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Impact of Spraying Sprouts Extracts on the Performance of Mango Trees under Desert Land Conditions

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Abstract

The study occurred in 2023 and 2024 on mango trees cv. keitt at Abo Ghaleb Road (Alexandria Desert Road, 68 km, Cairo, Egypt) in Giza Governorate, Egypt. In this study, examine the effects of foliar sprays of rocket , lupine and chickpea seed sprout extract at 0.2 %, 0.4 % and 0.6 % foliar spraying is done three times: the 1st week of March, the 3rd week of April, and the 3rd week of May during every season. The response of leaf area and chlorophyll reading, macro and micronutrients in leaves, yield, and fruit physical and chemical characteristics were used to assess the influence. The results indicated that spraying chickpea seed sprout extract at 0.6 % improved trees growth characteristics, nutritional status, yield , fruit physical and chemical properties. In addition, to evaluate the treatments efficiency, chickpea seed sprout extract at 0.6% raised the percentage the most of studied characteristics of keitt mango trees compared to untreated trees.

Keywords

Rocket, lupine and chickpea seed sprout extract, keitt mango trees, yield, fruit quality.

1. Introduction

A member of the Anacardiaceae family, the mango (*Mangifera indica* L.) is one of the most significant fruits. It grows in a variety of soil and climate conditions. In Egypt, after citrus, mango comes in the second position. The total area reaches 328284 Fedden and the productive area reaches 309488 Fedden with total yield up to 4.629 Ton / Fedden and total production up to 1429552 Ton according to the statistics of the Economic Affairs Department, Ministry of Agriculture and Land Reclamation 2023.Yet, mango growers face several challenges, including a lower output of poor quality. To reduce excessive usage of mineral chemical fertilizers and the negative health impacts they cause, we should consider using specific natural biological stimulants. “Spinelli *et al.,* “ [1], “Ahmed, *et al.,* “ [2], and “Anwar *et al.,* “ [3] investigated the potential the extracts of plant, which are distinguished by their superior concentrations of nutrient elements, growth regulators, antioxidants, and vitamins, to act as a potent nutritional supplement that might completely or partially take the place of the previously listed dangerous substances.

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Foliar spraying is an agricultural technique that complements soil fertilization rather than replacing it. This method provides plants with essential nutrients that may be unavailable in the soil due to washing, fixation, or alkalinity. As a result, foliar spraying significantly enhances vegetative growth, leading to increased production and improved quality of the crops.

Crews and Peoples" [4], "Biommerson" [5], "Abdallah" [6], "Darwish" [7], "Anderson and Cedergreen" [8], "Al- Shereif *et al.,* " [9], and "El- Sayed- Faten" [10]. Stated that, sprouting may break down all complex ingredients in a range of cereals, including proteins, carbs, and lipids, into simpler ones. This process also facilitates the production of soluble sugars, amino acids, natural hormones, and antioxidants. In addition to protecting trees from aging and adverse conditions, an increased content of sprouts derived from amino acids enhances the production of pigments and carbs as well as cell division. This enhancement is further supported by the presence of vitamins as well as macro and micronutrients.

Recent research has highlighted the benefits of using seed sprouts of fenugreek, celery, rocket, barley, wheat, garlic and onion to protect the environment from pollution, while also enhancing the growth of the plant, productivity, and nutritional value of fruit crops "Cazuola *et al.,* " [11], "Cairney" [12], "Biommerson" [5], "Dhekney" [13], "Oraby" [14], and "Ali *et al.,*" [15].

Huda" [37] Crops seeds sprout extracts are of great benefits when used to spray on plants. It contains high levels of major and minor nutrients, amino acids and vitamins, which are beneficial to the crop in quantity and quality.

Mango growth, yield, and fruit quality are all markedly improved by the administration of a wide variety of nutrients in different ways, as previous research has convincingly shown. Notable research by "El-Sayed-Esraa" [19], "El-Sayed-Esraa" [20], "Refaai" [21], "El-Khawaga" [22], "Ahmed" [23], "Abdel-Rahman" [24], "El-Sharony" [25], "Abdelaziz" [26], "Mohamed" [27], "Oraby" [14], and "Ali" [15] underscores the transformative impact of utilizing a holistic nutrient approach on the vitality and quality of mango crops.

This research was undertaken to conduct an investigation on the results of applying spray extracts from rocket, lupine, and chickpea seed sprouts on the development and production of keitt mango plants in desert regions.

2. Materials and Methods

The experiment indicated above was conducted out throughout the 2023 and 2024 growing seasons on keitt mango trees grafted onto seedling rootstocks. Abo Ghaleb Road (68 km from Cairo on the Alex. Desert Road) in Giza Governorate, Egypt, the trees were planted in sandy soil. The chosen trees were 18 years old, healthy and nearly uniform in strength. They were grown at 7x7 m and got the same cultural methods. A drip irrigation technique was used. Tables 1 and 2 reflect the results of the soil and water analyses.

Table 1: Chemical analysis of well water.

PH	Ec	soluble cations meq/L				soluble anions meq/L			
	ds/m	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Co_3^{-}	Hco_3^{-}	So_4^{-}	Cl^{-}
8.3	3.40	10.0	1.4	20.0	0.12	----	0.9	10.0	20.0

Table 2: Physical and chemical analysis of soil in the site

Sand %	Silt %	Clay %	Soil texture	PH	Ec ds/m	soluble cations meq/L				Soluble anions meq/L			
						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Co_3^{-}	Hco_3^{-}	So_4^{-}	Cl^{-}
93.3	0.2	6.5	Sandy	7.0	2.70	9.0	7.0	13.0	0.3	----	1.2	5.9	18.8

The ten treatments involved in the current study were as follows:

(T_1) rocket seed sprout extract at 0.2 %	(T_6) lupine seed sprout extract at 0.6 %.
(T_2) rocket seed sprout extract at 0.4 %.	(T_7) chickpea seed sprout extract at 0.2 %.
(T_3) rocket seed sprout extract at 0.6 %.	(T_8) chickpea seed sprout extract at 0.4 %.
(T_4) lupine seed sprout extract at 0.2%.	(T_9) chickpea seed sprout extract at 0.6 %.
(T_5) lupine seed sprout extract at 0.4 %.	(T_{10}) Control (water).

Rocket, lupine, and chickpea sprout extract were started by sowing the seeds in a place that is dark. and harvesting the sprouts three to four days later. After five minutes of homogenizing the sprouts with distilled water in an electric blender at a ratio of 1:10, they were filtered and should be stored in a refrigerator at 4°C until needed.

Rocket, lupine and chickpea seeds sprout extract were sprayed three times: the 1st week of March, the 3rd week of April, and the 3rd week of May During the two study seasons.

This extract was analyzed using the steps and techniques described by "A.O.A.C. " [28] and data are shown in Table (3). It was sprayed until overflow.

Assessment of the successful outcome of the treatment:

To assess the effectiveness of applying rocket, lupine, and chickpea seed sprout extract as foliar application.

The mean of the two seasons calculated as follows:

= (first season + second season)/2

The following formula is used to determine the superiority percentage:

= (treatment – control)/control*100

Table 3: The chemical structure of rocket, lupine and chickpea seed sprout extract "A.O.A.C. " [28].

