

Indigenous traditional knowledge (ITK) on seeds for agriculture sustainability in Kalyana, Karnataka region of India

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ABSTRACT

The prime improvement in agricultural systems be fallen with traditional knowledge before the contemporary findings of agricultural research and development and many farmers still depend on traditional knowledge. Seed plays a vital role in achieving the production and productivity of a desired crop and use of traditional seed treatment and storage methods are prominent in some parts of India. Hence, a study was conducted with an objective of documenting and disseminating the indigenous traditional knowledge pertaining to seeds prevalent among the farmers in Raichur district of Karnataka by adopting ex-post facto design and sampling technique was mainly based on random selection. From the study it was obvious that farmers have evolved and adopted several mechanisms for seed selection, seed production, seed treatment, and storage. Indigenous traditional practices on seeds espoused by farmers like use of common salt, neem leaves powder, camphor, lime, neem leaves, garlic cloves, salt and chilli powder, neem oil in seed storage, sun drying of seeds, seed treatment with ash, sand-seed layer method of storage, smearing storage bins with cow dung, and seed storage with wood/cow dung ash are described along with scientific rationale behind these aboriginal practices. The study concludes that indigenous traditional knowledge and practices are useful for sustenance and these guardians of indigenous knowledge compose a prominent role in agricultural development. Before such valuable knowledge gets lost, it would be prudent to guard and encourage indigenous knowledge and wisdom extensively for self-sustenance with a motto to diminish paucity and starvation among native folks.

Key words: *Acorus calamus, Indigenous traditional knowledge, ITK, Neem oil, Seed storage*

Introduction

“If farmers give up farming, even the Rishis (Sages) cannot afford to survive.”- Thirukkural (300 BC). This sacred verse from an ancient Indian literary text opines that no living person, however minimal his worldly needs be, could think of leading their lives without farming and the statement remains true even today. Agriculture, which forms the backbone of Indian economy, depended heavily on the tradi-

tional knowledge. Indigenous traditional knowledge (ITK) is a collection of knowledge unique to a particular culture, society or geographical region. They have been preserved over several generations and have been efficiently used for the betterment and conservation of natural resources (Mehta *et al.*, 2010). Indigenous Traditional Knowledge (ITK) is developed over a period of time through accumulation of experiences and intimate understanding of environment. This knowledge is gradually disap-

pearing due to population pressure and industrial development. Traditional crops and cropping practices are becoming extinct, of which modern farming practices are major contributors. Further climate change is a significant change in the statistical distribution of weather patterns. The Intergovernmental Panel on Climate Change Third Assessment Report 2001 concluded that current knowledge on adaptation to climate change is limited and emphasized the need for research on viable adaptation measures.

India is vulnerable to climate change as the majority of its population depends on agriculture, which is climate sensitive. Agriculture in India is involved in domestic food supply, employment and cash income. Recognizing the challenges to mitigate climate variability promotes more sustainable and resilient agriculture. The traditional knowledge for ecosystem management and use of natural resources is gaining credence as a key weapon to fight against climate change. Understanding the ITK will help sustain farming practices preventing plant genetic erosion and environmental deterioration. It contributes to sustainable food security and conservation of variety and variability of animals, plants and soil properties (Sandhya *et al.*, 2015).

ITK among farmers has evolved through experimentation, though unintended, as a result of adaptations based on pragmatic approach to survive in a fragile soil system (Adedipe, 1983). This knowledge system comes through generations of development, preservation and refinement as a result of interacting, observing and experimenting with the environment (Pushpangadan, 2002). Traditional knowledge has been disseminated on to succeeding generation through oral means. There are no/limited accounted forms of ITK, which can be conserved for future reference and dissemination (Pandey *et al.*, 2017). The source of ITK base is the older generation and there is an imminent requisite to document this before they fade away (Rajagopalan, 2003). Seed production, seed treatment and storage are important agriculture practices to achieve food security by enabling the seed availability at right time. Proper seed treatment benefits good germination, seedling and plant establishment, and crop protection in early stage of crop growth. Agriculture system is such that seeds produced in one season needs to be stored invariably for some time varying from 2-8 months depending on the crop. Proper seed storage helps in enhancing the longevity of the seed for sowing in the subsequent season. Kalyana-Karnataka

region comprising Bidar, Kalaburagi, Ballari, Yadgir, Koppal and Raichur, an agrarian area with an irrigation potentiality of 12 lakh hectares spanning a total geographic area of 44.96 lakh hectares accounting 33.60 per cent of the geographical area of the Karnataka state of India, of which nearly 68 per cent is under cultivation and has a unique combination of medium (32.42%) and large farmers (36.69%) bestowed with rich natural resources especially for agricultural development. Farmers use indigenous traditional methods of seed treatment and storage, which were regarded as more sustainable.

