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EFFECT OF K-FELDSPAR ROCK FERTILIZER ON GROWTH AND MINERAL CONTENT OF MORINGA SEEDLINGS (*MORINGA OLEIFERA*)

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ABSTRACT: A field experiment was conducted at the Botanical Gardens Research Department Land, Hort. Res. Inst. Alex., Egypt, during 2011-2012 and 2012-2013 seasons to study the effect of K-feldspar rock fertilizer on growth and mineral content of Moringa seedlings. Feldspar grinded rock and potassium sulphate were used as fertilizer sources of K fertilizer to Moringa plants. Fertilizer treatments consisted of three rates of K-feldspar (0, 200, 400 g /tree) and three rates of K-sulphate (0, 100, 200 g /tree), besides six combinations prepared from K-feldspar and K-sulphate. These amounts were added as a soil drench in two equal doses, the first one was applied immediately after planting (on April, $15^{th.}$), while the other after 3 months from the first (on July, $15^{th.}$). In addition, all Moringa seedlings received phosphate (50 g P_2O_5/ tree), organic manure (3kg/tree) and N (50 g / tree) at processing and preparing the soil to planting seedlings. Also, in the second season, Moringa seedlings were cultivated at the same age and height as well as the same agricultural practices as in the first one.

The obtained results indicated that all treatments increased plant height and stem diameter with various significant differences compared to the control at the different determinations assessed in the two seasons. However, the superiority in the two seasons was for the combination of 200g K-F + 100g K-S, which gave the tallest plants and widest stems, as well as K mineral content of either soil or plant. In general, connecting between K-F and K-S recorded better results than the individual application of each in most determinations registered in both seasons. Also, increasing the rate of either K-F or K-S, individually or in combination caused an addition improvement in all previous characters measured in different stages of the two seasons. Moreover, treatments that involved K-feldspar gave better results in the second period of each season than that included K-sulphate alone, indicating its ability to provide plants with K^+ ions for a long period.

So, it can be recommended to fertilize Moringa seedlings with 200g K-feldspar grinded rock + 100g of K-sulphate for to obtain the best growth with the least cost.

Key words: Potassium, feldspar rock, fertilizer, Moringa seedlings, growth, mineral content.

INTRODUCTION

Moringa oleifera Lam. belongs to the fam. of Moringaceae, is known as drumstick. It is a medium-sized soft wood tree of about 10 m height. Leaves can be eaten fresh, coocked or stored as dry powder for many months without refrigeration, and reportedly without loss of nutritional value. Moringa is promising as a food source in the tropics as it becomes in full leaf at the end of dry season when other foods are typically scarce (Aiyelaagbe, 2011). The cakes of Moringa seeds increased the mineral content of the soil, and this in turn increased the yield of the maize crop compared to the control. So, Moringa has a significant economic importance because of its multiple-use, but it has been more intensely used in the industry, medicinal and in the feeding human and animal as protein source, Emmanuel *et al.* (2011).

Potassium (K) is one of the most important essential nutrients required for plant growth and production. In Egypt, hundred percent of potassium fertilizers are met only by imports, therefore, there is a great need to optimize the use of the natural resources to continue the development and sustainability of agriculture. The approach of applying mineral source of K from natural deposits has been introduced by many investigators to reduce the tremendous increase of chemical fertilizer costs, Rogers *et al* (1998). Chemical fertilizers, however have an adverse impact on environment plus their high cost which may hinder its use in developing countries. The alternative approach to reduce the tremendous increase of chemical fertilizer costs is to exploit indigenous resources such as K-bearing minerals. One of the most important K-minerals is K-feldspar rock which its cost ranging between 600-800 LE/ton against 7000-8000 LE/ton for the chemical fertilizer. However, K occurs in feldspar is very weathering-resistant framework lattice positions (Sanz and Rowell, 1988). So, the K^+ ion is not easily released and is therefore not suitable for direct application to the plants.