Rocket		Lupine		Chickpea	
Constituents	**Unit (mg/100g F.W)**	**Constituents**	**Unit (mg/ 100g)**	**Constituents**	**Unit mg/100gF.W**
Cystine	4.1	**Threonine**	0.610	**Thiamin**	0.486
Cysteine	3.9	**Leucine**	1.00	**Riboflavin**	0.106
Methionene	3.8	**Lecithen**	0.540	**Folate**	0.44
Glutamic acid	3.5	**Methionene**	0.520	**Vitamin B_6**	0.492
Thamine	0.16	**Cysteine**	0.320	**Vitamin A**	41.00
Riboflavine	0.15	**Tyrosine**	0.700	**K**	846.00
Vit. E	0.49	**Alanine**	0.820	**Ca**	45.00
Vit. A	4.4	**Asparatic acid**	1.500	**Na**	64.00
Vit. C	101	**Glutamic acid**	3.00	**Zn**	2.81
K	496	**Glycine**	1.00		
P	1410	**Proline**	0.700		
Mg	460	**T. carbohydrates**	34.1%		
Fe	267	**Fats**	8.1 %		
Mn	16	**T. proteins**	30.1 %		
Zn	255				

Data analysis:

Complete randomized block design was used to set up the experiment. Two trees were used for each of the three replications of each treatment. "Duncan" [29] the mean values were compared at the 5% level using a test.

For both seasons, the following data were measured:

2.1. Leaf area (cm^2): was determined with a leaf area meter, leaf samples are taken at the month of September of each season, and the third and fourth leaves are taken from the bottom of the branch.

2.2. Leaf total chlorophyll: was measured in field, at the month of September, in fresh leaves ,by using SPAD-502 Minolta chlorophyll meter.

2.3. Macro and micronutrients in leaves: late week of September, 30 leaves/tree were collected representing the four main directions. Collected samples were prepared and analyzed for macro and micronutrients as described by "Peterburgski" [30], "Jones" [31].

2.4. Number of fruits/tree and yield (Kg /tree): was recorded at maturity stage, fruit ripening signs (The pulp is golden yellow in color, it accounts for 80% of the weight of the fruit, the pulp is buttery in taste, sweet, aromatic, without fibers.

2.5. Fruit parameters: to check the physical characteristics, fruit samples were collected at harvest (i.e., fruit length (cm), fruit diameter (cm), fruit thickness, fruit weight (g), pulp weight (g), seed weight (g) and peel weight (g).

2.6. Fruit quality: ten fruits were randomly selected from each replicate to be used to evaluate the quality of the fruit: (i.e., total sugars (%), reducing sugars (%), non-reducing sugars (%)) were determined according to [28], and T.S.S.(%) was measured using a hand refractometer.

3. Results

3.1. Leaf area and leaf total chlorophyll (SPAD reading)

Regarding Table 4 findings leaf area and total chlorophyll were influenced significantly by all foilar sprout in both seasons of the study. However, T_9 produced the highest leaf total chlorophyll (46.82 in the 1st and 46.86 (mg/100g F. W) in the 2nd season) and leaf area (67.63 cm^2 and 68.66 cm^2 in both seasons) followed by T_8. On the other side,during both seasons, the lowest acceptable values for leaf area and leaf total chlorophyll were obtained by T_{10}.

Table 4: Effect of foliar sprays with sprout extract of some plants on leaf area and leaf total chlorophyll of keitt mango trees during 2023 and 2024 seasons.

Treat.	Leaf area (cm^2)		Leaf total chlorophyll (mg/100g F. W)	
	2023	2024	2023	2024
T_1	51.33 g	51.56 ef	38.66 g	38.71 e
T_2	56.13 c	56.14 c	41.92 c	43.58 c
T_3	52.08 f	52.11 e	40.58 f	41.36 d
T_4	55.66 d	55.71 c	41.58 d	43.46 c
T_5	52.83 e	52.86 d	41.32 e	41.96 d
T_6	50.46 i	50.51 g	38.33 i	38.36 e
T_7	50.52 h	51.36 f	38.53 h	38.56 e
T_8	63.28 b	64.28 b	43.43 b	45.58 b
T_9	67.63 a	68.66 a	46.82 a	46.86 a
T_{10}	48.33 j	48.36 h	37.36 j	37.41 f

(T_1) Spraying rocket seed sprout extract at 0.2 %, (T_2) Spraying rocket seed sprout extract at 0.4 %,(T_3) Spraying rocket seed sprout extract at 0.6 %,(T_4) Spraying lupine seed sprout extract at 0.2%,(T_5) Spraying lupine seed sprout extract at 0.4 %,(T_6) Spraying lupine seed sprout extract at 0.6 %,(T_7) Spraying chickpea seed sprout extract at 0.2 %,(T_8) Spraying chickpea seed sprout extract at 0.4 %,(T_9) Spraying chickpea seed sprout extract at 0.6 % and (T_{10}) and control

(water). Mean values having the same letters in the same column in each season are not statistically different by Duncan's multiple range test at 5 % level.

Evaluation of the treatments efficiency:

The efficiency of different treatments compared to control of leaf area and total chlorophyll of keitt mango trees is shown in Fig. 1.The highest increase in vegetative growth percentages was obtained by (T_9) followed by (T_8), whereas the lowest one was obtained by (T_6).

