Influence of Effective Microorganisms on Growth and Fruit Characteristics of Papaya in Egypt

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***Abstract**: The study was conducted at the EM experimental plot "Groppir Fern" to investigate the effect, rate and application method of EM1 as plant and soil weekly application (EMPS) and EM compost as monthly application (EMC) on growth, yield and fruit quality of papaya plants in Egypt. Papaya plants were planted eight months before starting the experiment in clay loamy soil. Monthly measurements were collected concerning plant vegetative growth, fruit flesh, total soluble solids (TSS) and acidity in pulp juice.*

The EM1 results showed that the plants became more vigorous. No significant differences were found when using the higher tested rate of chemical fertilizers (TRCF) (27.7 cm, 4.1 cm) for height and girth respectively, together with reducing the (TRCF) to 50% and the (EMC) was doubled (28.8 cm 4.7 cm). While using EM1 only, comparable results (20.9 cm, 4.5 cm) were obtained. A similar trend was also obtained concerning the number of fruits per plant. An increase in yield per plant was also observed when using EM1 plus (TRCF) (95.5 kg/plant), or when reducing the (TRCF) to 50%, and the (EMC) was doubled (97.52 kg/: plant). While using EM1 (EMPS + EMC) only 87.9 kg/ plant) was obtained which was significant within the same rank.

Generally, EM resulted in an improvement in fruit quality. The higher total soluble solids and acid content in fruits was obtained when the plants received the EM1 alone without any chemical fertilizers (14,5%, 0.221%) respectively for TSS and acidity, on the other hand, using (TRCF) without EM gave significantly lower TSS, acidity values (11,25%, 0.151%).

More extended studies are now conducted to validate the effect of EM1 on the papaya plants and the soil physical, chemical and biological properties. But out preliminary study showed that commercial organic papaya production using EM1 could be possible.

Introduction

The influence of Effective Microorganisms (EM1) on increasing crop yield is widely reported. Many growers in Egypt have become interested in EM technology as a means of restoring soil productivity. There is increasing evidence that EM1 can increase the microbial balance, diversity of agricultural soils, plus improving soil and yield quality, and magnifying the growth of crops (Higa and Wididana, 1991; Pairintra and Pakdee, 1994).

EM1 solution, which contains naturally effective microorganisms is capable of enhancing the value of organic mater by accelerating its decomposition and releasing greater quantities of nutrients for crop utilization (Higa and Wididana, 1991;

Sangakkara and Higa, 1992; Wood et al. 1997). Chemical fertilizers have some inhibitory influence on the Effective Microorganisms (Sprent and Sprent, 1990). However it is difficult to draw valid conclusions about changes in soil properties as a result of EM1 because of the slow release of nutrients from EM1 fermentations activity which is not harmful to the plant and is conceptually different from oxidation decomposition effect (Higa, 1989). There are many reports indicating that EM1 increase crop yield (Arakawa 1991; Chowdhury et al. 1994) and others. Thus, the purpose of this experiment was to study the effect, dose and application method of EM1 and EM compost on the growth, yield and fruit quality of papaya in Egypt.

Materials and Methods

The study was conducted in the EM experimental plot "Groppi Farm" in Giza governorate to investigate the effect, rate and application method of EM1, and EM compost in combination with the tested rate of chemical fertilizers on the growth, yield and fruit quality of papaya CV "Solo" which was planted eight months before starting the experiment in clay loamy soil, and subjected to the same horticultural practices. The treatments adapted over the entire experimental period were as follows;

T1 : (EMPS)* + 100 gr./plant (EMC)** + the higher (TRCF).***
T2 : (EMPS) + 200 gr./plant (EMC) + 50 % (TRCF).
T3 : EM1 only (EMPS + 400 gr./plant EMC) + Zero (TRCP).
T4 : Zero EM1 + (TRCF).
Control : (ZERO) treatment.

* EMPS : EM1 as plant and soil weekly application (the rate of EMS applied was equivalent to one litre per feddan. The microbial solution (EM1) was also sprayed onto the leaves of the plants at a dilution rate of 1 : 1000).
** EMC : EM compost as monthly application
*** TRCF : tested rate of chemical fertilizers.

I. The following measurements were carried out at monthly intervals : 1 – Plant height : Average plant height was recorded in cm, 2- Stem girth : Average stem girth was measured 20 cm. above ground. 3 – Leaf number was counted. 4 – Leaf area : was estimated using leaf dry weights by using equation : "Y = 267.10X"; where Y is the leaf area cm^2 and x is the leaf dry weight gr. (Alyelaagbe and Faxusi 1998): The seven leaves from the apical growing point was used to determine the leaf area cm.

