Indian Journal of Traditional Knowledge
Vol. 13 (2), April 2014, pp. 398-403

Validation of ancient liquid organics - *Panchagavya* and *Kunapajala* as plant growth promoters

S Sarkar*, SS Kundu & D Ghorai
Krishi Vigyan Kendra, CRIJAF, Burdwan, Bud Bud-713403, West Bengal

E-mail: subrata_hort@rediffmail.com

Received 03.05.13, revised 22.07.13

Vedic literatures (*Vrikshayurveda*) have clearly outlined a systematized agricultural practices that insisted on the use of *panchagavya* (a mixture of the five products of cow in a specific ratio) and *kunapajala* (decomposed product of fish or animals in liquid form) to enhance the biological efficiency of crop plants and the production of fruits and vegetables. In the present investigation seedlings of chili, tomato and cow pea were treated with *panchagavya* (T_1), *kunapajala* (T_2) and combination of both (T_3) along with control (plain water). *Panchagavya* and *kunapajala* (using the fish Bombay duck) were prepared as per *Vrikshayurveda* and used on seedlings as soil drenching at the rate of 3% and 1%, respectively. All the experimental seedlings of each crops recorded higher rates of linear growth of both shoots and roots in all the three treatments over the controls. Combination of both *panchagavya* and *Kunapajala* showed best results in influencing all the growth parameters as well as yield of the vegetables. Leaf chlorophyll content was also consistently higher by the application of two organics and that was ultimately reflected on enhanced fruit yield of the crops. Application of *panchagavya* in all the three vegetables significantly induced production of defense related enzymes such as Polyphenol oxidase that could have enhanced the induced systemic resistance in the plant body, which in turn would have reduced the disease incidence.

Keywords: *Panchagavya*, *Kunapajala*, Vegetable seedlings, Growth promoter, Induced resistance, Polyphenol oxidase

IPC Int. Cl.[8]: A01, A01C 15/00-A01C 23/00, C05G, C05F

The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable agriculture. Chemical agriculture has made an adverse impact on the healthcare of not only soil but also the beneficial soil microbial communities and the plants cultivated in these soils. This eventually has lead to a high demand for organic produce by the present day health conscious society and sporadic attempts are being made by farmers all over the world to detoxify the land by switching over to organic farming dispensing with chemical fertilizers and pesticides. In India, organic farming was a well developed and systematized agricultural practice during the past and this 'ancient wisdom' obtained through Indian knowledge systems such as *Vedas* specify the use of *panchagavya* and *kunapajala* in agriculture for improving soil and plants health and protective measure against plant diseases. In Sanskrit, *panchagavya* means the blend of five products obtained from cow, namely cow dung, cow urine, cow milk, curd and ghee[1]. Meaning of Sanskrit word *kunapa* is "smelling like a dead body, stinking". *Kunapajala* (*jala*- water) was prepared since the ancient time by fermentation of animal or fish remains. The *Vriskshayurveda* systematizes the use of *panchagavya* and *kunapajala* to enhance the biological efficiency of the crop plants and disease resistance capacity of plant body. In the past few decades, fish amino acid extracted from sea fish have been showed to exhibit many bioactivities that include bio-stimulant, fertilizer and antimicrobial properties. Different forms of fish emulsion have been experimented and all of them have been reported to produce beneficial effects on cereals, pulses and flowering plants. In this paper, we present the results of an investigation made to evaluate the growth promoting potential of *panchagavya* and *kunapajala* as well as their efficacy in inducing plant's defence mechanism using some vegetables as experimental plants

Methodology

The present investigation was carried out at Krish Vigyan Kendra (CRIJAF), Burdwan during *rabi*, 2011. Germinating seeds of three vegetables, viz.