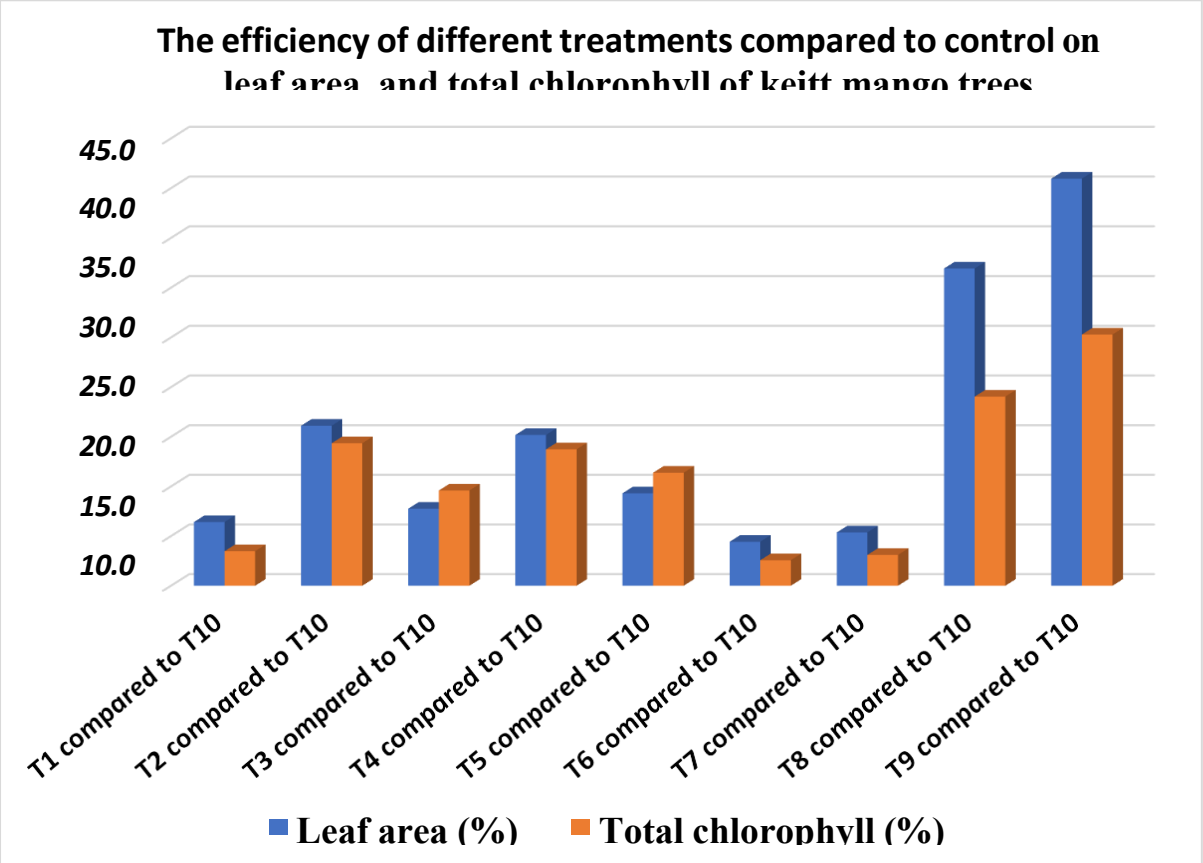

Fig. 1: The efficiency of different treatments compared to control on leaf area and total chlorophyll of keitt mango trees.

3.2. Macro and micronutrients in leaves

3.2.1. Leaf macronutrients contents:

Data presented in Table 5 disclose affected significant effects by all foliar sprays with sprout extract. of some plants in both seasons. In addition, T_9 produced the highest nitrogen (2.98 % in the 1st and 3.08 % in the 2nd season), phosphorus (1.20 % and 1.40 % in both seasons),

and potassium (2.46 % and 2.48 % for both seasons). However, T_{10} gave minimum significant values of their contents in the 1st and 2nd seasons.

Table 5: Effect of foliar sprays with sprout extract of some plants on macro nutrients contents in leaves of keitt mango trees during 2023 and 2024 seasons.

	N (%)		P (%)		K (%)	
Treat.	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
T_1	2.81 e	2.91 e	0.52 f	0.72 f	1.98 de	2.0 de
T_2	2.91 b	3.01 b	0.98 b	1.18 b	2.30 b	2.32 b
T_3	2.86 d	2.96 d	0.62 e	0.82 e	1.98 de	2.00 de
T_4	2.89 c	2.99 c	0.92 c	1.12 c	2.13 c	2.15 c
T_5	2.89 c	2.99 c	0.80 d	1.00 d	2.06 cd	2.08 cd
T_6	2.71 f	2.81 f	0.48 fg	0.68 fg	1.88 e	1.90 e
T_7	2.72 f	2.82 f	0.52 f	0.72 f	1.92 e	1.94 e
T_8	2.92 b	3.02 b	1.02 b	1.22 b	2.32 b	2.34 b
T_9	2.98 a	3.08 a	1.20 a	1.40 a	2.46 a	2.48 a
T_{10}	2.53 g	2.63 g	0.46 g	0.66 g	1.77 f	1.78 f

(T_1) Spraying rocket seed sprout extract at 0.2 %, (T_2) Spraying rocket seed sprout extract at 0.4 %,(T_3) Spraying rocket seed sprout extract at 0.6 %,(T_4) Spraying lupine seed sprout extract at 0.2%,(T_5) Spraying lupine seed sprout extract at 0.4 %,(T_6) Spraying lupine seed sprout extract at 0.6 %,(T_7) Spraying chickpea seed sprout extract at 0.2 %,(T_8) Spraying chickpea seed sprout extract at 0.4 %,(T_9) Spraying chickpea seed sprout extract at 0.6 % and (T_{10}) and control (water). Mean values having the same letters in the same column in each season are not statistically different by Duncan's multiple range test at 5 % level.

Evaluation of the treatments efficiency:

The most significant percent increase in leaf macronutrient content was recorded with T_9 whereas the lowest one was obtained by T_6. It can be concluded that chickpea seed sprout extract at 0.6 % proved to be the most effective treatment for keitt mango trees when compared to other treatments Fig. 2.

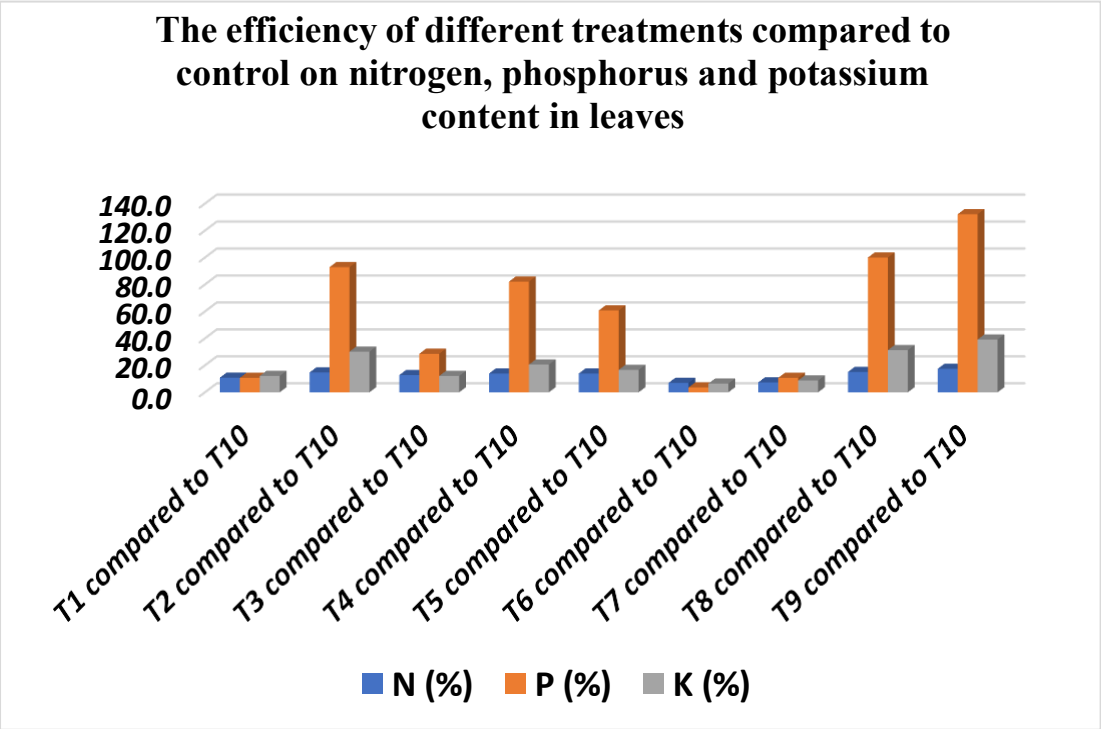

Fig. 2: The efficiency of different treatments compared to control on nitrogen, phosphorus and potassium content in leaves.

