Effect of organic and slow-release fertilizers on the growth and fruiting of Ewaise mango trees

By

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Abstract

This study was conducted during the 2020 and 2021 seasons on a 30-year-old Ewaise mango cultivar. The trees were grown in a private orchard located at Kom- Omboo city, Aswan Governorate, Egypt. The compost as an organic fertilizer, fortified with EM was used as a partial replacement for the mineral N fertilizer or slow release. The trial was nominated as a complete randomized block design. The collected results clarified that adding the recommended dose of nitrogen (RDN) via 25% as a mineral source and 25 to 50% as an organic one enriched with 50 or 25% of EM or 60 to 80% slow release improved the shoot length and leaf area as well as they're of total chlorophylls, N, P and K contents compared to use the RDN only as a mineral N fertilizer. The organic fertilizer enriched with 37.5% EM significantly induced these traits more than other used treatments. Moreover, the N fertilization with a combination of mineral and organic N sources with a bio-fertilizer or slow release significantly increased the yield and fruit quality compared to using the RDN only as a mineral source. The preferment in the yield and fruit quality was correlating with increasing the level of the bio-form from 25 to 50% of RDN. It is explicit that such an N fertilization program is very important for mango fruit production. It improves the nutrient status, yield, and fruit quality of mango trees. In addition, it reduces production costs and negative effects on the environment due to the use of chemical fertilizers.

Keywords: Organic, bio-fertilization, slow-release, mango, yield, nutrient status, environmental pollution.

Introduction

Mango is one of the important sectors between tropical and subtropical fruits. In Egypt, it ranks after citrus. According to **M.A.L.R. (2021),** the acreage of mango reached 321040 fed. which produced around 766128 tons annually. Enhancing the yield and quality of mangoes can be achieved through better cultural practices such as fertilization. Mango trees need a lot of fertilizers, especially nitrogen. Fertilization is one of the most important items to improve soil fertility and increase crop yield. Previous studies suggested that as much as 40-

50% of the applied nitrogen is not available to trees because of leaching, denitrification, and volatilization. Nitrogen fertilization effects depend upon the nutrient status of the soil and applied quantity as well as, sources and methods of application (**Koo, 1998 and El-Aila *et al*., 2001**). This adverse phenomenon not only has economic implications but also environmental pollution (**Bertol *et al*., 2017**).

The main goal of natural farming is to produce healthy fruits without the use of chemical fertilizers, synthetic auxins, and pesticides and without causing adverse effects on the natural environment (**Dahama, 1999; El-Salhy, 2004)**. Using organic fertilizers can help to stimulate soil fertility and biological activity, form natural hormones, antibiotics, and B vitamins, and develop plant roots as well as avoid environmental pollution that may result from conventional agriculture techniques. Most organic fertilizers depend on using recycled animal manure and farm residues to produce compost (**Russo and Perlyn, 1990 and Yagodin, 1990**). Bio-fertilization is useful in enhancing biological activity due to the high amounts of its own microorganism. It is responsible for the quell of plant pathogens and diseases conservation, solubilization of soil minerals and promotion of photosynthetic efficiency and biological N fixation. Nitrogen fixing cyanobacteria and the effective microorganisms (EM) are used to improve the soil fertility, fertilizer efficiency and productivity of fruit trees (**Myint, 1999; Kannaiyan, 2002 and El-Salhy *et al*., 2006**). In addition, adding slow-release nitrogen fertilizers reduce the total amount of nitrogen needed, the number of fertilizing applications, the residual of nitrogen fraction through the soil and plant as well as improves the efficiency of nitrogen fertilizer (**Wang and Alva, 1996 and Hassan *et al*., 2010**).

