International Journal of Agricultural Research

ISSN 1816-4897

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS International Journal of Agricultural Research

ISSN 1816-4897
DOI: 10.3923/ijar.2016.105.115

Research Article
Potassium Forms as a Macronutrient Application to Maximize Fruit and Oil Productivity of *Jatropha curcas* (Part 2: The use of Potassium Nitrate (KNO_3))

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Abstract

Objectives: This study has been done to investigate the effects of foliar spraying of potassium nitrate at different concentrations and times for increasing the fruit and oil productivity and quality of *Jatropha curcas* trees. **Methodology:** *Jatropha curcas* trees treated with three concentrations (0.5, 1.0 and 1.5%) of KNO_3 either pre and/or post bloom. Changes in leaf mineral content, flowering, fruit yield and seed oil content and their chemical characteristics were determined. Several oil properties as well as oil content, acid, peroxide and iodine values were measured too. **Results:** The results showed that all foliar spraying with different potassium nitrate (KNO_3) concentrations and times revealed a pronounced increase in leaf mineral contents. Also, KNO_3 spraying enhanced fruit yield and seed physical and chemical characteristics compared with control trees. The best results, with regards to leave mineral N, P and K were found due to foliar application with 1.5% twice and 1% once. In addition spraying potassium nitrate at 1% once which superior to increase the number of flowers, fruits per inflorescences, seed weight and oil content. Total seed weight and volume were obtained under spraying potassium nitrate at 1.5% twice. Foliar spraying of potassium nitrate 1% had the highest content of seed oil and its iodine value. Meanwhile, a good oil quality that had lowest oil acidity and peroxide value was observed with potassium nitrate concentration at 1.5% compared to untreated trees (control). **Conclusion:** The potassium nitrate had a positive effect of leaf mineral content with improving fruit yield, seed physical and chemical properties with greatest results at 1% potassium nitrate sprayed once as compared with control.

Key words: *Jatropha* trees, potassium nitrate, flowering properties, fruit yield, oil content and quality

Received: July 29, 2016 Accepted: August 26, 2016 Published: September 15, 2016

Citation: Aml R.M. Yousef, Enas A.M. Ali, Dorria M.M. Ahmed and M. Abd El-Hady, 2016. Potassium forms as a macronutrient application to maximize fruit and oil productivity of *Jartropha curcas* (Part 2: The use of potassium nitrate (KNO_3)). Int. J. Agric. Res., 11: 105-115.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

In Egypt, *Jatropha* plantations as a biofuel feedstock started as a part of its policy for safe use of treated sewage water, to expand the green stretch in the desert, producing high economic value trees. Moreover, as the population increases, waste-water represents a threat to both safety environment and population, but also represents a valuable resource which can be used for the agricultural expansion and making use of the marginal desert land. In addition, the increase in demand for biodiesel by EU markets can create a challenge for Egyptian exporters of biodiesel which is needed progressively in the future[1]. So, producing high quality of *Jatropha* oil in Egypt is very competitive prices could be considered one of few back bones of the agricultural economy and to establish a base for a new agricultural based industry.

Jatropha curcas L., as a commercially viable biofuel crop, is recognized as a promising feedstock for biodiesel production. It is one of the species that yield biodiesel and it is a multipurpose non-edible oil-yielding perennial shrub[2]. *Jatropha* plant is resistant to drought and adapted to arid/semi arid conditions which characterized by high soil salinity, low fertility and limited supply of high quality water[3,4]. It is adapted to a wide range of climate and soil and can be grown successfully as an agro forestry crop on waste lands and marginal lands[5]. *Jatropha curcas* is a potent oil crop that contains 30-35% oil content by seed weight and 50-60% of the kernel weight[6]. Seed and oil yield in *Jatropha* are affected by several factors, including genetics[7], age of the plant, field site characteristics, such as rainfall, soil type and fertility[8] and agronomic practices, such as plant spacing, pruning, irrigation and fertilization[9]. Meanwhile, it is limited knowledge on water requirement, lack of organized breeding programs and limited agronomic practices for inadequate investments by developing and private agencies. Also, for high yield rate, it requires more supply of water and nutrition[10,11].

Foliar application of nutrients is in general helpful to satisfy plant requirement and has a high efficiency[12]. Potassium (K) is an essential plant nutrient that plays a very important role in plant growth and development. Its role is well documented in photosynthesis, increasing enzyme activity, improving the synthesis of protein, carbohydrates and fats, translocation of photosynthetic, enabling their ability to resist pests and diseases. Also, potassium is considered a major osmotically active action of the plant cell[13] where it enhances water uptake and root permeability and acts as a guard cell controller, beside its role in increasing water use efficiency[14].