3.2.2. Leaf micronutrients contents:

Table 6 shown the impact of foliar spraying some plants sprout extract on leaf microelements contents of keitt mango trees during the 2023 and 2024 seasons. Leaf microelements contents were considerably impacted in both seasons by every foliar sprout treatment. Furthermore, T_9 produced the highest leaf iron content (297.1 ppm in the 1st and 298.0 ppm in the 2nd season, respectively) and manganese (58.0 ppm and 60.0 ppm) in the 1st and 2nd seasons, respectively. In addition, T_9 & T_8 gave the highest leaf zinc content (23.0 ppm in the 1st and 25.0 ppm in the 2nd season) (22.0 ppm in the 1st and 24.0 ppm in the 2nd season) and the highest leaf copper content (32.0 ppm and 33.0 ppm in the 1st and 2nd seasons) (31.0 ppm and 32.0 ppm in the 1st and 2nd season), respectively. Conversely, in the 1st and 2nd seasons,T_{10} had the lowest values of leaf microelement contents.

Table 6: Effect of foliar sprays with sprout extract of some plants on micronutrients contents in leaves of keitt mango trees during 2023 and 2024 seasons.

Treat.	Fe (ppm)		Mn (ppm)		Zn (ppm)		Cu (ppm)	
	2023	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
T_1	243.0 f	244.0 f	42.0 d	44.0 d	16.0 c	18.0 c	23.0 d	'24.0 d
T_2	288.1 b	289.4 b	48.0 c	50.0 c	18.0 b	20.0 b	28.0 b	29.0 b
T_3	258.2 e	259.3 e	42.0 d	44.0 d	17.0 bc	19.0 bc	23.0 d	24.0 d
T_4	279.3 c	280.2 c	47.0 c	49.0 c	18.0 b	20.0 b	26.0 c	27.0 c
T_5	276.3 d	277.3 d	42.0 d	44.0 d	17.0 bc	19.0 bc	23.0 d	24.0 d
T_6	213.4 h	214.2 h	38.0 e	40.0 e	12.0 d	14.0 d	21.0 e	22.0 e
T_7	231.2 g	232.4 g	41.0 d	43.0 d	12.0 d	14.0 d	22.0 de	23.0 de
T_8	288.0 b	289.1 b	53.0 b	55.0 b	22.0 a	24.0 a	31.0 a	32.0 a
T_9	297.1 a	298.0 a	58.0 a	60.0 a	23.0 a	25.0 a	32.0 a	33.0 a
T_{10}	211.0 i	212.1 i	36.3 e	38.3 e	12.0 d	14.0 d	18.0 f	19.0 f

(T_1) Spraying rocket seed sprout extract at 0.2 %, (T_2) Spraying rocket seed sprout extract at 0.4 %,(T_3) Spraying rocket seed sprout extract at 0.6 %,(T_4) Spraying lupine seed sprout extract at 0.2%,(T_5) Spraying lupine seed sprout extract at 0.4 %,(T_6) Spraying lupine seed sprout extract at 0.6 %,(T_7) Spraying chickpea seed sprout extract at 0.2 %,(T_8) Spraying chickpea seed sprout extract at 0.4 %,(T_9) Spraying chickpea seed sprout extract at 0.6 % and (T_{10}) and control (water). Mean values having the same letters in the same column in each season are not statistically different by Duncan's multiple range test at 5 % level.

Evaluation of the treatments efficiency:

The highest increase in keitt mango trees percentages of leaf micronutrients was obtained by T_9, whereas the lowest one was obtained at T_6.

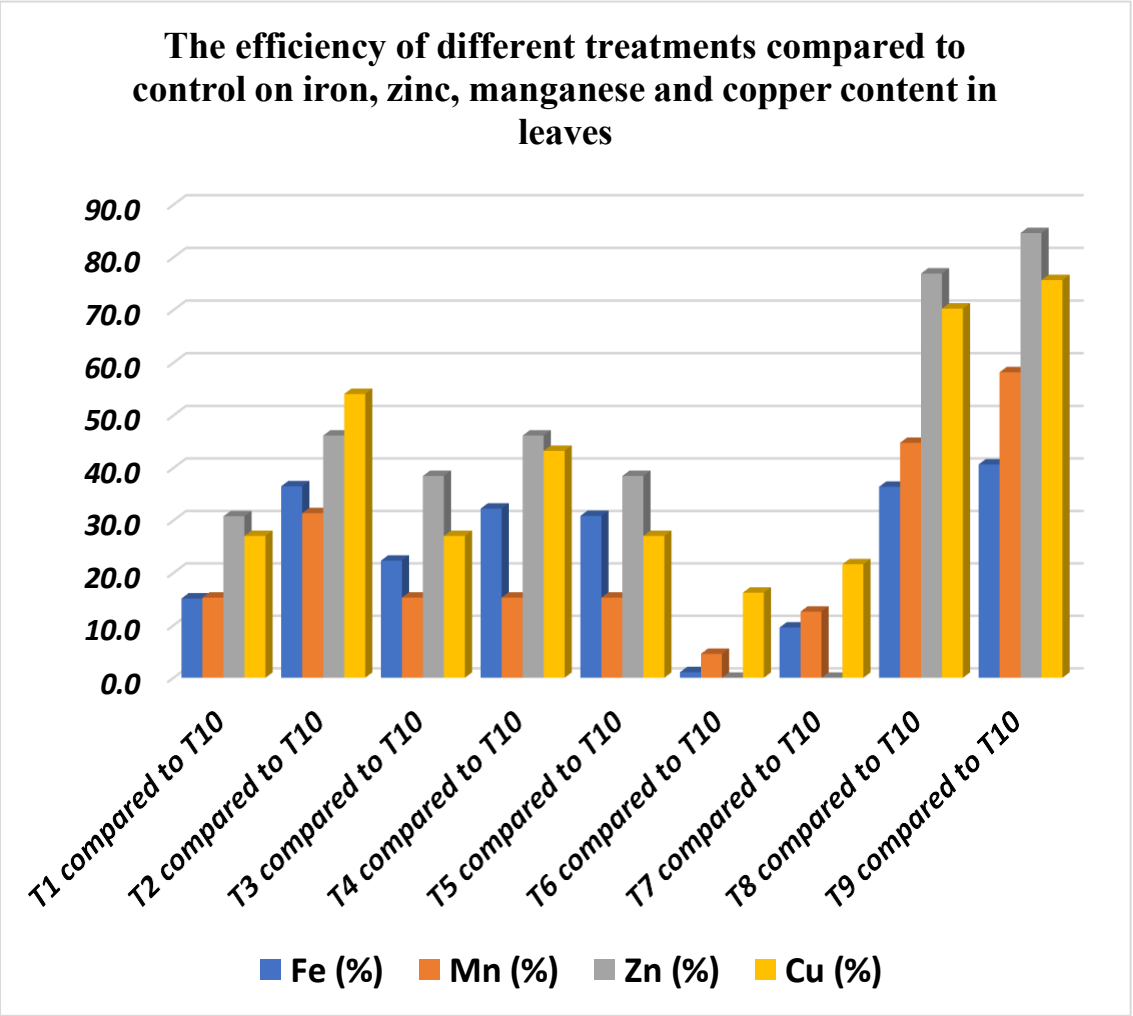

Fig. 3: The efficiency of different treatments compared to control on iron, zinc, manganese and copper content in leaves.

3.3. Fruit weight, number of fruits/tree and yield/tree

The data shown in Table 7 makes it clear that fruit weight, number of fruits / trees, and yield /tree were considerably better when rocket, lupine, and chickpea seed sprout extracts were applied than when the control treatment was used. T_9 gave the maximum fruit weight (876.2 g and 879.2 g) during both seasons, respectively. In the 1st season T_9 and T_8 resulted in the maximum number of fruits/trees and the highest yield, whereas in the 2nd season, T_9 gave the highest fruit weight and yield. T_{10} exhibited the lowest significant values for fruit weight, number of fruits/tree and yield in the 1st and 2nd seasons.

