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Improving Growth and Seed Yield of Squash by Foliar Applications with Moringa Leaf Extract, Ascorbic Acid or Benzyladenine

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FOLIAR SPRAY with nutrients and other amendments is becoming an essential addition to standard cultivation techniques and must be adjusted carefully to avoid off-target spray. Thus , this work has been intended to study the effect of foliar application of squash plants (var. Eskandrani) with moringa (Mo) dry leaf water extract (2,4 and 6 g/L), cytokines as benzyladenine (BA) or ascorbic acid (AsA) (50,100,200 ppm for both) and its reflect on the growth and seed yield. For that, two field experiments were conducted during summer seasons of 2013 and 2014 at Kaha, Kalyiobia Governorate, Horticulture Research Station, Egypt. Most examined growth attributes responded positively and gave significant increase than the control by adding the previous compounds. Concerning to moringa; the positive effect was directly proportional to the concentration used, while in BA and AA; it is clear that 100 ppm was the best concentration.

Squash plants sprayed with BA at 100 ppm recorded the highest mean value for number of leaves/ plant, leaves area/ plant and seed yield. Similarly, using AsA at 100 ppm had positive significant effect for plant height and fresh & dry weight/ plant. Also, the germination rate, i.e. the longevity of the period that the seeds required to indicate obvious germination, showed a significant decrease from the control by using any type or concentration of the applied substances.

All the compounds with its concentrations induced enhancement effect on NPK seed content compared to the control. In addition, BA 100 ppm appeared to represent the best stimulus for plant chlorophyll with a concomitant enhancement in carbohydrates content.

The results revealed that foliar application of squash plants with moringa leaf extract at the higher dose 6 g/L or benzyladenine as well as ascorbic acid at 100 ppm significantly increased the growth and seed yield parameters over the control with a concomitant enhancement on NPK seed content, leaves chlorophyll and carbohydrates.

Keywords: Squash, Moringa leaf extract, Ascorbic acid, Benzyladenine, growth, Seed yield.

All plants can absorb nutrients through their leaves and stems, thus foliar spraying is a valuable way to give the plants a varied and balanced diet by applying any needs or deficient compounds. Amendment kinds or concentrations must be selected and adjusted carefully to avoid off-target spray. Vegetables which include squash can be sprayed to hasten and regulate plant metabolism to improve its growth. Squash fruit contain more than 95% water, low in calories and a good source for vitamin C. Squash seeds are rich source for protein, oil and valuable active ingredients such as fatty acids, phytosterols and vitamin E (El Kramany *et al*., 2007).

Moringa is one of the most useful trees and one of the promising plants as almost every part of the tree has some beneficial properties and can be used in different purposes (Bamishaiye *et al*., 2011). Moringa leaves are rich in many active ingredients such as hormones and cytokines (Duck, 1992), thus its extract is considered natural stimulative substances for plants and enhance yield when applied as foliar spray. Moringa leaf extract was sprayed onto leaves of melon, onions, bell pepper, soya beans, and chili and induced obvious increases on the yields of these crops (Fuglie, 2000). In another trial (Culver *et al*., 2012) reported that moringa extract significantly increased above ground dry matter yield, root dry matter weight and plant height for tomato in both greenhouses and open field. Sweet pepper plants treated with 80 g/L of moringa leaf powder per plot recorded the highest mean value of plant height, number of leaves, number of fruits per plant, fruit weight per plant, total yield per plot and the thickest plant girth (Sowley *et al*., 2014).

Cytokinine such as Benzyladenine (BA), zeiaten and kinetine are growth regulators. Physiological role of this group of plant hormones is connected with stimulating cell divisions, delaying ageing processes, stimulating seed germination, and regulation of biochemical processes (Borkowska, 1997). Applied 500 mg/l kinetin to lentil showed insignificant increase in its growth as compared to control in the number of compound leaves and leaves area which being 14.72% after 30 days (Naeem *et al.* 2004). BA alone or in combination with gibberellic acid has the potential to be used to develop the growth of cucumber plants in terms of fruit size and yield (Batlang *et al*., 2006).