*Corresponding author

chili, tomato and cow pea were sown in earthen pots filled with sterilized garden soil. Seedlings were treated with three treatments, viz. *panchagavya* (T_1), *kunapajala* (T_2) and combination of both (T_3) along with control (plain water) with 10 replications in CRD. *Panchagavya* and *kunapajala* were applied as soil drenching at the concentration of 3% and 1% respectively at 7 days intervals. All the growth parameters were recorded at 45 days old seedlings. Yield parameters viz. number of fruits per plant and fruit weight per plant were recorded as and when harvesting was done up to the end of the crop growth. The Polyphenol oxidase (PPO) activity of the leaf sample was estimated at two different stages of the crop growth i.e. 45 and 90 days after planting and their mean was presented.

Panchagavya preparation

Panchagavya was prepared following the procedures outlined by Selvaraj[2]. It contained fresh cow dung 7 kg, cow urine 10 L, cow milk 3 L, curd 2 L, ghee 1L, water 10 L, tender coconut water 3 L, Jaggery 3 kg and well ripened banana 12 number. Cow dung and ghee were mixed in an 80 L plastic container and stirred thoroughly both in morning and evening hours and kept aside for 3 days. After 3 days cow urine and water added to the mixture and kept for 15 days mixing twice every day. After 15 days the rest of the materials were added. The *panchagavya* was ready in 30 days after proper sieving through a fine cloth.

Kunapajala preparation

kunapajala was prepared following the procedures outlined by Nene[3]. It contained Bombay duck fish 10 kg, grind sesame oil cake 4 kg, rice husk 4 kg, molasses 4 kg and fresh cow urine 30 L. Bombay duck (*Harpadon nehereus*) was selected as it is cheap, devoid of scales and easy to decompose. These ingredients were taken in an 80 L plastic pot, mixed well and allowed to ferment aerobically in shade for 60 days with intermittent stirring. After 60 days, the preparation was sieved well with the help of a fine cloth.

Estimation of photosynthetic pigments

Pigments from leaves of the developing seedlings were extracted with 80% acetone and the amounts of chlorophyll a, chlorophyll b and total chlorophyll were determined as described by Sadasivam and Manickam[4].

$$\text{Chlorophyll a} = [12.7\ (A_{663}) - 2.69\ (A_{645})] \times V/(1000 \times W)$$

$$\text{Chlorophyll b} = [22.9\ (A_{645}) - 4.68\ (A_{663})] \times V/(1000 \times W)$$

$$\text{Total Chlorophyll} = [20.2\ (A_{645}) + 8.02\ (A_{663})] \times V/(1000 \times W)$$

Where,

A_{663} and A_{645} represent the optical density (OD) values at the respective wavelengths.

V- Final volume of the chlorophyll extract in 80% acetone.

W- Fresh weight of tissue extracted.

Estimation of Polyphenol oxidase (PPO)

The polyphenol oxidase (PPO) activity of the leaf sample was estimated by the method of Bray and Thrope[5] at two different stages of the crop growth 45 and 90 days after planting and their mean was expressed as unit^{-1} min^{-1} mg of protein^{-1}. The leaf sample of 0.5 gm was macerated with 10 ml of sodium phosphate buffer (0.1 M, *p*H 7.0) using a pestle and mortar. The extract was centrifuged at 10000 rpm at 4ºC for 20 minutes. The supernatant solution of 0.5 ml was taken in a test tube and 2 ml of sodium phosphate buffer (125 µmol, *p*H 6.8), 0.5 ml of pyrogallol solution (50 µmoles) was added and kept in water bath for 5 minutes at 25 to 30 ºC and 0.5 ml of H_2SO_4 was added. The Optical Density was recorded at 420 nm against blank.

Results and discussion

To study the effect of *panchgavya* and *kunapajala* on seedlings of tomato, chili and cow pea different growth and yield parameters were estimated. Induced defence mechanism acquired by the crops due to application of liquid organics was quantified in terms of poly phenol oxidase content in plants.