Application of potassium to trees is an attractive method, especially in arid zones where a lack of water under water stress conditions in summer drastically depresses absorption of soil nutrients[15]. Additionally, Hiller[16] reported that, it has been established in various research studies that plant leaves and other above ground parts are capable of absorbing chemicals and nutrients by plants is not a function limited to the root system. Moreover, foliar nutrition is ideally designed to provide many nutrients to a crop that may be limiting production at a time when its uptake from the soil is inefficient or non-existent[17]. Thus, the advantages of this technique should be explored as the smaller fertilizer use lower cost, ease of application, good quality of fertilizer used and fertilizers readily soluble in water.

Therefore, the present investigation was carried out to study the effects of foliar spraying of potassium nitrate at different concentrations and times on leaves mineral contents and fruit and oil productivity and quality of *Jatropha curcas* trees grown under low quality soil and treated sewage water (Suez conditions).

MATERIALS AND METHODS

Plant material: This study was carried out during the two successive seasons of 2014 and 2015 in a private orchard of *Jatropha curcas* trees (4 years old) grown under Suez Government conditions, Egypt, to study the effect of foliar sprays of potassium form such as potassium nitrate (KNO_3) at different concentrations and times on leave mineral contents, fruit yield, seed properties, seed oil content and its quality characteristics.

The selected *Jatropha* trees were uniform in vigor and size, planted at 2×4 m apart. All trees received the same horticultural practices in the orchard. The treatments were carried out by spraying the chosen trees with potassium nitrate (KNO_3) at three different concentrations (0.5, 1.0 and 1.5%), while untreated trees (control) were sprayed with only water. Each treatment consists of three replicates and each replicate were two trees. All trees under the study were sprayed two times, first at full bloom (once) and second after fruit set (twice).

Water: *Jatropha* trees were irrigated by a drip irrigation system. Plot consisted of 14 lateral lines, 35 m long, 4 m between the rows and 2 m among trees with two drippers for each (dripper discharge 8 L h^{-1}). Irrigation process was carried 3 days weekly with total amount ranged from 32-40 L day^{-1} $tree^{-1}$. Experimental plots were irrigated by secondary treated sewage water (Table 1).

Table 1: Chemical characteristics of the investigated soil and water

			Soluble cations and anions (meq L^{-1})								
Chemical characters	EC (dS m^{-1})	pH	$Ca+Mg^{2+}$	Na^{+}	K^{+}	CO_3	HCO_3	Cl^{-}	SO_4	$CaCO_3$ (%)	OM
Soil	5.87	8.3	17.1	41.4	0.2	0.0	4.7	41.5	10.5	14.5	0.56
Water	4.22	7.5	18.6	23.4	0.2	0.0	3.5	27.4	11.2	SAR	7.67

Table 2: Hydro-physical characteristics of the investigated soil

Particles size distribution (%)				Soil water constant (%) wb				
Sand	Silt	Clay	Texture class	Saturation	Field capacity	Wilting point	Available water	Drainable poresis percentage relative to total porosity
65	28	7	Sandy loamy	23.0	15.6	6.4	9.2	32.1

Soil: The $CaCO_3$ were determined[18] and the organic matter was determined[19] after soil water constants such as field capacity and wilting point were measured[20] and available water was getting by subtracting. Soil and irrigation water analysis are given in Table 1 and 2. The following parameters were measured in both seasons.

Leaf mineral contents: At the end of each growing season during the first week of September, leaf samples were collected, washed and dried at 70°C until constant weight and then grounded for determining the following nutrient elements (Percentage as dry weight); N, P and K were determined according to AOAC[21].

Number of inflorescence per shoot: During the peak flowering period (May-June), the number of inflorescence present in a shoot was counted.

Number of flowers per inflorescence: The inflorescences in each individual shoot were tagged just before their emergence and the total number of flowers per inflorescence were counted.

Number of fruits per inflorescence: During the peak fruiting period, total number of fruits per inflorescence present on each plant were counted and average fruits per inflorescence was calculated.

Fruit yield: At maturity stage of two seasons (mid October), fruits of each tree were separately harvested, then weighed and yield as kilogram per tree was estimated.

Seed characteristics: Thirty seed per each tree were randomly selected for carrying out the seed measurements as follow:

- **Seed dimensions:** Seed length and diameter (cm)
- **Seed parameters:** 100 seed weight (g) and 100 seed volume (cm^3)

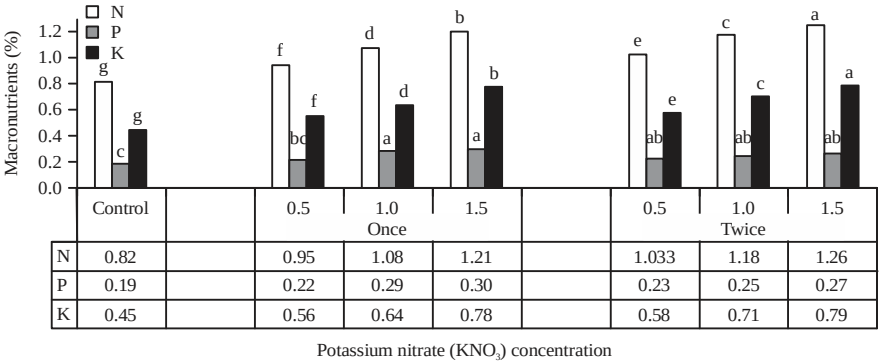
Seed oil content (%): The seeds were ground using mortar and pestle and 20 g of coarse seed powder was taken for oil extraction. Commonly used solvent extraction method in Soxhlet apparatus was applied, using petroleum ether (boiling point: 40-60°C) as solvent for extraction of the oil method according to De Pena *et al.*[22].