Another foliar spray such as ascorbic acid (AsA) which considered the most abundant water-soluble antioxidant in plants (Suza *et al*., 2010), can be used for improving vegetable performance. Foliar application of AsA resulted in a significant increment of vegetative growth (including plant height, number of leaves, number of branches and fresh weight of plants) and yield of eggplant compared to control plants (El-Tohamy *et al*., 2008). Foliar application of (AsA) induced a stimulatory effect on growth parameters of kidney bean which were accompanied by marked increases in nutrients concentration and photosynthetic system. In addition AsA application may induce an adaptive response in bean through stimulation of the antioxidant enzymes activities, photosynthesis processes and lower lipid peroxidation (Salama *et al*., 2014).

The objectives of this study were to evaluate the effects of foliar application with moringa leaves extract, benzyladenine or ascorbic acid on growth and seed yield of squash under open field condition.

Material and Methods

Pure seeds lot of squash (*Cucurbita pepo* L.) variety Eskandrany was obtained from the Vegetable Crops Seed Production and Technology Department, Horticulture Research Institute, Agriculture Research Center, Egypt. Two open field experiments were conducted during summer seasons of 2013 and 2014 at Kaha (Kalyiobia Governorate), Horticulture Research Station, Egypt. The experiment was carried out to evaluate the influence of different foliar spray substances, *i.e.* moringa leaf water extract or Bezyleadenine (BA) or ascorbic acid (AsA) on growth, seed yield and seed quality of squash. Moringa leaf extract was applied at dose of 2, 4, 6 g/L, while BA or AsA were used at levels 50, 100, 200 ppm. The experiments were laid out in a randomized complete block design with three replications. The foliar spray was carried out three times; the first application was applied after 4 weeks from sowing and then two times two weeks intervals. Sowing was done on 1st week of March during the two successive seasons of the present work. Each treatment containe 3 rows 4 m long and 0.80 m wide, making an area of 9.6 m^2. Hills were done 40 cm apart; 2 seeds per hill then thinned three weeks later to 1 plant/ hill. Other cultural practices were carried out as recommended for the conventional squash planting.

The substances used in this study were prepared as following

Moringa fresh leaves were picked and spread on dry blotters and left three days for to reach complete air dryness. During this period, leaves are bowed regularly to avoid fungal growth or rotting. The air dried leaves were grinded and sieved to become powder. This powder was homogenizes with water in blender according to the required concentration used, *i.e.* 2, 4 or 6 g/ L, then filtrated throw cotton cloth.

Ascorbic acid and benzyladenine were obtained as commercial chemical substances from El-Gomhorya Company (Egypt).

Measurements

Vegetative growth characters

The following growth attributes were measured at the end of flowering stage, using ten random plants from each plot: plant height (cm), number of branches/plant, number of leaves/plant, plant fresh weight (g) and plant dry weight (g).

Seed yield and its components

Squash fruits at seed stage were harvested for seed extraction. A sample of five random fruits from each replicates was used to record the following characters: seed weight/plant (g) and from seed weight per plot total seed yield

(kg/fed.) can be calculated. Almost, one fruit per plant could be mature for seed yield, while other fruits became atrophied.

Chemical constitute

At the end of flowering stage (about 50 days from sowing), top fifth leaf from 3 random plants in each of the three replicates were taken for determination of chlorophyll using Minolta chlorophyll meter SPAD- 502 as SPAD units. Total carbohydrates (%) were colorimetrically determined in leaves according to Herbert *et al.* (1971). Minerals (N P K) were determined as % in dry seeds according to (AOAC, 2003).

