Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(4): 2360-2364

Received: 20-06-2020
Accepted: 22-07-2020

Krishna Kumar
Department of Plant Pathology, A.N.D.U.A. & T. Kumarganj, Ayodhya, Uttar Pradesh, India

Ghanshyam Verma
Department of Plant Pathology, C.B.L. Degree College Rasulpur, Dhaurahara, Lakhimpur, Uttar Pradesh, India

Ram Veer
Department of Entomology, A.N.D.U.A. & T. Kumarganj, Ayodhya, Uttar Pradesh, India

Suraj Kumar
Department of Entomology, A.N.D.U.A. & T. Kumarganj, Ayodhya, Uttar Pradesh, India

Popin Kumar
Department of Plant Pathology, S.V.P.U.A. &T. Modipuram Meerut, Uttar Pradesh, India

Corresponding Author:
Krishna Kumar
Department of Plant Pathology, A.N.D.U.A. & T. Kumarganj, Ayodhya, Uttar Pradesh, India

Exploitation of Panchagavya, benefits and eco-friendly management of plant diseases: A review

Krishna Kumar, Ghanshyam Verma, Ram Veer, Suraj Kumar and Popin Kumar

Abstract
Panchagavya is a term used in Ayurveda to describe five important substances obtained from cow namely Urine, Dung, Milk, Ghee and Curd. Many people use Panchagavya in some rituals (puja) and for medicinal purposes. It has been used in traditional Indian rituals throughout history. It is also called Cowpathy treatment based on products obtained from cows used in Ayurvedic medicine and of religious significance for Hindus. Panchagavya is also used as fertilizers and pesticides in agricultural operations. Panchagavya is an organic product recommended for the improvement in organic agriculture**.** The application of Panchagavya, the plants show an increase in growth of side shoots. It will help in increasing the fruits. The Magic Fertilizer will help in increasing the root growth profusely. Also, the health of roots is very important for plants.

Keywords: Biodiversity, kunapajala, panchagavya, rhizosphere

Introduction
Panchagavya means "mixture of five products (cow dung, cow urine, milk, ghee, and curd) of the cow. Of these, the three direct constituents are cow dung, urine, milk and the two derived products are curd and ghee. It has been used in traditional Indian rituals throughout history. It is also called Cowpathy treatment based on products obtained from cows used in Ayurvedic medicine and of religious significance for Hindus. Panchagavya is also used as fertilizers and pesticides in agricultural operations. Panchagavya is an organic product recommended for the improvement in organic agriculture [38]. In Sanskrit literature, Panchagavya means the blend of five products obtained from cow. Every one of these five products are called 'Gavya' and together termed as 'Panchagavya.' Panchagavya plays an important role in the quality of fruits and vegetables. It is used as a foliar spray, soil application along with irrigation, as well as a seed treatment [23]. Farmers in South India practice panchagavya for sustainable agriculture. Use of chemical fertilizers and pesticides in agriculture fields led to environmental degradation and hence as an alternative to chemicals. Panchagavya is also being sought to improve crop establishment and health [19].

Fungicides are known to effectively control soil borne disease in general and damping-off in particular but their indiscriminate usage has led to the development of resistant strains of plant pathogens, destroyed natural predators and parasites [11], induced environmental pollution and health hazards [8, 28]. There is a need to develop and adopt an alternate and environment friendly plant protection solutions, like use of organic amendments and animal bi-products such as panchagavya, cow urine, fermented butter milk, verminwash and biosol. The exploitation of conventional organic inputs has already been described in Vedas, Puranas and Arthashastra [26]. Some people believe that chemicals alone could give the high yield. Frequently use of chemicals in agriculture has weakened the ecological base, in addition to degradation of soil, water resources and quality on foods. Soon the adoption of "Panchagavya" as a remedy to cure the ills of modern chemical agriculture, it is very much essential to develop a strong workable and compatible package of nutritional management through organic resources for various crops based on scientific facts, local conditions and economic viability. Panchagavya is a foliar nutrition prepared by organic growers, used widely for various agricultural and horticultural crops [50].

