).

لم تسجل فروق معنوية في النمو والإثمار نتيجة استخدام أي صورة من صور التسميد الثلاثي.

أدت جميع المعاملات السمادية إلي تحسين خصائص الثمار من حيث زيادة وزن الثمرة ونسبة اللب وكذلك زيادة محتواها من السكريات والأنثوسيانين وفيتامين (C) مع نقص نسبة الحموضة الكلية والتانينات. وذلك مقارنة باستخدام الأسمدة المعدنية فقط.

من نتائج هذه الدراسة يمكن التوصية باستخدام الأسمدة في الصورة الثلاثية (معدني + عضوي + حيوي) حيث يؤدي ذلك إلي تحسين النمو الخضري والحالة الغذائية للأشجار مع إنتاج محصول عال وثمار جيدة علاوة على تقليل تكاليف التسميد والتلوث البيئي الناشئ عن الأسمدة الازوتية الكيميائية.