Preceding studies confirmed the benefits of using appropriate amounts of N as in organic bio and slow release on growth and fruiting of mango orchards (**Mohamed and Ebeed, 2006; Mouftah, 2007; Santos, 2007; Mohamed *et al*., 2008; Ranjit *et al*., 2008; Abdel-Monem *et al*., 2009; Umesh *et al*., 2010; El-Kosary *et al*., 2011; El-Khawaga, 2012; Peralta-Antonio, 2014 and El-Salhy *et al*., 2016).**

Therefore, the main objective of the current study is to examine the partial reduction of mineral N fertilization of Ewaise mango orchards using organic and slow-release fertilizers, as alternatives, to protect the environment and minimize production costs.

Materials and Methods

This study was implemented during the two sequential seasons of 2020 and 2021 on eighteen 30-year-old Ewaise mango trees cultivated onto seedling rootstock planted at 7x7 M.

apart. Trees were cultivated in a private mango farm that was located in the Kom-Omboo district, Aswan Governorate, Egypt. where the soil has a sandy texture. The analysis of the orchard soil is presented in Table (1).

Table (1): Some physical and chemical properties of the tested orchard soil.

Soil property	Value	Soil property	Value
Sand (%)	72.20	Total N (%)	0.09
Silt (%)	16.00	$NaHCO_3$-extractable P (mg/kg)	5.1
Clay (%)	11.80	NH_4AOC-extractable K (mg/kg)	115
Texture	Sand	EDTA-extractable micronutrients (mg/kg):	
pH (1:2.5 suspension)	8.11	Zn	1.31
EC (1:2.5 extract) (dS/cm)	4.22	Fe	2.1
O.M. (%)	0.9	Mn	2.2
$CaCO_3$ (%)	1.29	Cu	0.7

The experiment included six nitrogen fertilization treatments as follows:

1- Application of the recommended dose of nitrogen (RDN) via 1000 g N/tree/ year (3.0 kg ammonium nitrate/tree/year) as mineral N form (T_1) (control).

2- Using RDN as 25% mineral, 25% organic, and 50% bio (EM) fertilizers (T_2).

3- Using RDN as 25% mineral, 50% organic, and 25% bio (EM) fertilizers (T_3).

4- Using RDN as 25% mineral, 37.5% organic, and 37.5% bio (EM) (T_4).

5- Application of the 80% RDN via slow release (T_5).

6- Application of the 60% RDN via slow release (T_6).

The trail was designed in a randomized complete block design with three replications per treatment, one tree each.

The source of mineral nitrogen was ammonium nitrate (33.5% N) applied in three equal batches on the first week of March, April, and May. Organic fertilizer (compost, 4.9% N) was added once in the last week of December in holes 100 cm apart from the trunk of each tree at 0.8 depth. EM was added in two equal batches, at the beginning of growth and one month later. Effective microorganisms (EM) are a bio-fertilizer that contains a mix of photosynthetic and lactic acid bacteria as well as actinomyces, yeasts, and fungi, where the slow release is perleka (19.8%) was applied once on at the growth starts.

Regular agricultural and horticultural practices are used in the orchard including pruning, hoeing, P and K fertilization, and irrigation with Nile water as well as pathogens, pests, and weed control were carried out as usual. The following measurements were possessed on the selected trees.

1- Shoot growth:

Twenty new shoots during the spring growth outburst were selected from ten labeled secondary branches/tree to size their growth as:

- Shoot length (cm). - Shoot diameter (cm). - Leaf number/shoot.

- Leaf area, twenty leaves below panicles in the chosen shoots were taken on the first week of July for measuring the leaf area (cm^2) according to **Ahmed and Morsy (1999)**.

2- Leaf chlorophyll:

The content was recorded by using a chlorophyll meter (Minolta SPAD 502 plus). Using ten leaves from the fourth terminal expanded leaf of the shoot.

3- Measurements of N, P, and K contents of leaves

The same previous leaves that were taken for leaf area measurement were well washed with running tap water followed twice using distilled water, oven-dried at 70°C for 24 hours, and ground in a stainless-steel mill. Wet digestion was done using concentrated sulphuric acid overnight. The digest was boiled and cooked using H_2O_2 till colorless. Nitrogen, P, and K contents of leaves were determined in the digest on the dry weight basis as described by **Chapman and Pratt (1965**).