History of Panchagavya
The first mention of *Vrikshayurveda* (VRK) is found in Kautilya's *Arthashastra*, but even by the time of Varahamihira [505-587 CE] [17], who compiled the Brihat Samhita) [7], the science

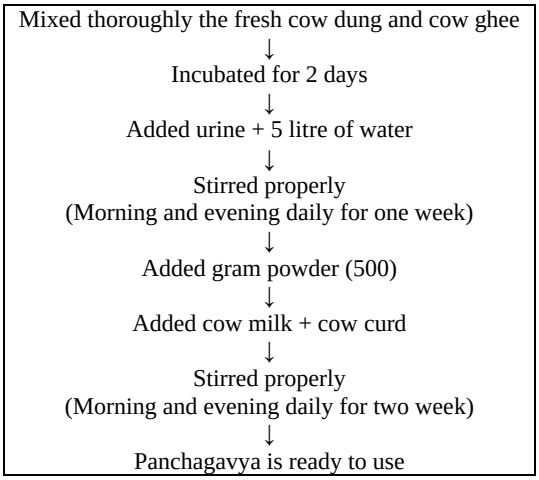
of VRK was in its early stages. The first systematic text on VRK was written in Sanskrit by Surapala [C.1000 CE]. Its English translation was published for the first time by the Asian Agri-History Foundation (AAHF) [35]. Almost around the same time as VRK, the compendium *Lokopakara* [1025 CE] with a chapter on Vrikshayurveda was compiled in old Kannada by Chavundaraya in Kalyani, near present-day Bidar in northern Karnataka [51]. Subsequently, texts on VRK with titles such as Vishvavallabha and Upavanavinoda [36, 37]. The most significant innovation, apparently a first in world agri-history, was the development of fermented liquid manures from organic wastes Kunapajala [literally, 'Filthy fluid'] or Kunapambu [fermented filth]. Surapala's procedure involved collecting and storing animal wastes as and when available. Although wastes from dead boar were mentioned first Surapala, expanded the source of wastes to other animals, especially those with horns. The wastes were cooked and then stored after mixing with husk. When needed for use, sesame oil cake, honey, soaked black gram, and finally ghee (clarified butter) were added to the preparation**.** Many historians and Indology scholars have a chronic habit of not accepting the dates given by Indian scholars from India. Surapala, in the colophon of his *Vrikshayurveda*, mentions that he was a physician [Ayurveda] in the court of King Bhimpala, son of Trilochanapala [35]. of the Shah Pala dynasty, in a Hindu confederation, spreading from Gujarat to the Kanauj region, including the Shivalik Hills [41]**.** Bhimpala died in 1026 CE. It was common during those times to ask Ayurvedic physicians to develop gardens for kings and nobles, and maintain them.

All these products are individually called as "Gavy" and collectively named as Panchagavya. Panchagavya has got reference in the scripts of Vedas and Vrikshayurveda [23]. Cow urine therapies in Indian system of medicine have a strong scientific base. Cow urine has been described in "Sushrita Samhita" and "Ashtanga Sangraha" to be the most effective substance/secretion of animal origin with innumerable therapeutic values. Ancient books on ayurveda state that consumption of cow urine increase resistance to diseases by up to 104%. In India, drinking of cow urine has been practiced for thousands of years. Panchagavya is a term used in Ayurveda to describe five important substances obtained from cow namely Urine, Dung, Milk, Ghee and Curd. Many people use Panchagavya in some rituals (puja) and for medicinal purposes. It is also used in Yajur Veda for ark as a medicine.

Kunapajala was prepared from virtually any animal waste and, therefore, gave flexibility to farmers in sourcing their materials. It is generally accepted that plant roots utilize chemical fertilizers faster than organic manures. This is true when the organic manures, which are soft and semi-dry, are scattered in the field. Application of Kunapajala was different from those of other organic manures. Kunapajala is a liquid and can quickly reach the rhizosphere when applied. Secondly, the ingredients of Kunapajala are fermented, which means the mass (proteins, fats, etc.) is already broken down into simple low-molecular-weight products; these would become available to the plant faster than in the case of traditionally applied organic matter [25].

Preparation of panchagavya

Fresh five products of cow such as Cow dung (3kg), Cow urine (3L) and Cow milk (2L), Curd (2kg), Cow ghee (1kg) were collected for making panchagavya. Required quantities of five ingredients were thoroughly mixed in a plastic container and allowed to fermentation for 7 days with twice stirring per day [9].



