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Review

Vrkshayurvedic Farming - A Revisit and Review

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Indian System of Agriculture *viz*., *Vrkshayurveda* is an ancient Indian farming and traditional ways for food production in concomitant with Mother Nature but now-a-days it is a remedial measure to manoeuvre the ill effects of modern chemical agriculture. Based on the authors experiences in *vrkshayurveda* with crops like green gram, onion, sorghum, maize, black gram, cow pea and bhendi, the available literature pertaining to this traditional knowledge is reviewed, discussed and presented.

Keywords : *Vrkshayurveda*, sustainable agriculture, Indian System of Agriculture.

Our Indian knowledge system is a treasure trove of information and traditional agriculture is usually associated with pre-industrial peasant agriculture. Indigenous knowledge is the "largest single knowledge source not yet mobilized in development enterprises". India has a treasure of indigenous knowledge concerning plant health, which was developed and documented several centuries ago (Sharmarao Jahagirdar *et al.*, 2003). This traditional knowledge, has been subjected to a process of refinement through generations of experience and now is receiving recognition. The scientific basis for such indigenous technology is evaluated and perfected.

Scope of *Vrkshayurveda*

Trees and plants have an essential part on human life, since the start of civilization. During Vedic period, greater importance was given to trees as a source of almost all the essentials in life, particularly agriculture. India had a rich agricultural heritage, since the time of Rig Veda (3700 BC), it is time now to reorient Indian System of Agriculture by looking back into traditional ways of food production. *Vrkshayurveda* (Indian plant science) provides ample scope to produce quality food products by adopting traditional methods by utilizing plants including tree extracts and by products. Enormous and elaborate literature is found in *Vrkshayurveda* on procedures and practices for raising a crop, pest and disease control, seed treatment for increasing crop growth and its yield (Vijayalakshmi and Shyamsundar, 1994).

In modern day scientific agriculture, the importance of understanding *Vrkshayurveda* needs to be brought out because food consumers have got awareness on environmentally disastrous and harmful effects of various agrochemicals used for pest control, disease management, nutrition of crops, growth regulation and promotion. A detailed understanding of *Vrkshayurveda* along with knowledge on trees and plant species widely utilized, and methods adopted for soil health building, crop growth enhancement, pest and disease control and management, enhancing shelf life of food grains, etc. would be highly beneficial to the agricultural scientists of different disciplines.

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Meaning and history of *Vrkshayurveda*

Vrkshayurveda is an ancient system exploited in Indian System of Agriculture. The three major ancient texts *inter alia* are : i) Varahamihira, 505 AD, *Birhat samhita Vrkshayurveda* part I (chapter (55) edited by M. Ramakrishna Bhatt, Bangalore, 1950)
ii) Chaundarya, 1025 AD, Lokopakaran *Vrkshay urveda* a (chapter (6) edited by H. Shesa Iyengar, Government Central Manuscript Library, Chennai, 1950) and iii) Sarangadhara 1363 AD, *Vrkshayurveda* (edited by S.K. Ramachandra rao, Kalpatharu Research Academy, P.O. Box 1857, Bangalore (1993) India. The most detailed of all three seems to be that of Chaundarya 1025, AD (Sharmarao Jahadirager *et al.,* 2003). *'Vrkshayurveda*' of Chaundaraya (Lokopakarum) (1025 AD), Kanada, which deals with agriculture and botany, describes the use of milk that changed the flower colour and enhances the fruit taste (Upendra Shenoy *et al.*, 2000). It deals with various species of trees and their healthy growth and productivity of the crops, suraphala *Vrkshayurveda* text mentioned glorification of trees, composition of planting and preparation of agriculture, horticultural crops, and all the cultivation aspects of plant and animal production (Vijayalakshmi, 1993a and Nen, 2004).

