Review article

IMPORTANCE OF *KUNAPAJALA* (TRADITIONAL LIQUID ORGANIC MANURE) OF *VRIKSHAYURVEDA* IN MEDICINAL PLANT CULTIVATION

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ABSTRACT

Medicinal plants play an important role not only as traditional medicine but also as trade commodities. With depleting natural resources, cultivation of medicinal plants has become the need of the hour to meet the growing demand of herbal drug requirement in the field of medicine. But using chemicals in the form of pesticide and fertilizers may have undesirable impact on the quality of these plants as well as human health. Recently various state governments in India have come up with different schemes to cultivate medicinal plants through organic farming under Good Agricultural Practices (GAP*). "Vrikshayurveda"* a sub branch of Ayurveda describes a particular type of liquid organic manure called "*Kunapajala*" for this purpose. Scattered references are found regarding the effect of *Kunapajala* on medicinal plant cultivation. This review highlights the importance of organic farming and results of research works carried out on the effect of *Kunapajala* on medicinal plant cultivation.

KEY WORDS: *Kunapajala, Vrikshayurveda,* Organic manure, Medicinal plants, Fertilizers

INTRODUCTION

Recently herbal health care sector is gaining impetus due to the shift in the mindset of people towards herbal medicines which are considered safe and having wider biological activity (Alok Sharma *et al.,* 2008). Growing demand for plant based medicines and health care products have led to an increase in the number of herbal drug manufacturers. With around 25,000 licensed herbal drug manufacturers in India it has become a lucrative business with a global market currently standing over $ 60 billion annually and is expected to get higher at 6.4% average growth rate. In Indian herbal industry, about 1000 single drugs and 3000 compound preparations have been registered so far. Except few plant species like Opium, Senna, Psyllium, Periwrinkle, Cinchona etc., which are obtained from commercial cultivation, majority of other plant species are collected from the natural sources (Inamdar *et al.,* 2008), (Sheetal Verma and Singh, 2008; Kamboj, 2000). Over exploitation of these natural resources due to increase in population, decrease in forest cover have made many medicinal plants endangered. According to the Red list of Threatened Plants, 19 species are already extinct and 1236 species are facing various degrees of threat across different biogeography regions in the country. (Ramprasad Naik, 2012). Hence cultivation of alternative supply sources of such species is therefore essential.

Cultivation of plant species using organic manure dates back to 1000AD in India. It is dealt in *Vrikshyayurveda,* which forms a part of Ayurvedic history and is treated as a separate subject owing to its importance and extensive nature. It is an age old agro practice which is of great relevance even today in sectors like agriculture and horticulture. It not only deals with pest and disease management of plants but also encompasses study areas like storage of seeds, sowing, germination, plant propagation, manuring etc. For nourishment of plants, use of a biofertilizer called '*Kunapajala'* has been mentioned. References of which can be traced in the manuscript of *'Vrikshayurveda'* written by Surapala, around 1000 AD. The details of *Kunapajala* are also found in a chapter called *Upavanavinoda* of an anthropological compilation called '*Sharangadhara Paddhati*' written by Acharya Sharangadhara, belonging to the thirteenth century (Lakshmipathi, 2004; Nene, 2006). The literary meaning of the Sanskrit word *Kunapa* is "smelling like a dead body or stinking" and the name is apt for the liquid manure which is prepared using excreta, bones, flesh and marrow of animals, fish, decayed plant products etc (Williams Monier, 2002). In this paper an attempt has been made to review studies carried out in this regard, highlighting the importance of *Kunapajala* in the field of medicinal plant cultivation.

Benefits of organic farming versus chemical fertilizers in medicinal plant cultivation:

India has varied agro-climatic conditions which make it suitable for growing a wide range and variety of valuable medicinal plants. But the higher cost of production as compared to the material collected illegally from the forests, unstable demand for the produce, slow growth rates and low prices paid for traditional medicines hardly make cultivation of medicinal plants a profitable exercise. These factors are luring the farmers towards use of chemical fertilizers to increase the yield in a short span of time (Cunningham, 1993).