II. Chemical constituents of fruit at harvest : 1 – Percentage of total soluble solids (TSS percent) in papaya pulp was estimated by hand refractometer. Fruit pulp was homogenized in electric blender for two minutes. 2 – Acidity percent was determined in pulp junice by NaO H titration according to A, O, A, C, (1995). 3 – TSS percent/acidity percent was calculated.

III Data were statistically analyzed as complete randomized blocks in factorial.

Results

Results in Table 1 show that papaya plants become more vigorous when treated with EM1 "(EMPS) plus (EMC)". No significant differences were found between the following two treatments : first, using (EMPS), (EMC) plus the higher (TRCF)… "T1" (27.7 cm., 4.1 cm.), (26.04 cm. 5.88cm) for the rate of increase in height and girth respectively during the first and second seasons. Second, reducing the (TRCF)

to 50 percent and doubling (EMC) to reach 200 gr./plant… "T2" (28.8 cm., 4.7 cm,), (26.72 cm., 6.52 cm.) while using EM1 only without chemical fertilizers, with doubling the (EMC) to reach 400 gr./plant gave comparable results…"T3".

A similar tend was observed concerning rate of increase in plant leaf number and plant leaf area (cm^2) which in turn increase plant photosynthesis rate and maintains healthy plants.

Data presented in Table 2 show that the addition of EM1 results in significant increase in number of fruits and yield per plant, upon applying "T1" treatment (107.7 fruit/plant, 95.51 kg/plant), (97.3 fruit/plant, 92.18 kg/plant) for number of fruit and yield respectively during the first and second seasons, or upon applying "T2" treatment (107.3 fruits/plant, 97.52 kg/plant), (101.1 fruit/plant, 91.64 kg/plant) for the number of fruits and yield respectively during the first and second seasons. Whereas, applying "T3" treatment, the number of fruits and yield per tree were significantly within the same rank.

There are many reports indicating that EM1 increases plant grwoth and yield (Higa 1989; Higa and Wididana 1991; Pairintra and Pakdee, 1094) and others.

Table 1. The Influence of Different EM1 Treatment on the Monthly Mean Rates of Increase of Papaya Vegetative Growth per plant.

	Season (1998/1999)				Season (1999/2000)			
Treatments	**Height (cm)**	**Girth (cm)**	**Leaf number**	**Leaf area (cm^2)**	**Height (cm)**	**Girth (cm)**	**Leaf number**	**Leaf area (cm^2)**
T1	27.70^{a}	4.10^{a}	9.17^{a}	97.8^{b}	26.04^{ab}	5.88^{a}	6.80^{a}	102.27^{b}
T2	28.80^{a}	4.73^{a}	9.27^{a}	100.67^{a}	26.72^{b}	6.52^{a}	6.88^{a}	107.87^{a}
T3	20.90^{b}	4.50^{a}	7.90^{a}	93.73^{c}	24.44^{c}	5.64^{a}	5.52^{b}	99.07^{bc}
T4	21.37^{b}	4.50^{a}	7.33^{b}	93.93^{c}	24.84^{bc}	5.72^{a}	5.0^{c}	97.27^{c}
Control	18.17^{c}	2.33^{b}	4.80^{c}	74.4^{d}	16.96^{d}	3.56^{b}	2.92^{d}	76.93^{d}
LSD5%	2.656	0.660	1.060	2.853	1.499	0.509	0.468	3.635

Table 2. The Influence of Different EM1 Treatment Means on the Papaya Fruit Number/plant, yield kg./plant, fruit TSS%, fruit acidity %, TSS/ acidity

	Season (1998/1999)					Season (1999/2000)				
Treat ments	**Fruit No./plant**	**Yield kg/plant**	**Fruit TSS %**	**Fruit acidity %**	**TSS /acidity**	**Fruit No./plant**	**Yield kg/plant**	**Fruit TSS %**	**Fruit acidity %**	**TSS /acidity**
T_1	107.70^{a}	95.51^{a}	12.25^{b}	0.1795^{b}	68.28	97.30^{b}	92.18^{a}	12.70^{b}	0.1850^{c}	68.82^{bc}
T_2	107.30^{a}	97.52^{a}	14.00^{a}	0.1992^{b}	70.26	101.10^{a}	91.64^{a}	14.43^{a}	0.2040^{b}	70.91^{b}
T_3	95.14^{ab}	87.88^{a}	14.50^{a}	0.2211^{a}	65.73	94.94^{b}	90.14^{a}	14.67^{a}	0.2260^{a}	64.82^{c}
T_4	84.29^{b}	69.66^{b}	11.25^{bc}	0.1511^{c}	74.59	85.86^{c}	65.58^{b}	11.73^{c}	0.1490^{d}	78.76^{a}
Control	48.00^{c}	26.76^{c}	10.00^{c}	0.1240^{d}	80.90	53.60^{d}	27.86^{c}	9.90^{d}	0.1230^{c}	80.18^{a}
LSD5%	15.386	9.724	1.2853	0.0205	NS	9.985	8.399	0.2622	0.0112	8.528