Chemical analysis of oil: Determinations for peroxide, iodine and oil acidity were carried out using[22], standard analytical methods.

Statistical analysis: All obtained data during both 2014 and 2015 experimental seasons were subjected to analysis of variances (ANOVA) according to Snedecor and Cochran[23] using MSTAT program. Least Significant Difference (LSD) was used to compare between means of treatments according to Duncan[24] at probability of 5%.

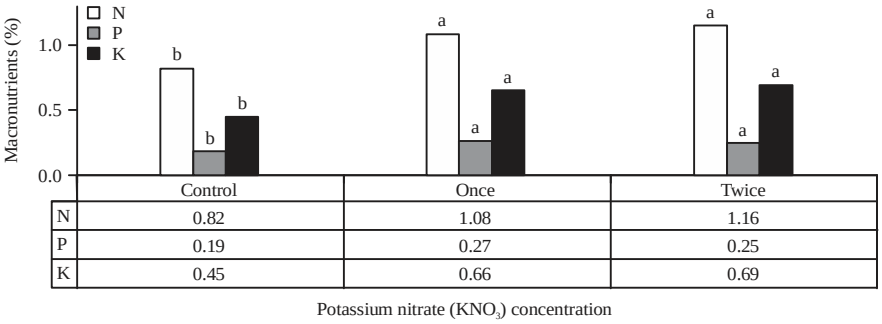
RESULTS AND DISCUSSION

Leaf mineral contents: Results in Fig. 1 revealed that, leaf mineral content of N, P and K were significantly increased by all spraying treatments as compared with control. As for nitrogen content in leaves, it was significantly affected by different spraying treatments. Foliar spraying of potassium nitrate at 1.5%, twice gave the highest value for average of both seasons of leave nitrogen content since it was 1.26 followed by using potassium nitrate at 1.5% once, which recorded (1.21). On the contrary, control treatment recorded the lowest value in this respect which gave (0.82). Regarding P content in leaves, results in Fig. 2 cleared that all spraying treatments improved P content in leaves as compared untreated trees. Foliar potassium nitrate at 1.5 and 1% once achieve the highest value since it was (0.30 and 0.29), respectively, followed by foliar spraying with potassium nitrate at 1 and 1.5% twice which gave (0.25 and 0.27), respectively. Meanwhile control treatment recorded the lowest one in this respect (0.19). Concerning leaves content of K, the results showed that K content in *Jatropha* leaves was significantly affected with different potassium spraying. Foliar potassium



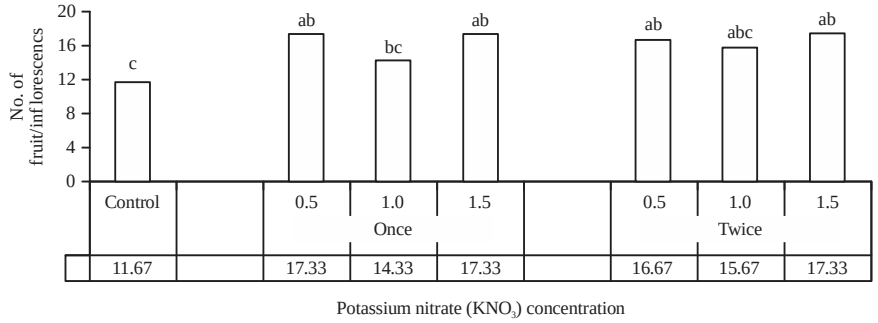
	Control	0.5	1.0	1.5	0.5	1.0	1.5
		Once			Twice		
N	0.82	0.95	1.08	1.21	1.033	1.18	1.26
P	0.19	0.22	0.29	0.30	0.23	0.25	0.27
K	0.45	0.56	0.64	0.78	0.58	0.71	0.79

Fig. 1: Effect of foliar spraying by KNO_3 at different rates on N, P and K of leaf content of *Jatropha curcas* trees. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)



	Control	Once	Twice
N	0.82	1.08	1.16
P	0.19	0.27	0.25
K	0.45	0.66	0.69

Fig. 2: Effect of No. of foliar spraying by KNO_3 on N, P and K the leaf content of *Jatropha curcas* trees. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)



	Control	0.5	1.0	1.5	0.5	1.0	1.5
		Once			Twice		
	11.67	17.33	14.33	17.33	16.67	15.67	17.33

Fig. 3: Number of fruit/inflorescence of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once and/or twice. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

at 1.5% twice registered the highest potassium content in leaves (0.79). Meanwhile, control treatment gave the lowest one in this respect since it was (0.45). In addition other treatments were in between ranges. Generally, spraying potassium nitrate twice was more effective than once sprays which registered the highest leaves N and K content in both seasons while spraying potassium nitrate once recorded the highest one concerning leaves P content.