4- Yield and fruit characteristics.

Harvest was during the regular commercial harvesting time under Aswan governorate climate (end of June) in both seasons. The yield expressed in Kilograms was recorded.

Ten fruits were randomly taken from the yield / of each tree to nominate the following physical and chemical properties of the fruits.

1- Fruit weight (g.)
2- The weight of pulp, peel, and seed and then, the percentage of pulp were calculated.
3- Percentages of the total soluble solids as well as sugar contents, total acidity as g citric acid (g/100 ml pulp) and ascorbic acid (mg/100 ml juice) were nominated according to **A.O.A.C.** methods (**1995**).
4- Total fiber %: Determination of raw content was accomplished using acetic acid glacial and nitric acid mixture at a ratio of 10.1 on 1 g sample according to the official methods described in **A.O.A.C. (1995)**.

All the collected data during this study were tabulated and statistically analyzed. The differences between various treatment means were compared using the new L.S.D. values at 5% according to **Gomez and Gomez (1984) and Mead *et al*. (1993).**

Results

1- Vegetative growth as well as leaf total chlorophylls, N, P, and K:

Tables (2 & 3) clarify the impact of nitrogen fertilization sources on the shoot length, leaf area, and total chlorophylls as well as leaf N, P, and K contents of Ewaise mango trees during the 2020 and 2021 seasons. It is evident that the results clarified a similar trend through the two studied seasons. Such results indicate that the application of the required N through using 25% of the recommended dose of nitrogen (RDN) as mineral N along with using 25 or 50% as an organic form enriched with 50 or 25% as a biofertilizer as effective microorganisms (EM) or 60-80% (RND) via slow release significantly improved such traits compared to use RDN only as a mineral N fertilizer. The upgrading of such growth traits was linked with increasing the applied level of the biform from 25 to 50% or slow release from 60 to 80%. Moreover, applications of the suitable amount of N via 25% as a mineral N as well as 37.5 organic N with 37.5% biofertilizers or 80% RND slow release significantly encouraged the shoot length and leaf area as well as total chlorophylls, N, P and K contents of leaves more than other used fertilization. The maximum values of the shoot

Table (2): Effect of slow-release and organic fertilizers on growth and fruits Ewaise mango trees during 2020 and 2021 seasons.

Treatments	Shoot length (cm)			Shoot diameter (cm)			Leaf No.			Leaf area cm^2			Total chlorophyll (SAPD)		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
1- Control 1000 g N	10.65	11.83	11.24	0.58	0.61	0.60	8.8	10.1	9.5	78.8	85.3	82.1	46.63	49.55	48.09
2- 25% m + 25% org. + 50 bio	13.18	14.32	13.75	0.67	0.71	0.69	10.9	12.6	11.8	89.1	97.1	93.1	51.87	55.11	53.49
3- 25% m + 50% org. + 25% bio.	12.11	13.44	12.78	0.64	0.67	0.66	10.2	11.66	10.9	86.5	92.6	89.6	50.10	53.31	51.71
4- 25% m + 37.5 org. + 37.5 bio.	13.91	15.62	14.77	0.69	0.72	0.71	11.6	13.3	12.5	90.4	98.1	94.3	51.73	54.96	53.35
5- 80% slow-R	13.22	14.23	13.73	0.66	0.71	0.69	11.1	12.8	12.0	88.8	96.2	92.0	51.21	54.45	52.83
6- 60% slow-R	11.91	13.20	12.56	0.62	0.65	0.64	9.6	11.1	10.4	84.1	90.9	87.5	50.12	52.16	51.14
New L.S.D. 5%	1.18	1.31		0.03	0.03		0.72	0.84		5.18	5.39		2.08	2.26	

Table (3): Effect of slow-release and organic fertilizers on growth and fruits Ewaise mango trees during 2020 and 2021 seasons.

