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# A Review on Seed Treatments Mentioned in *Vṛkṣāyurveda.*

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## ABSTRACT:

Nowadays various conventional methods of seed treatments are available for protecting the seeds from several seed borne or soil-borne pathogenic organisms and also for improving germination. Though many of them are detrimental to the health of humans and environment. Organic agriculture is an alternative approach for environmental supportive safe and quality production of plants. Here comes the importance of *Vṛkṣāyurveda* – an ancient science of Arbori – horticulture, is a branch of Ayurveda specifically meant for the health, healing and productivity of plants. Protocols and methods of *Vṛkṣāyurveda* are promising in the field of organic agriculture. The various seed treatments have been carefully designed in *Vṛkṣāyurveda* to obtain good quality of seedlings. Seeds which are treated and preserved in this manner are excellent for sowing and will sprout undoubtedly. *Viḍaṅga* (*Embelia ribes* Burm.), *Sarṣapa* (*Brassica juncea* L. Czern.), Gomaya (Cow dung), *Kṣoudra* (Honey), *Bṛhati* (*Solanum anguivi* Lam.), *Ghṛta* (Ghee), *kṣ*īra (Milk), *Tila* (Sesamum indicum L.), *Kamala nāla* (stalk of *Nelumbo nucifera* Gaertn.) are extensively used in various seed treatments. These are applied on the seeds in the form of soaking, coating, fumigation etc. *Kṛmihara* (antimicrobial), *Kleda viśoṣaka* (drying up the moisture and thus increasing shelf life) and *Poṣaka* (fortification of seeds) properties of these drugs might act here.

**Key words:** *Vṛkṣāyurveda*, seed treatments, Organic agriculture.

## INTRODUCTION

Seeds are of immense biological and economic importance. Most of the plants do often rely on seeds for reproduction over successive seasons and years. They contain high protein, starch and oil reserves that helps in the early stages of growth and development in plants. Nowadays various conventional methods of seed treatments are available for - protecting the seeds from several seed borne or soil-borne pathogenic organisms (dressing of seeds with pesticides), addition of nutrition, facilitation of easy sowing (by increasing the size of fuzzy seeds), to remove dormancy factors (removal of hard seed coat eg: acid scarification) and improving germination.[1] Most products used in the conventional methods are harmful to our health and

environment. But we are surprised by the fact that various methods of processing and preservation of seeds have been explained in detail in *Vṛkṣāyurveda* - an archaic science of Arbori –horticulture, thousands of years ago, which is crucial in enabling transition from chemical fertilizer based agriculture to organic agriculture. *Vṛkṣāyurveda* is a branch of Ayurveda specifically meant for the health, healing and productivity of plants. In ancient India, Ayurveda is not just considered to be a medical science for human beings but also for the betterment of plants and animals. According to *Acārya* Caraka, all the substances in the universe is made up of *Pañcamahābhūtas*, so all are basically similar.[2] It treats plants on the basis of the concepts of *Tridosās* similar to human beings. It is highly appreciable to have such a branch of science that assures the safety and quality of agricultural products. Scattered information about *Vṛkṣāyurveda* is available in *vedās, Purāṇās, Samhitās* etc. Brhat Samhita of *Varāha Mihira* (505 AD) mentions *Vṛkṣāyurveda* but doesn't appear to be provide authentic knowledge. Later it was systematically compiled by Surapāla on 10$^{th}$ AD. It deals with seed treatment prior to sowing, types of land, methods of propagation of plants, production of hybrid varieties, pest control, treatment for various plant ailments, like everything that modern agriculture says has been systematically codified and compiled. But this book was not widely circulated in later times.[3]A chapter titled *Upavana vinoda* in *Śārṅgadhara paddhati* of *Śārṅgadhara* (13$^{th}$ AD) deals with *Vṛkṣāyurveda* but all its information is similar to the *vṛkṣāyurveda* compiled by *Surapāla*. The various seed treatment processes have been carefully designed in *Vṛkṣāyurveda* to allow early germination, to obtain good quality of seedlings like soaking in milk, rubbing the seeds with cow dung, applying some herbal medicines to seeds etc. This paper intends to provide a detailed review about all these materials and methods. At the same time, compare the conventional methods and also understands the superiority of *Vṛkṣāyurveda* methods of seed treatments.