Seed quality

Three random samples of 100 seeds from each treatment were used for calculating the following records; weight of 100 seeds (g), germination percentage (%), germination rate, seedling length (cm). Germination rate was calculated according to the following equation;

$$\text{Germination rate} = \frac{(G1 \times N1) + (G2 \times N2) + \ldots\ldots\ldots\ldots\ldots\ldots (Gn \times Nn)}{G1 + G2 + \ldots\ldots\ldots\ldots\ldots\ldots Gn}$$

Where: G = Number of germinated seeds in a certain day, N = Number of this certain day

Statistical analysis

All the collected data were tabulated and statistically analyzed using the analyses of variance method as reported by Snedecor and Cochran (1980) and the treatments means were compared using the Duncan Multiple Range test (Duncan, 1955).

Results and Discussion

Vegetative parameters

Vegetative growth parameters as shown in Table 1 indicated that all substances used as foliar spray gave better results than the control. Cytokine at 100 ppm gave the best significant results in both seasons for no. of leaves/ plant, leaf area/ plant and dry weight/ plant. Ascorbic acid at 100 ppm recorded the best significant results in both season for fresh weight/ plant and for plant height in second season only, while in the first season moringa leaf extract (6 g/ L) recorded the best significant increase for that criterion.

In this connection, Naeem *et al*. (2004) detected improvement in vegetative growth of lentil indicated by leaf expansion and increase in leaves number and their area by applied kinetin, as a type of cytokine, at dose of 30 m g/L. Also, application of ascorbic acid as a foliar spray showed an increment in growth attributes of mung bean plants (Chaudhary & Agrawal 2014).

TABLE 1. Vegetative growth characteri Conclstics of squash as affected by foliar application with different concentrations of moringa leaves extract (Mo) , cytokinene (cyto) or ascorbic acid (Asc) in 2013&2014 seasons.

Character / Treatment [z]	1 st Season					2 nd Season				
	Plant height (cm)	No.of leaves/ plant	Leaf area/ plant (cm^2)	Fresh wt./ plant (g)	Dry wt./ plant (g)	Plant height (cm)	No.of leaves/ plant	Leaf area/ plant (cm^2)	Fresh wt./ plant (g)	Dry wt./ plant (g)
Cont.	42.9B	12.00B	3278D	272.6C	31.27B	45.90D	15.00C	3308E	302.6C	41.27BC
Mo1	50.17AB	13.05AB	3638CD	325.9BC	33.85AB	51.33BCD	16.05BC	3668CD	355.9B	43.85BC
Mo2	51.89AB	13.27AB	3670BCD	338.7AB	36.82AB	53.77ABC	16.27BC	3732CD	365.6B	46.36ABC
Mo3	56.75A	13.44AB	3702BCD	355.8AB	37.69AB	54.75ABC	17.77A	3866C	368.7B	46.82AB
Cyto1	47.5AB	14.16A	3480D	332.7AB	35.22AB	50.50CD	17.16AB	3510DE	362.7B	45.22BC
Cyto2	52.44AB	14.16A	4647A	342.6AB	40.99A	55.44ABC	18.33A	4677A	372.6B	50.99A
Cyto3	53.16AB	13.00AB	3521D	334.0AB	38.07AB	53.55ABC	17.16AB	3751CD	364.1B	48.07AB
AsA1	52.39AB	13.16AB	3787BCD	367.9AB	32.04AB	54.05ABC	16.16BC	3817CD	397.9A	42.70BC
AsA2	54.78A	14.00A	4252AB	390.7A	34.29AB	57.77A	17.44AB	4282B	420.7A	45.30BC
AsA3	53.8A	13.88A	4187ABC	385.2A	33.62AB	56.83AB	16.88AB	4217B	415.2A	44.29BC

[z] ;Mo 1,2,3= 2,4,6 (g/l), respectively; Cyto 1,2,3= 50,100,200 (ppm), respectively; AsA 1,2,3= 50,100,200 (g/l), respectively.
Values within the same column followed by the same letters are not significantly different at 5% level Duncan's multiple range test.