In general, the word *Vrkshayurveda* (literally meaning the "*ayurveda for plants*") is used to denote knowledge of plant life (Vijayalakshmi, 1993a). The

texts on *Vrkshayurveda* are systematizations of the practices that the farmers followed at field level, placed in a theoretical frame work and it defined certain plant growth stimulants.

Vrkshayurveda aims at producing quality food products by adopting traditional methods, by utilizing plant and/or tree extracts and by their by-products. Plant products are naturally evolved ingredients on the biosphere, they not only have an edge over the synthetic alien molecules but also merit reference and acceptance from the viewpoint of environmental safety and eco-friendliness. (Swaminathan *et al.,* 2007b).

Vrkshayurveda on growth of crops

Vijayalakshmi (1993b) reported that application of *Ferula asafoetida* leaves in ash gourd improved vegetative growth, flowering and yield while leguminous tree leaf extracts at 3 per cent increased the vegetative growth and flowering in balsam plant (Vaidya *et al.,*1994).

Devarani and Rangasamy (1998) found that 2 per cent *Morinda tinctoria* leaf extract treated with sorghum seeds enhanced germination, plant height and root length. In ragi, Palanisamy and Punithavathi (1998) reported that application of *Prosopsis* and pungam leaf extract 2 per cent as seed treatment increased root length, dry-matter production (DMP), shoot length and also enhanced seed germination by 90 per cent. Some tree species (*Alangium salvifolium, Aegle marmelos, Annona squamosa and Azadirachta indica*) were found to influence growth and development of crops (Swaminathan, 2000). Tripathi *et al.* (2000) reported that the *Dalbergia sissoo* leaf extract at 10 per cent enhanced the seed germination compared to water spray alone.

Prasad (2002) reported that neem leaf extract treated turnip seed enhanced the seed weight and germination up to 40 per cent. Manikandan (2002) reported that application of FYM @ 1 kg mixed with 100 g of asafoetida powder around the plants at a depth of half a foot in bottle gourd promoted flowering and also fruiting.

In green gram basal application of *Gliricidia* leaves at 10 t ha^{-1} and two sprays of leaf extract of *Aegle marmellos* at 5 per cent during 30 and 45 days after sowing recorded a grain yield of 2.14 t ha^{-1} (Swaminathan *et al.,* 2007b). Zodape (2010) found that foliar application of *Kappaphycus alvarezii* extract increased the yield and nutrition of green gram due to the presence of micro elements and growth regulators.

Kavitha *et al.* (2005) reported that application of panchagavya along with moringa leaf extract increased the number of leaves per plant (116.4) and shoot length in amaranthus. The foliar spraying of moringa leaf extract five per cent produced second best result, next to panchagavya, in terms of dry matter production and single plant yield in *Solanum nigrum* (Sritharan *et al.* 2010).

Nandhakumar (2010) observed higher germination in maize at 5 DAS with *Albizia lebbek* as green leaf manure and seed soaking with *vitex negundo* leaf extract. This might be due to the presence of secondary metabolites in the leaf extracts, which would have promoted the germination in maize

Vrkshayurveda on crop yields

Rice

Incorporation of *Gliricidia, Leucaena* and *Sesbania bispinosa* as green leaf manure significantly increased rice yield up to 70 per cent (Brewbaker and Glover, 1988). However, Karim and Savill (1991) reported that alley cropping and incorporation of *Gliricidia* leaves at 10 t ha^{-1} increased the yield of rice to 30 per cent. According to Prakash and Bhusan (2003) 100 per cent substitution of nitrogen through the green leaves of *Leucaena* improved yield (2055 kg ha^{-1}) compared to 25 per cent nitrogen substitution (1987 kg ha^{-1}) in rice. In rice field, application of *Gliricidia* leaves recorded 0.46 t ha^{-1} higher straw yield over control (Pal *et al.*, 2005).

