American-Eurasian J. Agric. & Environ. Sci., 20 (6): 399-412, 2020
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2020.399.412

Influence of Using Water Hyacinth Bio-Fertilizer and Micro-Organisms (EM) on Eggplant

Salwa A. El-Atbany

Vegetables Research Department, Horticulture Research Institute,
Agriculture Research Center, Giza, Egypt

Abstract: Tow field experiment were conducted during the two successive summer seasons of 2017- 2018 on eggplant (*Solanum melongena* L). cv. Laala-2 as two experiments one on the nursery (to investigate the effect of seed soaking at six hours in EM (Effective micro-organisms) and water hyacinth bio-fertilizer (WHB) using three concentrations from 30, 60, 90% from both compounds), while the second as field experiment. The two experiments were conducted at the Experimental Farm of Kaha Station, Qalubia Governorate, Egypt in clay soil. The aim of the current experiment was to examine the effect of two rates from the recommended mineral NPK of eggplant i.e.100% (as control) and 50%, as treatments whereas distribution in the main plots and four safety materials, i.e. water (as control), EM (Effective micro-organisms) at 3ml/l and water hyacinth bio-fertilizer (WHB) at1.5ml/L as foliar spray and their interactions which were arranged in the subplots and the influence of that on the vegetative growth, yield and its components of eggplant. The results indicated that, all different seed soaking treatments had highest values of all vegetative growth parameters, leaf chlorophyll concentration and germination parameters of the seedling at the nursery compared with seedling produced without soaking (control) or seeds soaked in water, it is notice that the using seed soaking in WHB 60% gave favorable significant values on seedling growth and germination parameters compared with the other treatments. Moreover, it noticed that in the field experiment the all treatments used, i.e. foliar spray by EM and WHB led to increment in the vegetative growth parameters, total yield and its components in the two seasons compared with the control, in addition the highest fruit yield (33.29 and35.51 ton/fed at the two successive seasons was obtained from the treatment of No9 (soaking eggplant seed in WHB 60% + spraying plants by WHB at 1.5 ml/L) comparing with the control which produced 27.08 and 27.38 ton/fed in the two seasons . The same treatment produced the pest fruit quality and the concentration of K% and total phenols in the fruits.

Key words: Eggplant ・ Recommended NPK rate ・ Effective micro-organisms (EM) ・ Fermented plant juices ・ Seed germination ・ Seedlings vigor ・ Yield

INTRODUCTION

Eggplant (*Solanum melongena* L.) is a member of the *Solanaceae* family and grown in several world regions, mainly under hot climates which grown during summer and autumn for local consumption and exportation in Egypt. Although the planted area is not significant, for cover its consumption whereas it is one of the most important public crops for the poor strata, so it is treated as a patriotic diet in many other tropical and sub-tropical countries, motivated by the demand for healthier and medicinal products by consumers [1]. Because its benefits to patients suffering from raised intraocular pressure (glaucoma) and convergence insufficiency, as well as in heart diseases and arteriosccerosis [2]. Eggplant contains phytonutrients i.e. nasunin and chlorogenic acid, which it consider a free radical scavenger and potent antioxidant that has been shown to safeguard cell membranes from damage. Also, eggplant is a very good source of potassium, dietary fiber, copper, manganese and vitamin B6, folate, niacin and magnesium [3].

Mineral fertilizers application is essential for plant growth, development and yield productivity of eggplant. The plants need nitrogen, phosphor and potassium as a certain mineral nutrients to grow and to produce high yield, being required in the largest quantities and

Corresponding Author: Salwa A. El-Atbany, Vegetables Research Department, Horticulture Research Institute, Agriculture Research Center, Giza, Egypt.

generally become deficient first in the soil. In this regard, Devi *et al*. [4] obtained better fruit weight and fruit yield of eggplant with the application of 120kg K_2O /ha. Moreover, many investigators reported that increasing the amount of NPK-fertilizer caused an increase in the vegetative growth of eggplant, fruit yield and fruit quality Meniutiu, [5] and Balliu *et al*. [6]. Kehinde *et al*. [7] showed that eggplant growth, yield and other shoot's characteristics greatly increased by adding 200kg NPK/ha application. Also, Suge *et al*. [8] reported that increasing NPK from 50% to 100% of the recommended rates encouraged the vegetative growth of eggplant with more fruit yield. In addition, Fouda and Abd-Elhamied [9] recorded that, vegetative growth parameters, yield, N, P, K and chlorophyll content as well as fruits quality of eggplant as affected by application of NPK fertilization there were a significantly increase with increasing rate of NPK from 50 up to 100% of the recommended dose then decreased with 150% NPK. However, the maintenance of fertile soil does not come cheap. Fertilizers and other soil additives can be expensive, due to the higher costs of shipping. It is vital farmers minimize costs wherever possible [10].

Effective micro-organisms (EM) is a trade name for a series of products founded and developed in the late of 1970's by Japanese horticulturist scientist Dr. Teruo Higa. It is microbial inoculants which contain a wide variety of beneficial and nonpathogenic of aerobic and anaerobic micro-organisms (photosynthetic bacteria, lactic acid bacteria, yeast, actinomycetes and others microorganisms), generally available in a liquid suspension produced through a natural process of fermentation [11]. These combinations of beneficial micro-organisms can synthesize useful substances i.e. antimicrobial substances, bioactive substances, amino acids, vitamins, sugars, lactic acid, enzymes and hormones, such substances had an important and effective role in promoting plant growth and root development, increasing nutrients availability, nutrients uptake and the effective microflora in the rizosphere, accelerating the decomposition of organic materials and suppressing soil borne diseases [12].

Also, EM can be applied to the seed before sowing as seed treatment, to the soil alone or combined with organic manures before sowing or applied to the soil alone after sowing at any stages of plant growth and/or foliar spraying [13, 14].

In this regard, El-Zeiny [15] reported that foliar spray with EM at rate of 2 or 4cm/L on tomato plants improve plant growth expressed as plant height, number of branches and leaf area. Meanwhile it increased average fresh and dry weight of plant, also increased total chlorophyll and total yield. Many investigators reported that EM foliar application illustrated beneficial effects on growth, crop yield and quality of vegetables Daiss *et al.* [16] on Swiss chard; Chantal *et al.* [17] on cabbage; Javaid and Bajwa [18] on mung bean; Ndona *et al*. [19] and Olle and Williams [20] on tomato.

Seed germination is considered an important step in the development cycle of the plant. Seed priming is an efficient method for increasing seed vigor and synchronization of germination and in addition the growth of seedlings of many crops under stressful conditions [21].

There are many types of seed priming, which it is a technique where seeds are soaked in sugar solution, strengthens the antioxidant system and increases seed germination potential, resulting in an increased stress tolerance in germinating seeds [22]. In hydro-priming technique which is a very important technique, only water is used to prime the seeds where water penetrate freely into seed caused rapid in germination, improved seed growth and uniform stand establishment in various crops [23]. There are a lot of benefits derived from seed priming particularly in all crops which included; faster emergence, more and uniform stands, less need to re-sow, more vigorous plants, drought tolerance, earlier flowering, earlier harvest maturity and higher seed yield of soybean [24]. Gonzales [25] soaked eggplant seeds in five vinegar concentration (10, 1, 0.1, 0.01 and 0.001%) and control. The result showed that application of 0.001% vinegar concentration showed significant effects in terms of percent germination and germination rate. Application of 10% vinegar concentration has detrimental effect of eggplant seeds. Thus, application of vinegar with 0.001% concentration is effective in germination eggplant seeds. Also, Neto *et al*. [26] found that soaking eggplant seeds in GA_3 at 750 mg L^{-1} increased seedling height, stem diameter, leaf area, root and shoot dry matter as well as, increasing germination percentage. In this way pepper seeds soaked in GA_3 at 600 or 900 mg/L and licorice extract at 50 or 70 g/L gave the highest values of all vegetative growth parameters and leaf chlorophyll concentration of the seedling at the nursery compared with seedling produced without soaking (control) or seed soaked in water [27]. Seed priming is considering the method to improve germinations and uniform emergence of seedlings in the field conditions. Although it will improve the vigour and crop establishment and finally enhance the yield. It is a very low cost hydration technique in which seeds are treated with various chemicals or sometimes with normal water also.

