

RESPONSE OF *ARTOCARPUS HETEROPHYLLUS LAM.* TO SOME NATURAL EXTRACTS AT THE EARLY GROWTH STAGES

1- VEGETATIVE GROWTH AND ROOT TRAITS

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ABSTRACT: A field experiment was consummated at the nursery of Horticulture Research Institute, ARC, Giza, Egypt, throughout two successive seasons (2012/2013 and 2013/2014). It was intended to improve vegetative growth and root parameters of *Artocarpus heterophyllus* Lam. at the early growth stages by studying the effect of treating the plants with different natural extracts botanicals (*Moringa oleifera*, Lam., *Thymus vulgaris*, L. and *Majorana hortensis*, Moench) at the levels of 0, 5 and 10%, besides the combination of moringa + marjoram, moringa + thyme and marjoram + thyme extracts at 2.5%. All of them were applied as a foliar spray commencing from November 20th in both seasons on transplants of 14-15 cm. height with 4-5 leaves till June 20th of the next year at 15 days interval. The plants were grown in sand + peatmoss mixture (1:1, v/v) under the condition of saran house of 65% shading. The results could be briefed as follows:

Most plants which received the highest natural extract level (10%) died after about six times of the beginning of spraying. So, the corresponding data of such treatments were excluded.

The prevalence of supplying plants with moringa extract at 5% for improving vegetative growth and root parameters of *Artocarpus heterophyllus* Lam. plant at the terminate of experiment (July 15th) as it increased leaf area, fresh and dry weights of either leaves or roots/plant. Also, it raised root length, root diameter, number of the secondary roots/plant, length of the longest secondary root. Meanwhile, using the combination of marjoram + thyme extracts at 2.5% belonged to the first and second degree for improving the above mentioned traits in most cases. In contrast, the least scores were a result of untreated plants (control) and plants which received only thyme extract at 5%.

From the aforementioned results, it could be recommended to apply either moringa extract at 5% or the combination of marjoram + thyme extracts at 2.5% on *Artocarpus heterophyllus* Lam. transplants for improving vegetative growth and root parameters of such economic important plant, besides, getting better plants without being forced to use chemical nutrients or synthetic growth regulators that may pollute the environment with getting a safe clean product.

Key words: *Artocarpus heterophyllus*, vegetative growth, *Moringa oleifera*, *Thymus vulgaris*, *Majorana hortensis* extracts.

INTRODUCTION

Artocarpus heterophyllus Lam. (Jack fruit) is belonged to family Moraceae. It is native to parts of southern and southeast Asia. Jack fruit is the National fruit of Bangladesh. Jack fruit is also found in East Africa. It is well suited to tropical lowlands, and its fruit is the greatest tree-born fruit reaching as much as 36 kg in weight and up to 90 cm long and 50 cm in diameter. The seeds may be boiled or backed like beans. Seeds from ripe fruits are edible. They have a milky, sweet taste. The wood of the tree is used for the production of musical instruments. Jack fruit wood is widely used in the manufacture of furniture, doors and windows (Wikipedia, 2011).

In Egypt, Jack fruit (*Artocarpus heterophyllus*, Lam.) is considered as an important economic plant, but suffer variable conditions to be maintain good quality especially at the early growth stages, besides the slow rate of vegetative growth, consequently the delay of fruiting time.

It is well known that the use of natural extracts of certain plants (referred to as biostimulants, botanical activators or botanicals) in improving the growth of agricultural crops is highly recommended as environment friendly and safe approach to get better plants without being forced to use chemical nutrients or synthetic growth regulators that may contaminate the environment.

Moringa oleifera, family Moringaceae is most widely grown. Since leaves of moringa are rich in zeatin, it can be used as natural source of cytokinins (Fuglie, 1999). In addition moringa leaves is also rich in ascorbates, carotenoids, phenols, potassium and calcium which have plant growth promoting capabilities and often applied as exogenous plant growth stimulator (Foidle *et al.*, 2001). Antioxidant such as ascorbic acid and glutathione which are found at high concentrations in moringa chloroplasts and other cellular compartments are crucial for plant defense against oxidative stress

(Noctor and Foyer, 1998). In view of all these reports, it is hypothesized that priming with leaf extract from moringa, having a number of plant growth promoters, mineral nutrients and vitamins in a naturally balanced compositions which may promote the plant growth.