T_1 : (EMPS) + 100 gr./plant (EMC) + (TRCF)
T_2 : (EMPS)+ 200 gr./plant (EMC) +50%(TRCF)
T_3 : (EMPS) + 400 gr./plant (EMC) +Zero(TRCF)
T_4 : Zero (EM1)+(TRCF)
Control : Zero (Treatment)

Results in Table 2 show that generally, EM1 improved fruit quality significantly through increasing flesh TSS percent and acidity percent. The higher flesh total soluble solids and acid content was obtained when the plants received "T3" treatement, (14.5 percent, 0.221 percent), (14.67 percent, 0.2261 percent) for TSS percent and, acidity percent respectively during the first and second seasons. On the other hand, using (TRCF) only without EM1 gave significantly lower TSS and acidity. While the control (Zero treatment) gave significantly poorly fruit quality.

In this respect, Wood et al., 1997 showed that the beneficial microorganisms contained EM1 produce plant hormones, beneficial bioactive substances, and antioxidants which solubilizing nutrients.

Our results revealed that EM1 improved fruit quality, as reported before by Higa and Wididana 1991; Pairtntra and Pakdee, 1994 and others.

However, a notable decrease was observed on plant growth and fruit quality when the plants received the higher (TRCF) plus EM1. "T1". This may be in part due to the inhibitory effect of the chemical fertilizers on the affective microorganisms as mentioned before by Sprent and Sprent, 1990.

Conclusion

These results indicate that some form of soil treatment should be used. Plants grow poorly in the control (zero) treatment. The best amendments was "T2" (EMPS, 200 gr./plant EMC plus 50 percent TRCF) which provided improved growth and yield while using "T3" (EMPS plus 400 gr./plant EMC) gave comparable results, and improved fruit quality to surpass all the other treatments. More extended studies are being conducted to validate the influence of EM1 used in combination with or without chemical fertilizers. However, these results show that commercial organic papaya production could be possible.

References

Alyelaagba, I. O. O. and M. O. A. Fawusi (1988). Estimation of the area of detached or intact leave of papaya. Indian Journal of Agriculture Sciences. 58 (4) : 322.

Arakawa, Y. 1991. Kyusei Nature Farming in Japan p 20-23. In J.F. Parr, S.B. Hornick and C.E. Whitman (ed.) Proceedings of the First International conference on Kyusei Nature Farming. U.S. Department of Agriculture, Washington D.C., USA.

Association of Official Agricultural Chemists (1975). Official Methods of Analysis A.P.A.C. 12th Ed. Published by A,O. A,C, Washington, D.C., USA.

Chowdhury, A. R. 1991. Nature Farming and vegetable production in Bangladesh. p 59-63, In J.F. Parr, S.B. Hornick and C.E. Whitman (ed.) Proceedings of the first International Conference on Kyusei Nature Farming U.S. Department of Agriculture, Washington D.C., USA.

Higa, T. 1989. Studies on the application of microorganisms in nature farming11. The practical application of effective microorganisms. Presented at the 7th IFOAM Conference, Quagadougou, Bukina Faso, West Africa.

Higa, T. and G. N. Wididana. 1991. Changes in soil microflora induced by effective microorganisms. p. 153 – 163. In J.F. Parr, S.B. Hornick and E.C. Whitman (ed.) Proceedings of the first International Conference on Kuysei nature Farming, United States Department of Agriculture, Washington D.C. USA.

Pairintra, C. and P. Pakdee. 1994. Population dynamics of effective microorganisms under saline soil conditions in Thailand. P.164 – 170. In J.F. Parr, S.B. Hornic and M.E. Simpos (ed.) Proceedings of Second International conference on Kyusei Nature Farming, U.S. department of Agriculture, Washington D.C., USA.

Sangakkara, U. R. and T. Higa. 1992. Effective microorganisms for organic agriculture : case study from Sri Lanka p. 152 – 159, In Kopke and U. Scutz (ed.) Proceedings of the 9th IFOAM Conference, Tholey – Theley, Germany.

Sprent, J. I. and P. Sprent, 1990. Nitrogen Fixing Organisms : Pure and Applied Aspects. Chapman Hall, England.

Wood, M. T., R. Miles and P. Tabora. EM Fermented Plant Extract and EM5 for controlling pickleworm (*Diaphania nitidalis*) in organic cucumber. School of Natural Resources, University of Missouri, USA and EARTH College, Limon, Costa Rica.