Effect on the linear growth of vegetable seedlings

Both *panchagavya* and *kunapajala* increased the linear growth of both shoot and root systems in all the vegetable seedlings compared to respective controls (Figs. 1 & 2). Enhancement in the growth of root and shoot systems in the experimental crops was more pronounced in seedlings grown in soil drenched with combination of *panchagavya* + *kunapajala* (T_3) rather than with *panchagavya* or *kunapajala* alone. Shoots

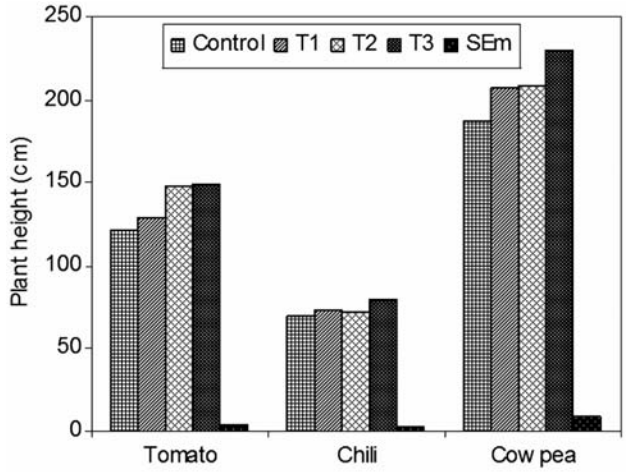

Fig. 1—Effect of liquid organics on plant height of vegetable seedlings

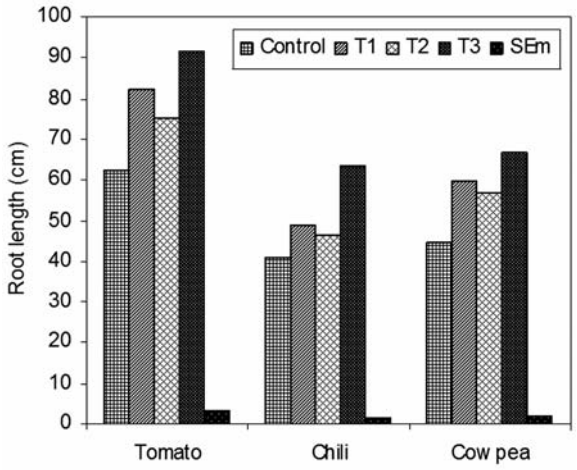

Fig. 2—Effect of liquid organics on root length of vegetable seedlings

of the tomato seedlings grown with combination of *panchagavya* + *kunapajala* exhibited 23.21% more growth than that of the control plants. In chili, the percent increase in the linear growth of shoots over control plants with different treatments was relatively low in the range of only 5 – 15% as compared to cow pea, in which it was 10 – 23%. Linear growth of root in the experimental plants too exhibited a similar response to treatment with combination product (Fig. 2). In T_3, about 50% increase in the linear growth of root could be observed in all the three vegetables as compared to controls. *Panchagavya* (T_1) and *kunapajala* (T_2) individually also showed a significant positive response over the control. Nevertheless, the effect of *panchagavya* + *kunapajala* was more than that observed for treatment with other two. A similar finding was observed in pulses and rice seedlings treated with *panchagavya* and sea weed amended *panchagavya*[6].

Effect on plant growth parameters of vegetable seedlings

Three characters, viz. branch number, node number and stem diameter play an important role in plant canopy formation. Vegetable seedlings treated with each of the treatments reflected better performance for all the characters than their respective controls. But not a single treatment showed a constant superiority over others. There was 50 to 380% increase in branch number over control in different treatments. All the three treatments indicated a significantly positive response but in different vegetables. Cow pea showed a highest response followed by tomato. Muthuvel[7] reported a higher plant height and number of branches plant $^{-1}$ with the application of *panchagavya* and moringa leaf extract. A similar trend was followed for the character stem diameter in which *panchagavya* + *kunapajala* increased the stem diameter about 80% in cow pea over control. Where as maximum significant and positive response was observed with the treatment of *panchgavya* in case of node number enhancement. It was as high as 67.24% in cow pea and 60.16% in chili.

