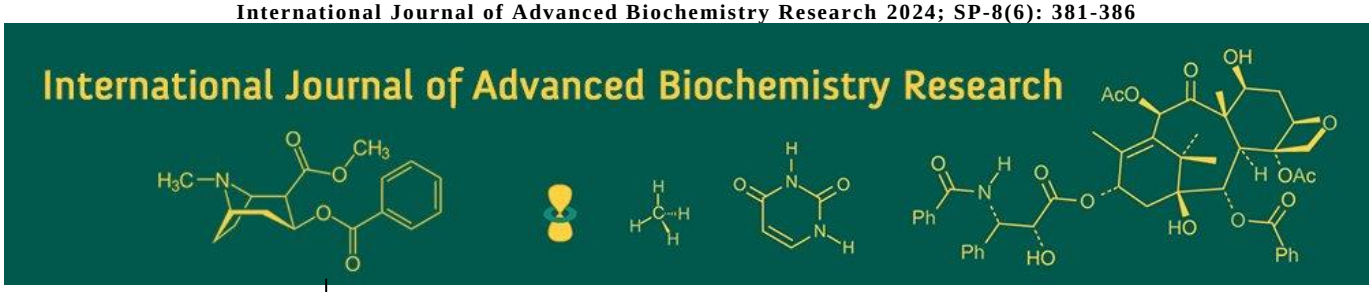

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Panchagavya a valuable organic product: A review

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Abstract
Panchagavya is a traditional organic preparation derived from cow dung, cow urine, milk, curd, ghee and coconut water, is believed to have several beneficial effects on crops. It is observed from the several studies that, foliar application of panchagavya was more effective at branching and flowering stages. Application of panchagavya @ 3-6 percent recorded better performance. Panchagavya performed better in vegetative growth, root nodules, yield parameters, quality parameters and soil health improvement.

Keywords: Growth promoter, panchagavya, soil health, yield and yield attributes

Introduction
Organic farming is the cultivation of crops without using chemical fertilizers, pesticides growth regulators and genetically modified crops. Organic farming is an agricultural approach that emphasizes the use of natural inputs and techniques to cultivate crops and raise livestock while minimizing synthetic inputs such as chemical fertilizers, pesticides, and genetically modified organisms (GMOs). Here are some key aspects of organic farming:

- **Soil Health:** Organic farming prioritizes soil health as the foundation of sustainable agriculture. Practices such as crop rotation, cover cropping, composting, and green manure application are used to improve soil fertility, structure, and microbial activity.
- **Biodiversity Conservation:** Organic farms often promote biodiversity by cultivating a variety of crops, maintaining natural habitats, and minimizing the use of monocultures. Diverse cropping systems help enhance ecosystem resilience, support beneficial organisms, and reduce the risk of pest and disease outbreaks.
- **Natural Inputs:** Organic farmers rely on natural inputs such as organic fertilizers (e.g., compost, manure), biological pest control methods (e.g., beneficial insects, trap crops), and cultural practices (e.g., mulching, crop diversification) to nourish crops and manage pests, weeds, and diseases.
- **Prohibition of Synthetic Chemicals:** Synthetic chemical inputs such as synthetic fertilizers, pesticides, herbicides, and growth hormones are prohibited in organic farming. Instead, organic farmers use approved natural and organic inputs that meet strict standards for environmental and human health.
- **Animal Welfare:** Organic livestock farming emphasizes the humane treatment of animals, providing access to outdoor areas, pasture grazing, and organic feed free from synthetic additives and GMOs. Livestock management practices prioritize animal health, welfare, and natural behaviors.
- **Certification and Standards:** Organic farming is regulated by certification bodies that set standards and guidelines for organic production and processing. Farmers must adhere to these standards and undergo regular inspections to obtain organic certification, which verifies compliance with organic principles and practices.
- **Environmental Benefits:** Organic farming practices have been associated with various environmental benefits, including reduced chemical pollution, conservation of water resources, enhanced biodiversity, and mitigation of climate change through carbon sequestration in soils.
- **Health and Nutrition:** Organic foods are often perceived as healthier and more nutritious than conventionally grown foods, although scientific evidence supporting these claims is mixed. Organic farming practices aim to produce food that is free from

synthetic chemical residues and potentially harmful additives, promoting consumer health and well-being.