Flow chart for preparation of panchagavya

Objectives of using panchagavya

- To maintain the genetic biodiversity of the crop and the environment.
- To encourage the biological cycles within the farming system by using microbe
- To promote the sustainable use of natural resource.
- To maintain the ecological balance between crop production and livestock
- To assess the efficiency of panchagavya in vegetable crops.
- To produce high-quality yield in enough quantity by using panchagavya.

Eco-friendly Management of Plant Diseases

Cow dung is being used for different purposes from the ancient time and has a significant role in crop growth because of the content in humid compounds and fertilizing bio elements available in it. Composted cow dung is rich in total nitrogen (0.74%) including some hormones and favour's plant growth [13, 20]. cow dung extract spray was also reported to be effective for the control of bacterial blight disease of rice and was as effective as *Penicillin*, *Paushamycin* and *Streptomycin*. Found that cow dung as organic manure increase vigour of plant and reduce the disease incidence of root rots in cotton caused by *Phymatotrichum omnivorum*. Similar investigations were conducted by [1, 3, 4] reported that organic manure reduce disease incidence caused by a wide range of plant pathogens including bacteria, fungi and nematode species. Therefore, application of cow dung in proper and sustainable way can enhance not only productivity of yield but also minimizing the chances of disease.

Coriander suffers from various abiotic and biotic diseases. Among the biotic diseases, stem gall caused by *Protomyces macrosporus* is a major disease, which causes yield loss up to 33-36% [19]. Damping-off is a serious fungal disease affecting seeds and seedlings in both nursery and field conditions. In this experiment, effectiveness of panchagavya in inhibiting the growth of two damping-off pathogens *viz*., *Fusarium solani* and *Sclerotium rolfsii* (Rathore and Patil, 2019). The cow urine against three fungal pathogens (*Fusarium oxysporum*, *Rhizoctonia solani*, and *Sclerotium rolfsii*) isolated from infected plants of Methi and Bhindi that showed symptoms of damping off and wilting disease by poison food

technique. The extent of growth of test fungi in plates poisoned with cow urine was lesser when compared with the control plates. Finally, we concluded that the cow urine has antifungal activities and the inhibitory activity can be used in the control of fungi [15]. In India, use of Panchagavya in organic forming is gaining popularity in recent years especially state like Tamil Nadu and Kerala [42]. It is also called cow pathway treatment based on products obtained from cows used in ayurvedic medicine and of religious significance for Hindu [47].

Panchagavya is an organic product recommended for crop improvement in organic agriculture [38]. It is used as a foliar spray, soil application along with irrigation, as well as seed treatment [23]. Panchagavya has played a significant role in providing resistance to pests and diseases, resulting in an increased over all yields [50]. Panchagavya possess the properties of fertilizers and bio pesticides and have been resulted in positive effect on growth and yield of crops [46]. Effective microorganisms in panchagavya are a mixed culture of naturally occurring beneficial microbes mostly lactic acid bacteria (*Lactobacillus*), yeast (*Saccharomyces*), actinomycetes (*Streptomyces*), photosynthetic bacteria (*Rhodopseudomonas*) and certain fungi (*Aspergillus*, *Penicillium* etc.) [53, 49]. Chemolethotrops and autotrophic nitrifies (Ammonifers and nitrifiers) are present in panchagavya, which colonize on the leaves and increased the ammonia uptake and enhance the total N supply [30]. The P^H of panchagavya was lowered to 4.5 at 30 days of fermentation; it is might due to *Lactobacillus* bacteria in panchagavya, which produced more organic acid during fermentation [21]. The 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. At the same time panchagavya can be used as prophylactic measures against the disease incidence of vegetable crops. Foliar spray of panchagavya provides the nutrient, IAA and GA to the plant which is present in the panchagavya.

Srimathi, *et al*., (2013) [47] reported the *J. curces* and *P. pinnata* seeds fortification with panchagavya at 2 and 5% concentration for 16 and 8 hours, respectively. Panchagavya soaking had highest invigoration effect than water soaking and control. This study suggests that panchagavya application is one of the traditional, eco-friendly and low-cost techniques to enhance the better invigoration and promote the successful large-scale afforestation in tree species. Panchagavya use of seed soaking and foliar spray tillering are higher enhanced growth and yield parameters of wheat crop [29]. The mixture of panchagavya sprayed on seedling of tomato, chilli and cowpea increased the linear growth of both shoot and root system in all the vegetable seedling [40]. They have found induced defence mechanism acquired by the tomato, chilli and cowpea due to application of liquid organics, which was quantified in terms of polyphenol oxidase contained in panchagavya.