The common practices and technologies under Indigenous Traditional Knowledge domain followed by farmers are seed treatment and storage method, borne setting methods and disease treatment. These methods were not expensive as farmers used materials available locally. Local knowledge or traditional knowledge is highly localized and restricted and is generally governed by local environmental factors and cultural conditions. Beliefs can play a fundamental role in a people livelihood and in maintaining their health and the environment. Women folk have accumulated knowledge of household practices over generations by observation, experimentation and by handling age old people's experiences and wisdom. Certain practices are unique to a given culture of a society and vary between countries, regions, villages and even communities.

In this study, an attempt has been made to document some of indigenous traditional knowledge related to seeds for their dissemination which increases the awareness of the younger generations towards the traditional knowledge. The present study of the aboriginal knowledge pertaining to seed production, seed treatment and storage predominant among farmers in Raichur district of Kalyana Karnataka has been catalogued along with scientific base for documented indigenous traditional knowledge on seeds.

Materials and Methods

The present study focused on documentation of Indigenous Traditional Knowledge (ITK) related to seeds aimed at assessing the extent of potential use of indigenous knowledge by farmers conducted at Raichur district of Karnataka State, India. Ex-post facto design was adopted in the present study as the event has already occurred and design was consid-

ered appropriate. Sampling technique used in this study was mainly based on random selection. Data were collected from various farmers by personnel contact using structured questionnaire. Discussions were instigated with the farmers regarding aboriginal practices specific to seeds. Altogether, 74 farmers were surveyed in this study. The sampling technique of the farmers chosen to contribute in this study was primarily centered on random selection. Through this technique, every participant of the study was picked arbitrarily and the choice was based exclusively on fortuitous. All the information that was collected from the farmers during the course of discussion was noted down immediately. This information were later grouped and analyzed. Further, the scientific rationale behind some of the important indigenous traditional practices adopted by the farmers is appraised through review of literature.

Results and Discussion

For centuries, farmers have planned agricultural production and conserved natural resources by adopting indigenous knowledge. The development of indigenous knowledge systems, including management of natural environment, has been a matter of survival to the people who generated these systems. In this backdrop, the study aims at elucidating the significance of such farmers' knowledge and role in sustainable agriculture in Raichur district of Karnataka state. The Green Revolution technologies, which partly solved the problem of food and fibre needs, appeared to be too expensive, as the costs of technology transfer, soil erosion and loss of plant genetic materials that were resistant to diseases are high (Davis and Ebbe, 1993). Traditional agriculture, as it was originally applied, can neither be fully resumed nor would it satisfy the food needs of the increasing world population. It is however useful to preserve and mobilize local knowledge, which reflects expertise in and understanding of the environmental aspects gained over thousands of years (Anil Kumar, 2010).

As mentioned earlier, India has traversed from deficient to self-sufficient in food grains production due to green revolution, but a post-harvest loss is the major concern. Biotic factors such as storage pests causes great losses to stored seeds. Even though chemical methods of management of storage pests are highly successful, still farmers are using

traditional methods of storage. The easily available and low cost inputs like ash, sand, salt, camphor and plants etc. are being used by the farmers for effective seeds storage because such practices are not only user-friendly but also increases the vigour and viability of seeds. The details of the indigenous technologies being followed by farmers in Kalyana Karnataka region pertaining to seeds were collected and presented Table 1.