Little studies were done to reveal the effect of K rates or sources on the initial growth and on the partition and accumulation of this element in the different organs of Moringa plants. Among of them that was undertaken by Chaves *et al.* (2005) who mentioned that *Moringa oleifera* was not responsive to the K external concentration above 2 mM as KCl salt. The K accumulation in stems was higher than in roots and leaves. The supplying with 2, 4, 6, 8 and 12 mM of K had not influenced on the translocation efficiency of K throughout the plants which showed to be more efficient to use K under a lower concentration of this ion in nutrient solution. Recently, Hussein and Abou-Baker (2014) found that all growth characters of Moringa plants increased with addition of potassium silicate and salicylic acid. On the other plants, Badr (2006) revealed that the response of tomato plants to the feldspar-compost (F-compost) inoculated with silicate dissolving bacteria (SDB) was dramatic when added to sandy soil of low K content and its effect was higher than K-sulphate. The conjunctive use of F-compost + SDB also produced maximum K use efficiency, total K uptake and considerable higher K recovery than K-sulphate. Also, available K released from feldspar increased markedly through composting process and the maximum increase was observed with 40% feldspar addition. The benefit of F-compost demonstrated the validity of sustained agronomic performance of tomato and reduces the cost of cultivation through the use of cheap feldspar. On the same line, were those results attained by Hellal *et al.* (2009) on faba bean, Labib *et al.* (2011) on cowpea, and Labib *et al.* (2012) on potato. In order to reduce the dependence on imported potash, feldspar a potash mineral, contains 11.25 % K_2O ($KAlSi_3O_8$) and therefore it could be a potential K-source for crop production. So, the main target of this trial is to evaluate the possibility of substituting partly or totally the expensive potassium fertilizer by natural deposits of feldspar bearing rocks.

MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm of the Botanical Gardens Dept., Hort. Res. Inst., Alex., Egypt, during the two consecutive seasons of 2011/12 and 2012/13 to examine the effect of fertilization with two sources of K, solely or in combination on growth performance and mineral content of Moringa seedlings. Therefore, trenches at dimensions of 40×40×50cm for length, width and depth, respectively were dig-up at a distance of 50 cm between each other on March, 25th for both seasons. A homogenous mixture of 3kg organic manure + 50g ammonium nitrate + 50g Ca-superphosphate was added to the bottom of each trench and mixed thoroughly with the soil and covered with about 10 cm of fine sand layer, then all trenches were filled with fresh water. Soil samples were taken from the experimental trenches at a depth of 0-30cm to determine some physical and chemical properties according to the standard methods of Richards (1954) and given in Table (a).

Table a. Some characters and nutritional status of investigated soil at (0-30cm) of soil depth.

Soil properties										
pH	OM %	EC dSm^{-1}	$CaCO_3$ %	Sand %	Silt %	Clay %	Texture	Available macronutrients (mg/kg)		
								N	P	K
7.52	1.08	3.22	8.36	75.32	14.53	10.15	LS	20.21	5.19	42.82

At mid of April, the previously prepared trenches were planted with uniform, 3-months-old seedlings of *Moringa oleifera* Lam. (one seedling/trench). After planting, trenches were refilled with the same soil that extracted from them 5 cm past ground surface. Soil is pressed well around the seedlings and then irrigated. The layout of the experiment in the two seasons was a complete randomized design with 3 replicates, as each replicate contained 3 seedlings (Das and Giri, 1986). In order to reduce the dependence on imported expensive potash, the following treatments were applied:

1. Without potassium of any source, referred to as control.
2. K-feldspar grinded rock (10.5% K_2O) at the rates of 200 and 400 g/seedling. These amounts were mixed well with 100 g of well decayed compost and added in two equal batches, each containing only about 50g of compost to render K more available for plants in the presence of organic acids released from degradation of this compost.
3. K-sulphate (48.5% K_2O) at the rates of 100 and 200g/seedling.
4. Six combinations were prepared from K-feldspar (K-F) and K-sulphate (K-S), each at different percent as follows:
   - 50% from the first level of both (100g K-F+50g K-S).
   - 50% from the second level of both (200g K-F+100g K-S).
   - 50% from the first level of K-F+50% from the 2nd one of K-S (100g K-F +100g K-S).
   - 50% from the second level of K-F+ 50% from the first one of K-S (200gK-F+50g K-S).
   - 75% from the first level of K-F + 25% from the first one of K-S (150g K-F + 25g K-S).
   - 75% from the second level of K-F + 25% from the second one of K-S (300g K-F + 50g K-S).