Though, chemical fertilizers increase the yield, they pose certain serious health threats to human beings especially infants, pregnant and nursing mothers (Vermeer *et al.,* 1998). Another concern for health is contamination of medicinal plants with toxic heavy metals like mercury, lead, cadmium, etc., through fertilizers, harmful industrial wastes contaminating the water sources etc. They can be absorbed into the plants and can cause disturbances in the kidneys, lungs, liver leading to several deformities like congenital paralysis, sensory neural defects and even cancer (Edward Someus, 2009; Dargan *et al.,* 2008). Twelve cases of lead poisoning attributed to Ayurvedic medicines were reported to the centres for disease control (CDC, 2004) over a four year span. Also certain plants of Brassicaeae family tend to accumulate lead in

larger quantities. (Adriane 2009). A study report by Kushwaha *et al*. (1999) showed that chemical fertilizer was generally associated with higher damage potentials than any of the animal wastes. In contrast, organic manures are considered to be safe and yielding good produce by improving water penetration, water-holding capacity, improvement in soil structure, microbial biomass, nutrient availability, drought and heat stress resistance. It also helps in improving the soil pH which has an impact on plant growth and soil microbial activity (Amigo Cantisano, 2000). They not only act as a source of nitrogen but also increase the efficiency of applied nitrogen (Zhu *et al.,* 1987; Satheesh and Balasubramanian, 2003).

Organic certification of medicinal plants

Bearing in mind the benefits and safety of organic farming, different state governments of Assam, Andhra pradesh, Bihar, Uttaranchal etc under Government of India have established State Medicinal Plants Board and a national level body called National Medicinal Plant Board for promoting the growth and development of medicinal plants sector in the country. The guidelines quote that any herbal product used for global trade is to be free from heavy metals, toxic impurities and certified to be organic or Good Agricultural Practices(GAP) compliant. Also, innovative group of committed farmers have promised assistance for cultivation of medicinal plants using organic farming technologies through eligible voluntary organisations that will provide technical and supervisory support (Anonymous, 2008, 2010). Organic certification methods are also seen in many other countries like Israel, Romania etc aiming towards global acceptance for organic certified plants and plant produce (Anonymous, 2001; Camelia, 2007).

Kunapajala as organic manure

a. Classical method for preparation of *Kunapajala:*

Flesh, fat and marrow of Pig, Deer, Fish, Sheep, Goat and Rhinoceros should be boiled in water. When properly boiled, the mixture is transferred to an earthen pot. To this mixture milk, powder of Sesame oil cakes, well cooked *Masha* (Black gram), honey, ghee and hot water are added. There is no mentioned fixity for the quantity of ingredients. The pot is then kept in a warm place for a fortnight and the resultant solution is called *Kunapajala* (Shrikrishna Jugnu, 2004).

In *Vrikshayurveda* of Surapala, different varieties of *Kunapajala* have been mentioned. The verse 101 mentions that excreta, bone marrow, brain, flesh and blood is mixed with water and kept as it is for some time to be known as *Kunapajala.* In the subsequent verses it is quoted that bones of Horses, dead Parrot, Fish, horns of Sheep and Goat, Cow dung cake should be boiled in water and later filled along with sufficient quantity husk in a previously oil smeared pot. Instead of boiling, it can also be roasted in an iron pot and mixed with sesame oil cakes and honey. Good quality black gram and ghee should be added in the end. The ingredients mentioned do not have specific measure but the prepared compound should be kept in a warm place (Sadhale Nalini, 1996).

b. Need for modification of *Kunapajala:*

Sharangadhara mentions that almost any animal waste can be used in preparing *Kunapajala* indicating the fact that a farmer has considerable flexibility in choosing the animals and their by products depending upon the crop. Since availability of flesh of Deer, Rhinoceros is not possible in the present days because of prohibition on killing of wild animals in India (Sanjay Upadhyay and Amruta Sane, 2009), *Kunapajala* would have to be modified using meat of other animals having similar properties. The Deer meat has nutrients like crude protein, Ca, P, Mg, Na, K, Cu, Zn, Fe, Mn etc. It can be substituted with chicken, pork and fish meat which are reported to be having the same nutrients and are also easily available (USDA, 1996; Zomborszky *et al.,* 1996).