While organic farming offers numerous environmental, social, and health benefits, it also presents challenges such as higher labor costs, lower yields in some cases, and limited access to organic inputs in certain regions. However, growing consumer demand for organic products, increasing awareness of environmental sustainability, and supportive policies are driving the expansion of organic farming worldwide.

Panchagavya, a traditional organic preparation derived from cow dung, cow urine, milk, curd, ghee and coconut water etc., is believed to have several beneficial effects on crops. While scientific research on the efficacy of panchagavya is still ongoing and results can vary depending on factors such as crop type, soil conditions, and application methods, there are some potential effects of panchagavya on crops:

- **Nutrient Supply:** Panchagavya contains a range of nutrients, including nitrogen, phosphorus, potassium, micronutrients, and beneficial microorganisms. When applied to crops, it can provide essential nutrients that support plant growth and development.
- **Plant Growth Promotion:** The growth-promoting hormones and enzymes present in panchagavya are believed to stimulate root growth, enhance nutrient uptake, and increase overall plant vigor. This can result in improved crop growth, higher yields, and better resistance to environmental stresses.
- **Disease and Pest Management:** Panchagavya is thought to possess antimicrobial and insecticidal properties, which may help suppress the growth of pathogens and pests on crops. Regular application of panchagavya can contribute to healthier plants with reduced susceptibility to diseases and pests.
- **Soil Health Improvement:** The organic matter and beneficial microorganisms present in panchagavya can improve soil structure, fertility, and microbial activity. This can enhance soil water retention, nutrient cycling, and overall soil health, leading to better crop growth and productivity.
- **Stress Mitigation:** Panchagavya is believed to help plants cope with various environmental stresses, such as drought, salinity, and temperature extremes. By boosting plant resilience and tolerance to stress, it can help crops withstand adverse conditions and maintain productivity under challenging circumstances.
- **Quality Enhancement:** Some proponents of panchagavya suggest that it can improve the quality of crops, including taste, aroma, shelf life, and nutritional content. However, empirical evidence supporting these claims may be limited and require further research.

It's important to note that while panchagavya has been used in traditional farming systems for centuries and anecdotal evidence of its benefits abounds, scientific validation through controlled studies is necessary to confirm its efficacy and optimal application methods for different crops and agroecological conditions. Farmers interested in using panchagavya should consider conducting small-scale trials and consulting with agricultural experts to determine its suitability and potential benefits in their specific context. In this context, several papers were reviewed and are discussed in different sub topics to know the subject clearly and the outcomes of the papers are discussed below

1. Stage of application: In a study Choudhary *et al*., 2014 [3], depicted that the foliar application of panchagavya along with leaf extract of neem, custard apple, glyricidia and oak The foliar application was sprayed at branching, flowering alone and at both of the stages. It was found that foliar application of panchagavya with other tree leaf extract both at branching and flowering stages were found to be superior with respect to the number of nodules, yield parameters like number of pods per plant, pod weight per plant, 100 kernel weight, pod yield, haulm yield, harvest index (HI) and shelling percentage of groundnut crop and also significantly increased the uptake of N and P uptake of kernels.

In another study by Gopal Lal Choudhary *et al*., 2017 [6], application of panchagavya at branching + flowering stages significantly increased seed yield, straw yield, biological yield and maximum nitrogen, phosphorus, potassium, sulphur, zinc and iron content in seed and straw and their uptake and protein content in seed of blackgram crop over the application of panchagavya at branching or at flowering stage alone.

It might be due to adequate and balanced nutrient supply to crop at the right time (both at branching and flowering stages) of requirement and optimum dose of bio-regulator panchagavya which provide more macro and micro nutrients as well as growth regulators like auxins and GA which helped in producing higher bio mass and also in better recovery of N, P, K, S, Zn and Fe in plant.