To study the long-term effect of the previous treatments on growth and mineral content, each season included two years, as the first season began on 15th of April, 2011 and lasted to 15th of October, 2012, whereas the second one started on 15th of April, 2012 and continued till 15th of October, 2013. So, the aforestated treatments were added as a soil drench in two equal doses, where the first one applied immediately after planting (on April, 15th) and the other after 3 months from the first (on July, 15th) in the first year of each season. All plants under various treatments received the usual agricultural practices recommended for such plantation whenever needed.

On the other hand, plant height (cm) and basal stem diameter (cm) were recorded at planting on April, 15th and two times afterwards with 3 months interval, i.e. on July, 15th and on October, 15th in the two years of each season, whereas K content was determined in dry leaf samples as percentage using the method of A.O.A.C. (1980) and in soil samples taken randomly from the four main directions of the 3 replicates of each treatment at a depth of 0-30 cm as mg/kg soil using the method described by Black *et al.* (1982) on July, 15th and October, 15th only of the two years of each season.

In the second season (2012-2013), Moringa seedlings were cultivated at the same age and height as well as the same agricultural practices as just done in the first season (2011-2012).

Data were then tabulated and statistically analyzed according to SAS institute program (1994) using Duncan's Multiple Range Test (Duncan, 1955) for elucidating the significancy between various treatments at 5% level.

RESULTS AND DISCUSSION

Effect of potassium fertilization treatments on:

1- Plant height and stem diameter:

It is clear from data averaged in Tables (1 and 2) that means of both plant height (cm) and stem diameter at the base (cm) were markedly improved in response to the different fertilization treatments applied in this study with various significant levels relative to control means at the different measuring times in the two seasons.

Table 1. Effect of potassium fertilization treatments on plant height (cm) of *Moringa oleifera* Lam. plant during 2011/2012 and 2012/2013 seasons.

Potassium fertilization treatments	First season: 2011-2012					
	First year: 2011			Second year: 2012		
	April, 15th	July, 15th	October, 15th	April, 15th	July, 15th	October, 15th
Control	50.30a	59.56h	78.30f	109.35h	126.72j	150.35g
K-F at 200g	50.03a	60.93gh	82.48e	112.94gh	130.93ij	157.00f
K-F at 400g	49.36a	62.03g	84.67d	113.99g	132.60j	163.94e
K-S at100g	48.67a	83.88b	105.53bc	133.49d	143.22h	171.76cd
K-S at 200g	49.25a	88.70a	109.80a	135.45c	151.93f	173.75c
100g K-F+50g K-S	49.20a	73.82d	104.90bc	130.36e	148.91g	172.30cd
200g K-F+100g K-S	49.67a	89.00a	110.33a	147.81a	173.94a	205.63a
100g K-F+100g K-S	48.54a	85.08b	106.30b	141.93b	168.35b	188.82b
200g K-F+50g K-S	49.85a	70.36e	103.99c	130.50e	158.10d	171.33cd
150g K-F+25g K-S	50.00a	65.33f	103.16c	126.73f	155.83e	169.02d
300g K-F+50g K-S	49.76a	77.25c	105.02bc	135.03c	162.56c	185.86b
Potassium fertilization treatments	**Second season: 2012-2013**					
	First year: 2012			**Second year: 2013**		
Control	54.33a	64.26h	80.64g	103.48i	125.35j	150.00f
K-F at 200g	54.00a	65.90gh	89.10f	120.00h	134.00i	163.47de
K-F at 400g	53.50a	67.28g	91.50e	124.10g	142.73h	172.50cd
K-S at100g	53.36a	90.50b	105.76d	123.68g	150.19g	160.76e
K-S at 200g	53.20a	95.80a	112.86cb	131.43e	157.80e	164.59de
100g K-F+50g K-S	54.00a	79.71d	113.30bc	138.38c	163.56cd	175.68c
200g K-F+100g K-S	53.68a	96.15a	120.56a	156.76a	187.92a	210.76a
100g K-F+100g K-S	54.50a	91.80b	114.00b	142.97b	169.69b	189.00b
200g K-F+50g K-S	54.73a	76.33e	112.32bc	133.40d	160.33d	174.90c
150g K-F+25g K-S	54.00a	70.76f	111.24c	129.08f	152.91f	166.33d
300g K-F+50g K-S	53.78a	83.50c	113.43b	138.20c	165.00c	190.00b