Seed yield

The results obtained (Table 2) showed that seed yiel/ plant and seed yield/ fed. were generally increased as a result of moringa application in a magnitude that was directly proportional to the concentration used. However, such effect was changed in case of using cytokines as benzyladenine or ascorbic acid where the increment continued gradually up to the second concentration (100 ppm) used then decrease with the third concentration (200 ppm) but it still higher than the control for each. The increments in seed yield/fed with benzyladenine application at 100 ppm was 50.9 % and 47.7 % over the control in first and second seasons, respectively. Thus we can use concentration more than 100 ppm but less than 200 ppm to give better results in case of using benzyladenine as well as ascorbic acid. It is also clear from the same table that the increase in squash seed yield/ fed was due to the increases of the other two parameters i.e. seed index (wt of 100 seeds) and seed yield/ plant. This trend was similar in both seasons of the experiment. Several invistigators explained the important of role of suing the mentioned substances for improving the crops yield. Moringa leaves is enrich with cytokinin, antioxidants and minerals (Azra *et al*., 2014) and thus its extract application improved productivity of tomato. Also application of Accel (a type of cytokines) increased number of snap bean pods per plant and pod yield per hectare (Emongor, 2007). In addition, Ibrahim *et al*. (2007) detected marked increase in vicia seed yield (pod length, number of pods / plant, number and weight of seeds per pod as well as weight of 100 seeds) from the application of benzyl adenine as bioregulators at a rate of 100 ppm.

TABLE 2. Seed yield and seed index of squash as affected by foliar application with different concentrations of moringa leaves extract (Mo), cytokinene (cyto) or ascorbic acid (Asc) in 2013&2014 seasons.

Character / Treatment [z]	1st Season			2nd Season		
	Seed index (wt of 100 (g))	Seed yield/ plant (g)	Seed yield /fed. (kg)	Seed index (wt of 100 (g))	Seed yield/ plant (g)	Seed yield /fed (kg)
Cont.	10.93 C	28.98 CD	221.8 E	15.93 C	38.97 C	209.1 E
Mo1	14.50 AB	32.22 BC	266.6 D	19.49 AB	42.25 BC	278.0 D
Mo2	15.47 AB	33.6 1B	286.7 CD	21.70 A	43.61 ABC	284.7 CD
Mo3	15.17 AB	34.92 B	294.4 BC	20.84 AB	42.36 BC	297.2 BCD
Cyto1	14.45 AB	35.1 9B	299.1 BC	19.45 AB	45.19 AB	299.0 BC
Cyto2	16.78 A	39.02 A	334.6 A	21.80 A	49.02 A	338.3 A
Cyto3	15.11 AB	35.32 B	311.6 AB	20.11 AB	45.32 AB	314.3 B
AsA1	13.13 BC	27.20 D	290.0 BCD	18.13 BC	40.53 BC	296.8 BCD
AsA2	15.86 AB	29.96 CD	302.3 BC	20.86 AB	42.62 BC	301.2 BC
AsA3	13.66 BC	29.31 CD	284.7 CD	18.65 BC	42.64 BC	302.8 BC

[z] **:**Mo 1,2,3= 2,4,6 (g/l), respectively; Cyto 1,2,3= 50,100,200 (ppm), respectively; AsA 1,2,3= 50, 100, 200 (g/l), respectively.

Values within the same column followed by the same letters are not significantly different at 5% level Duncan's multiple range test.

Seed quality

Data represented in Table 3 showed a significant increase than the control in germination percentage using benzyladenine 100 ppm in both seasons and when using ascorbic acid 100 ppm in second season only. Seedling length increased significantly in first season with the applications: cyto2, cyto3, AsA1 and AsA2 and in second season with the applications: cyto2 and AsA2. On the other hand, germination rate, i.e. the longevity of the period that the seeds required to indicate obvious germination (appearance of radical), showed significant decrease from the control by using the substances in this study with superiority by using second cytokine concentration. It means that the seeds produced from plants which received any type or concentrations of applied substances germinate faster than the control.