Flowering properties: Data illustrated in Fig. 3-5 indicated that the effect of foliar sprays of potassium nitrate (KNO_3) on flowering properties as well as a number of inflorescences per shoot, number of flowers per inflorescence and number of fruits per inflorescence. Obtained data revealed that the number of inflorescences per shoot at flowering stage was significantly influenced by different treatments as compared with control.

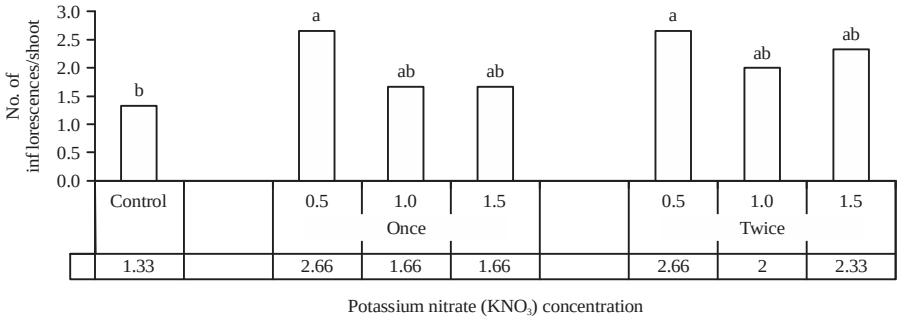


Fig. 4: Number of inflorescence of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once or twice. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

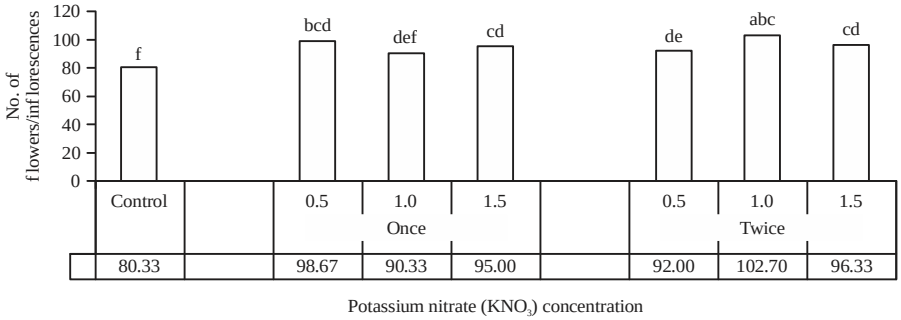


Fig. 5: Number of flowers/inflorescence of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once or twice. Values are the means of two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

Regarding number of fruits per inflorescence, data in Fig. 3 illustrated that all spraying treatments significantly increased the number of fruits per inflorescence as compared with control. Foliar sprays of potassium nitrate at 0.5% sprays once or 0.5 and 1.5 sprays twice recorded the highest number of fruits per inflorescence (17.33, 17.33 and 17.33), respectively. On the contrast, control treatment registered the lowest value in this respect since it was (11.67). Moreover, other treatments were in between ranges.

Figure 4 shows that, the maximum number of inflorescences per shoot was recorded by using of foliar potassium nitrate at 0.5% at once or twice sprays since it was (2.66 and 2.66), respectively. Meanwhile, the minimum number of inflorescence per shoot was found under control treatment which gave (1.33). Concerning the number of flowers per inflorescence according to the data illustrated in Fig. 5. It is cleared that total flowers per inflorescence were highly significantly affected by different application treatments of potassium as compared with control. Foliar sprays of potassium nitrate at 1% sprays twice recorded the highest value in this respect since it was (102.7). On the other contrary control treatment gave the lowest one in this respect (80.33).

Fruit yield and seed physical parameters: Data presented in Fig. 6 revealed that, fruit yield expressed as weight (kilogram per tree) was significantly increased in all different spraying treatments as compared with control. Untreated trees (control) had the lowest yield as (kilogram per tree) since it was 1.88 kilogram per tree. On the otherwise, trees received KNO_3 at 0.5 or 1.5% twice sprays exhibited 2.95 and 2.96 kg, respectively, followed by potassium nitrate sprays at 1% once or twice which recorded 2.91 and 2.92 kg, respectively.

As for seed length and diameter (cm), it could be noticed from Fig. 7 that, seed length and diameter was significantly affected by different potassium nitrate application at both seasons under study. The highest significant value of seed length and diameter were found due to using potassium nitrate at 1.5% spraying once which recorded (2.20 and 2.12 cm) for seed length and diameter, respectively. On the otherwise, the obtained results indicated that untreated trees exhibited the lowest values in this respect since it was (2.05 and 1.98 cm) for seed length and width cm, respectively.