After treating the seeds are re-dried and sowing in the field. Seed priming is generally adopted for better crop stand, germination and yield of various vegetable crops [28].

Fermentation is a chemical process by using molecules such as glucose is broken down anaerobically. More broadly, the frothing results from the evolution of carbon dioxide gas, though this was not recognized until the 17th century. French chemist and microbiologist Louis Pasteur in the 19th century used the term fermentation in a narrow sense to describe the changes brought about by yeasts and other microorganisms growing in the absence of air (anaerobically); he also recognized that ethyl alcohol and carbon dioxide are not the only products of this process. The formulation and application of fermented plant juices, a mixture which can improve soil fertility and enhance growth. It is a mixture of chopped plant shoots or leaves and molasses that is fermented for a week or less and diluted to water. The mixture is then used as foliar fertilizer or drenched in to the soil [29, 30]. As a natural growth enhancer - FPJ made from actively growing plant parts and fast growing plants may contain natural growth hormones and mineralized nitrogen that promotes plant growth. There is no overdose on the use of FPJ; it may be used liberally. However, the soil must be watered first before applying FPJ to avoid scorching of the roots. Fermented plant juice provides more nitrogen to plants and enhances the ability of plants to photosynthesize better. It also gives additional phosphorus and helps plants absorb more phosphorus from the soil. Hence, the use of FPJ could promote vegetative growth and increase the volume and size of crops. One form of organic material that is good to use is liquid organic hyacinth fertilizer fermented by *Trichoderma* sp. As a result of the research by Apzani *et al*. [31] shows that the liquid organic fertilizer of hyacinth can increase lettuce growth. Apzani and Wardhana [32] found that treated red onion with water hyacinth liquid organic fertilizer fermented *Trichoderma* sp. (LOF-FT) increased plant height, leaves number, plant fresh and dry weight as well as fresh tubers weight. At the end, farmers are able to obtain all the materials and equipment needed to cultivate IMO (indigenous microorganisms) directly from their farms or source them locally [10].

The aim of this study was to evaluate the effect of using water hyacinth bio- fertilizer in the presence of EM compound as foliar spray on eggplant and the reflect of that on growth and fruit yield, as well as producing organic production, in addition enhancing the fruit yield with best quality.

MATERIALS AND METHODS

The present investigation was conducted during two successive seasons of 2017 and 2018 on eggplant, which was divided into two studies parts;

The First Study: Nursery Experiment: Seeds of eggplant (*Solanum melongena* L. cv. *Laala*-2) were sown under plastic green house at the Experimental Farm of Kaha Station, Qalubia Governorate in the nursery at the first week of April during both 2017 and 2018 seasons and received the natural agriculture practices for producing the seedlings. The experiment was carried out in complete randomized block design with three replicates and eight treatments of seeds soaking at six hours before sowing using the following materials;

- Without soaking (control).
- Seeds soaking in water.
- Seeds soaking in EM (Effective Microorganisms) 30%.
- Seeds soaking in EM (Effective Microorganisms) 60%.
- Seeds soaking in EM (Effective Microorganisms) 90%.
- Seeds soaking in water hyacinth bio-fertilizer (WHB) 30%.
- Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%.
- Seeds soaking in water hyacinth bio-fertilizer (WHB) 90%.

The data recorded on the seedlings from the first study:

Growth Parameters of Eggplant Seedlings: Three seedlings were chosen randomly from each treatment in the three replicates after 45 day (age of seedling transplanting) from sowing in order to determine the following:

- Seedling stem length (cm)-number of leaves / seedling- seedling stem diameter (cm) - seedling TSS seedling -fresh weight (g).

Seedling Dry Weight (g): Seedling dried at 70°C till constant weight and the dry weight of whole plant was determined using the standard methods as illustrated by A.O.A.C [33].

Seedling Leaf Area: The leaf area was calculated according to the following formula of Wallace and Munger [34]:

Leaf area (cm^2) = Leaves dry weight (gm) x disk area / Disk dry weight (gm).

Total leaf chlorophyll content was measured at fruiting stage using Minolta chlorophyll meter SPAD- 501 as SPAD units.

Germination Parameters of Eggplant Seedlings:

- Germination percentage (GP %) = (Number of germinated seeds / Total number of seeds) × 100, according to Scott *et al*. [35].
- Germination rate (GR) = N1 x D1 + N2 x D2 + N3 x D3 + -------- / Total germinated seeds

where: N = Number of germinated seeds per day, D = Number of days from the start of the count, according to Scott *et al*. [35].

The germination index (GI) was calculated as described in the

Association of Official Seed Analysts [36] by following formula:
GI= No. of germinated seed / Days of first count+ ………… + No. of germinated seed/ Days of final count
4- Co-efficient of Germination Velocity (CGV %) = 100 × Σ Ni / ΣNi Ti

where: Ni = Number of germinated seeds per day, Ti = Number of days from the start of the count, according to Peyman and Yousef [37].

The Second Study

Field Experiment: After 45 day from seeds sowing healthy seedling were selected and transplanted at the Experimental Farm of Kaha Station, Qalubia Governorate. Soil was clay in texture with 7.5 pH, 3.47 EC m mhos, 1.23% organic matters, 113 ppm N, 49 ppm P and 103 ppm K (average two seasons). A split plot design system with three replicates was adopted twenty four treatments, i.e., the combination among two levels from the recommended mineral fertilization (50% and 100%) were distributed in the main plots. In addition, aqueous extract of the two nutrients bio-fertilizers [EM (Effective Microorganisms at 3ml/L) and water hyacinth bio-fertilizer (WHB) at1.5ml/L] and the control (without any addition) which was arranged in the sub plots. The plot area was 8.4m^2 and includes 3 ridges each of 0.7m width and 4.0m length. A guard row was left between each experimental unit to avoid drift spray. The plants fertilized with two levels (50, 100%) of the recommended mineral fertilization i.e., 130 kg N + 90 kg K_2O + 60 kg P_2O_5 which were distributed in the main plots. In addition, twelve treatments as following:

- Without soaking (control).
- Seeds soaking in water.
- Seeds soaking in water hyacinth bio-fertilizer (WHB) at 60%.
- Seeds soaking in EM (Effective Microorganisms) at 60%.
- Foliar spray with water hyacinth bio-fertilizer (WHB) at 1.5ml/L.
- Foliar spray with EM (Effective Microorganisms) at 3 ml/L.
- T2+T5 (seeds soaking in water + foliar spray with WHB at 1.5ml/L).
- T2+T6 (seeds soaking in water + foliar spray with EM at 3 ml/L).
- T3+T5 (seeds soaking in WHB at 60% + foliar spray with WHB at 1.5ml/L).
- T3+T6 (seeds soaking in WHB at60% + foliar spray with EM at 3 ml / L).
- T4+T5 (seeds soaking in EM at 60% + foliar spray with WHB at 1.5ml/L).
- T4+T6 (seeds soaking in EM at 60% + foliar spray with EM at 3 ml / L).

Plants were sprayed four times with aqueous solution of the used materials; the first spray was conducted at flowering stage (40 days from transplanting) whereas the second, third and fourth sprays were performed 15 days intervals.

Preparation of the Water Hyacinth Bio-Fertilizer: Mix water (10L), molasses (1kg) and micro-organism (1kg; take the 5th cm deep next any tree from the soil most active and containing beneficial micro-organisms as their roots contain a high amount of sugar. These sugars attract bacterial-dominated microbes and nematodes [38] and stir in one direction in bucket, then add the chopped weeds (water hyacinth weed) and continue stir in one direction. Set the bucket in a semi-sunny area for 15 days until ferment and dilute the concoction (30ml/20L) for direct foliar application. Chemical analysis of water hyacinth bio- fertilizer used in this study are presented in Table (1), which was analyzed in General authority for the agricultural budget fund, Ministry of Agriculture and Land Reclamation.

Table 1: Chemical analysis of water hyacinth bio-fertilizer.

EC (mlmos)	pH	N%	P%	K%	Ca%	Mg%	Pb%	Phenols%	Amino acids	Cytokinines
8.74	4.240	1.600	1.000	0.160	0.824	0.002	0.000	0.062	0.300	0.004

The other agricultural practices were followed according to the recommendation for eggplant.

The data recorded on the results obtained from the second study.