## MATERIALS AND METHODS

*Vṛkṣāyurveda of Surapāla* by Shrikrishna Jugunu (Hindi translation), *Bṛhat Samhita* of *Varaha Mihira* by N.C Iyer**,** *Surapala's Vrikshayurveda* (The science of plant life by Surapala) by Sadhale Nalini (English translation) and *Śārṅgadhara paddhati* of *Śārṅgadhara* were thoroughly reviewed to compile the seed treatments mentioned in *Vṛkṣāyurveda.*

**Various seed treatments mentioned in *Vṛkṣāyurveda***

Seeds should possess high standards of germination, vigour and purity but if they are contaminated with seed borne pathogens and insect pests, may be useless to farmers. It has been recommended that the seeds should be extracted from the dried fruits which become ripe in the natural course and season. Following methods of seed treatments are prescribed in *Vṛkṣāyurveda* for the production of healthy seedlings (Table 1 and Table 2 ). Seeds which are treated and preserved in this manner are excellent for sowing and will sprout undoubtedly. Trees grown from such seeds will bear ample flowers and fruits of supreme quality.

## RESULTS AND DISCUSSION

Discussing about the materials, mostly used for the seed treatments in *Vṛkṣāyurveda,* prior to sowing and also explains their probable mode of action.

**Importance of treating the seeds with *Gomaya* (Cow dung)**

*Gomaya* (Cow dung) is extensively used in the above mentioned treatments. According to Ayurveda, cow dung is not a waste product, but it is a purifier of all wastes in the nature. It is a "gold mine" due its wide applications in the field of agriculture, energy resource, environmental protection, and therapeutic applications. Cow dung is a cheap and easily available, rich source of microflora. Though cow dung has been used in several studies, but the breed of cow has not been mentioned. Ideally, the source of cow dung as per Ayurveda should be from a healthy Zebu cow, fed upon healthy diet of pastures including various natural herbs and which has been reared hygienically. It is a mixture of dung and urine in a ratio of around 3:1. It contains crude fibre (cellulose with lignin), crude protein, cellulose, hemicellulose, and 24 minerals like nitrogen, potassium, traces of sulphur, iron, magnesium, calcium, cobalt, manganese, and so forth.[6] Microbial composition of cow dung includes about 60 species of bacteria (Bacillus species, corynebacterium species, and lactobacillus species), fungi (Aspergillus and Trichoderma), about 100 species of protozoa and yeasts (saccharomyces and candida).[7] Usually cattle manure tends toward a neutral pH. Optimum pH values for seed germination is 6.0 – 7.0. Therefore treating with cow dung might maintains the pH at an optimum level.

A study conducted by Thanuja PC et al., on Enhancement of seed germination rate and seedling vigour index in Red sanders (*Pterocarpus santalinus* (Linn. F.): An endangered

tree medicinal plant through different pre-sowing seed treatments, concluded that Seeds were treated with different treatment such as growth regulators (GA3, NAA, Cytokinine), acid scarification (KNO3, HCl, H2SO4) and organics (hot water, cow urine, cow dung slurry). Among all the treatments seeds treated with cow dung slurry recorded the early germination (11.50 days), maximum germination percentage, final mean germination and seedling vigour index and germination speed.[8]

A study conducted by Suchi Srivastava et al., on Reduced cell wall degradation plays a role in cow dung mediated management of Wilt complex disease of chickpea seeds, concluded that Cow dung-coated seeds sown in presence of mixture of fungi (FCD) could reduce the activities of cell wall degrading enzymes produced by plant roots in response to pathogens, which were otherwise higher in mixture of wilt complex fungi/pathogens (FUN) treatment. Results indicate that cow dung treatment of chickpea seeds reduces activities of the cell wall-degrading enzymes in a transcriptionally regulated manner, which in turn function as bio-control measure for disease. Considering cow dung as a rich source of microflora, it was hypothesized that cow dung coating may be used to bacterize seeds which may play a role in cell wall-associated mechanisms of disease resistance.[9]

A strain of Bacillus subtilis from cow dung microflora has been shown effective against two postharvest Yam pathogenic fungi, F. oxysporum and Botryodiplodia theobromae, and stimulated the sprouting and root elongation of Yam minisetts by production of plant growth regulators. [10]