The growth of leaves which is one of the determining criteria for photosynthesis activity of the plant was high in all the experimental seedlings for all the treatments as compared to control. In tomato, the lamina size was nearly 51.13% larger with *kunapajala* followed by *panchagavya* + *kunapajala* (39.95 %). Per cent increase over control in the leaf area of the seedlings of tomato, chili and cow pea grown in soil drenched with fish emulsion was 51%, 10% and 30%, respectively (Fig. 3). Open flowers and fruits already set were all together recorded as flower number in the experiment. Tomato recorded highest respond to all the three different treatments in enhancement of flower number in comparison to other two vegetables. Tomato flowering grown with *panchagavya* + *kunapajala* was observed to be twice of that recorded for its respective control. *Panchagavya* and *kunapajala* individually also produced a significantly higher number of flowers in all the three vegetables over their respective control.

Effect on the biomass production of vegetable seedlings

Characters plant weight and root weight are indicators of biomass accumulation by any plant. All

the vegetable seedlings showed a significantly better performance in biomass production against each of the treatment over control. Plant weight was increased as high as 106.63% in tomato treated with *kunapajala* (Fig. 4). Though, a constant superiority of a single treatment was lacking. In case of root weight of seedlings T_3 (*panchagavya* + *kunapajala*) recorded a clear superiority over the other treatments in all the three vegetables. It ranged from 62.20% in tomato to 59.63% in cow pea over their respective control. *Panchagavya* (T_2) ranked second in enhancement of root weight. Tomato, one of the heavy feeder among the three crops was most positively influenced by the liquid organics for both of these characters.

Effect on photosynthetic pigments

Panchagavya and *kunapajala* had a profound effect on the quantities of chlorophylls too in leaves of the experimental plants (Table 1). A low chlorophyll a/b ratio as compared to the control was recorded in the leaves of all the vegetables treated with *panchagavya* + *kunapajala* preparations. This combine application was more effective than the individual application of *panchagavya* or *kunapajala* irrespective of the different crops. *Panchagavya* + *kunapajala* effectively decreased chlorophyll a/b ratio without decreasing the levels of the individual pigments. The treatment increased the quantities of chlorophyll b in the leaves of the experimental plants resulting in a low chlorophyll a/b ratio indicating a better availability of leaf nitrogen and efficient photosynthetic activity[8]. Tender coconut water being used in *panchagavya* preparation contains kinetin which has a role in enhancing leaf chlorophyll content[9].

Effect on yield attributes of vegetables

Number of fruits plant $^{-1}$ and fruit yield plant $^{-1}$ are indicators of yield attributing characters of any crop. All the three treatments showed better performances in inducing fruit number and yield per plant over control. Fruit number was increased as high as 107% in chili treated with *panchagavya* + *kunapajala* (Fig. 5). T_3 (*panchagavya* + *kunapajala*) also recorded a clear superiority over the other treatments in all the three vegetables for increasing fruit yield (Fig. 6). It ranged from 115% increased fruit yield in tomato to 127% in cow pea over their respective control. *Panchagavya* and *kunapajala* individually also contributed significantly in enhancement of fruit number and yield in all these crops.