Vegetative Growth Parameters: Three plants were taken randomly from every treatment in the three: replicates at flowering stage (after 75 days from transplanting) in order to determine the following:

- Plant length (the length of main stem cm), stem diameter, leaves number/plant and no. of. brunches/ plant
- Dry weight (g/plant): A random sample of three plants from each plot was taken and dried at 70°C till constant weight and the dry weight of whole plant was determined using the standard methods as illustrated by A.O.A.C [33].

The leaf area was calculated at fruiting stage after 100 days from transplanting from the fourth upper leaves were taken according to the following formula of Wallace and Munger [34]:

Leaf area (cm^2) = Leaves dry weight (gm) x disk area / Disk dry weight (gm)

Total Fruit Yield and its Components: Plant fruit yield (Kg), early fruit yield (ton/fed) as the first to fifth pickings, total fruit yield (ton/fed).

The Physical Characters of Eggplant Fruits: Five eggplant fruits were chosen randomly from each plot from the second picking to determine the following data:

Fruit length (cm), fruit diameter (cm), average fruit weight (g).

Dry matter percent in fruit 100 g from fruits was taken and dried at 70 Cº till constant weight and the dry weight was determined.

The Fruit Chemical Properties:

- Total leaf chlorophyll content was measured at fruiting stage (at 75 days after transplanting) from the fourth upper leaves using Minolta chlorophyll meter SPAD- 501 as SPAD units.
- Phosphorus and potassium were determined in dry fruit on the basis of dry weight according to the methods described by Olsen and Sommers [39] and Jackson [40], respectively.
- Phenolic content was measured using the Folin-Denis reagent [41].

Statistical Analysis: Data obtained from the two experiments were subjected to the proper analysis of variance (complete randomized block and split-plot design for nursery and field experiment respectively) as described by Snedecor and Cochran [42] using M. stat program. Averages between treatments were differentiated by using LSD at 5% level of probability in the two seasons.

RESULTS AND DISCUSSION

The First Study:

Nursery Experiment:

Vegetative Growth: Vegetative growth characters of seedlings determined at seedling transplanting stage as stem length (cm), stem diameter (cm), number of leaves, fresh weight , dry weight, leaf area (cm^2) and seedling leaf chlorophyll concentration of eggplant seedling as grown in the nursery are shown in Table (2) the data revealed that, all different seed soaking treatments i.e., seeds soaking in water (T2); seeds soaking in EM (Effective Microorganisms) 30% (T3); seeds soaking in EM (Effective Microorganisms) 60% (T4), seeds soaking in EM (Effective Microorganisms) 90% (T5), seeds soaking in water hyacinth bio-fertilizer (WHB) 30% (T6); seeds soaking in water hyacinth bio-fertilizer (WHB) 60% (T7); seeds soaking in water hyacinth bio-fertilizer (WHB) 90% (T8) recorded the highest values of all obvious characters compared with the treatment of using seeds without any soaking (control), it is noticed that using seed soaking in WHB at 60% (T7) gave the favorable significant values of seedling dry weight, leaf area, leaf chlorophyll concentration on both growing seasons and fresh weight on the second season. This increment might be due to the presence of macro nutrients, amino acids and cytokinines as shown in Table (1). Whereas it increase in the first season by using seed soaking in EM 60% (T5). This might be due to the presence of combinations of beneficial micro-organisms can synthesize useful substances i.e. antimicrobial substances, bioactive substances, amino acids, vitamins,

Table 2: Effect of seed soaking in liquid water hyacinth bio-fertilizer and micro-organisms (EM) on vegetative growth and leaf chlorophyll concentration of eggplant seedling during the two seasons of 2017 and 2018

	Seedling length (cm)		Stem seedling diameter (cm)		Number of Leaves/ seedling		Fresh seedling weight (g)		Dry seedling weight (g)		Seedling leaf area (cm^2)		Seedling leaf chlorophyll SPAD	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T1	10.89	10.00	0.20	0.20	4.00	3.67	2.47	2.87	0.21	0.20	115.07	110.69	35.18	35.6
T2	13.11	13.17	0.20	0.21	4.33	4.71	3.63	3.10	0.25	0.30	100.94	105.86	37.76	37.11
T3	10.91	10.83	0.19	0.19	4.00	4.52	3.63	3.57	0.24	0.25	107.35	110.28	37.82	37.92
T4	10.94	11.00	0.20	0.23	4.67	4.33	3.67	3.53	0.25	0.27	108.67	108.78	38.27	38.91
T5	9.99	10.00	0.19	0.18	3.67	4.00	3.40	3.10	0.23	0.24	100.79	110.11	35.42	35.01
T6	11.50	11.17	0.20	0.19	4.00	3.67	3.17	3.43	0.25	0.26	111.79	116.14	40.11	42.00
T7	11.50	11.17	0.20	0.21	4.33	4.33	3.43	3.57	0.31	0.31	112.58	117.15	44.05	43.81
T8	9.83	9.67	0.19	0.19	4.00	4.00	3.20	3.07	0.25	0.25	111.35	114.69	37.41	38.52
L.S.D at 5 % level	0.65	1.15	N.S	N.S	0.17	0.18	0.34	0.28	0.01	0.01	6.44	4.07	0.19	0.59

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in EM (Effective Microorganisms) 30%; T4: Seeds soaking in EM (Effective Microorganisms) 60%; T5: Seeds soaking in EM (Effective Microorganisms) 90%; T6: Seeds soaking in water hyacinth bio-fertilizer (WHB) 30%; T7: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T8: Seeds soaking in water hyacinth bio-fertilizer (WHB) 90%

Table 3: Effect of seed soaking in liquid water hyacinth bio - fertilizer and micro - organisms (EM) on germination parameters and TSS of eggplant seedling during the two seasons of 2017 and 2018

	G%		GR (day)		GI		CGV%		TSS	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T1	89.29	86.57	9.19	9.45	16.36	16.45	3.84	3.77	4.90	5.00
T2	86.43	86.19	9.09	9.63	17.38	18.75	4.05	4.17	4.90	4.80
T3	91.43	91.57	11.23	11.89	14.21	15.80	4.08	3.90	4.80	4.60
T4	92.56	95.45	14.98	14.79	14.36	15.98	4.29	4.31	5.20	5.40
T5	85.71	89.91	14.55	14.59	8.19	8.54	3.56	3.68	4.60	4.20
T6	92.14	93.11	12.77	13.22	12.18	13.46	4.24	4.29	5.00	5.40
T7	96.14	96.00	14.77	14.81	13.47	13.70	4.32	4.41	5.40	5.80
T8	91.00	92.17	15.15	14.34	9.19	9.25	3.97	3.87	5.00	4.80
L.S.D at 5 % level	1.62	1.24	0.56	0.55	0.17	0.06	0.15	0.17	0.16	0.18

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in EM (Effective Microorganisms) 30%; T4: Seeds soaking in EM (Effective Microorganisms) 60%;T5: Seeds soaking in EM (Effective Microorganisms) 90%; T6: Seeds soaking in water hyacinth bio-fertilizer (WHB) 30%; T7: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T8: Seeds soaking in water hyacinth bio-fertilizer (WHB) 90%

sugars, lactic acid, enzymes and hormones, such substances had an important and effective role in promoting plant growth and root development [12].

Concerning to seedling stem diameter all different seed soaking treatments had no significant effect while seed soaking in water increased seedling stem length and number of leaves on both growing seasons [28].

Germination Parameters: As shown in Table (3) eggplant seeds soaked in WHB 60% (T7) gave the highest values of germination percentage (GP %), co-efficient of germination velocity (CGV %), TSS on both growing seasons and Germination rate (GR) on the second season while it increased significantly on the first season by soaking seeds in WHB 90%. Concerning to soak eggplant seeds in water, EM and WHB at30 and 60% increased significantly germination index (GI) on both growing seasons. In the same data Gonzales [25] soaked eggplant seeds with five vinegar concentration (10, 1, 0.1, 0.01 and 0.001%) and a control. Thus, application of vinegar with 0.001% concentration is effective in germination of eggplant seeds. Also, Neto *et al*. [26] found that soaking eggplant seeds in GA3 at 750 mg L^{-1} increased germination percentage. Finally, Seed priming is the method to improve germinations and uniform emergence of seedlings in field conditions. It is a very low cost hydration technique in which seeds are treated with various chemicals or sometimes with normal water also. Seed priming is generally adopted for better germination of various vegetable crops [28]. This increment might be due to the presence of macro nutrients, amino acids and cytokinines as shown in Table (1).