Cow dung is termed as gomaya in Ayurveda and it is of *kaṣāya tikta* (astringent and bitter) in rasa (taste), *Laghu - Rūkṣa* (light and ununctuous) in *guṇa* (properties), *śīta* (cold) in vīrya (potency) and *kaṭu* (pungent) in *vipāka* (metabolic outcome).[11] Generally if the seed moisture content increases storage life decreases. If the seeds are kept at high moisture content the losses could be very rapid due to mould growth**.**[12]Here, the *kleda viśoṣana* property (drying up of moisture) of *kaṣāya* and *tikta rasa* (astringent and bitter taste) will help to keep the seeds moisture free and also the *kṛmihara* (antibacterial and antifungal) property of *tikta rasa* (bitter taste) will provide protection against fungal deterioration of seeds. It is recommended to coat seeds with the paste of cow dung and mud in *Vṛkṣāyurveda*. It can be clearly correlated with the seed dressing in the conventional practice, which involves the treatment of various crop seeds with fungicides or insecticides in order to combat soil borne fungal diseases. But the usage of pesticides have been shown to affect earthworms from the physiological to community level, where insecticides and fungicides appear to be the most toxic pesticides and also alter nutrient cycling with potential consequences for the functioning of agroecosystems.[13]

**Importance of treating the seeds with *Bhasma* (Ash)**

Many experimental studies reveal that ash treated seeds can be kept healthy and free from insects, fungi etc. for at least 12 months. Precise rationale behind the mechanism of action is still obscure. It has been suggested that dust particles such as ash blocks the air spaces between grains thereby inhibiting the insect movement during storage. Insects that attack seeds coated or submerged in ash are possibly killed as a result of desiccation of water damaging the cuticle.[14] In addition, the cessation of insect movement also results in less likelihood of ovi-position directly onto the seeds.[15]Besides insects, spores of storage fungi may also damage the seeds, because these storage fungi can grow in highly complex environments such as low moisture content and high osmotic pressure that inhibit the growth of normal fungi. It is probable that the ash maintains the seeds in a lowest possible dry state, a property that could prevent the growth of storage fungi.[16]

Ash is termed as *bhasma* in Ayurveda, which is obtained through incineration. *Bhasma* possess various peculiarities like maintaining optimum alkalinity and also neutralizing harmful acids. The particle size in the *bhasma* is 1-2 µ, which could be specified as the criterion for the final product confirming to all the traditional parameters under *bhasma parīkṣa*.[17] It is obvious that powder / ash of *Tila* (Sesamum indicum L.), *Vidanga* (*Embelia ribes* Burm.), *Brhati* (*Solanum anguivi* Lam.), *Kamala nāla* (stalk of *Nelumbo nucifera* Gaertn.) are extensively used in all treatments mentioned above. Here *Tila (sesamum indicum .L)* due to its *vāta śamaka* action will helps to alleviate *Vāta doṣa*.[18] The properties of *Vāta doṣa* are degenerative by nature and results in degenerative changes in the body in terms of *Dhātu kṣaya, Oja kṣaya* and *Bala kṣaya* (diminution of strength of the body). The same deterioration is happens in case of seeds also during their storage. Moreover, Sesame seed (Sesamum indicum L.), accessions contained significantly higher levels of $\gamma$-tocopherol than of $\alpha$-tocopherol and $\delta$-tocopherol.$\alpha$-tocopherol and $\gamma$-tocopherol are the two major forms of vitamin E. The primary function of tocopherols in plants is to limit non enzymatic lipid oxidation during seed storage, germination and early seedling development.[19] *Bṛhati*