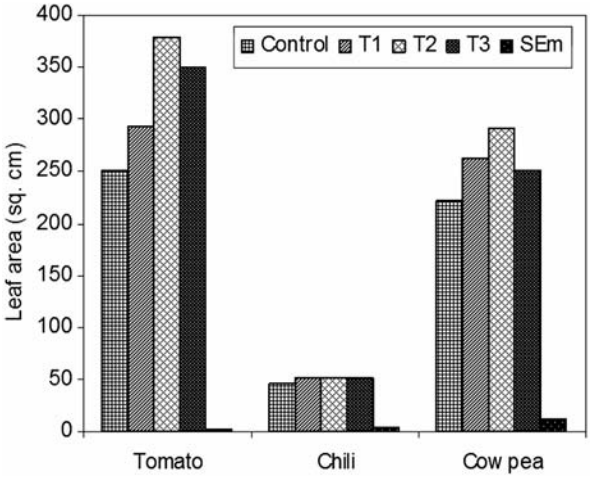

Fig. 3—Effect of liquid organics on leaf area of vegetable seedlings

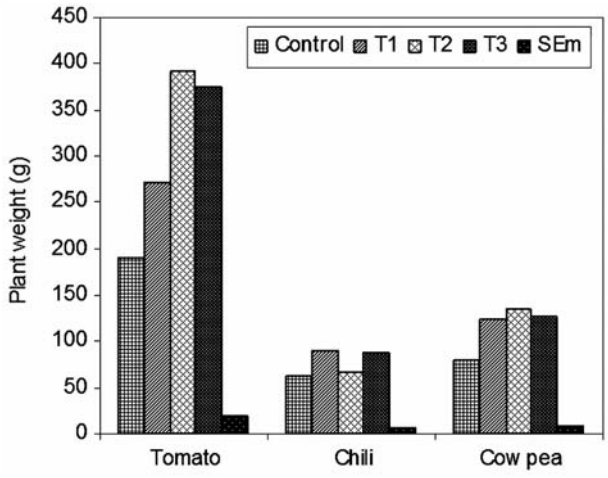

Fig. 4—Effect of liquid organics on plant weight of vegetable seedlings

Table 1— Effect of liquid organics on photosynthetic pigments

Treatment	Chlorophyll a			Chlorophyll b			Chlorophyll a/b		
	Tomato	Chili	Cow pea	Tomato	Chili	Cow pea	Tomato	Chili	Cow pea
Control	1.71^{ab}	1.95^{a}	2.36^{a}	1.10^{b}	0.92^{c}	0.87^{ab}	1.87^{a}	1.77^{a}	2.04^{a}
T_1	1.75^{a}	1.49^{bc}	2.31^{a}	1.08^{b}	1.21^{ab}	0.84^{b}	1.86^{a}	1.79^{a}	1.92^{ab}
T_2	1.55^{b}	1.68^{ab}	2.28^{a}	1.21^{a}	1.08^{b}	0.86^{b}	1.87^{a}	1.81^{a}	1.96^{ab}
T_3	1.38^{C}	1.25^{c}	1.91^{b}	1.30^{a}	1.33^{a}	0.97^{a}	1.79^{b}	1.65^{b}	1.85^{b}