Vegetables

Antonysamy (2004) found that aggregatum onion treated with three per cent of *panchagavya* along with Notchi (*Vitex negundo*), Calotropis (*Calotropis gigantea*), Nerium (*Nerium oleander*), Aloe (*Aloe vera*), and Pungam (*Pongamia pinnata*) in cow's urine for seven days increased the yield of bulbs by 17.5 t ha^{-1}. While in chillies the studies of Meera *et al.* (2004) revealed that the extract of *Allium sativum* sprayed at 20 per cent concentration recorded maximum seed germination (80%), and higher yield and fruit length and fruit weight. Christopher Lourduraj *et al.* (2005) opined that application of neem cake + *panchagavya* in bhendi, increased the number of fruits per plant (10.66), fruit girth (6.20 cm), fruit length (16.06 cm), fruit weight (16.06 g) and fruit yield (9.25 t ha^{-1}). Chelladurai (2006) reported that the yield parameters were greater in the treatment with *Gliricidia sepium* as green leaf manure, bulb soaking and foliar sprays of *Aegle marmelos* on onion (Table 1). Swaminathan *et al.* (2008) revealed that application of leaves of *Gliricidia sepium* @ 10 t ha^{-1} at 45 days before sowing of onion and followed by two sprayings of leaf extracts of *Aegle marmelos*
@ 5 per cent during 30 and 45 days after sowing recorded higher yield.

Pulses and oilseeds

In castor, alley cropping of *Dalbergia sissoo* and *Leucaena* and incorporation of leaves significantly increased yield by 79 per cent (Vani and Bheemaiah,

2003). In cluster bean, incorporation of *Gliricidia* leaves alone doubled the yield compared to control (Patel *et al.*, 2003). Singh and Attrey (2002) reported that in case of crop grown from the roots and seedlings the best yield was observed in beet leaf, when cake manure (Neem + Madhuca + Mustard cake in equal quantity) was applied @ 30 t ha^{-1}. Swaminathan and Gururajan (2005) found that application of *Gliricidia* leaves @ 10 t ha^{-1} in combination with five per cent of *Aegle marmelos* spraying after 30 and 45 days in cowpea and green gram increased yield by 2.14 t ha^{-1}(Table 2). It was followed by *Delonix regia leaves* 10 t ha^{-1} with combination of *Morinda tinctoria* 5 per cent spraying, which recorded yield of 2.12 t ha^{-1} compared to control (1.19 t ha^{-1}).

M a i z e

Nandhakumar (2010) reported that the yield of maize was higher in combination *Albizia lebbek* as green leaf manure and foliar spray of *Annona squamosa* leaf extract at 5 per cent concentration. The combination had higher grain number and grain row, cob weight and also the test grain weight (Table 3).

Table 1. Yield of aggergatum onion cv. CO 5 under vrkshayurvedic farming (t ha^{-1})

Treatment	*Foliar spray*				
Green leaf incorporation	Alangi	Annona	Aegle	Morinda	Mean
Albizia lebbek	13.50	12.38	14.61	11.27	12.94
Senna siamea	14.72	15.68	11.27	10.55	13.05
Gliricidia	13.61	14.61	16.16	13.50	14.47
Leucaena	13.50	11.27	15.05	11.27	12.88
Delonix regia	13.61	14.94	13.61	14.72	14.22
Mean	13.78	13.77	14.23	11.26	13.51
	M	S	M X S		
SEd	0.41	0.31	0.74		
CD(0.05)	0.96	0.64	1.57		

***Vrkshayurveda* for pest management**

Hazara *et al.* (1999) reported that neem leaf extract and Neem Seed Kernel Extract (NSKE) at 5 per cent effectively controlled onion thrips. Pawar *et al.* (2003) found that plant extracts of *Mentha arvensis* and *Nerium oleander* at five per cent concentration were effective in reducing the same pest in onion. For chilli thrips, the plant extracts of *Azadirachta indica*, *Pongamia pinnata* and *Vitex negundo* @ 5 per cent proved effective control with 50 per cent mortality for each treatment compared to application of dimethoate which had only 29.58 per cent mortality (Thambidurai and Jayaraj, 2000). Stoll (2000) was of the opinion that *Gliricida sepium* leaf extract at two per cent was effective in controlling cabbage army worm and tobacco bud worm. Neem oil in 50 EC one per cent, neem oil three per cent, Vitexol 50 EC one per cent, neem seed kernel extract five per cent and neem oil one per cent were also effective in reducing the population leafhopper on egg-plant (Ramamurthy and Rajaram, 2001).