(*Solanum anguivi* Lam.), is *kaṭu – tikta* (pungent-bitter*)* in rasa (taste), *Viḍaṅga* (*Embelia ribes* Burm.) is of *katu-kaṣāya* (pungent-astringent) in *rasa*.[19] Here *katu, tikta, kaṣāya rasās* (pungent, bitter, astringent tastes) possess *kleda upaśoṣana* property (drying up of moisture).[21]That might help in the long term storage of seeds. Moreover *kṛmihara* (antibacterial and antifungal) property and presence of Embelin in *Viḍaṅga* (*Embelia ribes* Burm.) might help to protect the seed from several seed or soil borne pathogenic organisms and thus helps in seed disinfection and disinfestation.[22] It is recommended to use honey along with *Viḍaṅga* (*Embelia ribes* Burm.). Honey in its raw and natural form has very low moisture content. For this reason, honey is a poor environment for most bacteria and microorganisms to live. *Kamala nāla* (stalk of *Nelumbo nucifera* Gaertn.) is of *madhura* (sweet) in *rasa* (taste) and *śīta* (cold) in *vīrya* (potency) and also possess *rasāyana* (rejuvenative) property.[23] *Madhura rasa* (sweet taste) is extremely nourishing and improves vital energy and is also life sustaining.[24] Besides that, Lotus stem is very nutritive and it contains protein, amino acids, starch and vitamin C, vitamin $B_1$ and vitamin $B_2$ in abundance. It also possess antibacterial effect against B.subtilis, B.pumilis, Pseudomonas aeruginosa etc. It is reported that the Lotus stem possess high water absorption index due to the presence of crude fibre content and starch.[25] Due to the above said properties Lotus stem might act as an fortifying, antibacterial and moisture drying agent in the seed treatment process.

A study conducted by Gangadhar T. Aralelimath et al., on 2019 revalidates the germination behaviour of dormant seeds *of Psoralia corylifolia* Linn. Dormancy factor is present in these seeds and must be counteracted to obtain prompt germination. From the obtained results it can be recommended to treat the seeds of *Bākuci (Psoralia corylifolia)* by soaking in milk for 12 hours, drying followed by application of Bṛhati (*Solanum anguivi* Lam.), *Tila* (Sesamum indicum L.), *Kamala nāla* (stalk of *Nelumbo nucifera* Gaertn.) and ghee paste for 12 hours for safe and better germination, in comparison with the conventional method of treating with sulphuric acid.[26]

**Importance of *Dhūpana* (fumigation) of seeds**

Smoke is an important factor involved in fire and post fire germination cues. Farmers throughout the world have traditionally used fire and smoke in grain drying practices. It is thought that these methods improve germination and seedling vigour. Smoke has been applied in agriculture mainly by two ways viz., Aerosol method and Smoke water method. In aerosol method, seeds were directly exposed to smoke generated from burning plant material. The role of smoke in stimulating germination was first highlighted in South Africa in a study on *Audouinia capitata*, a threatened fynbos species. Smoke-water is one of the most convenient means of application. The biologically active compounds present in smoke readily dissolve in water and when this smoke-extract is used as a diluted solution, treated seeds of many species show a marked improvement in germination. The main active germination compound of smoke-water derived from burnt plant materials and cellulose has been identified as butenolide [3-methyl-2H-furo (2, 3-c) pyran-2-one], which is effective at very low concentrations (1 ppb). The compound has recently been referred to as "karrikinolide". Following the initial isolation of KAR1, a whole new family of plant growth regulators, termed 'karrikins', were identified in smoke and several related compounds have been synthesized. It is estimated that between 2 and 5 g of KAR1 is more than sufficient for 1 ha of land application rates that are commercially viable.[27]

Ayurveda has given much importance for preventive medicine and it has described several modes for disinfection purpose. Fumigation (*Dhūpana*) with various drugs is one such method which is safe natural and cost effective. Mostly *Agni* and *Vāyu mahābhūta pradhāna dravyās* are used for this procedure.[28]They are of *Laghu, Rūkṣa and Tiksna* (light, rough and potent) *in guṇa* (properties), *Uṣṇa* (hot) in *vīrya* (potency) and *katu* (pungent) in *Vipāka* (metabolic effect). In *Vṛkṣāyurveda*, viḍaṅga (*Embelia ribes* Burm.) and *sarṣapa* (*Brassica juncea* L. Czern.) are used for the purpose fumigation of seeds. The antibacterial and antifungal properties of these drugs might help in the protection of seeds. *Vasā* (muscle fat) has also been recommended for smoking. The main role of *Vasā* (muscle fat) for *dhūpana* (fumigation), might help in the rapid combustion of cellulose of herbs and keep the fire alight.