Thymus vulgaris, L. family Lamiaceae is native to Mediterranean countries, growing abundantly over wide area in France, Spain, Portugal, Italy, Algeria and Morocco (Porte *et al.*, 2000). Moreover, it is also cultivated in other parts of Europe and North America, North Asia and Ocrania (Prubhi, 1976). Thyme is employed to season and suppress offensive odors, such as trimethylamino odor, in foods (Porte *et al.*, 2000 and Prubhi, 1976). The essential oil is well recognized for its medicinal properties in the treatment of bronchitis, whooping cough and tooth-ache. The herb or its infusion is also given for several disorders. It is possible that the flavonoids present may be important, such as in the spasmolytic activity of the smooth muscles of the Guinea pig ileum and trachea (Prubhi, 1976 and Nakatani *et al.*, 1989). It was found that the main components of the essential oil were thymol and carvacrol and that it had antimicrobial activity against fungi (some aflatoxins producers), virus, helminthes, Gram positive bacteria and Gram negative bacteria (Nakatani *et al.*, 1989 and Farag *et al.*, 1989).

Majorana hortensis Moench, (Marjoram) family Lamiaceae. Marjoram is indigenous to the Mediterranean area, it is a member of the *Origanum* genus, and similarity of flavor with oregano (*Origanum vulgar*). It has a strong and sharp spicy odor, Marjoram is a perennial evergreen shrub (treated as an annual under cultivation) growing to a height of about 40 cm. It has a square, red brown stem and small and hairy, gray-green leaves. During summer, the plant produces tiny, white to pink flowers. The parts used, is the whole plant. The useful compounds are caffeic and rosmarinic acid, carvacrol, flavonoids, linalool, sterpenes

triterpenoids, sabinen, sabinen hydrate (Health from Nature, 2011)

As for the very limited investigations were performed on the effect of natural extracts of the above mentioned plants, especially thyme or marjoram on vegetative growth and root parameters of woody or ornamental plants, the following findings may reveal some results which were gained on other plants in this regard. Foidle *et al.* (2001) reported that spraying the leaves of many field crops with moringa leaves extract (MLE) diluted with water produced some notable effects such as heavier stem and leaves. However, many authors attributed the beneficial effect of moringa extract to its content of zeatin, ascorbates, phenolic compounds, K and Ca (Makkar *et al.*, 2007). El-Bassiouny *et al.* (2005) reported that foliar spray with α -tocopherol (one of the components of thyme extract) on faba bean plants induced increase in growth parameters. Parabhu *et al.* (2010) worked on searled basil (*Ocimum sanctum*) and concluded that spraying the combination of 2% panchakavya + 0.2% humic acid + 2% moringa leaf extract resulted in higher plant height and number of leaves. Furthermore, the same treatment produced also a pronounced effect on fresh and dry herb weight. Mvumi *et al.* (2012) on *Lycopersicon esculentum* stated that moringa extract increased growth of the plant. Rana *et al.* (2013) experimented the effect of moringa leaf extract (MLE) on seedling growth of maize (*Zea maize*, L.) where different concentrations of MLE (5, 10, 15 and 20%) were used, and the different treatments were applied at two times (5 and 10 days (after sowing). Results indicated that application of 5% MLE at 5 days furnished maximum shoot length and fresh and dry weights per seedling.