Considerable thought must have been given over centuries to the agriculture practices before treatments to manage the seed problems could have been formulated. It is most significant that various methods of treatments, adopted today, were conceptualized and practiced centuries ago. Seed treatments, prior to sowing, to ensure successful and vigorous germination were given a lot of importance. Vrikshayurveda, mainly deals with various species of trees and their healthy growth and productivity. Special references are made to procuring, preserving, and treatment of seeds and planting materials. Treating roots before transplanting was recommended. Fumigation of trees and seeds by burning (to produce smoke) specific materials was considered to be useful. Spraying/dusting with appliances, as we do today, had not evolved, but the crude versions of these are found in sprinkling aqueous suspensions of materials and application of brick-powder as dust (Nalini Sadhale and Nene, 2009).

Recently, awareness of indigenous/local knowledge has been steadily gaining ground in the academic world, both within the social as well as in the natural sciences. A growing number of scientists and policy makers are aware of the contribution indigenous knowledge (IK) can make to a more sustainable development" (Viergever, 1999). These documented methods have scientific bases and also are cited in the ancient Indian texts. For example, drying and storing of seeds in airtight environments is mentioned in Krishi-Parashara where Parashara orated that storing of visually uniform and appropriately dried seeds in strong bags improves the seed longevity. The use of flours to store seeds is an ancient practice and stated in Varahamihira's Brihat Jataka. In this text Varahamihira mentioned about pelleting seeds with paste of sesame, and flour of paddy and even using turmeric powder for fumigating. In Surapala's Vrikshayurveda the classification and preservation of seeds is mentioned in Beejopathi Vidhi (Sadhale, 1996). The use of cow

Table 1. Indigenous traditional knowledge on seeds prevalent among of farmers in Raichur district of Karnataka, India

Sl.No	Crop	Component	ITK on seed
		Seed treatment and storage	<p>Selection of healthy and good sized panicles and proper drying seeds to low moisture and storage in dry place.</p> <p>Seeds were soaked in cow dung urine and cow dung slurry and later seeds were dried. These seeds used for sowing.</p> <p>Storage of seeds in gunny bag with neem leaves.</p> <p>Seeds soaked in cow dung and cow urine slurry (1 portion of cow dung and 2 portion of cow urine) for 30 minutes and drying. Later these seeds are stored with neem leaves.</p> <p>Storage of seeds in gunny bag and bamboo silo/structure plastered with cowdung and red soil.</p> <p>Dried red chillies are used for seed storage in bags.</p> <p>Common salt is mixed with paddy seeds (300g/100kg)</p> <p>Selection of healthy and good sized panicles and sun drying of seeds to low moisture and stored in gunny bags with neem leaves.</p> <p>Sun drying of farm saved seeds and storage in dry place.</p> <p>Garlic cloves are placed in layers in storage bags. The garlic cloves will act as repellent.</p>
2	Sorghum	Seed production	<p>Camphor is used for seed storage (2g/kg of seed).</p> <p>Selection of good sized earheads for seeds.</p> <p>Good sized ear heads selection at harvesting time & hanging these earheads in kitchen.</p>
		Seed treatment and storage	<p>Storage of sorghum seeds with ash (1 part of ash and 4 parts of seeds) and airtight storage in gunny bag.</p> <p>Use of cow dung powder for storage of seeds.</p>
3	Other cereals	Seed quality assurance	<p>Seed germination test: Seeds sown in pots during Dasara and regular watering. Good growth & development of seedlings indicates quality seeds.</p>
		Seed treatment and storage	<p>Seed drying to lower moisture and storage in dry place.</p> <p>Storage of seeds with lime powder (10g/kg).</p> <p>Seeds in gunny bags are stored in fodder stack.</p> <p>Camphor is used for storage of seeds in gunny bag (2g/5kg).</p> <p>Seeds are stored along with neem leaves.</p> <p>Earheads are selected, dried and stored in dry place like hanging in kitchen.</p>
4	Redgram	Seed treatment and storage	<p>Lime powder at 10g/kg of seed is used for dry seed storage.</p> <p>Storage of seeds in gunny bag with neem leaf powder.</p> <p>Storage of seeds in bamboo baskets smeared with cow dung and clay.</p> <p>Sun drying of seeds.</p> <p>Storage of seeds with salt and ash.</p> <p>Bamboo bins smeared with cow dung and clay used for seed storage.</p> <p>Seeds are filled and stored in plastic bags and tied airtightly.</p> <p>Use of salt and chilli powder for seed storage (200g salt and 200 g dry chilli powder for 15 kg seeds).</p> <p>Seeds are mixed with 200g salt and stored in gunny bag.</p> <p>Seeds treated with honge leaf extract, dried and used for sowing.</p> <p>Use of camphor during seed storage in gunny bag/air tight bag.</p> <p>For effective storage, seeds are mixed with lime powder at 10g/kg of seed.</p> <p>Neem leaves are used during seed storage.</p> <p>Seeds are smeared with castor oil to control insect infestation during seed storage.</p>