*** K-F: Potassium feldspar and K-S: Potassium sulphate.**

*** Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test at 5% level.**

Table 2. Effect of potassium fertilization treatments on stem diameter (cm) of *Moringa oleifera* Lam. plant during 2011/2012 and 2012/2013 seasons.

Potassium fertilization treatments	First season: 2011-2012					
	First year: 2011			Second year: 2012		
	April, 15th	July, 15th	October, 15th	April, 15th	July, 15th	October, 15th
Control	0.58a	0.61b	0.88f	1.10f	1.39e	1.70e
K-F at 200g	0.61a	0.63b	0.91ef	1.41ed	1.71d	1.85de
K-F at 400g	0.55a	0.66b	0.99e	1.50d	1.76d	1.99d
K-S at100g	0.57a	0.65b	1.11d	1.35e	1.78d	2.04cd
K-S at 200g	0.59a	0.80ba	1.15c	1.50d	1.89cd	2.16c
100g K-F+50g K-S	0.60a	0.89ab	1.15c	1.65c	2.01bc	2.26bc
200g K-F+100g K-S	0.60a	1.08a	1.50a	2.07a	2.40a	2.50a
100g K-F+100g K-S	0.56a	1.00a	1.21b	1.89b	2.18b	2.36b
200g K-F+50g K-S	0.58a	0.80ab	1.06de	1.58cd	1.93c	2.10c
150g K-F+25g K-S	0.59a	0.71b	1.10cd	1.50d	1.86cd	2.05cd
300g K-F+50g K-S	0.60a	0.90ab	1.10cd	1.70c	2.00cb	2.14c
Potassium fertilization treatments	**Second season: 2012-2013**					
	First year: 2012			**Second year: 2013**		
Control	0.58a	0.60c	0.79f	1.07g	1.40e	1.67e
K-F at 200g	0.60a	0.63c	0.90e	1.33ef	1.64d	1.87de
K-F at 400g	0.59a	0.70bc	1.00d	1.50d	1.80c	2.00c
K-S at100g	0.61a	0.68bc	0.92de	1.28f	1.70d	1.94c
K-S at 200g	0.60a	0.80b	1.00d	1.35e	1.75cd	2.10bc
100g K-F+50g K-S	0.61a	0.90ab	1.14c	1.65c	2.00bc	2.20bc
200g K-F+100g K-S	0.60a	1.10a	1.50a	2.00a	2.43a	2.55a
100g K-F+100g K-S	0.59a	0.90ab	1.26b	1.76b	2.10b	2.29b
200g K-F+50g K-S	0.61a	0.83ab	1.10c	1.60c	1.86c	2.04c
150g K-F+25g K-S	0.59a	0.72bc	1.00d	1.39e	1.75cd	1.96c
300g K-F+50g K-S	0.61a	0.88ab	1.21b	1.70d	2.00bc	2.10bc

*** K-F: Potassium feldspar and K-S: Potassium sulphate.**

*** Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test at 5% level.**

However, the prevalence was for the combination between K-feldspar at 200g and K-sulphate at 100g which gave the tallest and widest stem in the different stages of both seasons. This combination was followed by 100g K-F + 100g K-S combined treatment that recorded means occupied the second rank after the prevailing combination mentioned above. In general, connecting between K-feldspar and K-sulphate scored better results than the individual application of each in most determinations taken in both seasons. Also, increasing the rate of either K-feldspar from 200 to 400 g /seedling or K-sulphate from 100 to 200 g/seedling, individually or in combination caused additional improvement in these two parameters in most cases of the first and second seasons. Moreover, treatments that involved K-feldspar at any level gave better results in the second period (2nd year) of each season than those included K-sulphate alone. This may be attributed to that K-feldspar usually acts as a slow-release fertilizer that supplies K^+ ions for a long period, while K-sulphate is water-soluble-fertilizer and quickly lost with drainage water.