Table 2. Yield of green gram under *vrkshayurvedic* farming (t ha^{-1})

Treatment	*Foliar spray*			
Green leaf incorporation	*Alangium*	*Annona*	*Aegle*	*Morinda*
Albizia lebbek	1.68	1.91	1.86	1.77
Senna siamea	1.59	1.60	2.03	1.75
Gliricidia	1.67	2.01	2.14	1.97
Leucaena	1.59	1.90	2.02	1.86
Delonix regia	1.88	2.08	1.85	2.12
Mean	1.68	1.90	1.98	1.89

M = 0.62; S= NS; MXS =0.76

Aqueous leaf and seed extracts of *Annona squamosa* and their powders showed insecticidal, antifeedant and repellent activity against number of insects and pests (Vijayalakshmi *et al.,* 2002).

Boomiraj and Christopher Lourduraj (2006) reported that application of high level of poultry manure and neem cake along with spraying of herbal leaf extract reduced the population of leaf hopper, whitefly and aphids in bhendi.

Rahuman *et al.* (2009) suggested that hot water and petroleum ether extracts of *Ipomea carnea* had the potential to be used as an ideal eco-friendly approach for the control of the major lymphatic filariasis vector. The occurrence of pest incidence as well as weeds was also very low in the combination of *Albizia lebbek* + *Annona squamosa*, which also contributed to higher yield in maize (Nandhakumar, 2010).

Tomato plants treated with the extracts of *Artemisia nilagirica* were found to have lengthier shoots and increased shoot weight due to reduction in the nematode populations causing root gall (Sukul *et al.,* 2001). They also indicated that foliar spray with *Acacia auriculiformis* extract significantly increased the number of leaves per plant, leaf and root protein content, decreased the number of root galls, nematode population in roots and rhizosphere soil compared to control.

Table 3. Yield attributes, yield and pest counts in maize under vrkshayurvedic farming

Treatment	Cob length	Cob girth (cm)	Cob weight (cm)	Yield (kg/ha) (g)
GLM -Incorporation (M)				
Albizia lebbek	13.25	13.5	164.7	1751.87
Gliricidia sepium	12.03	12.5	147.2	1502.81
Leucaena leucocephala	10.16	12.9	126.5	1357.50
Delonix regia	11.76	12.9	151.4	1588.12
*Peltophorum ferrugineu*m	12.50	13.4	152.4	1607.12
SEd	1.64	0.30	12.06	153.70
CD (p=0.05)	NS	0.61	24.46	322.77
GLE Foliar Spraying (S)				
Alangium salvifolium	11.08	12.8	146.7	1533.5
Aegle marmellos	12.07	13	141.5	1516.25
Morinda tinctoria	11.92	13.1	140.5	1563.2
Annona squamosa	12.7	13.2	164.9	1633.0
SEd	1.28	0.24	8.54	83.1
CD (p=0.05)	NS	NS	16.90	165.09
Interaction M X S				
SEd	2.97	0.56	20.48	232.8
CD (p=0.05)	NS	1.12	40.86	454.30

***Vrkshayurveda* for disease management**

Vijaylakshmi *et al.* (2005) reported effective control of chillies leaf spot by 10 per cent, cow urine spray once in 10 days thrice followed by half-litre cow urine along with half-litre sour buttermilk mixed with nine litres of water once in 7 days twice.