Maha panchagavya, *Pythium aphanidermatum* causing damping-off in tomato and results showed 48.2 per cent control of disease in nursery beds [18]. Evaluated the antifungal potentiality of panchagavya against *R. solani, S. rolfsii, F. solani, S. sclerotiorum* and *Phytophthora colocasiae* [48]. The antifungal activity of panchagavya against major soil borne pathogens *viz. F. solani* f. sp. *pisi*, *F. oxysporum* f. sp. *pisi*, *R. solani*, *S. Solfsii* and *S. Sclerotiorum* were studied, and found 90 per cent inhibition in *F. oxysporum* f. sp. *pisi* and *F. solani* f. sp. *pisi* and 100 per cent inhibition in *S. rolfsii*, *S. sclerotiorum* and *R. solani.* [14]. Basak and Lee (2005) [5] conducted the experiment on the efficacy of cow urine and cow dung *in vitro* for controlling wilt caused by *F. oxysporum* f. sp. *Cucumerinum* and *F. solani* f. sp. *cucurbitae* in cucumber. (Plotnikova, 1977) [31] observed the presence of mycolytic bacteria in cow manure. The extract of cow dung compost has showed the presence of bacterial isolates, which inhibited the mycelial growth of *Fusarium oxysporum* f.sp. *cucumerinum* and *Helminthosporium sigmoideum* [16]. Czaczyk, *et al.*, (2000) [12] isolated four strains of *Bacillus* from cow dung which has possessed strong inhibition properties of *R. solani, Bipolaris sorokiniaria, S. sclerotiorum, Trichothecium roseum, F. solani* and *F. oxysporum.* Chung, *et al.* (2000) isolated *Paenibacillus koreensis* from compost that have antifungal activity against *Fusarium oxysporum, Colletotrichum lagenarium, Sclerotinia sclerotiorum, Botrytis cinerea* and *Rhizoctonia solani.* Muhammad and Amusa, (2003) [22] were found major microbes *Aspergillus niger, Trichoderma harzianum, Bacillus cereus* and *Bacillus subtilis* in cow dung compost. The microbes *Bacillus subtilis* and *B. cereus* were sprayed on seedling blight inducing pathogens such as *Sclerotium rolfsii, F. oxysporum, Pythium aphanidermatum, H. Maydis* and *R. solani*. Charest, *et al.*, (2005) [10] observed the presence of two bacteria *Pseudomonas aeruginosa* and *Rhizobium radiobacter* in cow dung manure. Raja and Kurucheve (1999) [32] studied the fungi toxicity of animal dung and urine against *Fusarium oxysporum* f. sp. *lycopersici*, the causal agent of tomato wilt. Soils amended with composts provided 20-60 per cent reduction in *Pythium ultimum, Rhizoctonia solani, Phytophthora, Fusarium oxysporum, Verticillium dahlia* and *Sclerotinia* [27].

Cow urine has got Agricultural importance in terms of control of insects and fungi [2]. The laboratory analysis of cow urine shows that it contains nitrogen, sulphur, phosphorus, sodium, manganese, iron, chlorine, magnesium and other minerals, which has attributed as growth inducer in plants [44]. These components enhance the fungicidal and insecticidal activities of Panchagavya. It is a mixed culture of naturally occurring beneficial microbes mostly lactic acid bacteria (*Lacto bacillus*), yeast (*Saccharomyces),* Actinomyces (*Streptomyces*) photosynthetic bacteria (*Rhodopseudomonas*) and contain fungi (*Aspergillus*), which promotes the disease free growth and yield in different crops and provide high B:C ratio due to presents of plants growth hormones like IAA and GA [29]. It is used as a foliar spray, soil application along with irrigation, as well as seed treatment [23]. Botanicals are unique because they can be produced easily by the farmers and small industries [34].

Effect of soil fertility and productivity

- Panchagavya improves fertility status in soils by increasing macronutrients, micronutrients and beneficial microorganisms thus increase soil health.
- It improves water holding capacity of soils because it acts as organic manure.
- It encourages growth and reproduction of beneficial soil microorganisms
- Increases nutrient uptake in plants and enhances plant growth.