Table 7: Effect of foliar sprays with sprout extract of some plants on fruit weight, number of fruits/tree and yield /tree of keitt mango trees during 2023 and 2024 seasons.

Treat.	Fruit weight (g)		N. of fruits/ tree		Yield /tree (kg)	
	2023	2024	2023	2024	2023	2024
T_1	842.2 c	843.3 d	17.0 c	20.0 d	14.32 cd	16.87 e
T_2	632.2 f	633.3 h	18.0 c	21.0 d	11.38 e	13.30 h
T_3	796.2 d	799.4 e	21.0 b	24.0 c	16.72 b	19.19 c
T_4	742.2 e	745.6 f	18.0 c	21.0 d	13.36 d	15.66 f
T_5	842.2 c	845.6 c	18.0 c	21.0 d	15.16 c	17.76 d
T_6	632.2 f	634.5 g	21.0 b	21.0 d	13.28 d	13.32 h
T_7	796.2 d	799.6 e	18.0 c	18.0 f	14.33 cd	14.39 g
T_8	871.2 b	876.2 b	23.0 a	26.0 b	20.04 a	22.78 b
T_9	876.2 a	879.2 a	24.0 a	29.0 a	21.03 a	25.50 a
T_{10}	504.2 g	501.2 J	13.0 d	16.0 g	6.55 f	8.02 i

(T_1) Spraying rocket seed sprout extract at 0.2 %, (T_2) Spraying rocket seed sprout extract at 0.4 %,(T_3) Spraying rocket seed sprout extract at 0.6 %,(T_4) Spraying lupine seed sprout extract at 0.2%,(T_5) Spraying lupine seed sprout extract at 0.4 %,(T_6) Spraying lupine seed sprout extract at 0.6 %,(T_7) Spraying chickpea seed sprout extract at 0.2 %,(T_8) Spraying chickpea seed sprout extract at 0.4 %,(T_9) Spraying chickpea seed sprout extract at 0.6 % and (T_{10}) and control (water). Mean values having the same letters in the same column in each season are not statistically different by Duncan's multiple range test at 5 % level.

Evaluation of the treatments efficiency:

The efficiency of different treatments compared to control of fruit weight, number of fruits/trees, and yield of keitt mango trees is shown in Fig. 4 The highest increase in Keitt mango trees fruit weight, number of fruits/tree, and yield percentages was obtained by (T_9) followed by (T_8), whereas the lowest one was obtained at (T_6) in fruit weight and yield. In addition, the lowest number of fruits/trees was recorded with T_7.

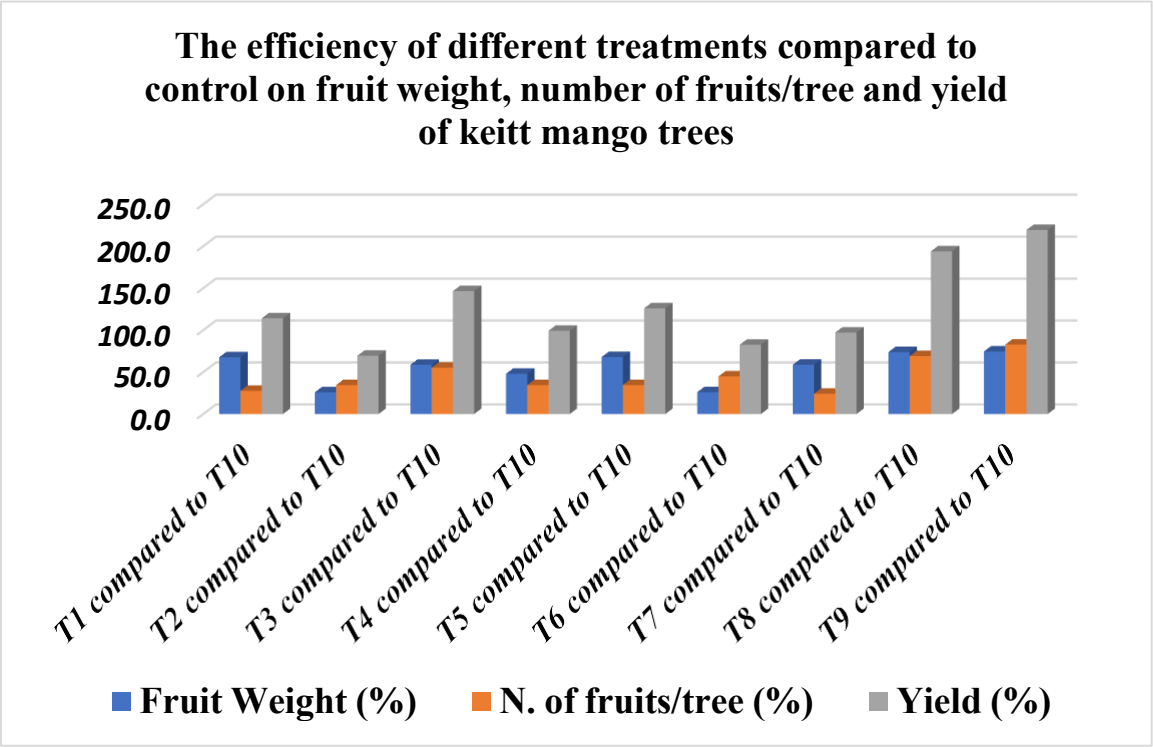

Fig. 4: The efficiency of different treatments compared to control on fruit weight, number of fruits/tree and yield/tree of keitt mango trees.

3.4. Peel weight, seed weight and pulp weight

Table 8 data clearly showed that applying a foliar spray with some plant sprout extract on peel weight, seed weight, and pulp weight of keitt mango trees led to a notable improvement in fruit quality in terms of reducing peel weight and seed weight and increasing pulp weight in opposition to the check treatment. T_9 led to the minimum peel and seed weight and the highest pulp weight in the two seasons, respectively. The peel weight, seed weight, and pulp weight of the untreated trees was negatively impacted. Similar outcomes were observed in the seasons of 2023 and 2024.

Table 8: Effect of foliar sprays with sprout extract of some plants on peel weight, seed weight and pulp weight of keitt mango trees during 2023 and 2024 seasons.