*Duncun's multiple range test was performed indicated by the superscript letters

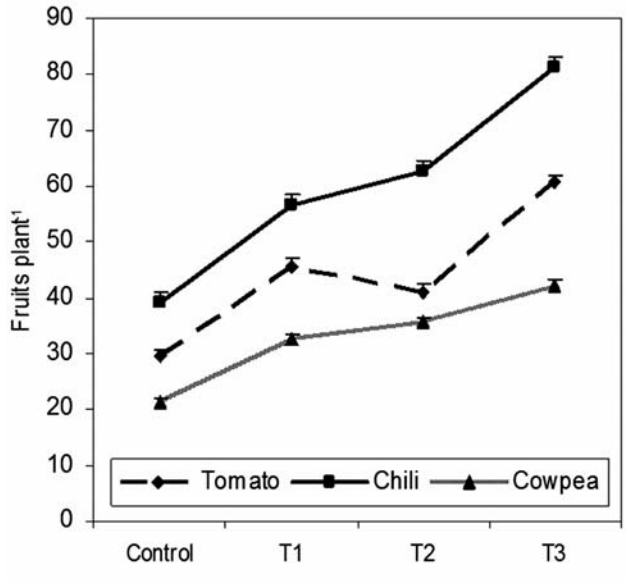

Fig. 5—Effect of liquid organics on fruits plant $^{-1}$ of vegetables

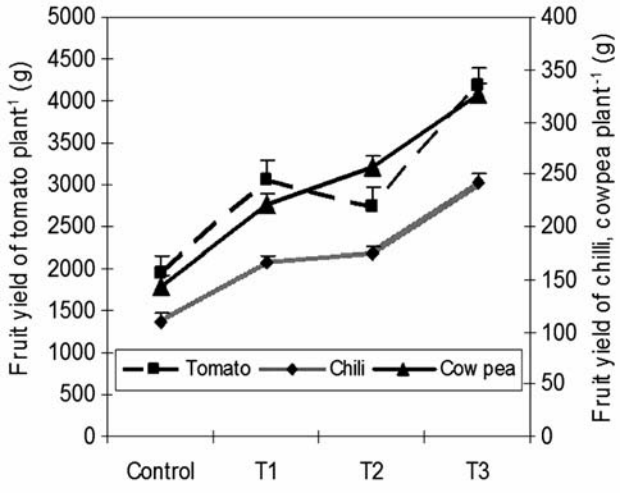

Fig. 6—Effect of liquid organics on fruits yield plant $^{-1}$ of vegetables

Table 2—Effects of liquid organics on polyphenol oxidase enzyme activity

Treatments	Tomato	Chili	Cow pea
Control	15.12^{c}	5.24^{b}	6.08^{b}
T_1	22.6^{a}	6.24^{a}	8.28^{a}
T_2	14.9^{c}	5.04^{b}	6.44^{b}
T_3	18.62^{b}	5.68^{ab}	6.96^{ab}

*Duncun's multiple range test was performed indicated by the superscript letters

Effect on Induced Systemic Resistance (ISR)

Accumulation of polyphenol oxidase has been correlated with induced systemic resistance in several plants[10]. The present study revealed that among the three different treatments *panchagavya* and combination of *panchagavya* + *kunapajala* had the effect on induction of polyphenol oxidase (PPO) in plant metabolism comparison to control (Table 2). Among the three different treatments *panchagavya* showed the most significant response in inducing the polyphenol oxidase enzyme. Similarly, enhanced PPO activity due to application of biocontrol agents have been reported by several workers. *P. fluorescens* induced PPO isozymes in rice against *R.solani*[11]. *P. fluorescence* plus chitin bio formulation was found to enhance the activity of polyphenol oxidase and suppressed the incidence of anthracnose in mango leaves[12]. From this study it has been concluded that all the three vegetable crops treated with *panchagavya* showed enhance induction of defense related enzymes such as PPO which could have enhanced the induced systemic resistance (ISR) of the these vegetables, which in turn would have reduced the disease incidence.

All the three treatments recorded a better linear growth and biomass production of both the shoot and roots of the vegetable seedlings. It also coincided with increased fruit number and yield per plant. The effect was pronounced in soils drenched with *panchagavya* + *kunapajala*. Increased length of roots would provide more surface area for absorption of water and minerals by the experimental seedlings than their controls. At the same time, large number of branch with greater leaf surface area could be construed as an indication of enhanced photosynthetic efficiency in plants grown in soil drenched with *panchagavya* and *kunapajala*. This is further confirmed by the marked decrease in the ratio of chlorophyll a to chlorophyll b in leaves of the plants grown in soil treated with liquid organics that ultimately reflected in terms of higher number of fruits and yield of all the vegetable crops. Interestingly such liquid organics particularly *panchagavya* has the efficiency to enhance the production of defence related enzyme i.e. polyphenol oxidase which in turn enhanced the induced systemic resistance (ISR) in plant body that can act as protective shield against disease incidence.