In a study carried out by Phiri and Mbewe (2010) on three common legumes (beans, cowpea and groundnut), authors indicated that moringa leaves extract (rich in cytokine as mentioned previously) forced beans to germinate early, increased germination percentage of cowpea by 4%, increased radical length by 4% in beans and increased hypocotyl length by 16.6% in groundnut. Also ascorbic acid has been reported to promote germination of seeds (Bauernfeind, 2009). In *Eruca sativa*, germination percentage, speed of germination, mean germination time as well shoot and root length were significantly affected by ascorbic acid treatment (Jyoti and Malik, 2013).

TABLE 3. Germination percentage (%), germination rate and seedling length of squash as affected by foliar application with different concentrations of moringa leaves extract (Mo), cytokinene (cyto) or ascorbic acid (Asc) in 2013&2014 seasons.

Character / Treatment [z]	1st Season			2nd Season		
	Germination (%)	Germination rate (day)	Seedling length (cm)	Germination %	Germination rate (day)	Seedling length (cm)
CONT.	95.30BC	3.70A	21.31 B	94.00 B	3.85A	21.87B
Mo1	97.00BC	3.37BC	21.75B	94.80B	3.44BC	22.87AB
Mo2	97.75AB	3.18DE	22.00B	95.00B	3.34BCD	23.00AB
Mo3	98.00AB	3.14DE	22.50B	96.00AB	3.22BCD	24.25A
Cyto1	98.00AB	3.24CD	22.75B	96.00AB	3.50B	22.91AB
Cyto2	100.00A	3.06E	28.25A	98.00A	3.06D	24.62A
Cyto3	96.67BC	3.17DE	26.55A	96.00AB	3.18BCD	23.06AB
AsA1	96.67BC	3.39B	26.62A	94.00B	3.32BCD	23.60AB
AsA2	97.60BC	3.08E	27.75A	97.33A	3.16CD	23.90AB
AsA3	96.00BC	3.46B	23.25B	96.33AB	3.16CD	23.25BA

[z] **:**Mo 1,2,3= 2,4,6 (g/l), respectively; Cyto 1,2,3= 50,100,200 (ppm), respectively; AsA 1,2,3= 50, 100, 200 (g/l), respectively.

Values within the same column followed by the same letters are not significantly different at 5% level Duncan's multiple range test.

Chemical composition of seeds

It is evident from Table 4 that the contents of squash seeds from N P K showed an increase by using various spray concentrations. In the first season, the best value for N was obtained from Asc at 200 ppm, for P from Mo 6 g/L while for K from Asc at 100 ppm. In second season there is a slight change whereas the best results for N was indicated by using Mo3, for P by using cyto2 and for K similar like the trend in first season. All above mentioned concentrations gave significant increase than the control. Also the data in same table indicated that there is a concomitant increase in N P K as moringa extract concentration increased. Cyto at a dose 100 ppm was the best for N and P and cyto3 for K. In case of ascorbic acid application, the best results for N were obtained with Asc3 while for P and K with Asc2. In this study; NPK enhancement by using different foliar spray may be due to those applications gave turgidity to plant cells and hence decrease solute leakage and also protect the plants from environmental injury. In this connection, El-Tohamy *et al*. (2008) and El-Hifny and El-Sayed (2011) detected an increase in N,P and K in sweet pepper plant leaves when foliar spray of ascorbic acid at the highest level (400 mg/L) combined with some biofertilizers had been applied. Also, mineral ions (Ca, K, and Mg) contents of *Vicia faba* L. plants were increased due to foliar application of benzyl adenine at the rate of 100 ppm (Ibrahim *et al*., 2007).

TABLE 4. N, P, and K percentage in squash seeds as affected by foliar application with different concentrations of moringa leaves extract (Mo), cytokinene (cyto) or ascorbic acid (Asc) in 2013&2014 seasons.