Root parameters were also affected by natural extracts as mentioned by many authors. Foidle *et al.* (2001) reported that spraying the leaves of many field crops with moringa leaf extract (MLE) diluted with water produced some notable effects such as

heavier roots. Phiri (2010) worked on major cereals maize (*Zea maize*, L.) where the seeds were treated with *Moringa oleifera* leaf extract at the ratio of 1:10 (w/v) by a foliar spray. Results revealed that *Moringa oleifera* increased radical length of maize root by 77.8%. Lobna *et al.* (2015) on jojoba reported that the addition of moringa leaves extract (3.5, 7 and 10%) positively affected the studied growth characters i.e. length of roots and its fresh and dry weights, Muhammed (2015) investigated the comparative efficacy of different priming techniques and their effect on seedling growth and development of cluster bean. Cluster been seeds were subjected to hydro priming, on farm priming, halo priming with 1% KNO₃, and priming with two concentrations (2% and 5%) of moringa leaf extract as experimental treatments. A control treatment was kept in comparison. The results revealed that priming with 9% moringa leaf extract increased final germination percentage (90 %) along with better root length. Priming with 5% moringa leaf extract also gave significantly higher root fresh weight and it was followed by 2% moringa leaf extract. Hydro priming performed better than on-farm priming and halo priming with 1% KNO₃, but was much less significant than either concentration of moringa leaf extract.

Therefore, the present experiment was conducted with the aim of determining the most efficient natural extract treatment that can be applied for *Artocarpus heterophyllus* Lam. for producing plants of healthy vegetative growth at the early growth stages of such important economic plant.

MATERIALS AND METHODS

The present experiment was conducted throughout two successive seasons (2012/2013 and 2013/2014) at the nursery of Horticulture Research Institute, Agriculture Research Center, Giza, Egypt. The second season was an exact repition of the first one. It was intended to study the response of *Artocarpus heterophyllus*, Lam. transplant to different levels of *Moringa oleifera* Lam.,

Thymus vulgaris L., and *Majorana hortensis*, Moench extracts (0, 5 and 10%) and some combinations (moringa + marjoram, moringa + thyme and marjoram + thyme extracts at 2.5%) on vegetative and root growth parameters for producing transplants of vigorous growth.

Plant material:

Seeds of *Artocarpus heterophyllus* Lam. were collected from Zohria Garden in both seasons.

The mixture of sand + peatmoss (1:1, v/v) was used in plantation in every season, as a preliminary study was conducted on the effect of some growing media on germination and early growth of newly established plants concerning, sand, peatmoss and the mixture of sand + peatmoss (1:1, v/v), where the later proved its mastery in this regard.

Some physical and chemical properties of the used sand (fine sand granules with diameter of 0.20: 0.25 mm) and chemical properties of peatmoss are shown in Tables (a) and (b), respectively.

Natural extracts: Different natural extracts of some plants with different levels (*Moringa oleifera* Lam., *Thymus vulgais*, L. and *Majorana hortensis* Moench) and some combinations were applied in both seasons, as follows:

- 1- Untreated plants (control)
- 2- Moringa extract at 5%
- 3- Moringa extract at 10%
- 4- Marjoram extract at 5%
- 5- Marjoram extract at 10%
- 6- Thyme extract at 5%
- 7- Thyme extract at 10%

8- Moringa + marjoram extracts at 2.5%

9- Moringa + thyme extracts at 2.5%

10- Marjoram + thyme extracts at 2.5%

Preparation of extracts:

Fresh leaves of moringa (*Moringa oleifera*, Lam.), thyme (*Thymus vulgais*, L.) and marjoram (*Majorana hortensis*, Moench) were collected directly from mature trees and plants. The sample was cleaned by rinsing bath in a distilled water, dried by shaking vigorously with hand. The leaves of every species were air dried in shade place. After drying, the leaves were ground by an electrical grinder and made powder. The powder was weighed and mixed with a distilled water at a ratio of 1:10 (w/v) i.e. 100 g powder + 1000 cm³ distilled water for preparing 10 % aqueous extract. The mixture was then shaken for four hours by an electrical stirrer and kept in dark room temperature for 24 h. Thereafter, the solution was heated till just before boiling. Afterwards, it was filtrated through two cheese cloth. The extracts served as the stock solution (10%) for each plant species, where different levels of natural extracts (0, 2.5, 5 and 10%) were prepared, using the crude aqueous extract of 10% of each and distilled water.