Based on this rationality, preparation of *Kunapajala* was modified by Asha (2006) using meat of Rat (*Rattus variegata*), Fish

(*Rastreiliger kanagurta*), Goat meat (*Capra aegagrus*), Chicken (*Gallus gallus*) and Goat blood where the modified *Kunapajala* showed the presence of nitrogen (4.8%), potassium (11.7%) and phosphorus (3.9%) and was used after 30 days of composting. Usually the raw organic matter decomposes into humus which will be further digested by soil microbes producing high levels of organic acids like humic, carbonic and fulvic acids and increases high cation (+) exchange capacity. This capacity is responsible for the mobilization of calcium, potassium and other plant nutrients. In order to obtain good results aerobic composting is said to be beneficial. Kunapajala also acts as organic manure composted under proper conditions to fulfil the requirements of nutrients like Nitrogen, Phosphorus and Potassium.

The nitrogen which is very essential for plant growth is supplemented by blood, cottonseed, fish meal and emulsion etc, whereas compost from bird manures, bone meal etc are rich source of Phosphorus and Potassium which helps in regulating root, bud, flower and fruit formation, cell division, sugar formation in the sap, chlorophyll production and photosynthesis, increasing crop resistance to diseases etc. The other important micronutrients are Magnesium, Calcium, Zinc, Manganese, Copper, Iron, and Selenium (Amigo Cantisano, 2000) which are also supplemented by the organic compost *Kunapajala*.

c. Experimental outcomes of *Kunapajala*:

Many scientists have carried out extensive research work on *Kunapajala* with special emphasis on cultivation of medicinal plants. Some of those works have been mentioned below.

Senna (*Cassia angustifolia* Vahl.):

Senna was grown by Brajeshwar (2002) using both laboratory prepared and commercial *Kunapajala*. It was sprayed at the rate of 2 ml per litre of water. Readings taken after 45 days of sowing showed significant results in parameters like height of the plants (cm), enhancement of leaf area index etc. Leaves being the main organ containing Sennoside, *Kunapajala* was helpful in substantially increasing it. The study also showed that fertilizer treated plants flowered very early but *Kunapajala* treated plants have delayed flowering resulting in harvesting of more foliage. Total Sennoside content per plant (g) was analyzed after 70 days which showed that Senna grown using laboratory prepared *Kunapajala* showed excellent results when compared to chemical fertilizer and control group.

Langali (*Gloriosa superba* Linn.):

Experimental studies on *Langali* by Asha (2006) showed that *Kunapajala* treated plants exhibited excellent result in terms of general growth of the plants and fruiting when compared to control group and chemical fertilizer group. Even though the yield of tuber was not significant enough, one of its active principle 'Colchicine' (methanol extract) was found in higher amount in *Kunapajala* treated plants.

Mango, Coconut, Chilly and Kiwi:

The first reported scientific experimentation with *Kunapajala* was by Ayangarya Sreenivasa (2004), who reported admirable results of *Kunapajala,* when applied to Mango and Coconut. He further tried an "herbal *Kunapa*" using naturally fallen sour Mango fruits and Soapnut (*Sapindus emarginatus*) and applied it on Chilly plants with excellent outcomes. In addition, he prepared *Kunapajala* from poultry (chicken) bird flesh and called it *Kukkutakunapa* (*kukkuta*=chicken), and used it very effectively in increasing Kiwifruit yield from 120 kg in November 2004 to 1700 kg in November 2005 (Ayangarya Sreenivasa, 2005).