Treatments	N %			P %			K %			Fruit set %			Yield/tree		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
1- Control 1000 g N	1.58	1.62	1.60	0.113	0.128	0.121	1.25	1.28	1.27	0.55	0.59	0.57	61.83	68.31	65.08
2- 25% m + 25% org. + 50 bio	1.73	1.78	1.76	0.128	0.146	0.137	1.37	1.41	1.39	0.78	0.84	0.81	96.71	104.22	100.47
3- 25% m + 50% org. + 25% bio.	1.71	1.74	1.73	0.124	0.141	0.133	1.42	1.46	1.44	0.75	0.78	0.77	92.83	98.67	95.75
4- 25% m + 37.5 org. + 37.5 bio.	1.75	1.80	1.78	0.127	0.144	0.136	1.38	1.42	1.40	0.80	0.85	0.83	98.51	106.19	102.35
5- 80% slow-R	1.74	1.78	1.76	0.123	0.139	0.131	1.35	1.39	1.37	0.75	0.79	0.77	91.95	99.68	95.82
6- 60% slow-R	1.66	1.69	1.68	0.120	0.135	0.128	1.31	1.33	1.34	0.70	0.74	0.72	84.65	92.76	88.71
New L.S.D. 5%	0.06	0.07		0.005	0.007		0.05	0.06		0.05	0.08		6.85	7.59	

length and leaf traits were registered on the trees that were fertilized with the required N as 25% in a mineral N form along with 37.5% in an organic 37.5% of organic and bio-form followed by 80% and a slow release. On the other hand, the lowest values of the growth traits as well as leaf total chlorophylls, N, P, and K contents were recorded for the trees that were treated with 100% mineral N (check trees). The recorded leaf area was (82.1, 93.1, 89.6, 94.3, 92.5, and 87.5 cm^2 as an av. of the two studied seasons) due to fertilization via 100% mineral-N (T_1), 25% m plus 25% or a 50% bio (T_2), 25% m plus 50% or. and 25% bio (T_3), 25% m plus 37.5 or. and 37.5% bio (T_4), 80% slow release (T_5), and 60% slow release (T_6), respectively. Then, the achieved increment of the leaf area was 13.40, 9.14, 14.86, 12.67, and 6.58% due to T_2 to T_6 compared to T_1 (check treatment), respectively. Therefore, N fertilization with organic and bio form as a partial substitute for mineral ones as well as slow-release fertilizers significantly increased the total leaf surface area, nutritional status, and vegetative growth of mango trees as well as decreased the opportunity for environmental pollution. The recorded total chlorophyll was 48.09, 53.49, 51.71, 53.35, 52.83, and 51.14 as an av. of the two studied seasons, due to T_1 to T_6, respectively. Hence, the increment percentage of total chlorophyll due to the use of fertilization treatments over check treatment (T_1) was attained at 11.23, 7.59, 10.94, 9.85 and 6.34%, respectively.

2- Yield

Table (3) clarified that the fertilization of Ewaise mango trees with the integration of mineral N and organic N sources with a bio-form as well as slow release significantly increased the mango yield/tree compared to using the RDN only as a mineral N source (check treatment, T_1). The advancement in the yield was linked with increasing the applied level of bio-form from 25 to 50% of RDN or slow release from 60 to 80% of RDN. The maximum mango yield/tree was recorded for the trees that were treated with 25% of RDN as a mineral N plus 37.5% as an organic source and 37.5% as a bio form followed using slow release at 80% of RDN. The recorded yield/tree was 65.08, 100.47, 95.75, 102.35, 95.82, and 88.71 kg/tree as an average of two studied due to the use of T_1, T_2, T_3, T_4, T_5, and T_6, respectively. The collected increment of yield/tree as averages of two seasons was 54.40, 47.15, 57.29, 47.26 and 36.33% as a result of using T_2, T_3, T_4, T_5, and T_6, respectively, compared to T_1 (check treatment). Therefore, the partial substitution of mineral N with organic and bio-sources as well as the use of slow release in the N fertilization of mango trees has beneficial effects.