Chemical composition of plant extracts:

Moringa oleifera Lam.: The chemical composition of *Moringa oleifera* oil: hemacosan (13.9%), pentacosan (13.3%) and heptacosan (11.4%) are the main components Ultra high performance chromatography. DAD analysis detected the flavonoids quercetin (126 mg/g) and luteolin (6.2 mg/g), The essential oil exhibited a relatively low free radical scavenging capacity (Titiana *et al.*, 2013).

Table a. Some physical and chemical analysis of the used sand.

pH	E.C. (ds/m)	S.P.	Cations (meq/l)				Anions (meq/l)			N (ppm)	P (ppm)	K (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
			Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻							
7.41	1.51	42.30	2.94	1.29	3.89	2.30	3.54	4.73	2.16	232.40	25.05	580	7.48	5.66	2.90	7.18

Table b. Some chemical properties of the used peatmoss.

Organic matter	90-95%	P	0.23%
Ash	8-10%	K	1.77%
Density (Vol. Dry)	80-90 mg/l	Fe	421 ppm
pH value	3.4	Mn	27 ppm
Water relation	60.75%	Zn	41 ppm
Salinity	0.3 g/l	Cu	8.8 ppm
N	1.09%	Mg	3.3 ppm

Thymus vulgaris, L.: shows a polymorphic variations in monoterpene production, the presence of intraspecific chemotype variation being common in the genus Thymus. Each of the six chemotypes geraniol (G), α -terpineol (A), thuyanol-4 (U), linalool- (L), carvacrol (C), and thymol (T), is named after its dominant monoterpene (Thompson *et al.*, 2003).

Majorana hortensis, Moench: Volatile oil components (%) of marjoram: alfa pinene (1.57%), beta pinene (4.79%), limonene (9.63%), 1.80 cineole (5.22%), Y- terpinen (2.23%), linalool (3.88%), terpinen-4-ol (49.37%), α -terpineol (9.38%), linalyl acetate (2.39%), estragol (1.56%), beta carophyllene (2.21%), eugenol (1.71%), unidentified (6.06%), (Parabhu *et al.*, 2010).

Procedure:

In both seasons seeds of *Artocarpus heterophyllus* Lam. were planted on August 8th in the mixture of sand + peatmoss (1:1, v/v) in 20 cm diameter plastic pots under saran house condition of 65% shading. After two months from planting (October, 8th) where the newly established plants reached about 5-6 cm length, bearing 2-3 leaves, were transplanted into 20 cm diameter of plastic pots (one transplant each) filled with about 2.5 kg of the same mixture used in germination (sand/peatmoss 1:1, v/v) and left to grow under saran house conditions of 65% shading. Thereafter, when the plants reached about 14-15 cm length bearing 4-5 leaves (November 20th), foliar spray of the different natural extracts treatments were applied till run off and then at 15 days interval till June 20th of the next year. Besides, untreated

plants (control) which received only foliar spray of distilled water. Thus, the plants were treated 15 times with foliar spray throughout the course of the study.

The layout of the experiment was a randomized complete block design (RCBD) with three replicates. Every experimental unit contained 4 plants and every treatment represented by 12 plants.

All the plants under various treatments received the usual agricultural practices, such as weeding, watering and fertilizationetc. recommended for such plantation whenever required. In this connection, Kristalon (19:19:19) at the rate of 2 g/l was applied at 15 days intervals as a soil drench, during the course of the study.

- At the terminate of the experiment (July 15th), the following data were recorded:

- Leaf area (cm²).
- Fresh and dry weight of leaves (g).
- Length of the main root (cm).
- Diameter of the main root (mm).
- Fresh and dry weights of the main root (g).
- No. of secondary roots/plant.
- The length of the longest secondary root (cm).

Data were then tabulated and statistically analyzed using SAS Computer Program (1994) and means were compared by L.S.D. test according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Effect of natural extracts on leaves parameter of *Artocarpus heterophyllus* Lam. (Table, 1):

A positive significant influence on leaf area of *Artocarpus heterophyllus* was brought about as a result of supplying plants with the different natural extract treatments in most cases in both seasons. However, it could be mentioned that treating plants with

Table 1. Effect of some natural extracts on leaves parameter of *Artocarpus heterophyllus*, Lam. on July 15th in the two seasons (2012/2013 and 2013/2014).