Table (4a): Effect of fertilization levels, seeds soaking and foliar spray by WHB and EM on vegetative growth and leaf chlorophyll concentration of eggplant at 75 days after transplanting during the two seasons of 2017 and 2018

Treatments	Plant length (cm)		No. of leaves/ Plant		No. of. brunches/ plant		Stem diameter (cm)		Dry weight g/plant))		Leaf area (cm^2)		Leaf chlorophyll SPAD	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Fertilization levels														
100% (cont)	77.67	79.64	264.89	288.77	24.25	25.34	2.12	2.32	193.19	207.80	1405.80	1456.00	57.11	58.03
50%	71.65	74.79	258.42	284.75	19.56	20.81	1.81	1.86	157.51	176.77	1354.10	1383.40	55.55	56.39
L.S.D at 5 % level	0.41	0.21	4.14	2.73	1.28	0.87	0.21	0.05	1.76	1.80	6.00	8.28	N.S	0.41
Soaked seeds and foliar spray														
T1	69.32	74.09	180.50	193.50	17.38	18.37	1.79	1.90	123.15	130.00	1309.90	1325.80	55.05	55.78
T2	68.29	72.19	187.50	206.00	15.69	18.92	1.8	2.07	134.30	157.06	1332.80	1381.60	51.65	53.47
T3	76.74	78.72	270.50	294.07	21.99	22.27	1.90	2.12	212.83	226.10	1352.00	1367.50	54.84	56.04
T4	66.21	68.65	269.50	289.50	22.52	24.00	1.78	1.95	193.56	209.79	1339.30	1347.50	54.40	55.50
T5	82.33	84.12	290.50	300.00	24.19	25.35	2.32	2.39	171.12	201.34	1474.00	1501.10	55.72	57.62
T6	77.82	79.50	238.00	256.50	19.76	22.26	1.97	2.05	139.90	158.90	1340.80	1344.80	54.77	54.18
T7	81.79	82.88	305.75	325.55	24.17	25.19	1.91	1.95	181.25	213.85	1394.60	1420.70	57.73	58.44
T8	72.25	73.11	249.50	276.50	24.24	25.11	1.79	1.81	162.60	172.75	1244.20	1289.40	56.05	56.85
T9	83.67	86.27	330.00	344.00	26.07	26.81	2.38	2.54	219.50	238.45	1625.80	1804.40	61.80	62.60
T10	82.29	83.93	256.00	319.50	23.37	24.12	1.68	1.82	200.80	206.08	1430.70	1484.90	57.10	58.20
T11	75.07	78.90	282.34	309.00	21.72	22.26	2.18	2.41	186.65	201.95	1497.40	1517.80	58.95	58.29
T12	60.17	64.24	279.75	327.00	21.76	22.24	2.00	2.12	178.55	191.15	1217.70	1251.30	57.91	59.59
L.S.D at 5 % level	0.48	0.91	8.31	8.59	0.74	1.14	0.08	0.09	7.46	8.74	8.03	10.23	1.83	0.98

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T4: Seeds soaking in EM (Effective Microorganisms) 60%; T5: Foliar spray with water hyacinth bio-fertilizer (WHB) 1.5ml/L; T6: Foliar spray with EM (Effective Microorganisms); T7: T2+T5; T8: T2+T6; T9: T3+T5; T10: T3+T6; T11: T4+T5; T12: T4+T6

The Second Study

Field Experiment

Vegetative Growth Parameter

Effect of Mineral Fertilization Levels: Data in Table (4a) illustrate that, the plants showed best growth attributes, i.e., plant length, number of leaves/plant, number of branches/plant, stem diameter, plant dry weight and leaf area in both growing seasons as well as, leaf chlorophyll concentration in the second season only by fertilizing with the level of 100% of the recommended mineral rate. In this regard Meniutiu, [5] on eggplant; Balliu *et al*. [6] on pepper; Kehinde *et al*. [7]; Suge *et al*. [8] and Fouda and Abd-Elhamied [9] on eggplant indicated that increasing the amount of NPK-fertilizer caused an increase in the vegetative growth.

Effect of Seeds Soaking and Foliar Spray with WHB and EM: As shown in Table (4a) all studied plant growth parameters, i.e., plant length, number of leaves, number of branches/plant, stem diameter; leaf area and dry weight of foliage per plant were significantly increased by all treatments compared to the control. Soaking eggplant seeds in WHB 60% + spraying the plants by WHB at 1.5 ml/L (T9) gave the highest values of all growth parameters followed by soaking eggplant seeds in EM and spraying the plants by WHB at 1.5 ml/L for stem diameter/plant, leaf area/plant and leaf chlorophyll concentration, then followed by spraying the plants by WHB at 1.5 ml/L (T3) for plant length and branches number/plant, these results were true in both growing seasons. Many investigators reported that using liquid organic fertilizer of hyacinth can increase growth parameters Apzani *et al*. [31] on lettuce, Apzani and Wardhana [32] on onion and Mal *et al*. [28] on various vegetable crops.

Effect of the Interaction Between Mineral Fertilization Levels, Seeds Soaking and Spray with WHB and EM: Data in Table (4b) show that, the plants fertilized by 100 % of the recommendation rate of NPK and soaked the seeds in WHB 60% + sprayed the plants by WHB1.5 ml/L (T9) increased plant length, stem diameter, leaves number, branches number and leaf area of foliage per plant in both growing season. On the other hand according to plant dry weight the best treatment was soaked the seeds in WHB 60 % (T3) and fertilization by 100 % of the mineral recommended fertilization treatment in both growing season.

Physical Fruit Characters

Effect of Mineral Fertilization Levels: Data in Table (5a) revealed that fertilizing eggplant plants with100% from the recommended rate of NPK increased significantly average of fruit weight and the dry weight of 100g, whereas fertilizing with 100% increased fruit length and diameter but did not reach to the significant level, these results were true in both growing seasons. It can say that these treatments as shown in Table (4a) showed obvious, increasing in plant growth which that reflect on yield and its components. The same trend was obtained by Meniutiu [5] on eggplant; Balliu *et al*. [6] on pepper; Kehinde *et al*. [7]; Suge *et al*. [8] and Fouda and Abd-Elhamied [9] on eggplant.

Table (4b): Effect of the interaction between fertilization levels, seeds soaking and foliar spray with WHB and EM on vegetative growth and leaf chlorophyll concentration of eggplant at 75 days after transplanting during the two seasons of 2017 and 2018