3- Fruit Quality

Tables (4, 5 & 6) showed that using N fertilization as 25% of the RDN as an N mineral source and 25 to 50% as an organic source enriched with 25 to 50% of EM as well as use 60 to 80% of RDN via slow-release fertilizers significantly enhanced the quality of fruits in terms of increasing fruit weight, pulp %, T.S.S.%, and sugar contents as well as, the content of vitamin C and minimizing the total acidity and total fiber % compared to using of the only recommended dose of nitrogen (RDN) as a mineral N source. N fertilization of mango trees using 25% of RDN in a mineral form and 25 or 50% in an organic form reinforced with 50 or 25% of bio-form, as well as slow-release fertilizers significantly enhanced the quality of fruits more than using mineral-N alone. The highest values of mango fruit characteristics were observed on the trees that were treated with the RDN via 25% as a mineral form and 37.5% as an organic form enriched with 37.5% of EM followed by using 80% RDN via a slow release.

The recorded average fruit weight of mango was 178.7, 203.2, 200.8, 205.2, 198.9, and 196.0 g for the trees that were treated with T_1, T_2, T_3, T_4, T_5, and T_6, respectively. The respective TSS of mango fruit was 17.78, 19.11, 18.82, 19.32, 18.77, and 18.54%. Hence, the average increment percentages of the attained fruit weight were 13.71, 12.37, 14.83, 11.30 and 9.68% due to using T_2, T_3, T_4, T_5, and T_6 treatments, respectively, compared to T_1 (check treatment). In addition, the respective average increase of TSS that was achieved by using these treatments was 7.48, 5.85, 8.66, 5.56, and 4.27%.

Hence, the cost-wise evaluation of the application of N sources is in favor of three forms 25% of the RDN in a mineral source and 37.5% in an organic one enriched with 37.5% bio (EM) or used 80% of RDN via a slow release. Such a fertilization program is very important to produce mango fruits since improving the fruit quality prompt an increase in the packable yield. In addition, these fertilization treatments reduce production costs and the negative effect on the environment.

Table (4): Effect of slow-release and organic fertilizers on growth and fruits Ewaise mango trees during 2020 and 2021 seasons.

Treatments	Fruit weight			Fruit height			Fruit width			Peel %			Seed %		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
1- Control 1000 g N	175.1	182.3	178.7	9.15	9.23	9.19	6.54	6.67	6.61	15.07	14.23	14.65	13.40	13.18	13.29
2- 25% m + 25% org. + 50 bio	200.7	205.6	203.2	9.67	9.75	9.71	6.93	7.02	6.98	12.39	11.22	11.81	11.10	10.64	10.87
3- 25% m + 50% org. + 25% bio.	196.5	205.1	200.8	9.63	9.71	9.67	6.87	6.96	6.92	12.69	11.45	12.07	11.19	10.69	10.94
4- 25% m + 37.5 org. + 37.5 bio.	201.9	208.5	205.2	9.78	9.86	9.82	7.01	7.15	7.08	11.62	11.12	11.37	10.82	10.08	10.45
5- 80% slow-R	194.5	203.3	198.9	9.59	9.67	9.63	6.84	6.91	6.88	13.05	11.81	12.43	11.95	11.88	11.92
6- 60% slow-R	191.8	200.1	196.0	9.52	9.61	9.57	6.82	6.93	6.88	13.39	12.31	12.85	12.10	12.05	12.08
New L.S.D. 5%	8.11	6.84		0.35	0.31		0.26	0.22		0.62	0.51		0.58	0.66	

Table (5): Effect of slow-release and organic fertilizers on growth and fruits Ewaise mango trees during 2020 and 2021 seasons.