Extracts	Leaf area (cm)		Fresh weight of leaves/plant		Dry weight of leaves/plant	
	2013	2014	2013	2014	2013	2014
Control	34.81	40.74	6.42	7.35	2.03	2.45
Moringa at 5%	47.53	50.74	11.11	13.48	3.71	4.34
Marjoram at 5%	44.78	47.15	9.10	10.84	2.91	3.00
Thyme at 5%	36.77	44.74	7.97	8.87	2.31	2.96
Moringa + marjoram at 2.5%	36.12	45.58	8.00	9.78	2.40	3.47
Moringa + thyme at 2.5%	45.97	48.24	9.57	11.24	3.06	3.60
Marjoram + thyme at 2.5%	46.12	49.58	10.57	12.42	3.38	3.85
LSD at 0.05	2.752	2.120	1.657	1.925	0.498	0.603

either moringa or marjoram extracts at 5% as well as applying the combination of either moringa + thyme extracts at 2.5% or that of marjoram + thyme extracts at 2.5% proved their superiority in raising leaf area over control and other used treatments.

Results of the effect of natural extract treatments on fresh weight of leaves/plant showed that treating plants with either moringa or marjoram extracts at 5% as well as with the combination of either moringa + thyme or that of marjoram + thyme extracts at 2.5% were the best treatments used for raising such trait in both seasons.

On the other hand, the highest records were obtained on dry weight of leaves/plant due to supplying plants with moringa extract at 5% in both seasons. Meanwhile, the second rank for raising the same parameter was belonged to plants which received the combination of either moringa + thyme or that of marjoram + thyme extracts at 2.5%.

The aforementioned results show the beneficial effects of the different natural extracts used in improving vegetative growth parameters of the plant (on July 15th). However, such results might be understood in the light of the findings of many scientists, on other plant species. Fodile *et al.* (2001) reported that spraying the leaves of many

field crops with moringa leaf extract (MLE) diluted with water produced some notable effects such as heavier stem and leaves, this substantiates its potential to be used as a foliar spray to accelerate young plant growth, especially under sub-optimal conditions. However, Makkar *et al.* (2007) attributed the beneficial effect of moringa extract to its contents of zeatin, ascorbates, phenolic compounds, K and Ca. Parabhu *et al.* (2010) worked on searled basil (*Ocimum sanctum*) and concluded that spraying the combination of 2% Panchakavya + 0.2% humic acid + 2% moringa leaf extract resulted in higher leaf area and leaf area index of basil both at 60 and 90 days after planting. Further, the same treatment also produced a pronounced effect on fresh and dry herb weight of both the stages of plant growth. Rana *et al.* (2013) experimented the effect of moringa leaf extract (MLE) on seedling growth of maize (*Zea maize L.*), where different MLE concentrations (5, 10, 15 and 20%) were used. Results in seedling growth bioassay, application of 5% MLE at 5 DAS furnished maximum shoot fresh and dry weight per seedling. Referring the beneficial effect of thyme, El-Bassiouny *et al.* (2005) reported that foliar spray with α -tocopherol (one of the components of thyme) on faba been plants induced increase in growth parameters.

Effect of natural extracts on root parameters of *Artocarpus heterophyllus* Lam. (Table, 2):

In the two seasons, the significantly heaviest fresh and dry weights of roots/ plant was a result of supplying plants with either moringa extract at 5% or with the combination of marjoram + thyme extracts at 2.5%. Treating plants with moringa extract at 5% proved its mastery in raising root length, comparing with that obtained from control and other treatments used. However, supplying plants with the combination of marjoram + thyme extracts at 2.5% came significantly in the second position in raising the same trait in both seasons. The highest records of root diameter were obtained due to supplying plants with either moringa extract at 5% or the combination of either moringa + marjoram or that of marjoram + thyme extracts at 2.5%. Great influence on number of secondary roots/ plant was observed due to treating plants with moringa extract at 5% in both seasons. Meanwhile, the second position for raising such trait was achieved by supplying plants with the combination of moringa + thyme extracts at 2.5%. Treating plants with either moringa extract at 5% or the combination of marjoram + thyme extracts at 2.5% recorded the utmost high values of the length of the longest secondary root in both seasons.