		Plant length (cm)		No. of .leaves/Plant		No. of. brunches/ plant		Stem diameter (cm)		Dry weight g/plant))		Leaf area (cm^2)		Leaf chlorophyll SPAD	
Treatments		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
100%	T1	71.13	75.00	200.00	210.00	21.81	22.50	1.94	2.10	138.00	145.40	1356.90	1373.80	56.73	57.03
	T2	71.50	73.17	204.00	219.00	18.25	19.08	1.90	2.33	152.80	189.42	1384.70	1451.20	54.47	55.10
	T3	82.67	83.33	273.00	293.14	21.98	23.25	2.00	2.40	240.94	252.50	1373.10	1383.80	56.15	57.20
	T4	67.75	69.00	278.00	296.00	24.60	26.75	1.90	2.10	219.32	245.38	1354.10	1364.00	54.35	55.40
	T5	85.15	87.10	300.00	305.00	28.08	28.56	2.64	2.80	168.60	211.09	1596.80	1632.30	56.20	58.03
	T6	78.97	80.50	200.00	225.00	19.15	22.01	2.17	2.30	145.40	159.10	1326.20	1333.40	54.78	56.10
	T7	84.90	86.25	319.50	341.10	27.00	28.33	1.96	2.00	226.30	230.90	1433.80	1475.20	58.74	58.77
	T8	77.17	77.21	247.00	278.00	28.73	29.08	1.80	1.80	207.90	211.20	1137.10	1247.50	56.60	57.30
	T9	86.25	89.03	360.00	364.00	29.63	30.13	2.65	2.83	247.40	254.70	1632.60	1860.00	62.50	63.90
	T10	84.67	86.83	235.00	298.00	27.99	29.25	1.80	2.00	214.90	218.97	1433.60	1475.20	58.10	58.70
	T11	76.17	79.11	266.67	292.00	21.68	22.44	2.45	2.81	183.50	192.40	1622.90	1650.90	57.89	58.40
	T12	65.67	69.17	295.50	344.00	22.13	22.67	2.20	2.40	173.20	182.60	1217.70	1225.00	58.84	60.37
50%	T1	67.50	73.17	161.00	177.00	12.94	14.25	1.65	1.70	108.30	114.60	1262.90	1277.80	53.36	54.53
	T2	65.08	71.20	171.00	193.00	13.13	18.75	1.74	1.80	115.80	124.70	1281.00	1312.00	48.83	51.83
	T3	70.80	74.11	268.00	295.00	21.99	21.29	1.80	1.84	184.73	199.70	1331.00	1351.20	53.53	54.88
	T4	64.67	68.30	261.00	283.00	20.44	21.25	1.66	1.79	167.80	174.20	1324.50	1331.00	54.54	55.60
	T5	79.50	81.13	281.00	295.00	20.31	22.13	2.00	1.98	173.63	191.60	1351.20	1369.90	55.23	57.20
	T6	76.67	78.50	276.00	288.00	20.38	22.50	1.77	1.80	134.40	158.70	1355.50	1356.20	54.75	52.25
	T7	78.67	79.50	292.00	310.00	21.35	22.04	1.85	1.90	136.20	196.80	1355.40	1366.20	56.72	58.10
	T8	67.33	69.00	252.00	275.00	19.75	21.13	1.79	1.81	117.30	134.30	1351.20	1331.40	55.50	56.39
	T9	81.08	83.50	300.00	324.00	22.50	23.49	2.11	2.24	191.60	222.20	1619.00	1748.90	61.10	61.30
	T10	79.90	81.03	277.00	341.00	18.75	18.99	1.56	1.64	186.70	193.20	1427.80	1494.60	56.10	57.70
	T11	73.97	78.69	298.00	326.00	21.75	22.08	1.90	2.00	189.80	211.50	1371.90	1384.70	60.00	58.17
	T12	54.67	59.30	264.00	310.00	21.38	21.80	1.80	1.84	183.90	199.70	1217.70	1277.60	56.97	58.80
L.S.D at 5 % level		0.23	0.45	4.13	4.26	0.37	0.57	0.03	0.04	3.70	4.34	3.98	5.08	0.91	0.49

\ T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T4: Seeds soaking in EM (Effective Microorganisms) 60%; T5: Foliar spray with water hyacinth bio-fertilizer (WHB) 1.5ml/L; T6: Foliar spray with EM (Effective Microorganisms); T7: T2+T5; T8: T2+T6; T9: T3+T5; T10: T3+T6; T11: T4+T5; T12: T4+T6

Table 5a: Effect of fertilization levels, seeds soaking and foliar spray with natural extracts (WHB and EM) on the physical characters of eggplant fruits during the two seasons of 2017 and 2018

	Fruit length (cm)		Fruit diameter (cm)		Average fruit weight (g)		Dry matter %	
Treatments	2017	2018	2017	2018	2017	2018	2017	2018
				Fertilization levels				
100% (cont)	11.82	12.27	2.55	2.74	8.69	9.09	42.13	43.55
50%	11.75	12.02	2.51	2.65	7.98	8.33	40.95	42.15
L.S.D at 5 % level	N.S	N.S	N.S	N.S	0.23	0.74	1.04	0.41
				Soaked seeds and foliar spray				
T1	9.99	10.77	2.18	2.28	6.79	7.93	38.44	40.78
T2	11.05	11.87	2.51	2.59	7.85	8.22	39.69	42.16
T3	12.35	12.63	2.54	2.76	8.57	9.12	41.46	43.18
T4	11.63	12.05	2.37	2.71	8.29	8.46	41.15	41.43
T5	12.44	12.78	2.91	2.87	9.21	9.37	43.79	44.30
T6	11.85	12.06	2.30	2.38	8.55	8.69	35.17	36.33
T7	12.78	12.99	2.61	2.78	8.66	8.93	42.69	44.26
T8	11.87	11.92	2.44	2.61	8.45	8.68	40.32	41.88
T9	12.84	13.06	2.98	3.35	9.79	10.35	46.85	48.04
T10	11.85	12.17	2.40	2.54	8.28	8.56	44.69	46.25
T11	11.43	11.89	2.66	2.79	7.80	7.84	42.31	43.41
T12	11.36	11.57	2.44	2.71	7.84	8.45	41.90	42.24
L.S.D at 5 % level	0.86	0.79	N.S	0.51	0.56	0.74	1.02	1.21

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T4: Seeds soaking in EM (Effective Microorganisms) 60%; T5: Foliar spray with water hyacinth bio-fertilizer (WHB) 1.5ml/L; T6: Foliar spray with EM (Effective Microorganisms); T7: T2+T5; T8: T2+T6; T9: T3+T5; T10: T3+T6; T11: T4+T5; T12: T4+T6

Table 5b: Effect of the interaction between fertilization levels, seeds soaking and foliar spray WHB and EM on physical characters of eggplant fruits during the two seasons of 2017 and 2018

Treatments		Fruit length (cm)		Fruit diameter (cm)		Average fruit weight (g)		Dry matter %	
		2017	2018	2017	2018	2017	2018	2017	2018
100%	T1	9.51	10.80	2.22	2.28	6.67	8.33	39.58	42.02
	T2	11.48	12.63	2.47	2.58	8.59	8.77	39.78	43.07
	T3	12.44	12.80	2.55	2.68	9.01	9.21	42.24	44.42
	T4	11.87	12.63	2.39	2.74	8.76	8.82	41.18	41.68
	T5	12.48	12.75	2.82	2.93	9.92	10.40	45.08	45.50
	T6	11.44	11.80	2.33	2.40	8.66	8.76	36.24	36.38
	T7	12.88	13.08	2.70	2.85	9.13	9.42	43.69	44.88
	T8	11.60	11.44	2.17	2.28	8.84	9.13	41.00	42.53
	T9	12.88	13.20	3.13	3.50	9.98	10.39	47.25	48.82
	T10	12.42	12.67	2.64	2.85	8.39	8.74	45.18	47.02
	T11	11.44	11.78	2.76	2.86	7.95	7.72	42.44	43.73
	T12	11.36	11.64	2.45	2.92	8.46	9.41	41.90	42.59
50%	T1	10.48	10.74	2.14	2.27	6.91	7.53	37.30	39.54
	T2	10.62	11.10	2.55	2.60	7.11	7.66	39.60	41.24
	T3	12.26	12.46	2.54	2.84	8.12	9.02	40.68	41.94
	T4	11.38	11.47	2.35	2.68	7.82	8.09	41.12	41.18
	T5	12.40	12.80	3.01	2.81	8.49	8.34	42.50	43.10
	T6	12.26	12.31	2.27	2.35	8.44	8.61	34.10	36.28
	T7	12.67	12.89	2.52	2.70	8.19	8.44	41.70	43.64
	T8	12.14	12.40	2.71	2.93	8.05	8.22	39.64	41.23
	T9	12.80	12.92	2.82	3.20	9.60	10.30	46.44	47.25
	T10	11.27	11.67	2.16	2.22	8.16	8.37	44.19	45.48
	T11	11.41	12.00	2.56	2.71	7.65	7.95	42.18	43.09
	T12	11.35	11.49	2.44	2.50	7.22	7.48	41.90	41.88
L.S.D at 5 % level		N.S	N.S	N.S	N.S	0.28	0.32	N.S	N.S

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T4: Seeds soaking in EM (Effective Microorganisms) 60% T5: Foliar spray with water hyacinth bio-fertilizer (WHB) 1.5ml/L; T6: Foliar spray with EM (Effective Microorganisms); T7: T2+T5; T8: T2+T6; T9: T3+T5; T10: T3+T6; T11: T4+T5; T12: T4+T6

Effect of Seeds Soaking and Foliar Spray with WHB and EM: The obtained results in Table (5a) showed some enhancing of physical characteristics in eggplant i.e. fruit length, fruit diameter (in the second season only), fruit weight and the dry weight of 100g. The data illustrated that, as in general all treatments especially soaking eggplant seeds in WHB at 60% + spraying the plants by WHB at 1.5 ml/L (T9) gave the highest values of all mentioned physical characteristics of eggplant fruit in both growing seasons. Many investigators reported that using WHB as soaking or spraying plants caused an increase in fruit quality as for EM Daiss *et al*. [16] on Swiss chard; Chantal *et al*. [17] on cabbage; Javaid and Bajwa [18] on mung bean; Ndona *et al*. [19] on tomato; Olle and Williams [20], regarding to liquid biorganic fertilizer of hyacinth Apzani and Wardhana [32] on red onion.