Treatments	Pulp %			TSS %			Total sugar content			Reducing			Non-Reducing		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
1- Control 1000 g N	71.53	72.59	72.06	17.11	18.45	17.78	12.63	12.98	12.81	4.68	4.25	4.47	7.93	8.75	8.34
2- 25% m + 25% org. + 50 bio	76.50	77.68	77.09	18.45	19.76	19.11	13.56	13.96	13.76	5.24	4.71	4.98	8.32	9.25	8.79
3- 25% m + 50% org. + 25% bio.	76.12	77.86	76.99	18.16	19.48	18.82	13.47	13.91	13.69	5.18	4.58	4.88	8.29	9.32	8.81
4- 25% m + 37.5 org. + 37.5 bio.	77.56	78.80	78.18	18.63	20.00	19.32	13.85	14.41	14.13	5.36	4.86	5.11	8.49	9.55	9.02
5- 80% slow-R	74.98	76.31	75.65	18.11	19.42	18.77	13.41	13.95	13.68	5.16	4.63	4.89	8.25	9.32	8.79
6- 60% slow-R	74.51	75.64	75.08	17.90	19.18	18.54	13.35	13.83	13.59	5.11	4.68	4.89	8.24	9.18	8.71
New L.S.D. 5%	2.91	3.18		0.58	0.61		0.48	0.52		0.23	0.26		0.22	0.31	

Table (6): Effect of slow-release and organic fertilizers on growth and fruits Ewaise mango trees during 2020 and 2021 seasons.

Treatments	V.C.			Fiber			Total acidity		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
1- Control 1000 g N	45.15	47.63	46.39	1.11	1.06	1.09	0.345	0.348	0.347
2- 25% m + 25% org. + 50 bio	49.32	52.16	50.74	0.85	0.88	0.87	0.267	0.265	0.266
3- 25% m + 50% org. + 25% bio.	48.63	50.71	49.67	0.89	0.85	0.87	0.273	0.276	0.275
4- 25% m + 37.5 org. + 37.5 bio.	50.23	52.88	51.56	0.83	0.82	0.83	0.260	0.253	0.257
5- 80% slow-R	48.36	50.69	49.53	0.90	0.88	0.89	0.288	0.285	0.287
6- 60% slow-R	47.35	50.12	48.74	0.93	0.91	0.92	0.296	0.302	0.299
New L.S.D. 5%	2.15	2.38		0.07	0.06		0.029	0.032	

Discussion

Organic fertilization has a positive impact on the action activation of microflora, water-holding capacity, aggregation of soil grains, and content of soil organic matter as well as the availability of nutrients. Such energizing of nutrient uptake by plants leads to improving the biosynthesis of organic foods and cell division **(Miller *et al.*, 1990).** Biofertilization has an important influence on biological, physical, and chemical soil specifications, as well as, on simplifying the fixation of atmospheric N, increasing the availability and uptake of nutrients, and decreasing the incidence of soil-borne diseases, then, improving the fertility of the soil **(Subba Rao, 1984; Kannaiyan, 2002; El-Salhy *et al*., 2006).** The impact of the slow release-N fertilization in enhancing the growth, nutrient status, and cropping trees could be attributed to their effect on regulating the release of its own N as the plants needed. Also, they gave the highest values of residual N due to their low activity index, while this soluble one gave the lowest values of available N left in the soil. In addition, the role of N as a constituent of amino acids and proteins is well an important influence in emboldening cell division and the development of meristem tissues (**Nijjar, 1985 and Wang and Alva, 1996**).

Hence, it could be mentioned that fertilization using organic, bio, or slow-release sources is efficient in improving the mango tree vigor expressed as an increase in shoot growth, leaf surface expansion, and nutrient status. These findings assure the vital importance of these fertilization sources in order to overcome the losses of nutrients by leaching and volatilization as well as the mobility of moved elements especially in sandy soils. In addition, enhancing the performance of nitrogen fertilizers. These sources also improve soil fertility due to their highest levels of residual nutrients, the enhanced solubility of nutrients, and the increased activity of microorganisms. In addition, such fertilization treatments are important for organic farming production.