Table 1. Continued ...

Sl.No	Crop	Component	ITK on seed
5	Chickpea	Seed treatment and storage	Seed storage with <i>Acorus calamus</i> powder. Seed treatment with castor oil. Use of camphor for seed storage.
6	Green gram	Seed treatment and storage	Seeds are stored in earthen pot containing ash. Seeds are covered with ash and another pot is being used to cover this pot i.e. pot over other pot.
7	Other Pulses	Seed treatment and storage	Storage of seeds in earthen pots. Storage of seeds in earthen pots and top of the pot is covered with ash. Garlic cloves are mixed with seeds during storage as repellents. Neem oil is smeared over seeds for good storage of seeds. Camphor is used for storage of seeds in gunny bag (2g/kg of seeds). Storage of seeds along with sand in pots (sand at the bottom of the pot followed by seeds and sand layer). Seed storage with <i>Acorus calamus</i> powder. Seeds are treated with castor seed oil. Seeds are stored with neem leaf powder in gunny bag. Mixing of seed with dry ash and stored in gunny bag. Use of cow dung ash for storage. Seeds were placed in pots and later these seeds were covered with cow dung ash (1/4 th volume). Bamboo storage bins smeared with cow dung and clay used for seed storage. Neem leaves are dried, mixed with seeds and stored in gunny bag/bins. Neem seed powder is mixed with seeds at 1% volume for seed storage. Neem seed powder and custard apple seed powder is used for seed storage (70g/kg). Seeds are stored in earthen pot containing ash. Seeds are covered with ash and another pot is being used to cover this pot i.e. pot over other pot. Use of castor oil for smearing over seeds to protect seeds from storage pests. Seeds are treated with pongamia leaf extract and dried. Later these seeds are stored/used for sowing immediately. Garlic cloves are mixed with seeds during storage as repellents (200g/10 kg of seed). Sand is used for seed storage in pots. Sand is placed at the base of pots and seeds are poured over the sand. Further, seeds are covered with sand layer. The pot is made airtight by plastering cow dung paste.
8	Groundnut	Seed storage	Proper drying of seeds and gunny bags are used for storage in dry place. Neem leaves were kept in gunny bags for insect control. Storage of seeds along with pods without removing shells Selection of good and uniform sized pods for sowing in the next season
9	Chili	Seed production	Chilli seedlings were dipped cow urine (1:3)
10	Onion	Seed storage	Storage of onion seeds in paddy straw heaps

dung, honey, and ghee for seed treatment is mentioned along with sowing seasons in Kautilya's Arthashastra. The scientific rationale behind indigenous traditional practices for seed production, seed treatment and storage are described below.

Seed storage with common salt

It is a practice among the farmers to use common salt in red gram (*Cajanus cajan*) seed storage. In this practice, about 200 g of salt was mixed for a kg of red gram seeds manually and stored in jute gunny

bags and the bags were stitched. This practice helps in keeping away insects from the stored seeds. As salt had abrasive action on insect skin prevents its movement inside the storage containers. Farmers perceived this practice to be moderately effective and affordable in cost (Karthikeyan *et al.*, 2009).

Sun drying of seeds

Sun drying is the common traditional practice followed by the farmers for pulses storage. If moisture content is high, they are dried for longer duration in sun before storing seeds. Sun drying rescinds prevailing insect pests and their different stages. (Kumar and Singh, 2013). Optimal seed moisture of 10-12% is essential for appropriate storage of seeds.