Traditional significance of study to the farmers and some constructive recommendations

Documented references to *panchagavya* and *kunapajala* are found in *vedic* literature, viz. *Vrikshayurveda* by *Suraphala* who possibly lived

around 1000 AD. The goal of such *vedic* organic agriculture is to re-enliven natural law in agriculture, bringing the farmer, the process of farming and the environment in complete harmony with each other. In modern days agriculture most emphasis are given on minimization of environmental pollution and the use of natural resources. Several reasons have been emphasized for the need of organic inputs, like limited land holdings, poor socio-economic conditions of farmers, rise in input cost etc. The broadest view shows that the population and environment emphasize the ultimate need for eco-friendly technologies. It is necessary to increase production without harming natural resources and the environment. Farmers would be thrust to invest heavily on inputs to improve yield and productivity. So the produces like *panchagavya* and *kunapajala* are going to become inevitable. Resource poor farmers of India can find these liquid organics derived from ancient wisdom as readily available and sustainable solution for improving agricultural productivity in an eco-friendly manner.

Conclusion

The liquid organics *panchagavya* and *kunapajala* individually as well as in combination proved their efficacy in promoting the growth and yield attributes of vegetables crops. Degree of efficiency of individual treatments varied but *panchagavya* + *kunapajala* was found to be best in better utilization of leaf nitrogen, efficient photosynthetic activity and improving yield. In the modern day's agriculture with the increase in organic inputs in the farming of high value vegetable crops use of such growth promoters through soil drenching will be efficient and economical choice for the farming community. At the same time *panchagavya* can be used as prophylactic measure against the disease incidence of vegetable crops.

References

1 Sadhale N, Surapala's Vrikshayuveda, (The Science of Plant Life by Surapala), Agri-Hisory Bulletin No. 1, (Agri-Hisory Foundation, Secundrabad, India), 1996, 104.

2 Selvaraj N, Anita B, Anusha B & Saraswathi MG, In: Organic Horticulture Creating a More Sustainable Farming, (Horticultural Research Station, TNAU, Udhagamandalam), 2006, 63.

3 Nene YL, Potential of some methods described in vrikshayurvedas in crop yield increase and disease management, Asian Agri-Hisory, 16(1) (2012) 45-54.

4 Sadasivam S & Manickam A, In: Biochemical Methods, 3r^{d} edn, (New Age International Publishers, India), 2010, 201.

5 Bray HG & Thorpe WV, Analysis of phenolic compounds of interest in metabolism, In: Methods of Biochemical Analysis, edited by Glick D, (Inter science Publishers, New York, USA), 1 (1954) 27–52.

6 Sangeetha V & Thevanathan R, Bio-fertilizer potential of traditional and panchagavya amended with seaweed extract, J Am Sci, 6(2) (2010) 61-67.

7 Muthuvel, Effect of organics on growth and yield of bhendi var. Varsh Uphar, In: Proceedings of National Conference on Glory of Gomatha: Panchagavya as Potentiator of Plant Cells: Effects on Crop Plants and the Physiology that Validates the Effects, Dec. 1-3, (SV Veterinary University, Tirupati, AP), (2002) 143-148.

8 Kitajima K & Hogan KP, Increases of chlorophyll a/b ratios during acclimation of tropical woody seedlings to nitrogen limitation and high light, Plant Cell Environ, 26 (2003) 857–865.

9 Nineemas G & Sreenivasa MN, Influence of liquid organic manures on growth, nutrient content and yield of tomato (Lycopersicon esculentum Mill.) in the sterilized soil, Karnataka J Agri Sci, 24(2) (2011) 153-157.

10 Ramamoorthy V & Samiyappan R, Induction of defense-related genes in Pseudomonas fluorescenstreated chilli plants in response to infection by Colletotrichum capsici, J Mycol Plant Pathol, 31 (2001) 146-155.

11 Radjacommare R, Pseudomonas fluorescens mediated systemic resistance in rice against sheath blight disease and leaf folder insect, M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore-3, India, 2000, 119

12 Vivekanandhan R, Ravi M, Sible GV, Prakasam V & Samiyappan R, Pseudomonas fluorescens (FP7) amended with chitin bioformulation for the management of anthracnose pathogen in mango cultivar Alphonso, Madras Agric J, 91(7-12) (2004) 475-482.