2. Rate of application: Panchagavya @ 3% was superior in the effect with respect to plant growth, yield, root nodules, oil content, protein and chlorophyll content in tomato, blackgram and soybean crops Debasish Panda *et al*., 2020 [5], Suresh Kumar *et al*., 2011 [24], Sutar *et al*., 2019 [25]. While, Gopal Lal Choudhary *et al*., 2017 [6], studies on blackgram shows significantly higher performance of the crop was observed with the application of panchagavya @ 4%. His study depicted that significant increase in seed yield, straw yield, biological yield and maximum nitrogen, phosphorus, potassium, sulphur, zinc and iron content in seed and straw and their uptake and protein content in seed was observed with the application of panchagavya 4% over control. Boraiah *et al*., 2017 [6], studies shows capsicum crop performed better when the panchagavya was sprayed @ 6.0 percent. His study shows that significantly higher fruit yield of capsicum, N-fixers life and P-solubilizers with panchagavya@ 6.0 percent.

3. Effect on vegetative growth: In tomato crop, foliar application of panchagavya @ 3.0% significantly increases the growth parameters *viz.* height (118.4 and 131.7 cm), stem girth (2.56 and 3.25 cm), number of leaves per plant of tomato (80.5 and 104.2) at 50 and 75 DAT, respectively Debasish Panda *et al*., 2020 [5].

In another study conducted by Suresh Kumar *et al*., 2011 [24], the foliar application of panchagavya @ 3 percent recorded significantly the higher values of growth parameters at all the observed stages of blackgram compared with control. Recommended dose of fertilizer, recorded the increased growth parameters but the value were slightly lower than foliar applied panchagavya. The LAI is

related to the supply and availability of N to plants which is supplied by the source of foliar applied panchagavya. It might have contained microbial metabolites in appreciable amount that help in maintaining the opening of stomata for longer period both in optimum and adverse conditions during the crop growth which led to increased LAI providing stronger source for sink (Xu *et al*., 2000) [28]. Improved nutrition may enable greater leaf area production that results in greater interception of light thereby increasing dry matter production (Kumawat, 2009) [7]. The significant improvement in the accumulation of dry matter in plant and its distribution in different plant parts in the study was attributed to increased supply of plant nutrients, specific weight of leaf, chlorophyll synthesis, nitrogen metabolism, root nodules and phytohormones with the application of panchagavya.

4. Nutrient uptake and content: Significantly higher N, P, K, S, Zn and Fe content and their uptake in seed and straw and also protein content in seed of blackgram was noticed with use of panchagavya spray @ 4% as compared to control, panchagavya spray @ 2%, 6%, 8% and 10%. Similar effect was observed with the application of panchagavya at both branching + flowering stages as compared application of panchagavya at either stage of branching or flowering stage alone. Gopal Lal Choudhary *et al*., 2017 [6].

It may be due to optimum dose of bio-regulator panchagavya which provide more macro and micro nutrients as well as growth regulators like auxins and gibberlic acid (GA) which helped in producing higher bio mass and also in better recovery of N, P, K, S, Zn and Fe in plant. Similar effects have also been observed by Beaulah (2002) [1] and Kumawat *et al*., 2009 [7].

Maximum N, P, K, S, Zn and Fe content and uptake in seed and straw and protein content in seed at both branching + flowering stages as compared application of panchagavya at the stages either at branching or flowering stages alone might be due to adequate and balanced nutrient supply to crop at the right time (both at branching and flowering stages) of requirement. Blackgram crop could accrue high quantity of biomass and partitioned a higher fraction of assimilates to the sink thus resulting in better yield as displayed by improvement in overall yield attributes and improvement in quality parameters. Similar findings were also reported by Rao *et al*., (2010) [16]. Higher N, P, K, S, Zn and Fe uptake by blackgram crop might be ascribed to higher N, P, K, S, Zn and Fe content in seed and straw which resulted higher seed and straw yield with application of panchagavya. The regulation of stomata was favourably influenced by the bioactive substances produced by beneficial microorganisms present in panchagavya, which also enhanced the uptake of nutrients of the blackgram. Similar findings were also reported by Shwetha *et al*., (2009) [21] and Shivakumar and Ponnusami (2011) [20].