Character / Treatment [z]	1 st Season			2 nd Season		
	N %	P %	K %	N %	P %	K %
CONT.	4.00D	1.03G	0.78F	3.72DE	1.04G	0.76E
Mo1	4.41AB	1.34CD	0.80F	3.86CD	1.20F	0.78DE
Mo2	4.42AB	1.80B	0.84E	4.38AB	1.32E	0.80CD
Mo3	4.53A	1.96A	0.88CD	4.44A	1.61B	0.84B
Cyto1	4.13CD	1.12F	0.84E	3.70DE	1.41D	0.78DE
Cyto2	4.54A	1.4C	0.86DE	4.21B	1.94A	0.78DE
Cyto3	4.23BC	1.21E	0.90BC	4.00C	1.61B	0.82BC
AsA1	4.10CD	1.15F	0.86DE	3.57E	1.33E	0.78DE
AsA2	4.20BCD	1.32 D	0.96A	3.97C	1.52C	0.90A
AsA3	4.55A	1.21E	0.92B	4.00C	1.41D	0.84B

[Z] **:**Mo 1,2,3= 2,4,6 (g/l), respectively; Cyto 1,2,3= 50,100,200 (ppm), respectively; AsA 1,2,3= 50,100,200 (g/l), respectively.

Values within the same column followed by the same letters are not significantly different at 5% level Duncan's multiple range test.

Chlorophyll and carbohydrates

The results presented in Table 5 indicate that foliar application with benzyladenine at 100 ppm gave the best results in leaf chlorophyll content. Also, the same concentration from ascorbic acid was quiet better. On the other hand, chlorophyll continue to increase as moringa extract concentration also increased lead us to a conclusion that higher concentration (than which were used in this study) may be more effective. In this regard, some investigators reported that moringa leaf extract increased chlorophyll (a) pigment in tomato (Azra *et al*., 2014). Ibrahim *et al*. (2007) detected an increase in photosynthetic pigments under the influence of benzyl adenine at the rate of 100 ppm.

This increase in chlorophyll was concomitant with substantial accumulation of carbohydrates, as the chloroplasts are the factories of carbohydrates production in plants. Consequently, the carbohydrate concentration increased with the above mentioned application. The increase in carbohydrate with the best application used (benzyladenine at 100 ppm) was 34.3% and 30.9% over the control in first and second seasons, respectively. It was found that, total carbohydrate increment in *vicia faba* plants was detected by using 100, 200 or 400 mg/litre ascorbic acid (El Bassiouny *et al*., 2005). In addition, benzyl adenine and other bioregulators caused significant increase (59.94 %) in total carbohydrate percentage of the produced *vicia faba* seeds resulted from the treated plants (Ibrahim *et al*., 2007).

TABLE 5. Chlorophyll and carbohydrates content of squash leaves as affected by foliar application with different concentrations of moringa leaves extract (Mo), cytokinene (cyto) and ascorbic acid (Asc) in seasons 2013 & 2014.

Character / Treatment [z]	1st Season		2nd Season	
	Chlorophyll (SPAD)	Carbohydrates (%)	Chlorophyll (SPAD)	Carbohydrates (%)
CONT.	41.20F	32.53G	42.30F	33.19F
Mo1	42.50E	39.27CD	43.06E	39.96CD
Mo2	43.90D	42.11AB	43.80D	41.87ABC
Mo3	45.10C	42.27AB	44.90C	42.31AB
Cyto1	43.80D	35.81F	44.03D	39.04DE
Cyto2	49.60A	43.68A	51.20A	43.46A
Cyto3	45.80B	40.66BCD	46.50B	41.18BC
AsA1	43.00E	37.11EF	43.90D	37.64E
AsA2	45.90B	41.16BC	45.20C	41.38BC
AsA3	44.10D	38.65DE	44.90C	39.11DE

[z] **:**Mo 1,2,3= 2,4,6 (g/l), respectively; Cyto 1,2,3= 50,100,200 (ppm), respectively; AsA 1,2,3= 50,100,200 (g/l), respectively.