In this concern, Labib *et al.* (2011) stated that K-feldspar is quite resistant to weathering and supply relatively small quantities of K during the growing season. However, their cumulative release of K over several years is very important acting as slow-release fertilizer. The positive influence of the fine grains of the K-mineral bearing rocks is improving the poor structure of loose sandy soil, consequently the water and nutrient capacities of this soil will be enhanced and increase their ability to plant uptake. Labib *et al.* (2012) added that the excessive application of relatively soluble chemical fertilizers has hazardous impact on environmental conditions since considerable proportions are usually lost through drainage and cause pollution of water channels. Besides, the positive effects of K-feldspar not only ascribed to the multi-benefits of K^+ ions, but also to its containing 70.4% SiO_2, 15.5% Al_2O_3, 8.4%K_2O, 3.2% Na_2O and traces of other elements such as Fe, Mg, P and Ti (Labib *et al.*, 2011).

The previous gains are in well agreement with those attained by Chaves *et al.* (2005) and Hussein and Abou-Baker (2014) on *Moringa oleifera*, Badr (2006) on tomato and Hellal *et al.* (2009) on faba bean.

2- Potassium content in the leaves:

Data in Table (3) exhibit that all potassium fertilization sources used in such trial, solely or in combination significantly increased K content% in the leaves of fertilized plants, with few exceptions when compared to the unfertilized ones at the different determinations undertaken during the two years of each season. Potassium sulphate alone recorded good content of K during the early stages of growth (the first year of each season), but this content was decreased afterwards. The opposite was the right concerning the effect of K-feldspar, as it raised K content slightly in the early stages, but caused a highly increment in the last stages (the second year of each season).

Table 3. Effect of potassium fertilization treatments on potassium (%) in the dry leaves of *Moringa oleifera* Lam. plant during 2011/2012 and 2012/2013 seasons.

Potassium fertilization treatments	First season: 2011-2012				Second season: 2012-2013			
	First year: 2011		Second year: 2012		First year: 2012		Second year: 2013	
	July, 15th	October, 15th	July, 15th	October, 15th	July, 15th	October, 15th	July, 15th	October, 15th
Control	0.10e	0.15f	0.21e	0.26e	0.12e	0.17e	0.24e	0.23f
K-F at 200g	0.11e	0.20e	0.32de	0.49d	0.15d	0.25d	0.37de	0.48d
K-F at 400g	0.13e	0.37c	0.58b	0.86b	0.18cd	0.36c	0.60b	0.80b
K-S at100g	0.20c	0.34c	0.36d	0.34de	0.22b	0.38bc	0.40d	0.36e
K-S at 200g	0.27b	0.40b	0.37d	0.38d	0.30ab	0.44b	0.41d	0.36e
100g K-F+50g K-S	0.18d	0.30d	0.55b	0.65c	0.20c	0.33c	0.48c	0.63c
200g K-F+100g K-S	0.34a	0.56a	0.69a	0.91a	0.36a	0.60a	0.71a	0.96a
100g K-F+100g K-S	0.28b	0.37c	0.50c	0.69c	0.30ab	0.41b	0.50c	0.67bc
200g K-F+50g K-S	0.18d	0.33c	0.54bc	0.71c	0.21bc	0.33c	0.58b	0.73bc
150g K-F+25g K-S	0.16de	0.28de	0.50c	0.63cd	0.18cd	0.30cd	0.47c	0.61c
300g K-F+50g K-S	0.20c	0.39bc	0.56b	0.81b	0.25b	0.41b	0.55bc	0.80b

*** K-F: Potassium feldspar and K-S: Potassium sulphate.**

*** Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test at 5% level.**

This could be reasonable because of the quick soluble of K-sulphate in water and lossing, while K-feldspar slowly releases K^+ ions for a long-term period. Joining between K-feldspar and K-sulphate induced more beneficial effect than the individual applying of each one, with the mastery of 200g k-feldspar + 100g K-sulphate combined treatment that recorded the utmost high K content over that of control at the various determinations registered in the two seasons.