Hema *et al.* (2006) studied soil application of neem cake 10 kg ha^{-1} + *Trichoderma harzianum* 2.5 kg ha^{-1}reduced fusarium wilt and increased seed germination, fruit yield and decreased seedling mortality and disease intensity.

Nargis *et al.* (2006) reported that the extracts of *Adhatoda vasica, Zingiber officinale, Vinca rosea* and *Azadirachta indica* in combination with cow dung, *Calotropis procera* and cow urine posses high ability to inhibit conidial germination of *Bipoloris sorokiniana* which might be used for controlling phytopathogens of crop plants.

Kannan *et al.* (2007) reported from their pot and field studies, combined application of buffalo urine and sheep urine as foliar spray (1:1 v/v) at 5 per cent concentration on peanut have completely inhibited the mycelial growth, production and germination of sclerotia of *Sclerotium rolfsii* when compared to control and chemical fungicide, mancozeb (0.05%). Subsequently it has increased the pod yield.

Patil (2008) found that among the seven commercially available neem based products tested *viz*., neem oil, Margotricure, Nimbicidine and Neem Gold at 0.5 per cent and Wanis at 1.0 per cent, sprayed thrice at an interval of 10 days starting from the onset of disease were found promising in reducing the soybean rust severity with significant increase in seed yield and 100 seed weight.

Rathod *et al.* (2010) tested leaf extracts of *Azadirachta indica, Ocimum sanctum, Polyalthia longifolia, Tridax procumbens, Catharanthus roseus,* and *Vitex negundo* and found that *Azadirachta indica* was more effective than other plant extracts showing inhibitory effect on growth of fungi.

***Vrkshayurveda* on soil fertility and nutrient uptake**

The leaves of *Albizia lebbek, Delonix regia, Leucaena*, neem and many other species were commonly used as green leaf manure trees (Nair, 1993).

Reddy and Reddy (1997) reported that application of tree leaves, as green leaf manure, in conjunction with inorganic fertilizer in tree based system had immense potential in supplementing part of N to the associated crop through efficient mineralization.

Prakash and Bhusan (2003) reported that incorporation of *Leucaena* green leaves as 100 per

cent substitution for fertilizer N increased soil organic carbon (0.21 to 0.31) content, soil available nitrogen, phosphorous and potassium. In a long term field experiment with different manurial treatments, decline in soil pH and EC was observed in maize - mustard cropping system. Maximum reduction was recorded in the plot receiving 100 per cent recommended nitrogen through FYM in rainy season (maize) and 100 per cent recommended N, P_2O_5 through fertilizer in winter season (mustard) which may be ascribed to the formation of acid during decomposition of organic matter (Kumpawat, 2004).

Pandey *et al.* (2006) reported that application of manures, irrespective of sources and rates, recorded significantly higher soil organic carbon, available N, P_2O_5 and K_2O compared to control. Higher content of organic carbon in soil may be due to increased yield of roots and plant residues, and external application of organic manures.

Nutrient uptake of crops

Karim and Savill (1991) reported that alley cropping and incorporation of *Gliricidia sepium* @ 10t ha^{-1} improved soil fertility and significantly improved N uptake by 40 kg ha^{-1} in rice.

Vani and Bheemaiah (2003) revealed that alley cropping + green leaf manuring (*Dalbergia* and *Leucaena*) + 80 kg of N ha^{-1} increased uptake of nitrogen in castor (116.4 kg N ha^{-1}) and P and K were also found significantly more under alley cropping with *Dalbergia* green leaf manure and N application. Patel *et al.* (2003) reported the effect of fertilizer N and *Gliricidia* leaves on yield of cluster bean. It has been recorded that nutrient uptake of cluster bean (96, 30.6, 152) NPK kg ha^{-1} with *Gliricidia* leaves @ 10 t ha^{-1} compared to 100 per cent of RDN + *gliricidia* leaves (134, 44, 211 kg ha^{-1} NPK uptake).