**Importance of treating the seeds in *Kṣīra* (Cow's Milk)**

To meet the demand for an appropriate soaking duration and priming type, there is a need to embrace cheap, fast, natural, accessible and adaptable physiological techniques as soaking of seeds in water and fresh cow's milk. Fresh cow's milk contains hormones that relieve seeds from photo, thermo, physiological and mechanical dormancy. A study conducted by Sadiqur Rahman et al., on Effect of Milk and Hydro- priming on Seed Germination Characteristics of Bitter Gourd (*Momordica charantia* L.) concludes that the percentage germination value of seeds

soaked in all concentrations of fresh cow's milk was better than hydropriming. A significant germination percentage value of 96% and 93% were recorded for seeds treated for 18 hours in 80% and 100% concentrations of fresh cow's milk respectively. Maximum uncertainty of the germination process and minimum synchrony of germination process was recorded in untreated seed.[29] Cow's milk also helps in seed fortification. The main objective is to achieve the high vigour to overcome unfavourable soil reactions. From the perspective of Ayurveda, Cow's Milk is *madhura* (sweet) in *rasa* (taste) and *Vipāka* (metabolic effect), is *snigdha* (unctuous ), increases *ojas* (vitality) and *dhātus* (tissues), pacifies *Vāta* and *Pitta*, is *Vṛṣya* (aphrodisiac), increases *Kapha* and is *guru* (heavy) and *śīta* (cool). Cow's milk is *jīvanīya* (restorative) and ras*ā*yana (regenerative). It is suitable for those affected with *kṣata kṣīṇa* (weakness after injury).[30] All these are the benefits that humans get from the milk. But as mentioned earlier, it can be seen that all these things are applicable to seeds as well, while there is no difference between humans and plants. Here seeds are considered like that of human embryo. Just as an embryo getting nourished with *jīvanīya auṣadha* (restorative medicines) like milk, so the seeds are also nourished and in order to keep the seeds intact for a long time. Modern seed treatments like hydration-dehydration, soaking-drying are well explained in *Vṛkṣāyurved**a***. Here seeds are soaked in milk and then dried in the shade or sunlight.

Hydration – Dehydration (H-D)

It is the process of soaking the low and medium vigour seeds in water with or without added chemicals usually for short durations to raise the seed moisture content to 25 – 30% and drying back the seeds to safe limits for dry storage.

Soaking – Drying (S-D)

Stored seed is soaked in water or solution of chemicals sufficient to cover it and kept at room temperature for 2-6 hour depending on the material with occasional stirring. The soaked seed is taken out and after surface drying in the shade for some time, dried back to the original moisture content. Seeds dehydrate during the final stages of their development and, therefore, need to absorb water from the ambient surroundings to rehydrate their tissues and start the germination process. This dehydration during seed production is a natural process that allows the seeds to reduce their metabolism before dispersal in the environment where they can remain viable for longer periods to subsequently germinate. However, depending on where the seed is dispersed, this rehydration event, which will result in seed germination, may be interrupted by a lack of water in the soil and when this occurs the seeds interrupt their germination process and begin to lose the absorbed. This event of loss of water by the seeds during the germination process is observed more frequently in arid and semi-arid ecosystems because, in these regions, there is a water limitation in the soil and in the time that this resource is available for the seeds, even during the rainy periods discontinuous hydration renders the seeds of native species a high rate of survival during desiccation, demonstrating that these seeds may have a hydration memory, caused by the imbibition process, which preserves the resulting characteristics of the prior hydration. The main advantages attributed to discontinuous hydration are related to the high rate of survival during desiccation and the significant increase in germinability, speed and uniformity of seed germination, as well as production of more vigorous seedlings.[31]

**Importance of treating the seeds with fruits of *Śleṣmātaka* (*Cordia dichotoma* Forest.f) and *Ankola* (*Alangium salviifolium* L.f)**

Fruits of *Śleṣmātaka* (*Cordia dichotoma* Forest.f) and *Ankola* (*Alangium salviifolium* L.f) are of *madhura* (sweet) in *rasa* (taste) and *śīta* (cold) in *vīrya* (potency) and of *guru guna* (heavy) and also possess *bṛmhana* (nourishing) property.[32] *Both of these are* extremely nourishing and improves vital energy and is also life sustaining.[32]

