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EVALUATION OF MICROORGANISM FOR THE GROWTH AND PERFORMANCE OF BITTERGOURD

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Abstract: In the coming decades it will be a significant challenge to feed all of the world's growing population and the world needs to begin to greatly increase agricultural productivity, and to do so in a sustainable and environmentally friendly manner. That is, as a consequence of both increasing population and industrialization, the earth's atmospheric, terrestrial and aquatic systems are no longer sufficient to absorb and break down the increasing amount of waste that we produce. As a result, the environment is increasingly contaminated with a range of toxic metals and organic compounds. It is necessary to re-examine many of the existing approaches to agriculture that includes the use of chemical fertilizers, herbicides, fungicides, and insecticides. Instead, sustainable agriculture will likely make much greater use of Effective Micro-organisms (EM) and plant growth-promoting bacteria or PGPB that are claimed to enhance microbial turnover in soil and thus increase soil macronutrients and increases plant growth and yield. In the present study the EM formulations, PGPR and *Psuedomonas* were evaluated for improving the productivity of bitter gourd which is a highly priced vegetable in Kerala market that needs large quantity of chemicals consequently lead to the pollution of soil and aquatic systems. Different EM formulations viz., Fish amino acid, Egg albumin, Panchagavya, and diluted cow's urine; *Psuedomonas fluorescence* and PGPR Mix I were applied to the bitter gourd during its cultivation. These formulations were applied at the time of seed germination and flowering. Observations on the vegetative growth of the plant, incidence of pest and disease, days to flower and yield of the crop were recorded. It was observed that the EM solution Panchagavya and the PGPR Mix I produce very good vegetative growth of the plant. The technology of Effective Microorganisms was developed during the 1970's at the University of Ryukyus, Okinawa, Japan. Studies have shown that EM may have a number of applications, including agriculture, livestock, gardening and landscaping, composting, bioremediation, cleaning septic tanks, algal control and household uses. The practical application was developed by Professor Teuro Higa. He has found microbes that can coexist in mixed cultures and are physiologically compatible with one another. In the present study early flowering was noticed in plants treated with EM formulation fish amino acid and PGPR Mix I. The disease incidence and pest infestation are also very less in the above treatments. Yield was found to be higher in treatment with Panchagavya and PGPR Mix I. Saharan & Nehra (2011), in his review article commended that inoculation of ornamentals, forest trees, vegetables, and agricultural crops with PGPR may result in multiple effects on early-season plant growth, as seen in the enhancement of seedling germination, stand health, plant vigor, plant height, shoot weight, nutrient content of shoot tissues, early bloom, chlorophyll content, and increased nodulation in legumes. PGPR are reported to influence the growth, yield, and nutrient uptake by an array of mechanisms. Inoculation of crop plants with certain strains of PGPR and EM formulations at an early stage of development improves biomass production through direct effects on root and shoots growth. A microbial inoculant containing many kinds of naturally occurring beneficial microbes called 'Effective Microorganisms' has been used widely in nature and organic farming. When these cultures are introduced into the natural environment, their individual beneficial effects are greatly magnified in a synergistic fashion. Hence the introduction of the ecofriendly growth promoters in the form of EM or PGPR could minimize the ill effects on soil health largely and can thus safeguard our environment from pollution.

Key words: Effective microorganisms, Plant growth promoting bacteria, Bitter gourd, Panchagavya, PGPR

INTRODUCTION

In the coming decades it will be a significant challenge to feed all of the world's growing population and the world needs to begin to greatly increase agricultural productivity, and to do so in a sustainable and environmentally friendly manner. That is, as a consequence of both increasing population and industrialization, the earth's atmospheric, terrestrial and aquatic systems are no longer sufficient to absorb and break down the

increasing amount of waste that we produce. As a result, the environment is increasingly contaminated with a range of toxic metals and organic compounds. It is necessary to reexamine many of the existing approaches to agriculture that includes the use of chemical fertilizers, herbicides, fungicides, and insecticides. Instead, sustainable agriculture will likely make much greater use of Effective Micro-organisms (EM) and plant growth-promoting bacteria or PGPB that are claimed to enhance microbial turnover in soil and thus increase soil macronutrients and increases plant growth and yield. Since microorganisms are useful in eliminating problems associated with the use of chemical fertilizers and pesticides, they are now widely applied in nature farming and organic agriculture (Higa, 1991; Parr *et al*., 1994).

Effective Micro-organisms were first developed by Professor Teruo Higa of the Ryukus University in Okinawa, Japan, during many years of investigation and study which were completed in 1982. This is a combination of various micro-organisms normally found in food or which are used in food production. EM is made up from three main kinds of bacteria – Phototrophic bacteria, yeast bacteria and lactic acid bacteria. When the effective combination of these micro-organisms makes contact with organic materials, they secrete beneficial substances like vitamins, organic acids, minerals and anti-oxidants. When applied to the earth, they transform the micro-flora and the macro-flora, improving the natural equilibrium in such a way that the bacteria which previously caused problems are converted into bacteria which help to restore the natural health of the soil. All this helps to improve plant growth and serves as an excellent tool when used together with sustainable organic agriculture techniques.