Storage of seeds using camphor

Seed quality is affected to the large extent by biotic and abiotic factors. Seeds of cereals and pulses are infested by number of storage pests. To overcome this problem, farmers indigenously adopted simple method in seed storage. In this practice, about 1 g of camphor piece per 5 kg of seeds was placed as such in the jute gunny bags and fresh camphor is replaced with sun drying of seeds every 3-4 months. The camphor used inside the seed storage bag repelled the storage pests due to the strong odour emanated from camphor (Karthikeyan *et al.*, 2009).

Neem leaves in seed storage

Farmers collect neem leaves from the trees and dried in shade and mixed with seeds and stored in gunny bags or bins. Neem leaves encompasses bitter amalgams called meliacins like nimbin, salannin, meliantriol etc., and acts as anti-feedants against storage pests. The active ingredient azadirachtin, found in neem leaves, acts as an insect repellent and insect feeding inhibitor and sterilant with antifungal and nontoxic qualities (Misra, 2014). The strong odour of these leaves keep the storage pests like lesser grain borers (*Rhyzopertha dominica*), saw toothed beetle (*Oryzaephilus surinamensis*) and flat grain beetle (*Cryptolestes minutus*) away (Karthikeyan *et al.*, 2009).

Use of garlic cloves

Farmers are having a practice of keeping garlic cloves in layers in the storage bins filled with seeds (Pulses). The garlic cloves acts as a repellent for several pests. Diallyl di-sulphide, diallyl tri-sulphide and diallyl sulphide are the major compounds

present in garlic has anti-feedant, bactericidal, fungicidal, insecticidal, nematicidal and act as a repellent for various storage pests (Prowse *et al.*, 2006).

Seed treatment with ash

Sorghum (*Sorghum bicolor*) seeds are mixed with ash at the ratio of 4:1 wherein seeds were tied airtight in the jute gunny bags before storage. The favorable effect of ash seed treatment is due to presence of silica in ash which interferes with insect feeding and also hinders fungal pathogen multiplication. Ash dust diminishes the relative humidity of the storage condition and also dries the seed surface. Egg laying and larval development of the storage pests could be hindered because ash dust covers the seeds. It also masks the insect movement to search for mating partners and friction of the dust particles with the insect's cuticle leads to desiccation and hampers the development of the pests (Rekha and Padmakar, 2014).

Storage bins smeared with cow dung

Before storing seeds (pulses) in bamboo bins, farmers have a practice of smearing bins with clay and cow dung which thwarts insect attack from outside. Soil particles absorb remaining moisture in the seeds and evades spoilage. Soil and cow dung paste performance as a barrier between seeds and storage insects and acts as a repellent for storage insect pests (Prakash *et al.*, 2016).

Use of salt and chilli powder

Pulses seeds are stored with mixture of 200g salt and 200 g dry chilli powder for 15 kg seeds in a plastic bag or bin. The pungent nature of chilli exhibits repellent effect on insects and salt has a hygroscopic and insecticidal property resulting in better control of storage insects (Madhumathy *et al.*, 2007).

Sand-seed layer method of storage

In this method of sand-seed layer method of storage, a thick layer of sand is maintained at the base of the mud pot and sundried seeds are spread over this sand. Again sand is added over the seeds. This process of filling sand-seed mixture layer by layer is continued till it reaches up to the brim of the pot. The container is fastened with a lid and it is made air tight by smearing with cow dung paste. The sand particles act as an abrasive agent of insect cuticle and kill the insect pests. It also acts as a blockade between seeds and insects and cow dung smeared at

the top of the pot acts as a repellent which protects the seeds from storage pest (Prakash *et al.*, 2016).

Use of Lime powder (Calcium carbonate)

In this method, farmers store pulse seeds by dusting with lime. Lime powder is mixed homogeneously with seeds and stored them in gunny bags at dry place. Generally 10- 15 g of lime is used for 1kg of grains. The repellent, anti-feedant property of lime prevents storage insect infestation and it also averts insects' multiplication (Rekha and Padmakar, 2014).