Results of the effect of various natural extract treatments on root parameters in the current study indicated the prevalence of supplying plants with moringa extract at 5% followed by that of the combination of marjoram + thyme extracts at 2.5% in most cases. However, a lot of workers obtained a positive influence of these treatments on other plants. Foidle *et al.* (2001) reported that spraying the leaves of many field crops with moringa leaf extract (MLE) diluted with water produced some notable effects such as heavier roots. Phiri and Mebewe (2010) added that moringa extract increased radical length by 4% in beans. Phiri (2010) worked on major cereals maize (*Zea maize* L.), where the seeds were treated with *Moringa*

oleifera leaf extract at the ratio of 1:10 (w/v) by a foliar spray. Results revealed that *Moringa oleifera* increased radical length of maize by 77.8%. Moreover, he attributed the beneficial effect of moringa leaf extract in improving root traits to the presence of various growth promoters as well as macro and micro elements in such organ. Mvumi *et al.* (2012) evaluated the effect of *Moringa oleifera* extract as a growth hormone on growth of tomato (*Lycopersicon esculentum* L. var Rodade). Five treatments were used: the control, where only water was added (MO), second control when ethanol 80% was added (ME), moringa extract applied once at 2 weeks from emergence (M_1), moringa extract applied 2 and 4 weeks from emergence (M_2), and moringa extract applied every 2 weeks starting from germination. Results showed that moringa extract significantly increased root dry matter weight. Rana *et al.* (2013) experimented the effect of moringa leaf extract (MLE) on seedling growth of maize (*Zea maize*, L.), where different MLE concentrations (5, 10, 15 and 20%) were used. A distilled water (control) maintained for comparison. The different treatments were applied at two times (5 and 10 days) after sowing. Results in seedling growth bioassay furnished maximum root length and root fresh and dry weights per seedling. Lobna *et al.* (2015) worked on jojoba plants and mentioned that the addition of moringa leaves extract (3.5, 7 and 10%) positively affected the studied growth characters, i.e. length of roots, fresh and dry weight of roots. Muhammed (2015) worked on seedling growth of cluster bean (*Cyamopsis tetragonoloba* L.) and concluded that the maximum root length (23.2 cm) was given by 5% moringa leaf extract priming and it was followed by 2% moringa leaf extract (22.6 cm). He added that the significantly higher root length was recorded by moringa leaf extract which might be due to the presence of various growth promoters as well as macro and micro nutrients in moringa leaf extract. With regard to the beneficial effect of thyme, El-Bassiouny *et*

Table 2. Effect of some natural extracts on root parameters of *Artocarpus heterophyllus* Lam. on July 15th in the two seasons (2012/2013 and 2013/2014).

Extracts	Fresh weight of roots/plant (g)		Dry weight of roots/plant (g)		Root length (cm)		Root diameter (mm)		No. of secondary roots/plant		Length of the longest secondary root (cm)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Control	2.02	2.93	0.61	0.88	16.79	19.38	4.22	6.00	18.67	24.17	10.57	13.02
Moringa at 5%	5.35	5.96	1.71	1.97	30.67	34.67	7.56	8.27	30.33	35.93	16.40	22.00
Marjoram at 5%	3.95	4.01	0.98	1.11	18.20	20.26	6.06	6.54	21.97	27.63	13.02	15.40
Thyme at 5%	2.28	3.04	0.68	0.91	17.90	21.40	6.86	7.60	20.93	26.50	12.00	17.43
Moringa + marjoram at 2.5%	3.05	4.95	1.23	1.54	19.40	26.33	6.93	7.90	25.00	27.00	14.00	19.00
Moringa + thyme at 2.5%	2.92	3.69	0.88	1.28	20.01	23.40	6.08	6.93	23.00	28.00	12.94	16.17
Marjoram + thyme at 2.5%	4.87	5.58	1.56	1.79	25.47	28.60	7.00	8.00	27.00	30.03	15.56	21.17
LSD at 0.05	1.427	1.582	0.749	0.902	2.464	3.020	1.187	1.579	1.135	2.847	2.138	1.942

al. (2005) reported that foliar spray with α -tocopherol (one of the components of thyme) on faba bean plant induced increase in growth parameters.