The aforementioned results can be interpreted and discussed as done before in case of plant height and stem diameter traits. However, analogous observations were also detected by Badr (2006) on tomato, Labib *et al.* (2011) on cowpea and Labib *et al.* (2012), who noted that addition of equal rates of K-feldspar and K-sulphate resulted in the highest content of starch, monosurose, protein and both vitamin A and C in potato tubers. In this connection, Hussein and Abou-Baker (2014) revealed that K-silicate in combination with salicylic acid gave the higher increases in N, P and K in the leaves of Moringa plants.

3- Potassium content in the soil:

As shown in Table (4), potassium content in the soil (mg/kg soil) amended with the different sources of K at various rates took a parallel trend to that of K content in the leaves of Moringa plants treated with the same sources and rates. So, this content was higher in the soil at the two determinations menstruated in the first year of both seasons due to the sole application of K-sulphate at the high level (200g/seedling). That was true in the second year of both seasons when K-feldspar was added individually at the high rate (400g/seedling).

Table 4. Effect of potassium fertilization treatments on potassium content (mg/kg) in the soil cultivated with *Moringa oleifera* Lam. plant during 2011/2012 and 2012/2013 seasons.

Potassium fertilization treatments	First season: 2011-2012				Second season: 2012-2013			
	First year: 2011		Second year: 2012		First year: 2012		Second year: 2013	
	July, 15th	October, 15th	July, 15th	October, 15th	July, 15th	October, 15th	July, 15th	October, 15th
Control	43.89h	41.90g	38.70g	30.81f	48.27h	46.00g	40.58h	33.69h
K-F at 200g	46.51g	48.62f	56.90e	59.33cd	51.70g	53.50f	62.70e	65.30d
K-F at 400g	48.50f	58.20c	66.71b	71.30ab	53.50f	61.70bc	73.40b	74.67b
K-S at100g	60.36b	58.42c	51.39f	40.63e	58.76de	56.33e	50.00g	40.00g
K-S at 200g	62.31a	60.11b	56.50e	48.90d	64.71b	61.50bc	55.47f	46.63f
100g K-F+50g K-S	53.42d	55.32de	57.85de	58.85c	58.68de	61.00ba	64.70d	66.32cd
200g K-F+100g K-S	62.48a	69.00a	70.12a	72.46a	67.92a	75.90a	76.98a	80.31a
100g K-F+100g K-S	56.63c	58.26c	60.00c	62.70b	62.30c	63.80b	65.79cd	68.20c
200g K-F+50g K-S	52.40e	55.00de	58.76d	60.00b	56.58e	60.50c	62.71e	67.00cd
150g K-F+25g K-S	50.96ef	63.00e	55.63fe	58.29c	55.00ef	58.46d	61.20ef	62.33e
300g K-F+50g K-S	54.00d	56.93d	59.90cd	60.36b	59.41d	61.60bc	66.00c	68.49c

*** K-F: Potassium feldspar and K-S: Potassium sulphate.**

*** Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test at 5% level.**

However, such content reached the maximum at combining between 200g K-feldspar and 100g K-sulphate, where this combination registered the highest K content in the soil at the different stages throughout the two seasons. The presence of K-feldspar, alone or in combined treatment continuously provides the soil with K^+ ions at various stages over many years, as it acts as a slow-release fertilizer as mentioned before. The advantages of applying K-bearing rock on poor fertility sandy soil can be related to their improvement of physical and chemical properties, particularly when combined with organic amendment (Labib *et al*., 2012). Manning (2010) claimed that under conditions where soils are rapidly leached with low capacity to retain soluble nutrients, the use of K-feldspar does give a yield response greater than conventional fertilizers.

On the same line, were those results postulated by Badr (2006) on tomato, Labib *et al.* (2011) on cowpea and Labib *et al.* (2012) on potato.

From the previous findings, it can be concluded that binding between K-feldspar at the rate of 200g /seedling and K-sulphate at the rate of 100g/seedling is the best combination for the best growth of Moringa seedlings cultivated in loamy sand soil and for reducing the cost of cultivation through the use of cheap feldspar.