MATERIALS AND METHODS

In the present study the EM formulations, PGPR Mix I and *Psuedomonas* were evaluated for improving the productivity of bitter gourd which is a highly priced vegetable in Kerala market that needs large quantity of chemicals consequently lead to the pollution of soil and aquatic systems.

With a view to test the efficacy of micro organisms in bittergourd plant, a field trial was conducted during October 2012 to February 2013 at farmer's field near Farming Systems Research Station, Kottarakkara, Kerala Agricultural University on Priyanka variety. Seven treatments were tested in Randomised Block design with three replications.

	Treatments
T1	cow's urine (10 times dilution)
T2	Biocontrol agent *Psuedomonas* sp. (20g/l)
T3	Egg albumin
T4	Panchagavya
T5	Biofertilizer PGPR Mix I. (1 kg in 100 kg dried cowdung)
T6	Fish amino acid
T7	Untreated control

The crop was sown with a spacing of 2 m x 2m. The crop is maintained as per KAU 2010. Five plants were randomly selected from each net plot and tagged. Observations on the vegetative growth of the plant, incidence of pest and disease, days to flower and yield of the crop were recorded for each tagged plants. These formulations were applied at the time of seed germination and flowering..

Preparation egg albumin

Egg	-	10
Lemon juice		
Jaggery	-	250 g

Keep the egg immersed in lemon juice of 15 – 20 number of lime for 10 days. Add liquefied Jaggery and mix the contents. Keep air tight for another 10 days. This formulation is applied one week after germination and at flowering stage at a dilution of 1 ml formulation in 10 l of water.

Preparation of fish amino acid

Fish	-	1 kg
Jaggery	-	1kg

Mix the items and keep for 4 weeks in an air tight container. Stir well and strain through a nice cloth. This can be used at a dilution of 3 ml in 1 litre water.

Preparation of Panchagavyam

Cowdung	-	5 kg
Cow's urine	-	5 litre
Milk	-	3 litre
Curd	-	3 litre
Ghee	-	1 kg
Water	-	10 litre

Mix cowdung and ghee. Add cow's urine to the mix. Then add milk and curd. Keep the mixture in an air tight container for 15 days. Stir every day. We can mix jaggery, tender coconut water and small plantain fruit and keep for another 30 days in order to increase the effeciency. 3 ml of Panchagaryam can be mixed with one litre of water and spray in the evening.

RESULTS AND DISCUSSION

The technology of Effective Microorganisms was developed during the 1970's at the University of Ryukyus, Okinawa, Japan. The practical application was developed by Professor Teuro Higa. He has found microbes that can coexist in mixed cultures and are physiologically compatible with one another. Studies have shown that EM may have a number of applications, including agriculture, livestock, gardening and landscaping, composting, bioremediation, cleaning septic tanks, algal control and household uses (Karthick *et al*., 2011).

In the present study it was observed that the EM solution Panchagavya, PGPR Mix I and the application of diluted cow's urine produce very good vegetative growth of the plant(Table 1). When compared to control Psuedomonas and Fish amino acid also show good biomass. Cold – tolerant Psuedomonas fluorescence isolated from Garwal Himalayas act as potential plant growth promoting and bio control agent in pea (Negi *et al*., 2005). Psuedomonas fluorescence MSP – 393, a plant growth promoting rhizobacterium is an efficient biocontrol agent in rice grown in saline soils of coastal ecosystems(Paul *et al*., 2006). The presence of *Psuedomonas fluorescence* inoculants in the combination of microbial fertilizer plays an important role in stimulating yield and growth traits of chickpea (Rokhzadi *et al*., 2008).

In the present study early flowering was noticed in plants treated with EM formulation fish amino acid and PGPR Mix I. Saharan and Nehra (2011), in his review article commended that

Table 1. Vegetative growth, flowering and yield of bittergourd

Treatments	Vegetative growth	Days to flower (average) (days)	Yield (kg)
T1	++++	57.33	51.25
T2	+++	54.33	50.67
T3	++	56.33	46.98
T4	++++	56.00	60.50
T5	++++	47.67	57.42
T6	+++	47.33	52.67
T7	++	65.67	46.73
MSE		6.92	0.8495
C D		3.827	1.340