Devipriya and Kumarasamy (2004) observed that application of 37.5 kg of rock phosphate with green manure @ 12.5 t ha^{-1} increased available P uptake of rice (77.2 kg P ha^{-1}) compared to control (33.8 kg P ha^{-1}).

Sarawad *et al.* (2005) in rabi sorghum - chickpea yearly crop rotation, observed significant increase in carbon and available nutrients with incorporation of sunhemp as green manure. It also reduced the bulk density and improved the infiltration rate, water stable aggregates, hydraulic conductivity, available water content and water holding capacity of the soil.

Combined application of green manure and inorganic fertilizer increased N and K uptake of rice and the highest value was recorded as 21.56 kg ha^{-1} in *Gmelina arborea* and 53.04 kg ha^{-1} in *Trewia nudiflora* treated plot respectively. Significant increase of organic carbon and NPK content of soil was also recorded in combined treatment (Indrani *et al.,* 2008).

Incorporation of green leaf manure to castor recorded significantly higher nitrogen uptake (72.35 kg ha^{-1}) over control (Mohan Chavan *et al.,* 2010). The uptake of nitrogen, phosphorus and potassium was high in *Albizia lebbek* as green leaf manure and foliar spraying of *Annona squamosa* leaf extract in maize (Nandha kumar, 2010).

Availability of nutrients

Application of green manure significantly increased the P content in soil (Atvar Singh and Bahl, 1993). In laboratory condition, application of *Sesbania aculeatea* as green leaf manure significantly increased the available K content in soil (Debnath and Hajra, 1972).

According to Tolsanur and Badanur (2003) application of 50 per cent N through *Leucaena* + recommended dose of fertilizer (RDF) 50 per cent, in combination increased organic carbon, phosphorus, potassium and lowered nitrogen. Vani and Bheemaiah (2003) reported that application of green leaf manure (*Leucaena, Albizia* and *Dalbergia*) @ 5 t ha^{-1}, improved the soil available NPK and also significantly increased soil organic carbon. The incorporation of *Gliricidia sepium* leaves as green manure improved soil quality by a rising both soil nitrogen and organic matter content (Bandara Krmu *et al.,* 2008)

***Vrkshayurveda* on soil physical and chemical properties**

Physical properties

Organic farming lowers soil bulk density thereby increases water holding capacity, soil aggregation, drainage and decreased vulnerability of soil to mechanical pressure. It has been well documented that addition of organic manure and green leaf manure imparted good physical soil environment for crop growth.

Sultani *et al.* (2007) found that application of green manure to crops, reduced soil bulk density (5%), enhance total porosity (8%), and macropores and large mesopores (28%). Maximum reduction (7%) in soil bulk density and an increase (11%) in total soil porosity and available water content (17%) were observed in plots where *Sesbania* was incorporated as green manure. Incorporation of green manure (*Gliricidia sepium*) improved the soil properties of home gardens significantly when compared to cropping fields, although the impact declined with increasing inclination and the soil depth (Wijesinghe, *et al.,* 2009).

Chemical properties

Sriramachandrasekran *et al.* (1996) compared different organic manures for micronutrient availability and reported higher availability of Zn, Fe, and Mn on *Sesbania aculeata* treated soil as compared to paddy straw and composted coir pith.

Organic carbon

Increased soil organic carbon three weeks after application and incorporation of tree leaves was observed in wheat (Belachew and Abera, 2011).

Vrkshayurveda on soil microbes

Cow's urine and milk contain microorganisms, that are useful for digestion. These organisms also produce substances, that have wide antibiotic activity. Some of the organisms may produce substances, which can either kill or inhibit the growth of microbes involved in food poisoning. Urine of cow contains microorganisms, which probably help the growth of plants. Fresh cow's urine exhibits anti-microbial activity.