Values within the same column followed by the same letters are not significantly different at 5% level Duncan's multiple range test.

Conclusion

Moringa is a highly valued plant and has attained massive awareness due to its leaf composition being rich in cytokines, vitamins, antioxidants and other growth regulators. In this study, leaf extract of moringa at three levels, i.e. 2, 4, 6 g/L had been applied as foliar spray on squash plants. The results indicated that, the growth and seed yield of squash were generally improved as a result of moringa application in a magnitude that was directly proportional to the concentration used. Thus we can assume that higher concentration may be more effective. Using Benzyle adenine (cytokine) or ascorbic acid were also effective by using them as foliar spray which improved all studded growth attributes of squash, especially at 100 ppm concentration.

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تحسين نمو وإنتاجية بذور الكوسة بإستخدام الرش الورقى بمستخلص أوراق المورينجا، حمض الأسكوربيك أو البنزيل أدينين

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إن الرش الورقى بالمواد الغذائية وغيرها من الإضافات أصبح ضرورة فى تقنيات الزراعة القياسية ويجب إختيارها وظبطها بعناية لتجنب تأثيرها الضار. ولذلك فقد أجرى هذا البحث لدراسة تأثير الرش الورقى لنباتات الكوسة (صنف إسكندرانى) بمستخلص مائى لأوراق المورينجا الجافة (٢، ٤،٦ جرام / لتر) أو البنزيل أدينين كسيتوكين BA أو حمض الأسكوربك AS (٥٠، ١٠٠، ٢٠٠ جزء فى المليون لكل منهما) على النمو والمحصول البذرى. أجريت تجربتان حقليتان خلال موسمي الزراعة الصيفى ٢٠١٣ و ٢٠١٤ فى المزرعة البحثية بقها (محافظة القليوبية- مصر). وقد وجد أن معظم صفات المحصول المدروسة تأثرت بشكل إيجابى وأعطت زيادة معنوية عن الكنترول بإستخدام أنواع الرش المذكورة. بالنسبة للمورينجا كان التأثير الإيجابى يتناسب طردياً مع التركيز المستخدم بينما مع البنزيل أدينين وحمض الأسكوربيك فمن الواضح أن تركيز ١٠٠ جزء فى المليون كان الأفضل.

و قد أتضح أن رش نباتات الكوسة بالبنزيل أدينين بتركيز ١٠٠ جزء فى المليون سجل أعلى قيمة لمتوسطات: عدد الأوراق/نبات، مساحة الأوراق/نبات وكذلك المحصول البذرى. وبالمثل إستخدام نفس التركيز من حمض الأسكوربيك أعطى زيادة معنوية فى إرتفاع النبات والوزن الطازج والجاف للنبات. وأيضاً فإن معدل الإنبات، أي الفترة التى تحتاجها البذور لتمام الإنبات، أظهر إنخفاضا معنوياً عن الكنترول بإستخدام أي نوع أو تركيز من المواد المطبقة. أسفرت جميع تركيزات المواد المستخدمة فى تعزيز محتوى البذور من NPK مقارنة بالكنترول. وبالإضافة إلى ذلك فإن تركيز ١٠٠جزء فى المليون من البنزيل أدنين كان أفضل حافز لزيادة محتوى الأوراق من الكلوروفيل و يصاحب ذلك زيادة محتواها من الكربوهيدرات.

وتخلص النتائج بأن الرش لنباتات الكوسة بمستخلص أوراق المورينجا أعلى تركيز ٦ جرام فى اللتر أو إستخدام تركيز ١٠٠ جزء فى المليون لكل من البنزيل أدينين أوحمض الأسكوربيك أعطى زيادة معنوية فى النمو والمحصول البذرى ويصاحب ذلك زيادة فى محتوى البذور من NPK و زيادة محتوى الأوراق من الكلوروفيل والكربوهيدرات.