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استجابة نبات الجاك فروت (الكاكايا) لبعض المستخلصات الطبيعية في المراحل المبكرة من النمو ١ - صفات النمو الخضرى والجذري

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تم إجراء تجربة حقلية بمشتل معهد بحوث البساتين، مركز البحوث الزراعية ، جيزة ، مصر، خلال موسمين زراعيين متتاليين (٢٠١٣/٢٠١٢ و ٢٠١٤/٢٠١٣) بهدف تحسين النمو الخضرى وصفات الجذور لنباتات جاك فروت *Artocarpus heterophyllus*, Lam. في المراحل المبكرة من نمو النباتات وذلك بدراسة تأثير معاملاته بالمستخلصات الطبيعية لنباتات المورينجا (*Moringa oleifera*, Lam) والزعتر (*Thymus vulgaris*, L.) والبردقوش (*Majorana hortensis*, Moench) وذلك بإستخدام تركيزات (٥٪، ١٠٪، ١٥٪) هذا بالإضافة إلى دراسة تأثير مخلوط مستخلصات المورينجا والبردقوش ، المورينجا والزعتر ، البردقوش والزعتر بتركيز ٢,٥٪ حيث تم إستخدام تلك المستخلصات ومخاليطها عن طريق الرش إبتداء من ٢٠ نوفمبر في كل الموسمين على الشتلات (١٤-١٥ سم في الإرتفاع ذات ٤-٥ أوراق) وحتى ٢٠ يونيو من السنة التالية وذلك كل ١٥ يوم. وقد تم نمو النباتات في بيئة مخلوط الرمل + البنت موس (١:١ حجما) وتحت ظروف الزراعة بالصوبية الساران ذات تظليل قدره ٦٥٪ . ويمكن إيجاز النتائج المتحصل عليها في الآتي:

بدايةً أدى إستخدام تركيز ١٠٪ من المستخلصات الطبيعية السابقة إلى موت معظم النباتات بعد ٦ شهور من بداية الرش وذلك فقد تم إستبعاد البيانات المتحصل عليها من تلك المعاملات.

أكدت النتائج التقويق الواضح لإمداد النباتات بمستخلص المورينجا بتركيز ٥٪ في تحسين النمو الخضرى والجذري لنباتات جاك فروت *Artocarpus heterophyllus*, Lam. حيث أدت تلك المعاملة إلى زيادة مساحة الورقة والوزن الطازج والجاف للأوراق والجذور/ نباتات كذلك أدت إلى زيادة طول وسمك الجذر وعدد الجذور الثانوية/ نباتات وطول أطول جذر. في نفس الوقت إحتل إستخدام مخلوط البردقوش + الزعتر بتركيز ٢,٥٪ الدرجة الأولى والثانية في تحسين الصفات سابقة الذكر في معظم الحالات. بينما تم تسجيل أقل القيم بالنسبة لنفس الصفات كنتيجة للنباتات الغير معاملة (الكونترول) والنباتات التي تم إمدادها بمستخلص الزعتر بتركيز ٥٪.

من النتائج السابقة يمكن النصح بإستخدام مستخلص نباتات المورينجا بتركيز ٥٪ أو مخلوط مستخلصات نباتات البردقوش + الزعتر بتركيز ٢,٥٪ على نباتات جاك فروت (*Artocarpus heterophyllus*, Lam.) في المراحل المبكرة لنمو النباتات وذلك لتحسين النمو الخضرى وصفات الجذور لهذا النبات الاقتصادي الهام. بالإضافة إلى الحصول على نباتات جيدة دون الإضطرار لاستعمال المغذيات الكيميائية ومنظمات النمو المختلفة التي قد تضر بالبيئة مع الحصول على منتج نظيف آمن.