Figure 8 clearly showed that all different spraying treatments significantly increased the average of 100 seed weight (g) and volume (cm^3) during both seasons of study. The highest average of two seasons for 100 seed weight was

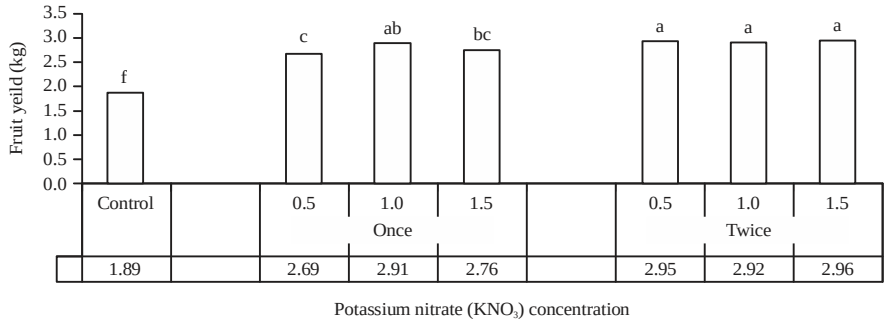


Fig. 6: Fruit yield of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once or twice. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

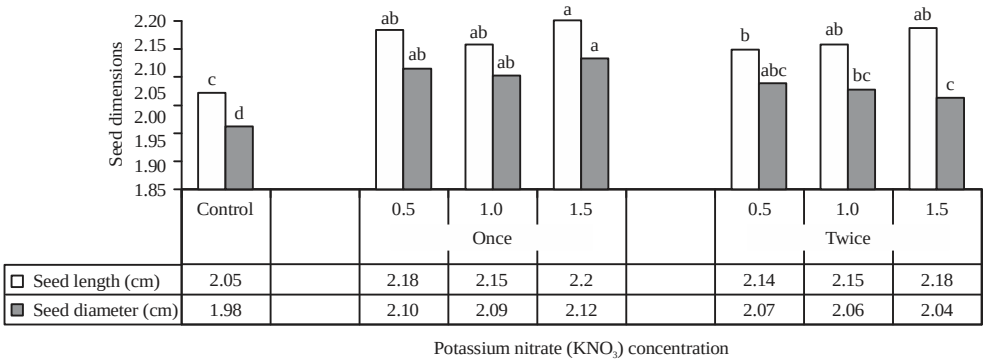


Fig. 7: Seed dimensions (Length and diameter) of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once or twice. Values are the means of two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

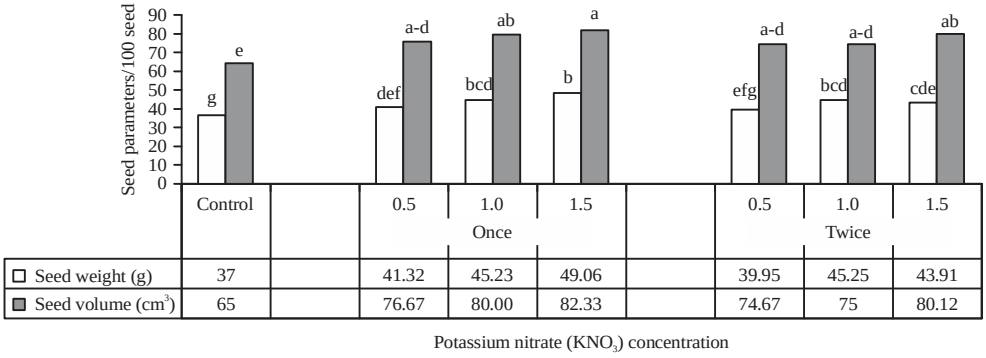


Fig. 8: Seed parameters (weight and volume) of 100 seeds of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once and/or twice. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

recorded by using foliar potassium nitrate at 1.5% sprays once since it was (49.06 g) followed by 1% sprays once or twice which recorded (45.23 and 45.25 g), respectively. On the other contrary, control treatment gave the lowest one in this respect (37.00 g). Meanwhile, other treatments showed the average values which were in between the previous range.

Concerning the average volume (cm^3) of 100 seeds, data in Fig. 8 revealed that spraying potassium nitrate at 1 and 1.5 once and 1.5 twice recorded the highest 100 seed volume than other treatments which being (80.00, 80.12 and 82.33 cm^3), respectively. Meanwhile, the lowest one in this respect (65.00 cm^3) was obtained under control treatment.