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تأثير التسميد البوتاسى بصخر الفلسبار على النمو والمحتوى المعدني لشتلات المورينجا

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أجريت تجربة حقلية بالمزرعة التجريبية لقسم بحوث الحدائق النباتية، معهد بحوث البساتين (فرع أنطونيادس) - الأسكندرية، مصر خلال موسمي ٢٠١١/٢٠١٢ ، ٢٠١٢/٢٠١٣ لدراسة تأثير التسميد البوتاسى بصخر الفلسبار على النمو والمحتوى المعدنى لشتلات المورينجا وإمكانية الإستبدال الجزئي أو الكلي لسماد سلفات البوتاسيوم مرتفع الثمن، بصخر الفلسبار رخيص الثمن. لذا، زرعت شتلات متجانسة من المورينجا عمر ثلاثة أشهر في جور أبعادها (٤٠×٤٠×٥٠سم) وضع بها مخلوط مكون من: ٣كجم سماد عضوي + ٥٠جم نترات امونيوم + ٥٠جم سوبرفوسفات كالسيوم و الذي خلط جيداً بتربة الحفرة. ثم تعرضت النباتات في تجربة مصممة تصميماً عشوائياً تاماً للمعاملات السمادية . وقد استخدم مصدرين للتسميد البوتاسى وهما صخر الفلسبار ($KAlSi_3O_8$) و سماد كبريتات البوتاسيوم (K_2SO_4). إشتملت معاملات التسميد على ثلاث مستويات من البوتاسيوم هى صفر و٢٠٠ و٤٠٠ جرام من صخر الفلسبار وكذلك صفر و ١٠٠ و ٢٠٠ جم سماد كبريتات البوتاسيوم . كما تضمنت المعاملات إستبدال جزء من البوتاسيوم المعدنى بجزء من صخر الفلسبار عند٢٥% و ٥٠% و ٧٥% من الكمية في ستة توليفات مختلفة. و لقد أضيفت هذه الكميات كإضافة أرضية، على دفعتين متساويتين، الدفعة الأولى عقب الزراعة مباشرة (في منتصف ابريل) و الثانية بعد الأولى بثلاثة أشهر (في منتصف يوليو) . في الموسم الثانى (٢٠١٢-٢٠١٣) تمت نفس الاجراءات لزراعة الشتلات عند نفس الأعمار والأطوال وكذلك نفس الاجراءات الزراعية كما في الموسم الأول (٢٠١١-٢٠١٢).

و لقد أوضحت النتائج المتحصل عليها ان جميع المعاملات المستخدمة بهذه الدراسة أدت إلى زيادة إرتفاع النبات و قطر الساق بفروق معنوية متباينة عند مقارنتها بالكنترول خلال مراحل النمو المختلفة بكلا الموسمين. إلا أن السيادة في هذه القياسات كانت للتوليفة المكونة من ٢٠٠ جم فلسبار + ١٠٠جم سلفات بوتاسيوم و التي أعطت أطول نباتات و أسمك سيقان على الإطلاق مقارنة بالإضافات الفردية و التوليفات الأخرى بكلا الموسمين. نفس الإتجاه تم الحصول عليه فيما يتعلق بمحتوى أوراق النباتات و كذلك محتوى التربة من البوتاسيوم. و بصفة عامة، أدى الجمع بين صخر الفلسبار و سماد سلفات البوتاسيوم إلى اعطاء نتائج أفضل من الإضافة الفردية لكل منهما على حدة بالتقديرات المختلفة التي أجريت خلال موسمي الدراسة. أيضاً، أدت زيادة معدل الإضافة لأي من الفلسبار او سلفات البوتاسيوم، فردياً أو في توليفات إلى إحداث تحسناً إضافياً في جميع القياسات السابقة بمعظم الحالات في كلا الموسمين.

نتائج هذه الدراسة توصى بتسميد شتلات المورينجا بمخلوط من ٢٠٠جم فلسبار مطحون + ١٠٠جم من سلفات البوتاسيوم للحصول على أفضل نمو للشتلات وبأقل تكلفة ممكنة.