	Peel weight (gm)		Seed weight (gm)		Pulp weight (gm)	
Treat.	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
T_1	70.2 h	71.2 e	44.7 f	45.7 f	727.3 c	726.4 c
T_2	70.8 g	74.8 d	46.7 d	47.7 d	514.7 h	510.8 g
T_3	89.8 c	90.8 b	42.2 h	43.2 h	664.2 e	665.4 d
T_4	76.8 d	77.8 c	52.8 b	53.8 b	612.6 g	614.0 f
T_5	71.2 f	72.2 e	45.7 e	46.7 e	725.3 d	726.7 c
T_6	71.8 e	75.8 d	47.7 c	48.7 c	512.7 i	510.0 g
T_7	90.8 b	91.8 b	43.2 g	44.2 g	662.2 f	663.6 e
T_8	57.2 i	58.2 f	41.2 i	42.2 i	772.8 b	775.8 b
T_9	54.7 j	55.7 g	32.3 j	33.3 j	789.2 a	790.2 a
T_{10}	109.2 a	108.0 a	53.6 a	54.6 a	341.4 j	338.6 h

(T_1) Spraying rocket seed sprout extract at 0.2 %, (T_2) Spraying rocket seed sprout extract at 0.4 %,(T_3) Spraying rocket seed sprout extract at 0.6 %,(T_4) Spraying lupine seed sprout extract at 0.2%,(T_5) Spraying lupine seed sprout extract at 0.4 %,(T_6) Spraying lupine seed sprout extract at 0.6 %,(T_7) Spraying chickpea seed sprout extract at 0.2 %,(T_8) Spraying chickpea seed sprout extract at 0.4 %,(T_9) Spraying chickpea seed sprout extract at 0.6 % and (T_{10}) and control (water). Mean values having the same letters in the same column in each season are not statistically different by Duncan's multiple range test at 5 % level.

Evaluation of the treatments efficiency:

The highest percentage increase in pulp weight was recorded with T_9, whereas the lowest one was obtained at T_2. on the other hand, T_9 decreased the values of percentage of peel weight and seed weight. When compared to the treatments shown in Fig. 5, it can be determined that chickpea seed sprout extract at 0.6% is the most effective of all.

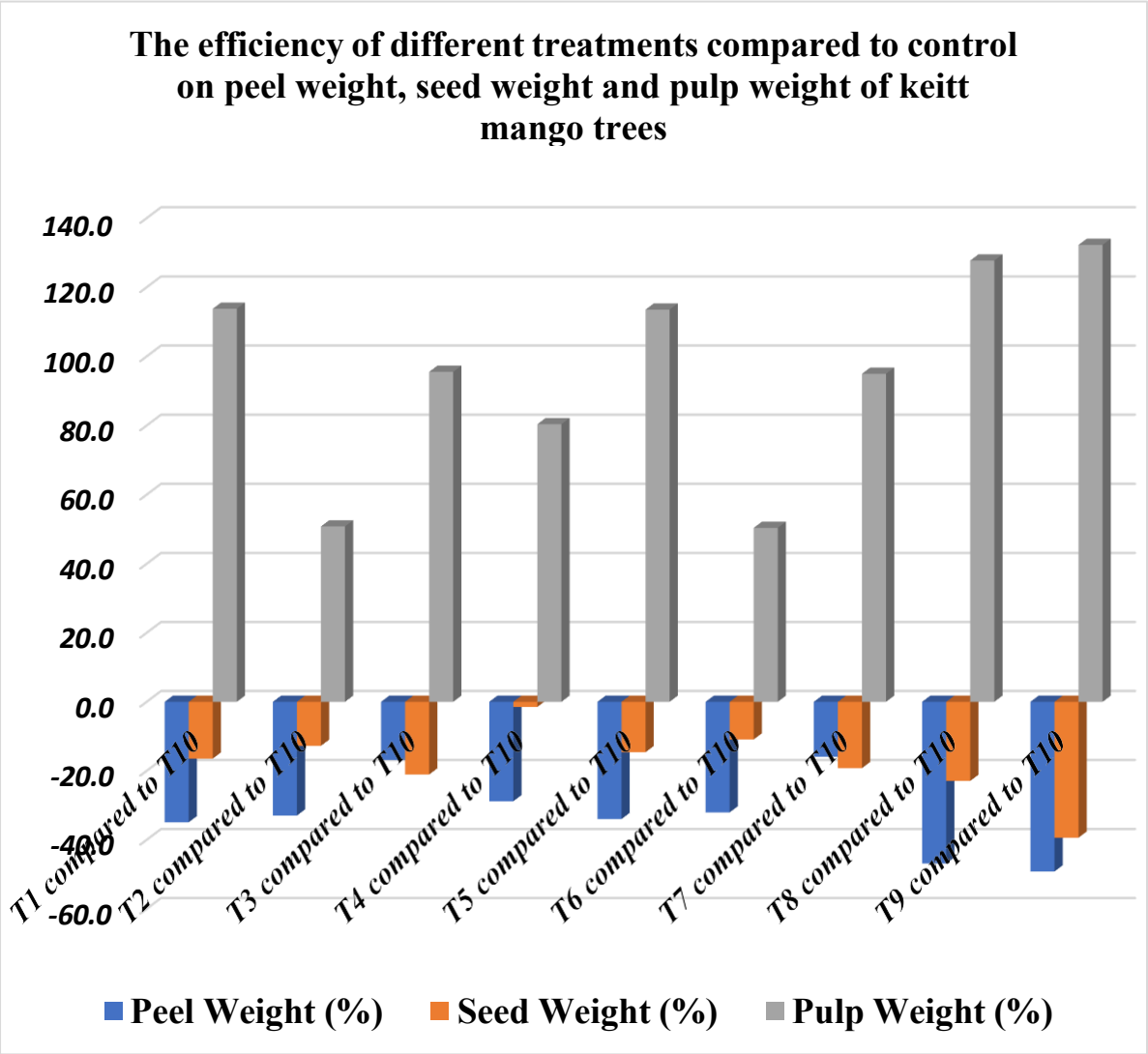

Fig. 5: The efficiency of different treatments compared to control on peel weight, seed weight and pulp weight of keitt mango trees.

3.5. Fruit length, fruit diameter and fruit thickness

Table 9 highlights clear that foliar treatments with sprout extract greatly enhanced the quality of the fruit in terms of fruit length, fruit diameter, and fruit thickness compared to untreated ones (T_{10}). T_8 and T_9 produced the highest fruit length (13.2 cm and 13.4 cm) and (13.3 cm and 13.5 cm) in the 1st and 2nd seasons, respectively. In addition, T_9 gave the best fruit diameter (9.7 cm and 9.9 cm in the 1st and 2nd seasons, respectively) and the highest values of fruit thickness (8.6 and 8.8 cm in the 1st and 2nd seasons, respectively). But, out of all the fruit qualities, T_{10} had the lowest values.

Table 9: Effect of foliar sprays with sprout extract of some plants on fruit length, fruit diameter and fruit thickness of keitt mango trees during 2023 and 2024 seasons.

Treat.	Fruit length (cm)		Fruit diameter (cm)		Fruit thickness (cm)	
	2023	2024	2023	2024	2023	2024
T_1	12.6 c	12.8 c	8.6 e	8.8 e	7.2 d	7.4 d
T_2	13.0 b	13.2 b	8.9 c	9.1 c	7.8 bc	8.1 bc
T_3	12.6 c	12.8 c	8.7 de	8.9 de	7.3 d	7.5 d
T_4	12.9 b	13.1 b	8.8 cd	9.0 cd	7.6 c	7.8 c
T_5	12.6 c	12.8 c	8.8 cd	9.0 cd	7.3 d	7.5 d
T_6	11.8 d	12.0 d	8.2 f	8.4 f	7.2 d	7.4 d
T_7	11.8 d	12.0 d	8.6 e	8.8 e	7.2 7	7.4 d
T_8	13.2 a	13.4 a	9.3 b	9.5 b	7.9 b	8.1 b
T_9	13.3 a	13.5 a	9.7 a	9.9 a	8.6 a	8.8 a
T_{10}	11.3 e	11.5 e	8.2 f	8.4 f	6.7 e	6.9 e

(T_1) Spraying rocket seed sprout extract at 0.2 %, (T_2) Spraying rocket seed sprout extract at 0.4 %,(T_3) Spraying rocket seed sprout extract at 0.6 %,(T_4) Spraying lupine seed sprout extract at 0.2%,(T_5) Spraying lupine seed sprout extract at 0.4 %,(T_6) Spraying lupine seed sprout extract at 0.6 %,(T_7) Spraying chickpea seed sprout extract at 0.2 %,(T_8) Spraying chickpea seed sprout extract at 0.4 %,(T_9) Spraying chickpea seed sprout extract at 0.6 % and (T_{10}) and control (water). Mean values having the same letters in the same column in each season are not statistically different by Duncan's multiple range test at 5 % level.