Brinjal (*Solanum melongena*):

A unique variety of Brinjal locally called as '*Mattu gulla*' in Udupi District of Karnataka state of India is being cultivated by applying a special type of organic manure like Kunapajala

prepared from a local fish variety called '*Bhutaai'*. Locals claim that this treatment results in large number of branches, higher yield, fruits with lesser seeds and lower susceptibility to diseases when compared with plants grown with artificial fertilizer (Bhat Ramesh and Vasanthi, 2008).

Paddy:

Mishra (2007) studied the growth of paddy using *Kunapajala* specially prepared for growth of cereal plants. 10 g each of Barley (*Hordeum vulgare* Linn.), Black gram (*Vigna mungo* Linn.), Sesame seed (*Sesamum indicum* Linn.) and Green gram (*Vigna radiata* Linn.) powder was mixed in hot water and allowed to cool. This preparation was used to manure paddy plants for every 10, 15, 20 and 25 days. Reading for evaluating growth of rice plants were taken after 100 days. Mean of readings for two consecutive years were taken for interpretations. *Kunapajala* applied for every 10 days showed significant increase in growth parameters like plant height, leaf length, inflorescence length, number of grains per inflorescence etc

Vegetables:

Study report by Narayanan (2006) shows that improved modifications in the preparation of *Kunapajala* by mixing *Panchagavya* (Cow's milk, Curd, Ghee, Urine, and Dung) show tremendous results when applied to vegetables.

DISCUSSION

Kunapajala, a liquid bio fertilizer is a natural organic product derived from animal and plant products containing a significant quantity of one or more of the primary nutrients like Nitrogen, Phosphorus, and Potassium which are necessary for plant growth. Oil cakes, blood meal, fish manure etc are said to be concentrated organic manures. These are also known as organic nitrogen fertilizers. Before their organic nitrogen is used by the crops, it is converted through bacterial action into readily usable ammoniacal nitrogen and nitrate nitrogen. These organic fertilizers are, therefore, relatively slow acting, but they supply available nitrogen for a longer period (Neff *et al.,* 2003).

Chicken manure, feathers, fish contain more of nitrogen which is essential to increase the leaf area. This is evidenced by the study report of Senna in which there was increase in the amount of foliage after the application of *Kunapajala*. Animal manure, fish, blood and bone meal, hoof and horn meal contain ample amounts of Phosphorus and Potassium. Phosphorus is used to establish a strong root system in young plants, fruit and shrubs while Potassium helps the plant absorb and hold onto water. It increases protein synthesis from Nitrogen. This explains why it is particularly good to enhance fruit development. Larger amounts of Potassium help plants produce more flowers and fruit rather than leaves (Olson, 1987). This is supported by the version of Surapala that for obtaining good yield of fruits and flowers, *Kunapajala* should be mixed with decomposed excreta and flesh of animals (Shrikrishna Jugnu, 2004). This offers an inspiration to design different combination of ingredients for preparation of *Kunapajala* according to the need of the plant part to be used.

Composting *Kunapajala* helps in breaking down the manure into simpler forms, making it available to plants faster than the traditionally applied organic matter. Also compost nutrients are released slowly, allowing them to stay in the soil for a longer period enhancing microbial action in the soil, allowing it to absorb and retain water and nutrients more efficiently. Being a liquid it is readily available for the roots in a short time (Prabha *et al.,* 2008).

CONCLUSION

Kunapajala by virtue of its behaviour as plant growth regulator is readily available as a simple compost manure showing its potency in increasing the leaf area, higher yield of flowers and fruits as well as phyto-constituents. It also seems that *Kunapajala* has some plant growth regulatory actions through which it enhances the overall growth of plants. Being a liquid bio-fertilizer it is a more suitable form of manure

and can be beneficial in growth of medicinal plants with probably minimal toxic effects on human body when compared to chemical fertilizer. Researchers suggest that application of the principles of *Vrikshayurveda* like *Kunapajala* does produce phenomenal and interesting results. Since few research works have been carried out, this discipline of science needs to be developed through concerted R & D efforts to ascertain its utility.

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