5. Protein and oil content: In soybean crop, the treatment RDF + foliar spray of panchagavya @ 3% recorded significantly higher protein and oil yield. Significantly higher oil content (19.55%) was found in treatment RDF + panchagavya @ 3% foliar spray compared to control Sutar *et al*., 2019 [25]. Reason may be (Lende *et al*., 2007) [8] that foliar application of 200 ppm vermiwash which contain sulphur, it involved in the synthesis of fatty acids and also increased protein quality through the synthesis of certain amino acids such as cystine and methionine this might be a reason for increases the oil content.

6. Yield attributes and yield: In soybean crop, significantly higher number of pods per plant was recorded with the treatment RDF + panchagavya @ 3% foliar spray recorded at pod formation (34.18) and at harvest stage (37.65) compared to control. Same treatment recorded significantly higher straw yield (2685.18 kg ha^{-1}), grain yield (1591.35 kg ha^{-1}) and total dry matter (4276.53 kg ha^{-1}) Sutar *et al*. 2019 [25].

In tomato crop the yield attributes *viz*. fruit length (5.60 cm), number of fruits per plant (46.1), fruit diameter (4.41 cm), fruit yield per plant (2.81 kg) of tomato were significantly higher with the application of panchagavya @ 3%. Debasish Panda *et al*., 2020 [5].

Application of panchagavya on reproductive growth *viz*., pods $plant^{-1}$, seeds pod^{-1} and test weight, were important yield attributes having significant positive correlation with seed & straw yield. Similar findings have been reported by Somasundaram *et al*., 2007 [22], Kumawat *et al*., 2009 [7] and Mudigoudra *et al*., 2009 [10]. The pronounced increase in yield might be due to sustained availability of nutrients (N, P, K, S, Zn and Fe) at growth phases of blackgram and also due to enhanced carbohydrate synthesis and effective translocation of photosynthates to the developing sink. Panchagavya increased synthesis of growth promoting substances which in turn helped in increased growth and yield attributes and finally grain yield. Application of panchagavya @ 4% gave higher seed yield (801 kg ha^{-1}), straw yield (1735 kg ha^{-1}), biological yield (2536 kg ha^{-1}) of blackgram over the control. Gopal Lal Choudhary *et al*., 2017 [6], also observed that application of panchagavya at branching + flowering stages recorded the highest seed yield (751 kg ha^{-1}), straw yield (1617 kg ha^{-1}), biological yield (2368 kg ha^{-1}) of blackgram. The easy transfer of nutrients and growth stimulants to plants through foliar spray of optimum dose of panchagavya might be the reason for enhancement in yield attributes. And they quoted that smaller quantities of IAA and GA present in panchagavya when foliar sprayed could have created stimuli in the plant system which in turn increased the production of growth regulator in cell system and the action of growth regulators in plant system stimulated the necessary growth and development and it leading to better yield. The pronounced increase in yield might be due to sustained availability of nutrients (N, P, K, S, Zn and Fe) at growth phases of blackgram and also due to enhanced carbohydrate synthesis and effective translocation of photosynthates to the developing sink. Panchagavya increased synthesis of growth promoting substances which in turn helped in increased growth and yield attributes and finally grain yield. Similarly findings have been reported by Swaminathan *et al*., 2007 and Choudhary *et al*., 2014 [3].

Panchagavya @ 6 percent spray recorded significantly higher fruit yield of capsicum (30.25, 37.49, 48.91, 118.91, 96.15, 86.29, 47.81 q ha^{-1} at 60, 70, 80, 90, 100, 110 and 120 DAT, respectively) Boraiah *et al*., 2017

Choudhary *et al*., 2014 [3], results revealed that foliar application of panchagavya + leaf extract of neem recorded significantly higher number of nodules, number of pods per

plant, pod weight per plant, pod yield, haulm yield and harvest index as compared to other treatments. Panchagavya + leaf extracts of neem recorded significantly higher 100 kernels weight, shelling percent, nutrient uptake of N and P, oil content of groundnut over other sources of organics and control.