Beaulah (2001) [6] The beneficial microorganisms from panchagavya and their establishment in the soil improved,

sustainability of agriculture as the microorganisms presenting the rhizosphere environment around the roots influence the plant growth and crop yield. It may be due to presence of plant growth promoting substance in cattle dung and other nutrients which provide substrate for growth of microbes. Panchagavya enhances the growth and vigour of crops, inducing resistance to pests and diseases and improving the keep inequality of vegetables and fruits [23]. Panchagavya spray was also reported as effective on all the crops than their commended nutrients and growth regulators (RFS) in terms of higher growth and productivity [46].

Benefits of panchagavya

- The beneficial microorganisms of panchagavya and their establishment in the soil have improved the sustainability of agriculture as the microorganisms present in the rhizospheric environment i.e. around the roots, which influence the plant growth and crop yield was might due to presence of growth accelerating enzyme in panchagavya which favoured rapid cell division and multiplication [39, 52].
- A work carried out on modern approaches has showed that cow urine has different activities like antioxidant, anti-diabetic, wound healing property, immune modulator, also act as bio enhancer to increase the efficacy of antibiotics, nutrients and anticancer drugs like taxol [45].
- It helps in increasing the size of the leaves thus by having a denser canopy and final yield.
- With the application of Panchagavya, the plants show an increase in growth of side shoots. It will help in increasing the fruits.
- The Magic Fertilizer will help in increasing the root growth profusely. Also, the health of roots is very important for plants.
- Panchagavya use will increase the shelf-life of fruits and vegetables.
- The quality of yield increases considerably.
- Panchagavya in Agriculture helps in decreasing the use of Chemical Fertilizers.
- Panchagavya for Plants is perfect for Organic Farming.
- You can also use this as feed for cattle animals like Cow, Buffaloes, Pigs, Fish and Poultry etc.
- Since it has many antibodies, you can use it for many diseases in animals and humans.
- It is one of the easiest processes to prepare at home.
- Anyone can prepare this magic fertilizer at their home.
- No need for Technical Knowledge to prepare and use it.
- Cost of Preparation is very less.

Conclusion

Panchagavya is used as fertilizers and pesticides in agricultural operations. Panchagavya is an organic product recommended for the improvement in organic agriculture. Cow dung is being used for different purposes from the ancient time and has a significant role in crop growth because of the content in humid compounds and fertilizing bio elements available. Panchagavya improves fertility status in soils by increasing macronutrients, micronutrients and beneficial microorganisms thus increase soil health. It improves water holding capacity of soils because it acts as organic manure. The beneficial microorganisms from Panchagavya and their establishment in the soil improved the sustainability of agriculture as the microorganisms presenting the rhizosphere environment around the roots influence the plant growth and crop yield.