Evaluation of the treatments efficiency

The most significant percentage improvements in fruit length, fruit diameter, and fruit thickness were recorded with T_9, whereas the lowest one was obtained at T_6. It can be concluded that, when compared to other treatments, chickpea seed sprout extract (0.6%) is the most effective for keitt mango trees Fig. 6.

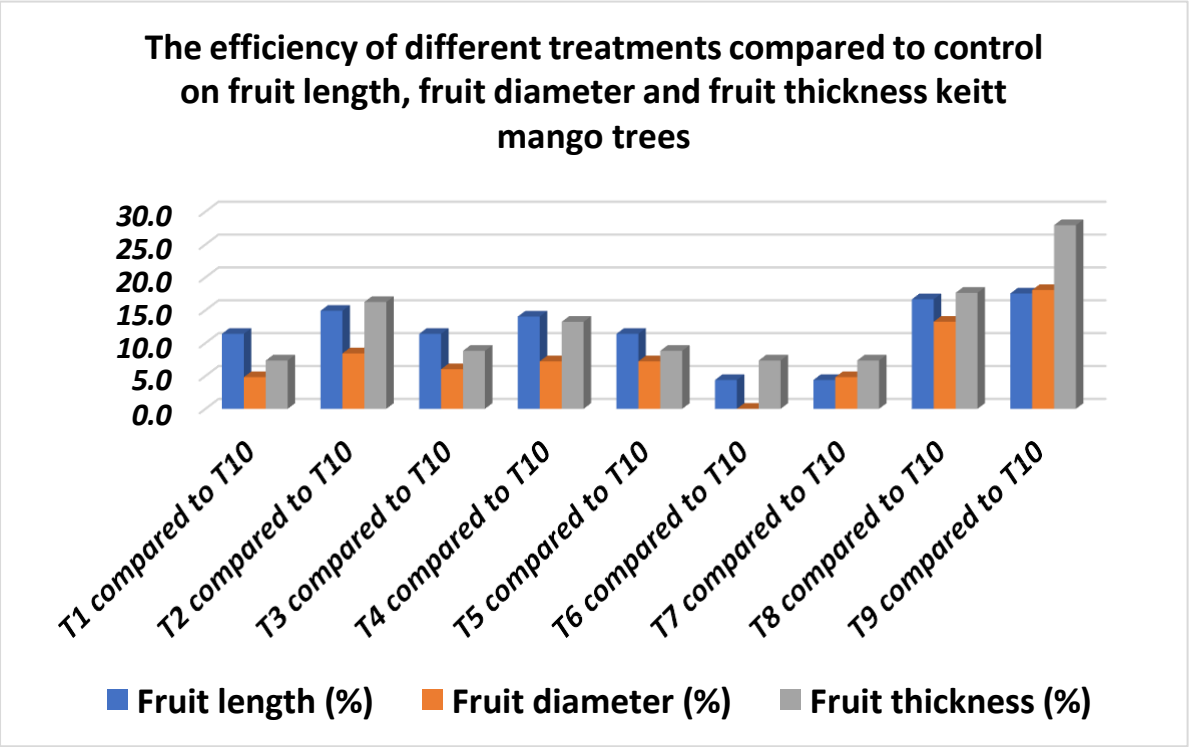

Fig. 6: The efficiency of different treatments compared to control on fruit length, fruit diameter and fruit thickness of keitt mango trees.

3.6. Reducing sugars, non-reducing sugars, total sugars, and T.S.S.

Table 10 data clearly indicates that, when compared to the control treatment (T_{10}), spraying extracts of rocket, lupine, and chickpea seed sprouts significantly improved the quality of the fruit in terms of reducing sugars, non-reducing sugars, total sugars, and T.S.S. in the juice. T_9 and T_8 gave the highest percentage of reducing sugars (6.1 and 6.2 %) and (5.9 and 6.0 %) in the 1st and 2nd seasons, respectively. In addition, T_7 gave the highest non-reducing sugars in the 1st and 2nd seasons. Furthermore, total sugar and T.S.S. had the best value with T_9, T_8, T_6, and T_2 in the 1st and 2nd seasons. Fruit quality was least affected by T_{10} trees. Similar results were reported for both seasons of the study.

Table 10: Effect of foliar sprays with sprout extract of some plants on total sugars, reducing sugars, non-reducing sugars, and T.S.S of keitt mango trees during 2023 and 2024 seasons.

Treat.	Reducing sugars (%)		Non-Reducing sugars (%)		Total Sugars (%)		T.S.S (%)	
	2023	2024	2023	2024	2023	2024	2023	2024
T_1	4.4 d	4.5 d	13.5 f	14.1 f	17.9 d	18.6 d	20.9 d	21.0 d
T_2	4.3 d	4.4 d	15.4 b	16.0 b	19.7 a	20.4 a	22.7 a	22.8 a
T_3	5.3 b	5.4 b	12.0 h	12.6 h	17.3 e	18.0 e	20.3 e	20.4 e
T_4	5.2 b	5.3 b	12.6 g	13.2 g	17.8 d	18.5 d	20.8 d	20.9 d
T_5	4.8 c	4.9 c	14.1 d	14.8 d	19.0 c	19.7 c	22.0 c	22.1 c
T_6	5.3 b	5.4 b	14.4 c	15.1 c	19.7 a	20.4 a	22.7 a	22.8 a
T_7	3.4 e	3.5 e	15.9 a	16.5 a	19.3 b	20.0 b	22.3 b	22.4 b
T_8	5.9 a	6.0 a	13.9 de	14.6 de	19.8 a	20.5 a	22.8 a	22.9 a
T_9	6.1 a	6.2 a	13.8 e	14.4 e	19.9 a	20.6 a	22.9 a	23.0 a
T_{10}	2.6 f	2.7 f	12.1 h	12.7 h	14.7 f	15.4 f	17.7 f	17.8 f

(T_1) Spraying rocket seed sprout extract at 0.2 %, (T_2) Spraying rocket seed sprout extract at 0.4 %,(T_3) Spraying rocket seed sprout extract at 0.6 %,(T_4) Spraying lupine seed sprout extract at 0.2%,(T_5) Spraying lupine seed sprout extract at 0.4 %,(T_6) Spraying lupine seed sprout extract at 0.6 %,(T_7) Spraying chickpea seed sprout extract at 0.2 %,(T_8) Spraying chickpea seed sprout extract at 0.4 %,(T_9) Spraying chickpea seed sprout extract at 0.6 % and (T_{10}) and control (water). Mean values having the same letters in the same column in each season are not statistically different by Duncan's multiple range test at 5 % level.