Suresh Kumar *et al*., 2011 [24], studies reveal that the application of panchagavya significantly increased pods per plant, number of seeds per pod, grain yield and test weight by 20, 7, 4.2 kg, 3.9 g respectively over recommended dose of fertilizer (RDF) and control. The results were obtained for the RDF treated plants were slightly lesser than panchagavya treated plants. Significant improvement in dry matter accumulation, chlorophyll content and nitrogen content described above may be ascribed to higher yield and yield attributes with panchagavya. Selvaraj (2003) [18] observed 36% increased yield of french bean with application of vermicompost + panchagavya. Natarajan (2002) [12] reported increased yield of crop plants with panchagavya application due to enhancement in the biological efficiency of crop plants.

7. Quality parameters: The values of quality parameters of tomato *viz*., chlorophyll carotenoids, TSS, ascorbic acid and lycopene were significantly higher under 3% panchagavya. Significantly higher chlorophyll a (2.06 and 1.84 mg g^{-1} at 50 and 75 DAT respectively), chlorophyll b (1.05 and 0.74 mg g^{-1} at 50 and 75 DAT respectively), total chlorophyll (3.11 and 2.58 mg g^{-1} at 50 and 75 DAT respectively) and carotenoids content (0.40 and 0.32 mg g^{-1} at 50 and 75 DAT respectively) were recorded with 3% of panchagavya. Higher chlorophyll and carotenoids content of leaves obtained by application of panchagavya may be due to presence of mineral nutrients in it. Significantly higher TSS content (5.67%) was recorded with 3% of panchagavya followed by 5% of Panchagavya, Ascorbic acid content of fruits was significantly increased by the application of panchagavya @ 3% (23.6 mg $100g^{-1}$ compared to control (17.4 mg $100g^{-1}$) and significantly higher lycopene content of fruit (9.10mg $100g^{-1}$) was recorded from 3% of panchagavya followed by 5% of panchagavya compared to control (7.54mg 100g-1) in tomato Debasish Panda *et al*., 2020 [5]. Similar findings were observed by Sarkar *et al*., 2014 [17], Rakesh *et al*., 2017 [15], Mishra *et al*., 2015 [9] and Muthukumar *et al*., (2019) [11] reported an increase in the chlorophyll content of leaves with application of panchagavya.

In soybean crop, significantly higher oil (311.15 kg/ha) and protein yield (651.10 kg/ha) were significantly increased with the foliar application of panchagavya (RDF + Panchagavya @ 3%). Sutar *et al*., 2019 [25].

Suresh Kumar *et al*., 2011 [24], studies revealed that the chlorophyll a, b and total chlorophyll content of fresh leaves were detected by UV-vis spectrophotometer after 60 DAS. The panchagavya treated plant showed the amount of chlorophyll a, b and total was 2.2, 0.9 and 3.2 mg/wt. respectively followed by NPK and control. The increased chlorophyll content in the study might be associated with the supply of essential nutrients to the plants. Since chlorophyll synthesis in the plants is directly related to the availability of the physiologically active Fe, N, P and S micronutrients in plants available form. Hence the availability of these nutrients to plants helps in the formation of chlorophyll in the leaves. Increased chlorophyll 'a', 'b' and carotenoids content in green leaves with foliar application of organic solution has also been observed by Tejada and Gonzalez (2003) [27] in rice. The isolates screened for efficiency based on N content and a value of 5.50 percent was present in the nodule. Panchagavya foliar application increased N content from 1.5 to 3.5 fold in groundnut as reported by Kumawat (2009) [7]. The economic evaluation done in the investigation showed that the organic source of nutrients, panchagavya not only recorded the increased growth and yield under each component crop but also comparatively lowered the cost of cultivation in panchagavya and net return.