++ Moderate; +++ Good; ++++ Very good

Table 2. Pest and Disease incidence

Treatments	**Disease incidence**	**Pest occurrence**
T1	--	Fruit fly
T2	Slight mosaic	Fruit fly
T3	Slight incidence of downy mildew	Light incidence of White fly
T4	--	-
T5	Slight incidence of downy mildew	Fruit fly, epilachna beetle & White fly
T6	Slight incidence of downy mildew & mosaic	--
T7	Downy mildew & mosaic	Fruit fly, Jassids & White fly

Table 3. Fresh fruit yield per harvest

Treatments	Yield per harvest (kg)									TOTAL
	Ist	IInd	IIIrd	IVth	Vth	VIth	VIIth	VIIIth	IXth	
T1	3.08	3.17	7.42	6.42	7.08	7.33	6.67	6.33	3.75	51.25
T2	4.08	5	5.92	7.17	6.25	7.17	6.83	5.1708	3.	50.67
T3	3.25	4.1	6.0	5.75	6.83	7.17	6.5	5.08	2.3	46.98
T4	3.17	4.17	6.83	6.92	8.33	9.25	8.67	8.17	5.00	60.5
T5	4.33	4.42	6.08	5.42	8.58	8.67	9.08	6.92	3.92	57.42
T6	4.67	4.83	6.08	6.00	7.08	7.42	7.17	6.08	3.33	52.67
T7	2.33	4.23	4.92	7.08	6.33	7.92	6.67	4.17	3.08	46.73

inoculation of ornamentals, forest trees, vegetables, and agricultural crops with PGPR may result in multiple effects on early-season plant growth, as seen in the enhancement of seedling germination, stand health, plant vigor, plant height, shoot weight, nutrient content of shoot tissues, early bloom, chlorophyll content, and increased nodulation in legumes.

The disease incidence and pest infestation are also very less in all the treatments when compared to control (Table 2). Plants treated with Panchagavya and diluted cow's urine were free from viral disease also. Fusarium, which is one of the main putrefactive, fungal pathogens in soilis found to be managed by inoculating the soil with beneficial, antagonistic, antibiotic-producing microorganisms such as actinomycetes and certain fungi (Higa and Wididana, 1991). Fish amino acid and Panchagavya are also found to be efficient in the management of pests affecting the crop.

Yield was found to be higher in treatment with Panchagavya (60.50) followed by the application of PGPR Mix I (57.42) (Table 1). PGPR are reported to influence the growth, yield, and nutrient uptake by an array of mechanisms. The bacteria isolated from composts which included farm waste compost, rice straw compost, Gliricidia vermi compost and macrofauna associated with compost show the synergistic effect on the growth of pearl millet (Hameeda *et al*., 2006). The use of PGPR with P- enriched compost in an integrated manner improves the growth, yield and nodulation in chickpea (Shahzad *et al*., 2008). From Table 3 and Fig. 1 it

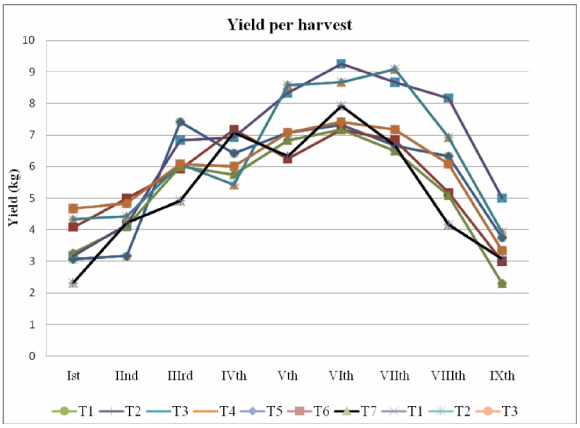

Fig 1. Fresh fruit yield per harvest

	Treatments
T1	cow's urine(10 times dilution)
T2	Biocontrol agent *Psuedomonas* sp. (20g/l)
T3	Egg albumin
T4	Panchagavya
T5	Biofertilizer PGPR Mix I. (1 kg in 100 kg dried cowdung)
T6	Fish amino acid
T7	Untreated control

is clear that eventhough the flowering start late in the case of Panchagavya (T4) and the yield was found to be greater and plant was still in the fruiting stage even in the last harvest recorded.

CONCLUSIONS

Inoculation of crop plants with certain strains of PGPR and EM formulations at an early stage of development improves biomass production through direct effects on root and shoots

introduced that are physiologically and ecologically compatible with one another. When these mixed cultures become established their individual beneficial effects are often magnified in a synergistic manner. A soil can be transformed into a soil with disease-suppressive potential if mixed cultures of effective microorganisms with the ability to transmit these properties are applied to that soil. Once the "new" microflora is established and stabilized, the desired effects will continue indefinitely and no further applications are necessary unless organic amendments cease to be applied, or the soil is subjected to severe drought or flooding. Hence the introduction of the ecofriendly growth promoters in the form of EM or PGPR could minimize the ill effects on soil health largely and can thus safeguard our environment from pollution.

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