The current obtained results are in harmony with those instituted by **Mohamed and Ebeed (2006), Mouftah (2007), Mohamed *et al*. (2008), Abdel-Monem *et al*. (2009), Umesh *et al*. (2010), El-Kosary *et al*. (2011), El-Khawaga (2012), Peralta-Antonio (2014) and El-Salhy *et al*. (2016)**. They confirmed that the N application in either organic or bio form along with the mineral one as well as the slow release was effective in improving the growth vigor and nutrient status of mango trees in favor of enhancing the fruiting.

Conclusion

Finally, it could be concluded that using of N fertilization with organic and bio sources as a partial substitute for the mineral one as well as slow release improves the nutrient content, yield, and fruit quality of Ewaise mango trees leading to an increase in the harvested yield. In addition, it minimizes the production costs and environmental pollution which could be happened due to using of chemical fertilizers.

These featured results will eventually enable farms to get a high yield with better quality. Furthermore, using organic and bio-fertilization sources enhance soil fertility and reduces the added fertilizer requirements. Thus, the farmers will be able to produce organic products.

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تأثير الأسمدة العضوية وبطيئة التحلل علي نمو وإثمار أشجار المانجو "العويسي"

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الملخص

أجريت هذه الدراسة خلال موسمي ٢٠٢٠ ، ٢٠٢١ بمزرعة خاصة تقع في كوم أمبو – محافظة أسوان – مصر. لدراسة تأثير الاستبدال الجزئي للتسميد الآزوتي المعدني بخليط من الأسمدة العضوية والحيوية أو كلية بالأسمدة بطيئة التحلل علي النمو الخضري والحالة الغذائية والمحصول وخصائص ثمار المانجو العويس. حيث تم إضافة السماد المعدني (نترات الأمونيوم) علي ثلاث دفعات (مارس / أبريل / مايو) بينما أضيف السماد الحيوي مرتين في بداية النمو وبعد شهر والأسمدة بطيئة التحلل مرة في بداية النمو . كما أضيف السماد العضوي (الكمبوست) دفعة واحدة في نهاية شهر ديسمبر.

وقد أظهرت النتائج ما يلي:

- سبب استخدام الجرعة السمادية الآزوتية الموصي بها من خلال ثلاث مصادر (معدني + عضوي + حيوي) أو ٦٠-٨٠٪ سماد بطئ التحلل زيادة معنوية لطول الأفرع ومساحة الأوراق ومحتواها من الكلوروفيل الكلي والعناصر الغذائية (NPK) مقارنة باستخدام الجرعة السمادية علي صورة معدنية فقط.
- أدت جميع المعاملات السمادية إلي زيادة المحصول وتحسين خصائص الثمار من حيث زيادة وزن الثمرة ونسبة اللب وكذلك محتواها من المواد الصلبة الذائبة والسكريات وفيتامين (C). مقارنة باستخدام السماد المعدني فقط.
- ارتبطت زيادة النمو الخضري والحالة الغذائية للأشجار وبالتالي المحصول وخصائص الثمار بزيادة نسبة السماد الحيوي في المخلوط السمادي المعدني-العضوي المستخدم أو الأسمدة بطيئة التحلل.

من نتائج هذه الدراسة يمكن التوصية باستبدال ٧٥٪ من الجرعة السمادية الآزوتية الموصي بها بالأسمدة العضوية والحيوية حيث يتكون مخلوط الأسمدة من ٢٥٪ معدني ، ٢٥٪ عضوي ، ٥٠٪ حيوي أو استخدام ٨٠٪ في صورة الأسمدة بطيئة التحلل. حيث يؤدي ذلك إلي تحسين النمو الخضري والحالة الغذائية لأشجار المانجو الزبدية مع إنتاج محصول عال ذو خصائص ثمرية جيدة فضلاً عن تقليل تكاليف التسميد والتلوث الناشئ عن زيادة الأسمدة المعدنية وإمكانية إنتاج ثمار مانجو عضوياً.