Effective microorganisms (EMO) are the mixed culture of naturally occurring beneficial microbes (predominantly lactic acid bacteria (*Lactobacillus*), yeast (*Saccharomyces*), actinomycetes (*Streptomyces*l photosynthetic bacteria (*Rhodopseudomonas*) and certain fungi (*Aspergillus*) improved soil quality, growth and yield of sweet corn, which was equal to or higher than chemical fertilizers (Xu and Xu, 2000).

Significant differences in total aerobic bacteria, fungal and actinomycetes were observed in soil amended with green manure *viz*., *Sesbania rostrata* and *Crotalaria juncea* and inorganic fertilizers such as urea super granules and sulphur application (Ramalingam and Kannaiyan, 2006).

The soil microbial population was influenced by the application *Albizia lebbek* as green leaf manures and higher concentration of micronutrients in *Annona squamosa* as foliar spray in maize (Nandakumar, 2010).

Other recipes used in *Vrkshayurveda*

Panchagavya

Panchagavya is a combination of five products obtained from the cow like, cow dung, cow urine, cow milk, curd and ghee. This is also mentioned in *Vrkshayurveda* texts and it has been commonly used by many of the farmers. It had a significant role in providing resistance to disease, pests and increasing over all yields (Subhashini Sridhar *et al.,* 2001).

Panchagavya has a pH of 3.7 and EC 0.40 %, N 1.28 %, P 0.72 %, K 2.23 % and organic carbon 17.45 % (Perumal *et al.*, 2006). When sprayed with panchagavya, the plants produce larger leaves and develop denser canopy. The stem produces more lateral shoots and much more sturdy branches to bear heavy yields. Application of *panchagavya* in cassava as sett treatment and in field significantly increased number of tillers, number of tubers with increased size and weight and three per cent spray of panchagavya on *Jaffna morniga* before the end of fruiting stage produced 100 fruits per harvest (Natarajan, 2002).

Panchagavya was an important one that enhanced the biological efficiency of crops and the quality of fruits and vegetables.(Swaminathan *et al.*, 2007a).

Effective micro organism present in *panchagavya* might have produced bioactive substances that increased the photosynthetic efficiency and ultimately increased yields (Xu and Xu, 2000); the *panchagavya* application enhanced the biological efficiency of crop plants and quality of fruits and vegetables (Natarajan,1999). It is considered as a growth stimulant and insecticidal principle that increased yield of crops (Natarajan, 2002; Somasundaram *et al*., 2003a; Selvaraj, 2004).

Panchagavya spray resulted in significantly higher productive tillers hill^{-1}, panicle length, number of filled grains panicle^{-1} and seed test weight as well as grain yield in rice over control (Christopher Lourduraj *et al.*, 2005). While Ganesh (2007) found that rice cv. White Ponni gave higher grain yield when sprayed with *panchagavya*. Higher grain yield in maize and sunflower were obtained when treated with biogas slunny and *panchagavya* (Somasundaram *et al.*, 2007). A spray of 2 per cent was effective to enhance the growth and yield of rice (Vivekanandan, 1999b) and to advance the paddy harvest by 10 days (Vivekanandan, 1999a).

Panchagavya spray @ 1.0 per cent reduced the flower drop, increased fruit size, retained freshness and enhanced taste, prevented fruit drops from green worms attack in Hosakere village of Karnataka (http://www.greenconserve.com)

The experiment carried out by Cynthia (2003) in *Withania somnifera* (L.) Dunal indicated that application of panchagavya at four per cent produced the highest dry matter and total alkaloid content. Growth characters and physiological parameters were also increased. *Panchagavya* sprayed on chillies produced dark green leaves and new growth within 10 days (Subhashini Sridhar *et al.,* 2001) while advancement of days to first flowering and 50 per cent flowering was observed in annual moringa (Beaulah, 2001).

Crude fibre, protein, ascorbic acid, carotene content and shelf life in annual moringa were higher under organic manures applied with *panchagavya* as spray (Beaulah *et al.,* 2002).