Results further reveal that maximum N, P, K, S, Zn and Fe content and uptake in seed and straw and protein content in seed of blackgram was observed with the application of panchagavya at both branching + flowering stages. It might be due to adequate and balanced nutrient supply to crop at the right time (both at branching and flowering stages) of requirement and optimum dose of bio-regulator panchagavya which provide more macro and micro nutrients as well as growth regulators like auxins and GA which helped in producing higher bio mass and also in better recovery of N, P, K, S, Zn and Fe in plant. Similar effects have also been observed by Beaulah (2002) [1] and Kumawat *et al*., (2009) [7]. Blackgram crop could accrue high quantity of biomass and partitioned a higher fraction of assimilates to the sink thus resulting in better yield as displayed by improvement in overall yield attributes and improvement in quality parameters. Similar findings were also reported by Rao *et al*., (2010) [16]. Higher N, P, K, S, Zn and Fe uptake by blackgram crop might be ascribed to higher N, P, K, S, Zn and Fe content in seed and straw which resulted higher seed and straw yield with application of panchagavya. The regulation of stomata was favourably influenced by the bioactive substances produced by beneficial microorganisms present in panchagavya, which also enhanced the uptake of nutrients of the blackgram. Similar findings were also reported by Shwetha *et al*., (2009) [21] and Shivakumar and Ponnusami (2011) [20]. Gopal Lal Choudhary *et al*., 2017 [3].

8. Soil health: Panchagavya and kunapajala has a good potential as manure to improve the physical, chemical and biological properties of soil that leads to enhance the soil fertility, crop productivity and also provide food grains free from the health hazards and also used an alternative against chemical fertilizers and pesticides. Thus, panchagavya and kunapajala plays a major role in organic farming and sustainable agriculture. These review paper collected literature mainly emphasizes liquid organics Panchagavya and Kunapajala the need to adopt eco-friendly agricultural practices to improve soil health and crop productivity for sustainable food production. Sharath Chandra *et al*., 2019 [19].

Panchagavya @ 6 percent spray recorded significantly higher N-fixers life (23.68, 25.59 at 60 DAT and 17.77, 17.18 X 103 at harvest during *kharif* and summer, respectively). The organic liquid manures *viz*., panchagavya, prepared by using cow products are known to contain beneficial microflora like azospirillum, azotobacter, phosphobacteria, pseudomonas, lactic acid bacteria and methylotrophs in abundant numbers and also contain some useful fungi and actinomyctes (Sreenivasa, 2009 and

Palekar, 2006) [23, 14]. P-solubilizer (28.43, 33.04 at 60 DAT and 27.46, 34.53 X 103 at harvest during kharif and summer, respectively). The foliar spray of panchagavya might have enhanced microbial activity on the plant parts like on leaves, shoot and fruits. Natarajan (2007) [13] reported that the panchagavya contains macronutrients like N, P and K, essential micronutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA, which may provide nutrition to rhizosphere microorganisms and thus help to increase their population. Boraiah *et al*., 2017 [2].

The study was aimed to improve the growth and yield of groundnut (*Arachis hypogaea* L.) under foliar spray of panchagavya and leaf extracts as organic source of nutrient. The results revealed that foliar application of panchagavya + leaf extract of neem recorded significantly higher number of nodules compared to other treatments. Choudhary *et al*., 2014 [3].

Panchagavya is an organic product produced by using five different by-products of cow like cow dung, cow urine, cow milk, cow ghee, cow curd and other ingredients. It has the potential to play the role of promoting growth and providing immunity in plant system thereby confers resistance against pest and diseases. Panchagavya contains several nutrients i.e. macronutrients like N, P, K and micronutrients which are required for the growth and development of plants and also contains various amino acids, vitamins, growth regulators like auxins, gibberellins and also beneficial micro organisms like pseudomonas, azatobacter and phosphor bacteria etc.

Conclusion

Panchagavya as an organic product, its foliar application improves the crops vegetative growth, yield, nutrient uptake, quality parameters and also on soil health. As an organic product it also helps to the quality of the product to maintain the standards for environment and human health.

Future line of work

Study of foliar application of panchagavya in other various crops and vegetables. It is also better to know the exact quantity of application.

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