References

1. Abawi GS, Widmer TL. Impact of soil health management practices on soilborne pathogens, nematodes and root diseases of vegetable crops, Applied Soil Ecology. 2000; 15:37-47.
2. Abubakar U, Adamu T, Manga SB. Control of *Meloidogyne incognita* (kofoid and white) chitwood (root-knot nematode) of *Lycopersicon esculentus* (tomato) using cow dung and urine. African Journal of Biotechnology. 2004; 3(8):379-381.
3. Akhtar M, Malik A. Roles of organic soil amendments and soil organisms in the biological control of plant-parasitic nematodes: A review. Bio-resource Technology. 2000; 74:35-47.
4. Alias A, Ram M. Panchagavya is a bio-fertilizer in organic farming. International Journal of Advanced Science and Research. 2017; 2(5):54-57.
5. Basak AB, Lee MW. Efficacy of cow dung in controlling root rot and *Fusarium* wilt of cucumber. Indian Journal of Plant Pathology. 2005; 23(1, 2):81-84.
6. Beaulah A. Growth and development of moringa (*Moringao leifera* Lam.) under organic and inorganic systems of culture. Ph.D. Thesis. Tamil Nadu Agriculture University, Coimbatore, 2001.
7. Bhat MR. Varahmihira's Brhat Samhita. South Asia Books. 2010; 1:610.
8. Brimmer T, Boland GJ. A review of the non-target effects of fungi used to biologically control plant diseases, Agriculture Ecosystem Environment. 2003; 100:3-16.
9. Chadha S, Rameshwar, Ashlesha, Saini JP, Paul YS. Vedic Krishi: Sustainable livelihood option for small and marginal farmers. Indian Journal of Traditional Knowledge. 2012; 11(3):480-486.
10. Charest MH, Beauchamp CJ, Antoun H. Effects of the humic substances of deinking paper sludge on the antagonism between two compost bacteria and *Pythium ultimum*. FEMS Microbiology Ecology. 2005; 52(3):219-227.
11. Corke ATK. Modern developments in the control of plant diseases: Biological Control Methods, Science Horticulture. 1980; 31:54-59.
12. Czaczyk K, Trojanowska K, Stachowiak B. Antifungal activity of *Bacillus* sp. isolated from compost. Folia Microbiology. 2000; 45(3):552.
13. Dhama K, Chauvhan RS, Lokesh S. Anti-Cancer Activity of Cow Urine: Current Status and Future Directions, International Journal of Cow Science. 2005; 1(2):1-25.
14. Dogra S. Anti-fungal potential of panchagavya against some soil borne pathogens. M.Sc. Thesis, Department of Plant Pathology, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India, 2006, 76.
15. Jaindaik S, Preeti T, Kumar V. Efficacy of cow urine as plant growth enhancer and antifungal agent. Advances in Agriculture. 2015; 7:ID620368.
16. Kai H, Ueda T, Sakaguchi M. Antimicrobial activity of bark compost extracts. Soil Biology and Biochemistry. 1990; 22(7):983-986.
17. Kangle RP. Kautilyam arthasastram [in Marathi]. Mumbai, India: Maharashtra Rajya Sahitya Sanskriti Mandal. 1995, 683.