Effect of the Interaction Between Mineral Fertilization Levels, Seeds Soaking and Foliar Spray with WHB and EM: As shown in Table (5b) the interaction between mineral fertilization levels (100 and 50%), seeds soaking in (water, EM and WHB at 30, 60 and 90%) and foliar spray by EM at 3 ml/L and WHB1.5 ml/L increased physical characteristics of eggplant fruit i.e. fruit length, fruit diameter and the dry weight of 100g but did not reach to 5% level of significance in the two growing seasons. Regarding to fruit weight it increased significantly when eggplant plants fertilized by 100 % of the recommended rate of NPK and soaked seeds in WHB 60% + sprayed the plants by WHB1.5 ml/L (T9), these results were true in both growing seasons.

Yield and its Components

Effect of Mineral Fertilization Levels: Data in Table (6a) as general show that fertilizing eggplant plants with100 % from the recommended rate of NPK increased early fruit yield, fruit yield/plant and total fruit yield, these results were true in both growing seasons. It can say that these treatments as shown in Table (4a) showed obvious increasing in plant growth which that reflect on yield and its components. The same trend was obtained by Meniutiu [5] on eggplant; Balliu *et al*. [6] on pepper; Kehinde *et al*. [7]; Suge *et al*. [8] and Fouda and Abd-Elhamied [9] on eggplant.

Table 6a: Effect of the interaction between fertilization levels, seeds soaking and foliar spray with WHB and EM on eggplant fruit yield and its components during the two seasons of 2017 and 2018

	Fruit yield/plant Kg		Early fruit yield Ton/fed		Total fruit yield Ton/fed	
Treatments	2017	2018	2017	2018	2017	2018
			Fertilization levels			
100% (cont)	3.07	3.39	10.64	11.02	29.58	30.82
50%	2.38	2.54	9.85	10.25	28.62	29.68
L.S.D at 5 % level	0.10	0.13	0.04	0.46	0.82	0.83
			Soaked seeds and foliar spray			
T1	2.20	2.29	8.29	8.27	25.63	26.57
T2	2.17	2.51	8.06	8.86	25.54	26.53
T3	3.07	3.30	10.29	10.59	29.65	31.46
T4	2.88	2.94	9.77	9.97	27.42	28.92
T5	2.74	2.85	10.24	10.93	31.59	32.25
T6	2.68	3.10	9.85	10.54	29.33	30.19
T7	2.43	2.84	10.83	10.95	28.59	29.54
T8	2.31	2.67	10.78	11.15	27.17	27.88
T9	3.39	3.82	11.75	12.41	32.74	34.35
T10	2.83	2.86	10.85	11.28	30.69	31.04
T11	3.08	3.13	11.27	11.39	31.12	32.31
T12	2.96	3.25	10.99	11.31	29.72	32.00
L.S.D at 5 % level	0.08	0.10	0.07	0.47	1.03	1.00

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T4: Seeds soaking in EM (Effective Microorganisms) 60%;

T5: Foliar spray with water hyacinth bio-fertilizer (WHB) 1.5ml/L; T6: Foliar spray with EM (Effective Microorganisms); T7: T2+T5; T8: T2+T6; T9: T3+T5; T10: T3+T6; T11: T4+T5; T12: T4+T6

Table 6b: Effect of the interaction between fertilization levels, seeds soaking and foliar spray with WHB and EM on eggplant fruit yield and its components during the two seasons of 2017 and 2018

		Fruit yield/plant Kg		Early fruit yield Ton/fed		Total fruit yield Ton/fed	
Treatments		2017	2018	2017	2018	2017	2018
100%	T1	2.45	2.50	8.30	8.24	27.08	27.38
	T2	2.24	2.84	7.83	8.29	25.75	26.98
	T3	3.52	3.96	10.01	10.29	30.18	31.72
	T4	3.22	3.25	9.39	9.43	25.97	27.87
	T5	2.90	3.02	11.37	11.88	32.42	32.63
	T6	3.02	3.63	10.83	11.63	29.84	30.23
	T7	2.64	3.11	10.87	11.03	30.29	32.83
	T8	2.42	2.82	10.85	11.45	27.76	27.45
	T9	4.05	4.73	12.52	13.81	33.29	35.51
	T10	3.04	3.07	11.98	12.26	30.83	31.29
	T11	3.79	3.92	12.03	12.06	31.40	33.45
	T12	3.56	3.79	11.70	11.89	30.09	32.50
50%	T1	1.95	2.08	8.28	8.30	24.17	25.75
	T2	2.09	2.17	8.28	9.43	25.33	26.07
	T3	2.61	2.64	10.56	10.88	29.12	31.19
	T4	2.53	2.62	10.14	10.50	28.87	29.97
	T5	2.58	2.68	9.10	9.98	30.75	31.87
	T6	2.34	2.57	8.86	9.44	28.81	30.15
	T7	2.23	2.57	10.79	10.86	26.89	26.24
	T8	2.20	2.51	10.71	10.85	26.57	28.31
	T9	2.73	2.90	10.98	11.01	32.19	33.19
	T10	2.61	2.64	9.71	10.29	30.55	30.78
	T11	2.36	2.33	10.51	10.73	30.83	31.17
	T12	2.36	2.71	10.29	10.73	29.35	31.50
L.S.D at 5 % level		0.04	0.05	0.04	0.23	0.51	0.50

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T4: Seeds soaking in EM (Effective Microorganisms) 60% T5: Foliar spray with water hyacinth bio-fertilizer (WHB) 1.5ml/L; T6: Foliar spray with EM (Effective Microorganisms); T7: T2+T5; T8: T2+T6; T9: T3+T5; T10: T3+T6; T11: T4+T5; T12: T4+T6

Effect of Seeds Soaking and Foliar Spray with WHB and EM: Data in Table (6a) noticed that, the highest values of yield fruits kg/plant, early fruit yield and total fruit yield ton/fed were recorded the highest values (32.74 and 34.35 ton/fed in the two seasons, respectively) by soaking eggplant seeds in WHB 60% + spraying the plants by WHB at 1.5 ml/L (T9) followed by soaking eggplant seeds in EM 60% + spraying the plants by WHB at 1.5 ml/L (T11) which gave 31.12 and 32.31 ton /fed in the two seasons, respectively as for early yield ton/fed in both growing seasons and yield fruits kg/plant in the first season but in the second season was followed by soaking eggplant seeds in EM60% (T3). Regarding to the total yield it gave the favorite result with T9 (seeds soaking in WHB 60% + spraying the plants by WHB at 1.5 ml/L) , i.e. the increment which reached to 77.35% and 78.28% at the two seasons comparing with the control (without treating); followed by soaked seeds in EM60% in the first season and soaking eggplant seeds in WHB60%+ spraying the plants by EM at 3ml/L ml/L (T10).

The positive effect of applying WHB or EM could be expected because its have favorable conditions for increasing eggplant vegetative growth as shown in Table (4a) Moreover, its considered as a valuable source of highest concentration from N, P and K as shown in Table (1) macronutrients such as phosphorus, nitrogen and potassium that are essential for plant nutrition. These results agreements with those obtained by El-Zeiny [15] on tomato plants; Daiss *et al*.[16] on Swiss chard; Chantal *et al*. [17] on cabbage; Javaid and Bajwa [18] on mung bean; Ndona *et al*., [19] on tomato; Olle and Williams [20]; for spraying plants by EM. According to use liquid organic hyacinth fertilizer increased the volume, size and fresh tubers weight of red onion Apzani and Wardhana, [32].