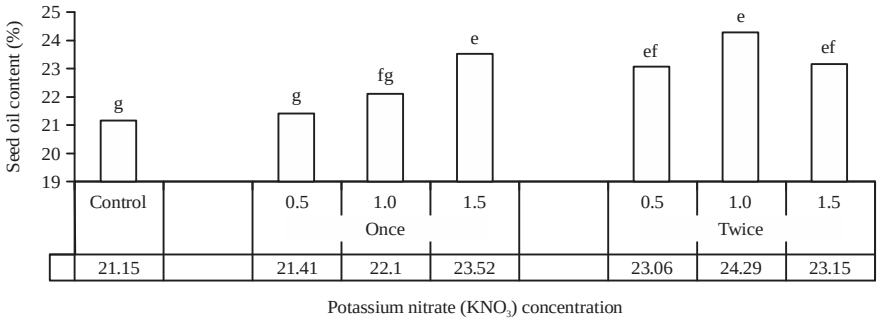


Fig. 9: Seed oil content of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once or twice. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

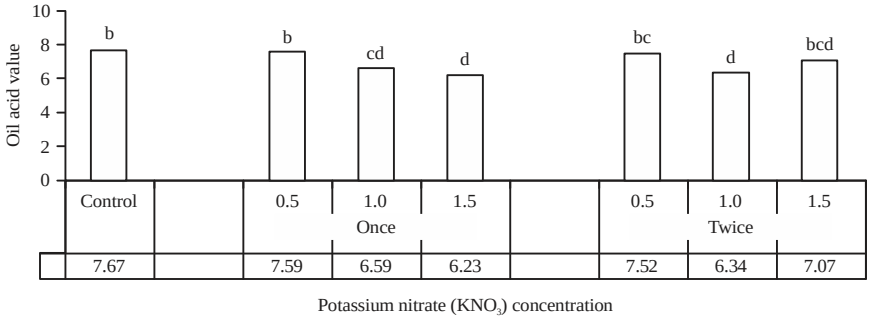


Fig. 10: Oil acid value of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once or twice. Values are the means of the twos seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

Seed oil content and chemical properties of oil seed: The physical and chemical characteristics of *Jatropha* seed oil can varied depends on environmental factors, genetics and the maturity of the seeds. The oil content of *Jatropha* seeds varied significantly after spraying treatment with different concentrations of potassium nitrate (Fig. 9). Different spraying treatments (once and twice) produced significantly higher seed oil content as compared to control. On the other side, spraying KNO_3 twice showed an increase in the seed oil content compared to spraying once. The highest percentage of seed oil content was observed at potassium nitrate sprayed twice 1% (24.29%) followed by 1.5% sprayed once. Meanwhile, untreated trees (control) recorded the lowest percent (21.15) of oil content.

Chemical properties of seeds oil: The chemical properties of seed oil are the most important properties that described the present condition of the oil. The various number of test parameters like: Acid value, peroxide value and iodine value had been estimated. The acid value of *Jatropha* seeds oil which valuable measure of oil quality in Fig. 10 showed significant effect by different concentrations of potassium nitrate compared to control (untreated trees). The lowest oil acidity (6.23) recorded by 1.5% potassium nitrate spraying once followed by 1% (6.34) sprays twice. Untreated trees (control) clarified the highest percent of seed oil acid value (7.67).

Results are presented in Fig. 11 illustrated the effect of spraying potassium nitrate on oil quality as well as iodine value which measure the average amount of unsaturation of fats and oils. Spraying of different concentrations of potassium nitrate once showed a higher iodine value compared to spray twice. The highest iodine value which due to its high content of unsaturated fatty acids obtained by potassium nitrate 1% (102.6) have followed by 1.5% (101.6) then 0.5% (95.57) sprayed once.

The results in Fig. 12 showed that peroxide value of the *Jatropha curcas* seed oil affected with different concentrations of potassium nitrate compared to control. The lowest peroxide value obtained by 1.5% potassium nitrate (4.52) twice spray compared to untreated trees (control) which recorded the highest peroxide value (12.13).

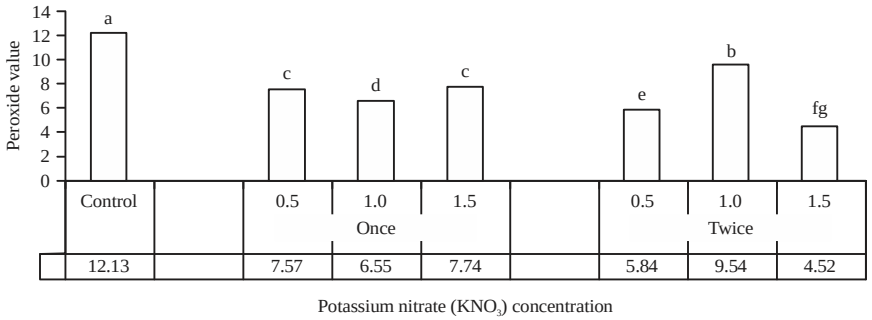


Fig. 11: Oil peroxide value of *Jatropha curcas* trees treated with foliar spray of KNO_3 at 0.5, 1.0 and 1.5% once or twice. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