Vijaykumar (2002) reported that application of *panchagavya* significantly improved the growth, development and yield of onion as intercrop in turmeric field.

Maha Pancha Gavya -3 (MPG-3) improved soil health and productivity (http: //www.cowindia.org). The microorganisms present in the rhizosphere environment around the roots influence the plant growth and crop yield. The beneficial micro organisms from *panchagavya* and their

establishment in the soil improved the sustainability of agriculture.

Amirthakaraisal (in Tamil)

Amirthakaraisal acts as an organic pesticide. Application through irrigation, reduced the root borne diseases and also increased soil enzymatic activities; acted as a nutrient and growth promoter (Sethuraman, 2002). The materials required for preparing *amirthakaraisal* includes: Fresh cow dung, cow urine, jaggery and water. The extract would be ready for use in a day or two.The product is applied through irrigation water to improve soil fertility (Tony Cisse, 2004). Rajareega (2008) opined that the *amirthakaraisal* mixed with irrigation water acted as a tonic for soil and enrich with nutrients. It was an effective medium for thousands of beneficial micro organisms and bacteria essential for crop growth. It was also suggested that 500 litres of the solution was sufficient for one hectare.

Thaemorkaraisal (in Tamil)

Thaemorkaraisal is one of the organic formulations used to induce flowering. The required materials for the preparation of *thaemorkaraisal* for one hectare spray includes: coconut, fermented milk, and palm jaggery. The product is ready for spray in 15 days. It is used as spray before three months. There were also evidences to indicate that coconut water spray increased the chlorophyll content of rice (Thangaraj and Siva Subramanian, 1992). Mamaril and Lopez (1997) reported that coconut water acted as growth hormone, increased the biomass yield of sweet pepper and enhanced the photosynthetic activity of soybean (Kalarani and Jeyakumar, 1998). Tender coconut water spray enabled to maintain uniform flowering in rice (Tony Cisse, 2004).

Source material for *Vrkshayurveda*

The word *Vrkshayurveda* literally means "*Ayurveda for plants*" is used to denote knowledge of plant life in all its varied aspects. In Varahamithira's *Brihat Samhitha* as well as in the *Agni Purana* there are separate sections dealing with *Vrkshayurveda*. The very same term with the word *gulma* preceding it - *Gulmavrkshayurveda* occurs in Kautilya's *Arthasastra* listing the functions of the officer in charge of agriculture, and his assistants. The three works in which this term is used and a complete section has been devoted to the subject, are not texts which are devoted to *Vrkshayurveda* completely. The first text *Agni Purana,* is a popular encyclopedia of all kinds of knowledge and practices; the second, the *Brihat Samhitha* is a manual containing directions for the applications of the knowledge of astronomy and astrology in practice; the third, the *Arthasastra*, is a handbook discussing matters relating to royal polity and the art of governance. Thus, all of them are non-botanical treatises; they are intended not so much to acquaint the students with theories as with practices. In all the three, there is an exclusive section dealing with '*Vrkshayurveda*". Besides these texts there are texts like *Upavana vinoda*, *Krishisukthi, Krishiparasara, Vrkshayurveda* of *surapala* which deal exclusively with different aspects of *Vrkshayurveda*. (Subashini, *et al* 2000)

Conclusion

Vrkshayurvedic farming is a method of farming which primarily uses trees and plants in whole or in part besides the extracts, decoctions of parts of trees and plants, smokes produced from burning of the tree parts and excludes the use of harmful chemicals such as chemical fertilizers, pesticides and herbicides for crop growth, soil health building, control of pests and diseases and to maintain ecological balance and to provide stability in the production level without polluting soil, water and air. With the growing popularity and patronage for Indian Systems of Medicine like *Siddha, Ayurveda* and *Unani* for body health; agriculturists, farm scientists and scholars would also look back to one of the ancient time tested practices so called *Vrkshayurvedic* farming to ensure better quality food for future generation.

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