18. Kumar R, Hooda I, Karwasra SS. Efficacy of Maha-panchagavya (mpg) in controlling damping-off in tomato caused by *Pythium aphanidermatum*. Bangladesh Journal of Agricultural Research. 2010; 35:11-16.
19. Kumar S, Chaudhary VP, Pathak SP, Kumar K. Integrated disease management approaches for stem gall disease of coriander incited by *P. macrospores.* International Journal of Chemical Studies. 2019; 7(1):878-881.
20. Mary CA, Dav VPS, Karunakaran K, Nair NR. Cow dung extract for controlling bacterial blight. International Rice Research News. 1986; 11:19.
21. Mathivanan R, Edwin SC, Viswanathan K, Chandrasekaran D. Chemical, Microbial composition and antibacterial activity of modified panchagavya. International Journal of Cow Science. 2006; 2(2):8-10.
22. Muhammad S, Amusa NA. *In vitro* inhibition of growth of some seedling blight inducing pathogens by compost inhibiting microbes. African Journal of Biotechnology. 2003; 2 (6):161-164.
23. Natarajan K. Panchagavya: A manual. Other India Press, Mapusa, Goa, India. 2002; 33.
24. Natarajan K. Panchagavya for plant. Proceedings of National conference glory gomatha. 2007, 72-75.
25. Neff JC, Chaplin FS, Vitousek PM. Breaks in the cycle: dissolved organic nitrogen in terrestrial ecosystems. Frontiers in Ecology and the Environment. 2003; 1(4):5-11.
26. Nene YL. Crop Disease Management Practices in Ancient, Medieval, and Pre-Modern India, Asian Agriculture History. 2003; 7:185-201.
27. Noble R, Coventry E. Suppression of soil-borne plant diseases with composts: A review. Bio-control Science and Technology. 2005; 15:1.
28. Okigbo RN, Ogbonnaya UO. Antifungal effects of two tropical plant leaf extracts (*Ocimum gratissimum* and *Aframomum melegueta*) on postharvest yam (Dioscorea spp.) rot, African Journal of Biotechnology. 2006; 5:727-731.
29. Pagar RD, Patel MM, Munde SD. Influenced of Panchagavya on Growth and Yield of Wheat (*Triticum aestivum* L.). Agriculture for Sustainable Development**.** 2015; 3(1):57-59.
30. Papen H, Gables A, Zumbusch E, Rennenberg H. Chemolitho autotrophic nitrifies in the phyllosphere of a spruce ecosystem receiving high nitrogen input. Current Microbiology. 2002; 44:56-60.
31. Plotnikova LZ. Dung infusion as a means for controlling powdery mildew of rose. Zashchita Rastenii.1977; 2:28.
32. Raja J, Kurucheve V. Fungicidal activity of buffalo (*Babulus bubalis*) urine: A new record. Madras Agricultural Journal. 1999; 86(10, 12):614-616.
33. Rathore MS, Avinash, Patil D. Panchagavya, An Organic Amendment for Inhibiting Damping-Off Causing *Fusarium solani* and *Sclerotium rolfsii* under *In-vitro* Conditions, Indian Journal of Pure Applied Bioscience. 2019; 7(4):203-206.
34. Roy B, Amin R, Uddin MN, Islam ATMS, Islam MJ, Halder BC. Leaf extracts of Shiyalmutra. 2005; 6:32-35.
35. Sadhale N. Surapala's vrikshayurveda (the science of plant life by Surapala). Secunderabad, India: Asian Agri-History Foundation. 1996, 104.
36. Sadhale N. Vishvavallabha (dear to the world: the science of plant life). Secunderabad, India: Asian Agri-History Foundation. 2004, 134.
37. Sadhale N. Upavanavinoda [woodland garden for enjoyment]. Secanderabad, India: Asian Agri-History Foundation. 201, 64.
38. Sangeetha V, Thevanathan R. Effect of Panchagavya on Nitrate Assimilation by Experimental Plants. Journal of American Science. 2010; 6(2):76-82.
39. Sanjutha S, Subramanian S, Indu Rani C, Maheswari J. Integrated Nutrient Management in *Andrographis paniculata*. Research Journal of Agriculture and Biological sciences. 2008; 4(2):141-145.
40. Sarkar S, Kundu SS, Ghoria D. Validation of ancient liquid organics- Panchagavya kunapajala as plant growth promoters. Indian Journal of Traditional Knowledge. 2014; 13(2):398-403.
41. Sen SN. Ancient Indian history and civilization. 2nd Edition. New Delhi, India: New Age International Private Limited. 1999, 615.
42. Shailaja B, Mishra I, Gampala S, Singh VJ, Swathi K. Panchagavya- An Ecofriendly Insecticide and Organic Growth Promoter of Plants. International Journal of Advanced Research. 2014; 2(11):22-26.
43. Shakuntala NM, Vasudevan SN, Patil SB, Doddagoudar SR, Macha RCMSI, Vijaykumar AG. Organic biopriming on seed vigour inducing enzyme in paddy - An alternative to Inorganic Ecoscan. 2012; 1:251-257.
44. Singla S, Kaur S. Biological activities of cow urine: an ayurvedic elixir. European Journal of Pharmaceutical and Medical Research. 2016; 3(4):118-124.
45. Singla S, Kaur S. Biological Activities of Cow Urine: An Ayurvedic Elixir. European Journal of Preventive Medicine. 2016; 3(4):118-124.
46. Somasundaram E, Amanullah MM. Panchagavya on growth and productivity of crops: A review. Green Farming. 2007; 1:22-26.
47. Srimathi P, Mariappan N, Sundara Moorthy L, Paramathma M. Efficacy of Panchagavya on seed invigoration of bio-fuel Crops. Academic Journals. 2013; 8 (41):2031-2037.
48. Sugha SK. Antifungal potential of panchagavya. Plant Disease Research. 2005; 20:156-158.
49. Swaminathan C, Swaminathan V, Vijay Lakshmi K. Panchagavya boon to organic farming. International Book Distributing Co. Lucknow. 2007, 332.
50. Tharmaraj K, Ganesh P, Kumar SR, Anandan A, Kolanjinathan K. A critical review on Panchagavya-a boon plant growth, International Journal of Pharmaceutical and Biological Archive. 2011; 2(6):1611-1614.
51. Valmiki SA. Lokopakara [for the benefit of people]. New Delhi: Munshiram Manoharlal Publishers Pvt. Ltd. 2006, 139.
52. Vasumathi R. Influence of organic manures, bio-fertilizers and plant density on growth, yield and alkaloid content of Bhumyamalaki (*Phyllanthus amarus* Schum. and Thonn.). M.Sc., (Hort.). Thesis TNAU, Coimbatore-3. India, 2001.
53. Xu HL. Effects of a microbial inoculants and organic fertilizers on the growth, photosynthesis and yield of sweet corn. Journal of Crop Production. 2001; 3:183-214