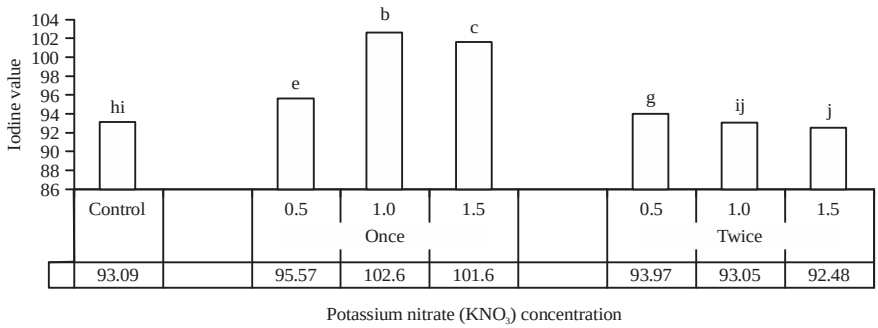


Fig. 12: Oil iodine value of *Jatropha curcas* trees treated with foliar spray of $KKNO_3$ at 0.5, 1.0 and 1.5% once or twice. Values are the means of the two seasons. The letters represents LSD level according to Duncan[24] ($p \leq 0.05$)

DISCUSSION

The obtained results, regarding the influence of spraying potassium nitrate on leaf mineral content are in agreement with those obtained by El-Razek *et al.*[25] found that spraying mango trees with sward (25% potassium) raised leaf mineral content of N, P and K. Furthermore, Taha *et al.*[26] on mango tree showed that all different potassium forms applications had a positive effect on improve leave mineral content, also Hegazi *et al.*[27] on picual olive trees cleared that sprayed potassium nitrate enhance nutritional status of trees. On the other hand, the improvement in leave mineral content under foliar potassium sprays due to shorten the time required for uptake compared to soil application[28]. In addition, Southwick *et al.*[29] indicated that uptake of K from foliar spray may be more predictable and efficient than uptake from the soil. Also, foliar spray of KNO_3 may be attributed to the best uptake of N, P, K and Ca. Concerning flowering, fruit set and yield the obtained results are in harmony with these of Montenegro *et al.*[30], who found that fertilization of *J. carcus* plants with nitrogen and potassium at a dose of 150+120 kg ha^{-1} increased fruit and seed production by more than 90%, as compared with the unfertilized control. Moreover, Rojas *et al.*[31] found that spraying of KNO_3 at (6%) on mango trees during September-October significantly increased the percentage of flowering/shoots and the number of mixed panicle. Similar results was found with Rajput and Singh[32] who noticed that spraying of KNO_3 significantly increased the flowering percentage of mango.

Generally, potassium nitrate concentrations especially in combination with urea gave better results for most of the flowering and yield parameters of 'Tommy Atkins' mango[33,34] is claimed that KNO_3 at 4% had improved flowering and fruiting in mango. In addition, the results of the present investigation are in agreement with the findings of El-Fangary[35], Mostafa and Saleh[36] and Sarrwy *et al.*[37] who found that spraying potassium using different forms had a positive effect yield as number or fruits weight of citrus trees. The highest flowering and fruit yield which was obtained by foliar spray of KNO_3 may be attributed to the best uptake of N, P, K and Ca. There is no doubt that K, as important nutritional elements, plays its part in regulation of many physiological criteria in plant which in turn affect the resulted total yield. In addition, foliar potassium spray's success in preventing the leaf contents of K and other mineral nutrients from declining to low levels during fruit set[38,39].

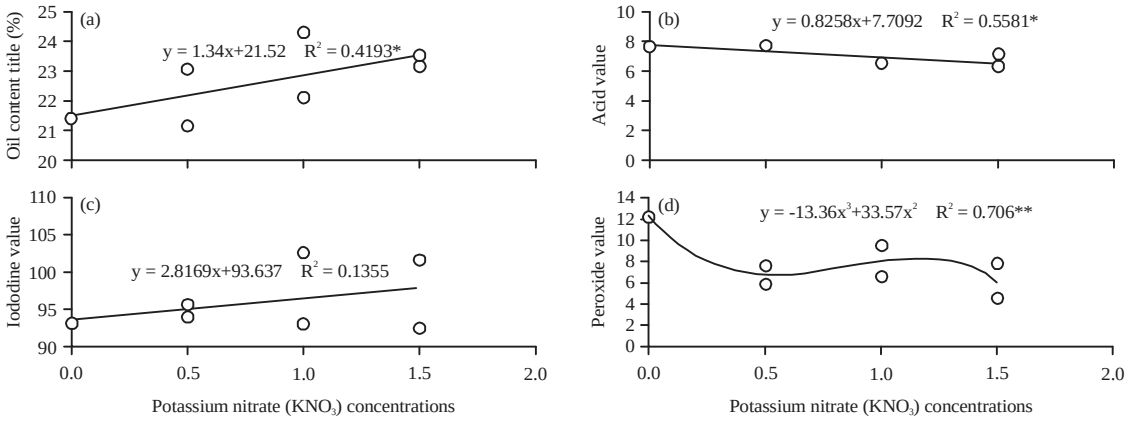


Fig. 13(a-d): Regression equation between the main *Jatropha* characteristics and KNO_3 at different concentration