**Scarification of seeds**

Seeds often require an ample amount of time before they are fully capable of germinating. The time may differ from several days to months and it may take even years. In *Vṛkṣāyurveda* it is recommended that the cutting off the tips of the seeds of hard testa, like *Bakula* (*Mimusops elengi* L.*)* etc. helps them to germinate without delay. This method is termed as scarification, refers to the process by which hard outer coverings of seeds are softened to help them absorb water better, eventually leading to germination. Other conventional methods of scarification are also there, like acid scarification, hot water scarification and warm moist scarification. The treatment method recommended for the *Ervāruka* (*Cucumis melo var. utilissimus* (Roxb) seeds can be taken as warm moist scarification. Here seeds are placed in a warm medium to soften the seed coat.

Finally these seed treatment processes can be categorized under the following 3 headings- *kṛmihara, kleda viśoṣaka* and *Poṣaka.* (Table 3)

## CONCLUSION

Seed treatment finds essential application in plant ecology and agriculture that allows seeds to overcome un favourable conditions. Most products used in the conventional methods are harmful to our health and environment. But we are surprised by the fact that various organic methods of processing and preservation of seeds have been explained in detail in *Vṛkṣāyurveda* thousands of years ago. The various seed treatment processes have been carefully designed in V*ṛkṣāyurveda* to allow early germination, to obtain good quality of seedling like soaking in milk, rubbing seeds with cow dung, applying some herbal medicines to the seeds etc. We can categorize these treatments under the following three headings – *kṛmihara* (antimicrobial), *kleda viśoṣaka* (drying up the moisture and thus increasing shelf life) and *Poṣaka* (fortification of seeds). *Vṛkṣāyurveda* is an area that still needs a lot of research and it is destined to play a major role in exciting, motivating and educating researchers and farmers from all over the world. *Vṛkṣāyurveda* methods of cultivation increases soil fertility and soil health and it helps in the production of safe and quality agricultural products. It also enhances the growth of microbial flora in the soil. The role of *Vṛkṣāyurveda* is crucial in enabling transition from chemical agents based agriculture to organic agriculture. This will pave the way for the agricultural revolution itself where agriculture will be ecofriendly.

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**Table 1: Various seed treatments mentioned in *Vṛkṣāyurveda* of *surapala*[4]**

| Sl.no. | Seed treatment procedure | Materials used |
|---|---|---|
| 1. | Seeds are soaked in *Kṣī*ra (Cow's Milk).<br>⬇<br>Dried in sunlight for five days.<br>⬇<br>Smoked with *Viḍaṅga* (*Embelia ribes* Burm.) and *Sarṣapa* (*Brassica juncea* L. Czern.) | *Kṣī*ra (Cow's Milk).<br>*Viḍaṅga* (*Embelia ribes* Burm.)<br>*Sarṣapa* (*Brassica juncea* L. Czern.) |
| 2. | Seeds are soaked in *Kṣī*ra (Cow's Milk).<br>⬇<br>Smeared with ash of *Tila* (Sesamum indicum L.) and *Bṛhati* (*Solanum anguivi* Lam.) mixed with *Ghṛta* (Ghee).<br>⬇<br>Apply the paste of *Gomaya* (cow dung) and mud over them.<br>⬇<br>Smoked with *Vasā* (muscle fat ) | *Kṣī*ra (Cow's Milk).<br>*Tila* (Sesamum indicum L.)<br>*Bṛhati* (*Solanum anguivi* Lam.)<br>*Ghṛta* (Ghee)<br>*Gomaya* (Cow dung)<br>Mud<br>*Vasā* (muscle fat) |
| 3. | Seeds soaked in *Kṣī*ra (Cow's Milk).<br>⬇<br>Rubbed with *Gomaya* (Cow dung)<br>⬇<br>Dried in sunlight<br>⬇<br>Profusely smeared with *Kṣoudra* (Honey) and powder of *Viḍaṅga* (*Embelia ribes* Burm.) | *Kṣī*ra(Cow's Milk).<br>*Gomaya* (Cow dung)<br>*Kṣoudra* (Honey)<br>*Viḍaṅga* (*Embelia ribes* Burm.) |
| 4. | Seeds soaked in *Kṣī*ra (Cow's Milk).<br>⬇<br>Dried well in shade<br>⬇<br>Rolled into powder of *Bṛhati* (*Solanum anguivi* Lam.), *Tila (Sesamum indicum* L.) and *Kamala nāla* ( stalk of *Nelumbo nucifera* Gaertn.) mixed with *Ghṛta* (Ghee) | *Kṣī*ra(Cow's Milk).<br>*Bṛhati* (*Solanum anguivi* Lam.)<br>*Tila (Sesamum indicum* L.)<br>*Kamala nāla* ( stalk of *Nelumbo nucifera* Gaertn.) |
| 5. | Seeds of *Bakula* (*Mimusops elengi* L.*)* are good when dried and treated as stated above and when the tips are cut. | |
| 6. | Seeds of *Ervāruka* (*Cucumis melo var. utilissimus* (Roxb)) are sprinkled with *Guḍāmbu* (jaggery water)<br>⬇<br>Tied in a leaf vessel<br>⬇<br>Placed in a warm place for 3 days and then taken out. | *Guḍāmbu* (jaggery water)<br>Leaf vessel |