Effect of the Interaction Between Mineral Fertilization Levels, Seeds Soaking and Foliar Spray with WHB and EM: The obtained data in Table (6b) revealed that, soaking eggplant seeds in WHB 60% + spraying the plants by WHB at 1.5 ml/L (T9) and fertilized the plants by 100% of the mineral recommended fertilization treatment increased early fruit yield, total fruit yield ton/fed and fruit yield kg/plant. Moreover, the data indicated that were the best treatment generally then followed by soaking eggplant seeds in EM 60% + spraying the plants by WHB 1.5ml/L (T11) for fruit yield kg/plant in two growing seasons and early yield in the first season, on the other hand it followed by soaking eggplant seeds in WHB 60%+ spraying the plants by EM 3ml/L. Whereas the increment reached to 32.74 and 34.53 ton/fed. at the two seasons comparing with the control (without treating) which produced 25.63 and 26.57 ton/fed at the two seasons respectively.

Table 7a: Effect of fertilization levels, seeds soaking and foliar spray with natural extracts (WHB and EM) on chemical properties of eggplant fruits during the two seasons of 2017 and 2018

Treatments	P%		%K		Total phenols	
	2017	2018	2017	2018	2017	2018
			Fertilization levels			
100% (cont)	0.54	0.55	3.79	3.93	0.14	0.14
50%	0.49	0.52	3.39	3.42	0.12	0.13
L.S.D at 5 % level	N.S	N.S	0.04	0.08	0.003	0.006
			Soaked seeds and foliar spray			
T1	0.39	0.41	3.39	3.43	0.08	0.08
T2	0.36	0.36	3.42	3.46	0.08	0.09
T3	0.50	0.51	3.73	4.11	0.13	0.14
T4	0.46	0.49	3.51	3.77	0.12	0.13
T5	0.57	0.59	3.81	3.87	0.15	0.16
T6	0.57	0.58	3.49	3.53	0.12	0.13
T7	0.48	0.52	3.58	3.62	0.13	0.13
T8	0.46	0.44	3.59	3.60	0.11	0.12
T9	0.71	0.73	3.87	3.91	0.19	0.19
T10	0.57	0.59	3.66	3.73	0.16	0.17
T11	0.54	0.56	3.69	3.77	0.15	0.16
T12	0.59	0.61	3.28	3.32	0.13	0.14
L.S.D at 5 % level	0.09	0.10	0.07	0.23	0.008	0.005

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T4: Seeds soaking in EM (Effective Microorganisms) 60%; T5: Foliar spray with water hyacinth bio-fertilizer (WHB) 1.5ml/L; T6: Foliar spray with EM (Effective Microorganisms); T7: T2+T5; T8: T2+T6; T9: T3+T5; T10: T3+T6; T11: T4+T5; T12: T4+T6

Table 7b: Effect of the interaction between fertilization levels, seeds soaking and foliar spray WHB and EM on chemical properties of eggplant fruits during the two seasons of 2017 and 2018

Treatments		P%		K		Total phenols	
		2017	2018	2017	2018	2017	2018
100%	T1	0.41	0.42	3.66	3.71	0.08	0.08
	T2	0.33	0.33	3.71	3.76	0.09	0.09
	T3	0.51	0.51	3.83	4.58	0.14	0.14
	T4	0.42	0.44	3.76	4.21	0.12	0.13
	T5	0.58	0.60	3.89	3.98	0.16	0.17
	T6	0.59	0.61	3.74	3.77	0.12	0.13
	T7	0.51	0.52	3.89	3.91	0.13	0.14
	T8	0.46	0.40	3.85	3.89	0.12	0.13
	T9	0.84	0.85	4.00	4.06	0.20	0.21
	T10	0.62	0.63	3.80	3.93	0.17	0.18
	T11	0.55	0.56	3.91	4.03	0.17	0.18
	T12	0.63	0.65	3.30	3.36	0.14	0.15
50%	T1	0.39	0.39	3.11	3.14	0.08	0.08
	T2	0.38	0.39	3.14	3.17	0.08	0.09
	T3	0.49	0.49	3.63	3.65	0.13	0.14
	T4	0.49	0.54	3.26	3.33	0.12	0.13
	T5	0.57	0.58	3.73	3.75	0.14	0.15
	T6	0.54	0.56	3.24	3.29	0.12	0.13
	T7	0.45	0.52	3.27	3.34	0.12	0.12
	T8	0.46	0.42	3.33	3.32	0.10	0.12
	T9	0.58	0.60	3.74	3.75	0.19	0.19
	T10	0.51	0.55	3.43	3.52	0.15	0.16
	T11	0.52	0.56	3.48	3.50	0.14	0.15
	T12	0.56	0.57	3.26	3.29	0.13	0.14
L.S.D at 5 % level		N.S	N.S	0.03	0.12	0.004	0.002

T1: Without soaking (control); T2: Seeds soaking in water; T3: Seeds soaking in water hyacinth bio-fertilizer (WHB) 60%; T4: Seeds soaking in EM (Effective Microorganisms) 60% T5: Foliar spray with water hyacinth bio-fertilizer (WHB) 1.5ml/L; T6: Foliar spray with EM (Effective Microorganisms); T7: T2+T5; T8: T2+T6; T9: T3+T5; T10: T3+T6; T11: T4+T5; T12: T4+T6

Fruit Chemical Properties

Effect of Mineral Fertilization Levels: Data in Table (7a) revealed that, fertilizing eggplant plants with100 % from the recommended rate of NPK increased concentration of K% and total phenols. While the concentration of P% in the fruits was not affected by increase of mineral fertilization levels. These results were true for K% only in both growing seasons. These results agreements with those obtained by Fouda and Abd-Elhamied [9].

Effect of Seeds Soaking and Foliar Spray with WHB and EM: As shown in Table (7a) all fruit chemical properties, i.e., P%, K% and total phenols were significantly increased by all treatments compared to the control. Soaking eggplant seeds in WHB 60% + spraying the plants by WHB at 1.5 ml/L (T9) gave the highest values of chemical properties followed by soaking eggplant seeds in EM 60% and spraying plants by WHB at 1.5 ml/L(T11). These results were true in the both growing seasons.

Effect of the Interaction Between Mineral Fertilization Levels, Seeds Soaking and Foliar Spray with WHB and EM: Data in Table (7b) show that, plants fertilized by 100 % from the recommended rate of NPK and T9 (Soaking eggplant seeds in WHB 60% + spraying the plants by WHB at 1.5 ml/L) followed by T10 (Soaking eggplant seeds in WHB 60% + spraying the plants by EM at3ml/L) which gave the highest values of chemical properties i.e., K% and total phenols. On the other hand P% was not affected by soaking and spraying treatments in the both growing seasons.

REFERENCES

1. Filgueira, F.A.R., 2000. Novo manual de olericultura. Agrotecnologia moderna na produção e comercialização de hortaliças. Viçosa, Brasil, UFV.
2. Harish, B.N., P.A. Babu, T. Mahesh and Y.P. Venkatesh, 2008. A cross–sectional study on the prevalence of food allergy to eggplant. Clinical and Experimental Allergy, pp: 22-34.