Regarding seed physical and chemical characteristics as well as (seed weight, volume, dimension and oil quantity and quality). The results of the investigation lend support to the findings of Inglese *et al.*[12] who found that foliar application of KNO_3, during the second and the third phase of olive growth improved the fresh weight and the flesh to pit ratio[40,41] on olive trees reported that potassium fertilization improved yield and quality as well as fruit weight, flesh to pit ratio and oil content of olive fruit. In addition, Sarrwy *et al.*[37] on citrus trees concluded that enhanced fruit physical and chemical characteristics were obtained by sprayed both KNO_3 and KTS at 1.5% concentrations. The beneficial effects of potassium nitrate on fruit and oil quality may be attributed to their vital role in stimulating cell division and elongation as well as the biosynthesis and enhancing fruiting of trees[42].

Moreover, potassium is an essential plant nutrient that plays avery important role in plant growth and development. Its role is well documented in photosynthesis, increasing enzyme activity, improving synthesis of protein, carbohydrates and fats. Also, potassium (K) is well recognized as the essential plant nutrient with the strongest influence on many quality parameters of fruits[43]. Although, K is not a constituent of any functional molecules or plant structures, it is involved in numerous biochemical and physiological processes vital to plant growth, yield and quality[44], in addition to its role in stomatal regulation of transpiration[45].

Furthermore, the increased of oil quantity and quality due to foliar sprayed potassium nitrate. It also has a relationship to synthesis of protein and fats, synthesis of chlorophyll, stimulation of adenosine triphosphate formation and photosynthesis, anabolism and metabolism of carbohydrates, translocation of photosynthetic. In addition potassium used to increase of lipids synthesis in oil crops. It also can contribute in action of approximately 60 enzymes.

Figure 13 illustrated the relation between spraying by KNO_3 and oil content, acid value, peroxide value and iodine value. Positive regression equation was obtained between KNO_3 concentration and both oil content and iodine value, where the oil content is significant at 5% level and with iodine value is not. While, acid value showed negative sigio significant linear correlation with KNO_3 concentration (Fig. 13). It is clear that negative correlation was obtained between KNO_3 from side and peroxide value from the other one but this equation was polynomial one form the 3rd degree and get R^2 significant at 1%. This finding could attributed to the concentration of KNO_3 had not get good effect on the peroxide value more than 1% KNO_3. Data was supported by getting simple correlation between KNO_3 concentration from side and leaf content from N, P, K and flower characters flowers, number of flowers/inflorescences and number of fruit/inflorescences. Significantly correlation coefficient were obtained with value 0.961**, 0.967** and 0.985** for leaf content from N, P and K, respectively. While, r value were 0.865**, 0.570* and 0.624* for flowers, number of flowers/inflorescences and number of fruit/inflorescences, respectively.

CONCLUSION

In summary, the results of this study indicated that:

- All foliar application of potassium nitrate had a positive effect on increased *Jatropha* leaf mineral content and improved yield, seed physical and chemical properties as compared with control of *Jatropha carcus* trees grown under suez conditions
- The best treatment to increase the number of flowers, fruits per inflorescences, seed weight and oil content was under spraying potassium nitrate at 1% once
- Meanwhile, total seed yield and volume were obtained under spraying potassium nitrate at 1.5% twice

SIGNIFICANCE STATEMENTS

- The objective of this study was to investigate the effects of foliar spraying of potassium nitrate at different concentrations and times for increasing the fruit and oil productivity and quality of *Jatropha curcas* trees
- The methodology including treating *Jatropha curcas* trees with three concentrations (0.5, 1.0 and 1.5%) of KNO_3 either pre and/or post bloom. Changes in leaf mineral content, flowering, fruit yield and seed oil content and their chemical characteristics were determined. Several oil properties as well as oil content, acid, peroxide and iodine values were measured too
- The results showed that all foliar spraying with different potassium nitrate (KNO_3) concentrations and times revealed a pronounced increase in leaf mineral contents
- Foliar spraying of potassium nitrate 1% had the highest content of seed oil and its iodine value and leave mineral N, P and K. Meanwhile, good oil quality that had lowest oil acidity and peroxide value was observed with potassium nitrate concentration at 1.5% compared to untreated trees (control)
- The potassium nitrate had a positive effect of leaf mineral content with improving fruit yield, seed physical and chemical properties with greatest results at 1% potassium nitrate sprayed once

ACKNOWLEDGMENT

The researchers are grateful and express their deep thanks to those who have contributed to this study especially to National Research Centre who financed the project of "Plantation and Potential Applications of Jojoba and *Jatropha* Trees Under Sinai Peninsula Conditions" (Cod. No. 10060109).

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