**Table 2: Various seed treatments mentioned in The Bṛhat Samhita of Varaha Mihira[5]**

| Sl.no. | Seed treatment procedure | Materials used |
|---|---|---|
| 1. | Seeds are soaked in Cow's Milk for ten days.<br>↓<br>Smeared it with ghee.<br>↓<br>Rubbed with cow-dung<br>↓<br>Smoked with flesh of hog and the deer.<br>↓<br>Mixed with muscle fat of fish and pig.<br>↓<br>Sown in a well prepared soil.<br>↓<br>Watered with mixture of milk and water. | Cow's Milk<br>Ghee<br>Cow-dung<br>Flesh of hog and deer<br>Muscle fat |
| 2. | Seeds are soaked in paste or oil of *Ankola* (*Alangium salviifolium* L.f) or fruit of *Śleṣmātaka* (*Cordia dichotoma* Forest.f) *for* hundred times<br>↓<br>Sown in a well prepared soil | Paste or oil of *Ankola* (*Alangium salviifolium* L.f)<br>Fruit of *Śleṣmātaka* (*Cordia dichotoma* Forest.f) |
| 3. | Seeds are soaked in the fruit pulp of *Śleṣmātaka* (*Cordia dichotoma* Forest.f) after removing its seeds.<br>↓<br>Soak it in the water of ripe fruit of *Ankola* (*Alangium salviifolium* L.f)<br>.<br>↓<br>Repeat this process for seven times.<br>↓<br>Rub the seeds with buffalo-dung and Keep it buried in the same dung for some time.<br>↓<br>Sow in the soil drenched with coconut water. | Fruit of *Śleṣmātaka* (*Cordia dichotoma* Forest.f)<br>Fruit of *Ankola* (*Alangium salviifolium* L.f)<br>Buffalo –dung<br>Coconut water |

**Table 3 : Categorization of drugs and procedures involved in the seed treatments**

| ***kṛmihara*** (antimicrobial), | ***kleda viśoṣaka*** (drying up the moisture and thus increasing shelf life) | ***Poṣaka*** (fortification of seeds) |
|---|---|---|
| • *viḍaṅga* (*Embelia ribes* Burm.)<br>• *sarṣapa*(*Brassica juncea* L. Czern.)<br>• *Gomaya* (Cow dung)<br>• *Kṣoudra* (Honey)<br>• *Dhūpana*(fumigation) | • *Bṛhati* (*Solanum anguivi* Lam.)<br>• *Ghṛta* (Ghee)<br>• *Gomaya* (Cow dung)<br>• *Kṣoudra* (Honey)<br>• *viḍaṅga* (*Embelia ribes* Burm.)<br>• *Dhūpana*(fumigation) | • *Kṣ*īra (Cow's Milk).<br>• *Tila*(Sesamum indicum L.)<br>• *Kamala nāla* (stalk of *Nelumbo nucifera* Gaertn.)<br>• Fruits of *Śleṣmātaka* (*Cordia dichotoma* Forest.f) and *Ankola* (*Alangium salviifolium* L.f) |