Use of Neem leaves powder in seed storage

In crops like pulses and oilseeds, a wide range of seed storage pests like pulse beetles (*Callosobruchus maculatus*), lesser grain borers (*Rhyzopertha dominica*), etc. instigated significant loss both in terms of seed quality and also economic returns. Farmers employed indigenous post-harvest seed management techniques which does not require a high degree of technical skills and copious cost. One such method was the use of neem leaves in storage of pulses and other crops. From time immemorial farmers were cognizant of the insecticidal properties of neem. The bitter taste of neem gives protection to seeds against pests and pathogens as it has numerous properties like repellence, feeding, and ovipositional deterrence, growth inhibition (Kwasi Opoku *et al.*, 2011).

Seed storage with wood/cow dung ash

Storage of seeds with wood/ cow dung ash is an age old method in practice among farmers. Farmers indigenously stockpiled pulse in earthen mud pots wherein seeds were filled in earthen pot to its $\frac{3}{4}$ th volume and then remaining top $\frac{1}{4}$ th top was then covered with wood/ cow dung ash to regulate various storage pests like pulse beetles (*Callosobruchus maculatus*). For extended storage, the seeds were wide-open to sun after few months storage, and then the ash was spread above the seeds surface and kept for storage.

Storage of seeds with *Acorus calamus*

This is an indigenous way of storing seeds wherein seeds are mixed with *Acorus calamus* (sweet flag) powder (10 g per one kg of seeds) for protection of seeds from insects attack in pulses, cereals and oil seeds storage. The strong odour emanated from *Acorus calamus* acts as a repellent against all the storage pests.

Neem oil in seed storage

The strength of a rural subsistence-based economy is agriculture. On the basis of topography, agro-ecology and cultural backgrounds, farmers have adopted diverse agricultural practices with their time tested indigenous knowledge and technologies. One such practice is application of neem (*Azadirachta indica*) oil to coat the seeds uniformly for seed treatment before storage. Neem oil acted as repellent against various storage insects such as weevils, red flour beetles (*Tribolium castaneum*), long headed flour beetle (*Latheticus oryzae*) and fig moth (*Ephestia cautella*) etc. It controls a variety of insects mostly damaging legumes at the egg stage itself due to its principle properties like repellence, feeding and ovipositional deterrence, growth inhibition, etc.

The integration of scientific and traditional knowledge would help to develop technologies which are need based better problem solving, locally available easily acceptable, cost effective, convincing and credible to the rural clientele. Indigenous practices emanate from the cultural contact of the people concerned and evolve in close contact with specific environmental conditions and are based on traditional societies intimate knowledge of their environment. These factors imply that indigenous knowledge is ecofriendly and safe to both man and his environment (Karthikeyan *et al.*, 2009). Indigenization of knowledge originating outside a region often involves adoption to suit the specific characteristics of the region. Consequently, the knowledge embedded in the prevailing practices or technology, its users and innovators in a region at any point of time may not necessarily be whole. Indigenous knowledge continuously interacts with non-local knowledge and changing socio-economic, ecological conditions of the region. Consequently, indigenous knowledge should not be seen as a static pool of knowledge. The quantum and content of indigenous knowledge change continuously and probably this dynamics of indigenous knowledge is more important from the point of view of policy relating to research and development (Agrawal, 2002).

Farmers in the Raichur district of Karnataka are relying on agriculture for their livelihood security. Farming is not just an enterprise for livelihood but a socio-economic and cultural activity. Seed is a biological entity and deterioration is unavoidable beyond physiological maturity, which is influenced by many biotic and abiotic factors. Seed storage pests

significantly reduce seed vigour and viability resulting in loss of seed quality. By employing synthetic pesticides, the seed quality can be maintained during storage but they have exhibited delirious effects on environment and persist for longer period in form of residues. Before evolution of synthetic pesticides, farmers were practicing eco-friendly indigenous traditional methods for seed treatment and storage. These aboriginal methods protect the seeds, do not possess health hazards as observed in synthetic chemicals apart from being eco-friendly, cheaper and practiced with locally available materials. Indigenous traditional practices have benefits over modern techniques which cost little or no cost and are easily available. This documentation of indigenous traditional practices signifies the farmers' role in safeguarding and upholding the sustainable use of the natural resources. From the study, it was obvious that the local knowledge of seed selection, seed treatment, and storage of subsistence crops is useful for sustenance. It is imperative to recognize that indigenous traditional knowledge to uphold the existence of cultural and biological diversity.

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