Evaluation of the treatments efficiency:

T_9 recorded the largest percentage increases of total sugars, reducing sugars, and T.S.S of keitt mango trees. On the other hand, the lowest non-reducing sugars were obtained by T_3.

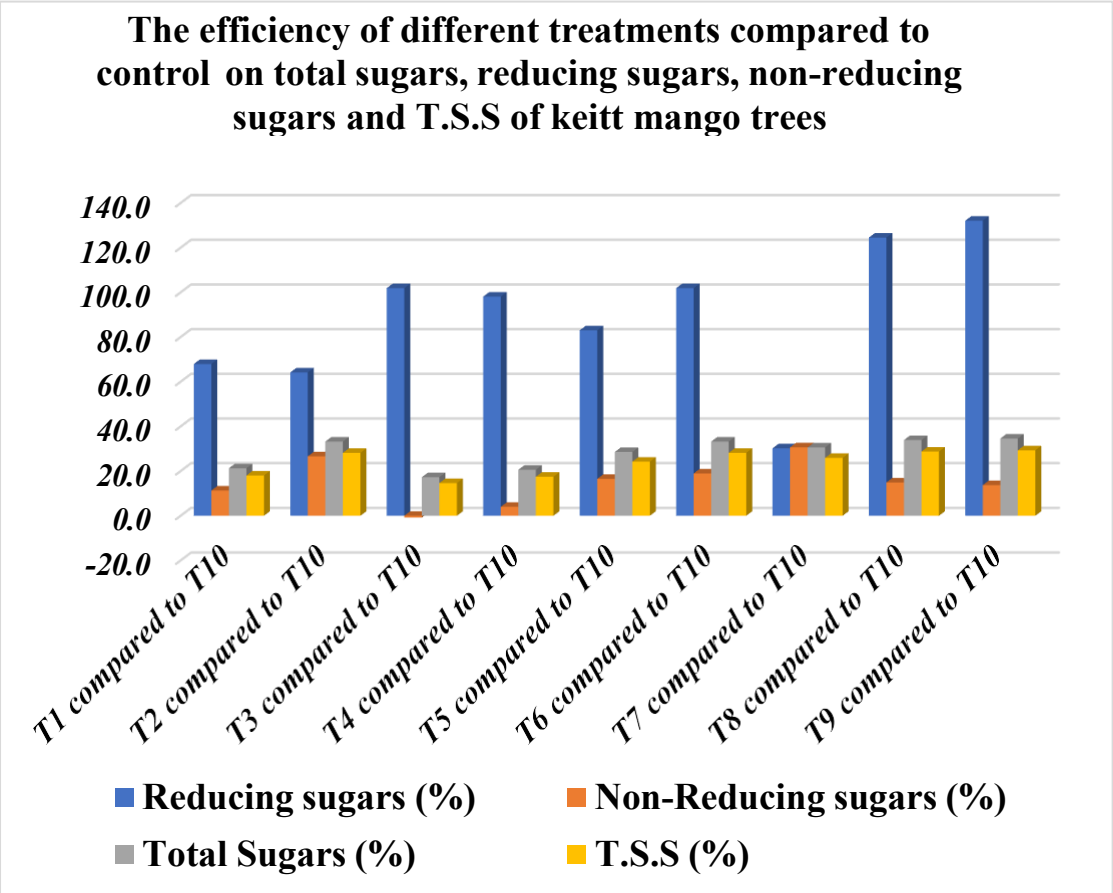

Fig. 7: The efficiency of different treatments compared to control on total sugars, reducing sugars, non-reducing sugars and T.S.S of keitt mango trees.

4. Discussion

The higher content of minerals, vitamins, antioxidants, and amino acids found in seed sprout extract may explain the favorable impacts on growth and fruiting of keitt mango trees. Improvements in tree growth, nutritional status, productivity, and fruit quality were probably influenced by these factors "Cazuola" [11], "Cairney" [12].

"Mengel" [33] stated that the biosynthesis of many plant compounds, such as pigments, DNA, RNA, amino acids, vitamins, antioxidants, sugars, and other materials linked to plant metabolism, cell division, cell wall development, and enzyme function, is greatly aided by macro and micronutrients. They are also essential for the production of plant hormones such as (IAA), (GA_3), cytokinins, (ABA), and ethylene. Important processes that affect the overall quality of fruit are influenced by the availability of these nutrients.

Some studied indicated that chickpea seed protein contains more nutrients than other pulse grains "El-Adawy" [34] and has higher levels of calcium and phosphorus compared to other pulses "Wood, [35].

Germination of seeds increases the availability of organic and mineral nutrients “Biommerson” [5], “Anwar” [3], and “Dhekney” [13] this improvement in growth and tree nutrition status undoubtedly leads to higher yield and better fruit quality.

“Cazuola” [11], “Cairney” [12], “Biommerson” [5], “Dhekney” [13], “Oraby” [14], and “Ali” [15]. Indicated that, the use of crop seed sprouts improves growth, nutritional value, yield, and fruit quality in fruit crops while also reducing environmental pollution.

The results obtained are consistent with those from previous studies “El-Sayed-Esraa” [20] on Ewaise mango trees; “Refaai” [21] on Keitte mango trees; “El- Khawaga” [22] on Washington navel orange trees; “Ahmed” [23] on Keitte mango trees; “Abdelaziz” [26] on Ewaise mango trees; “El-Sharony” [25] on the Fagri Kalan cultivar of mango trees; “Mohamed” [27] on Succary mango trees; “Oraby” [14], “Ali” [15] on Ewaise mango trees; and “El-Salhy” [36] on mango trees of the Ewaise cultivar.

“ Vijayalakshmi *et al.,* ” [38] concluded that foliar spraying of 3% chickpea sprout extract at active tillering stage and seed filling enhances seed yield attributes and yield in rice.

Showed that the foliar application of plant biostimulants on mango cv. Keitt. gave the highest increments for inducing the number, length, and thickness of shoots, leaf area, and leaf chlorophyll over the control treatment. In addition, it also heightened the fruit set, fruit yield, and the fruit’s physical and chemical characteristics Additionally, these biostimulants contribute to improved plant health and quality by supplying essential nutrients that stimulate overall growth “Khalid *et al.,* ” [39].

“Doaa *et al.,* ” [40] found that sprayed mango with plant extract showed significant improvements in growth, and leaf nutrient content compared to control treatment.

Additionally, there was a noticeable improvement in the physical and chemical properties of some keitt mango fruits when chickpea seed sprout extract was applied as a spray. Therefore, it is advisable to use chickpea seed sprout extracts at a concentration of 0.6%, applied three times throughout the growing season: once in the first week of March when growth begins, again in the first week of April when fruit set starts, and finally in the third week of May. This approach could serve as an effective natural biostimulant treatment to enhance the growth and fruiting of Keitt mango trees under similar testing conditions. Morover, to evaluate treatment efficiency, 0.6% chickpea seed sprout extract improved all studied parameters of keitt mango trees as opposed to the control.

5. Conclusion

In light of the earlier findings, it would appear appropriate to suggest that an environmentally friendly treatment for mango trees cv. keitt would be to spray them with chickpea seed sprout extract at 0.6 %. Furthermore, because of its great potential and nutritional value, this therapy could be applied to other crops in addition to fruit orchards.

6. Conflicts Of Interest

The authors declare no conflict of interest.

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