3. Sabo, E. and Y.Z. Dia, 2009. Awareness and Effectiveness of Vegetable Tech. Information packages by vegetable Farmers in Adamawa State, Nigeria. J. Agric. Res., 4(2): 65-70.
4. Devi, H.H., T.K. Maity, N.C. Paria and U. Thapa, 2002. Response of brinjal to different sources of nitrogen. J. Veg. Sci., 29(1): 45-47.
5. Meniutiu, D., 2006. Research concerning plant directing method and fertilization method on eggplant cultivated in plastic tunnels. Notulae Botanicae Horticulture Agrobotanici Cluj Napoca, 34: 69-74.
6. Balliu, A., G. Sallaku, S. Kuci, E. Cota and S. Kaciu, 2007. The effects of major nutrients (NPK) on the growth rate of pepper and eggplant seedlings. Acta. Hort., 729: 341-346.
7. Kehinde, N.I., T.O. Adeniyi, A.M. Olabiyi and C.V. Okechukwu, 2011. Effects of NPK fertilizer on growth, dry matter production and yield of eggplant in southwestern Nigeria. Agric. Biol. J. N. Am., 2(7): 1117-1125.
8. Suge, J.K., M.E. Omunyin and E.N. Omami, 2011. Effect of organic and inorganic sources of fertilizer on growth, yield and fruit quality of eggplant (*Solanum Melongena* L). Archives of Applied. Sci. Res., 3(6): 470-479.
9. Fouda, K.F. and A.S. Abd-Elhamied, 2017. Influence of mineral fertilization rate and foliar application of yeast and ascorbic acid on yield, vegetative growth and fruits quality of eggplant. J.Soil Sci. and Agric. Eng., Mansoura Univ., 8 (11): 643-648.
10. Keliikuli, A., K. Smith, Y. Li and C.N. Lee, 2019. Natural Farming: The Development of Indigenous Microorganisms Using Korean Natural Farming Methods. Korean Natural Farming: Development of Indigenous Microoganisms, SA-19(2).
11. Higa, T., 2000. What is EM technology? EM world J., 1: 1-6.
12. Higa, T., 2004. Effective micro-organisms - a new dimension for nature farming. In: Parr J.F., Hornick S.B., Simpson M.E. (Eds) Proceedings of the 2nd International Nature Farming Conf., USDA, Washington DC, USA, pp: 20-22.
13. Xiaohou, S., L. Diyou, Z. Liang, W. Hu and W. Hui, 2001. Use of EM-technology in agriculture and environmental management in China. Nat. Farm Environ., 2: 9-18.
14. Javaid, A., 2010. Beneficial microorganisms for sustainable agriculture. Sustain. Agric. Rev., 4: 347-369.
15. EL-Zeiny, O.A.H., 2007. Tomato (*Solanum Lycopersicon*) growth and productivity as influenced by the application of effective microorganisms (EM). Egypt. J. Appl. Sci., 22(12A): 229-240.
16. Daiss, N., M.G. Lobo, A.R. Socorro, U. Bruckner, J. Heller and M. Gonzalez, 2008. The effect of three organic pre-harvest treatments on Swiss chard (*Beta vulgaris* L. var. Cycla L.) quality. Eur. Food Res. Technol., 226: 345-353.
17. Chantal, K., S. Xiaohou, W. Weimu and T.I.O. Basil, 2010. Effects of effective microorganisms on yield and quality of vegetable cabbage comparatively to nitrogen and phosphorus fertilizers. Pak. J. Nutr., 9: 1039-1042.
18. Javaid, A. and R. Bajwa, 2011. Field evaluation of effective microorganisms (EM) application for growth, nodulation and nutrition of mung bean. Turk. J. Agric. For., 35: 443-452.
19. Ndona, R.K., J.K. Friedel, A. Spornberger, T. Rinnofner and K. Jezik, 2011. Effective microorganisms (EM): an effective plant strengthening agent for tomatoes in protected cultivation. Biol. Agric. Hort., 27: 189-204.
20. Olle, M. and I.H. Williams, 2013. Effective microorganisms and their influence on vegetable production - a review. The J. Hort. Sci. Biotech., 88(4): 380-386.
21. Bajehbaj, A.A., 2010. The effects of NaCl priming on salt tolerance in sunflower germination and seedling grown under salinity conditions. African Journal of Biotechnology, 9: 1764-1770.
22. Chen, K. and R. Arora, 2011. Dynamics of the antioxidant system during seed osmopriming, post priming germination and seedling establishment in spinach (*Spinacia oleracea*). Plant Sci., 180(2): 212-220.
23. Adebisi, M.A., T.O. Kehinde, M.A. Abdul-Rafiu, O.A. Esuruoso, O.D. Oni and O. Ativie, 2013. Seed physiological quality of three Capsicum species as affected by seed density and hydropriming treatment durations. Journal of Agronomy, 12: 38-45.
24. Chavan, N.G., G.B. Bhujbal and M.R. Manjare, 2014. Effect of Seed Priming on Field Performance and Seed Yield of Soybean [*Glycine max* (L.) Merill]Varieties. The Bioscan, 9(1): 111-114.
25. Gonzales, L.M.R., 2015. Germination response of eggplant (*Solanum melongena* L.) seeds to different vinegar concentration as seed priming agents. International J. Sci. and Res., 5(53): 2250-3153.

26. Neto, F.J.D., S.J. Dalanhol, M. Machry, A.P. Junior, J.D. Rodrigues and E.O. Ono, 2017. Effects of plant growth regulators on eggplant seed germination and seedling growth. Australian J. Sci., 11(10): 1277-1282.
27. Bayan, U.A.I., M.S. Gaafar and H.E.E. Sallam, 2018. Effect of licorice plant and gibberllic acid on seedling and pepper fruit yield under sandy soil conditions with drip irrigation. Egypt. J. Appl. Sci., 33(11): 433-454.
28. Mal, D., J. Verma, A. Levan, M.R. Reddy, A.V. Avinash and P. K. Velaga, 2019. Seed Priming in Vegetable Crops: A Review. Int. J. Curr. Microbiol. App. Sci., 8(6): 868-874.
29. Buenaventura, C.V. and M.P. Bulong, 2011. Community Based Participatory Action Research on Organic Vegetables Production Project (Annual Report Vegetable Farming-Bureau of Agricultural Research. Downloaded on January 21, 2014 at (http://www.bar.gov.ph/vegetablefarming). International J. Advanced Res., 5(9): 25-30.
30. Miller, S.A., D.M. Ikeda, E.W. Weinert, K.C.S. Chang, J.M. Mc Ginn, C. Keliihoomalu and M.W. Du Ponte, 2013. Natural Farming: Fermented Plant Juice. College of Tropical Agriculture and Human Resources. University of Hawaii at Manoa, Sustainable Agriculture 2013 S-7. Download on Feb.5, 2014 at (http://www.ctahr.hawaii.edu/oc/ freepubs/ pdf/SA-7.pdf).
31. Apzani, W., A.W. Wardhana, I.M. Sunantra and A. Z. Baharuddin, 2017. Effectiveness of Liquid Organic Fertilizer of Hyacinth (*Eichhornia crassipes*) Fermented by *Trichoderma* spp. for Growth of Lettuce (*Lactuca sativa* L.). International Journal of Agronomy and Agricultural Res., 11(6): 23-31.
32. Apzani, W. and A.W. Wardhana, 2018. The effect of hyacinth (*Eichhornia crassipes*) liquid organic fertilizer fermented by Trichoderma sp. to the growth of onion (*Allium ascalonicum* L.). International Journal of Agronomy and Agricultural Res., 13(4): 37-50.
33. A.O.A.C., 1990. Official Methods of Analysis of Association of Official Agricultural Chemists, 15th pp: 1045-1106.
34. Wallace, D.H. and H.M. Munger, 1965. Studies of the physiological basis for yield differences.1.growth and analysis of six dry bean varieties. Crop Sci., 5: 343-348.
35. Scott, S.J., R.A. Jones and W.A. William, 1984. Review of data analysis method of seed germination, Crop. Sci., 24: 1192-1199.
36. Association of Official Seed Analysis (AOSA), 1983. Seed Vigor Testing Handbook. Contribution No. 32 to the handbook on Seed Testing.
37. Peyman, A.M. and A. Yousef, 2014. Evaluation of important germination traits of soybean genotypes through factor analysis in osmotic drought stress conditions. Bulletin of Environment. Pharmacology and Life Sciences, 3(5): 5-8.
38. Cho, H.K. and J.Y. Cho, 2010. Natural Farming. Han-Kyu Cho. CGNF. Seoul, South Korea.
39. Olsen, S.R. and L.E. Sommers, 1982. Phosphorus. In: Page, A.L.; R.H. Miller and D.R. Keeney (Eds). Methods of soil analysis. Part 2 Amer. Soc. Agron. Madison, W. I. USA, pp: 403-430.
40. Jackson, M.L., 1967. Soil chemical analysis. Prentic-Hall, India, Private Limited, New Delhi.
41. Shahidi, F. and M. Naczk, 1995. Methods of analysis and quantification of phenolic compounds. In: "Food Phenolic: Sources, Chemistry, Effects and Applications". Technomic Publishind Company, Inc: Lancaster, pp: 287.
42. Snedercor, G. W. and W. G. Cochran, 1980. Statistical Methods, 7th Ed., The Iowa state Univ., Press, Ames, Iowa, U S A, pp: 325-330.