सत्यमेव जयते
Ministry of AYUSH
Government of India

G20 भारत 2023 INDIA
वसुधैव कुटुम्बकम्
ONE EARTH • ONE FAMILY • ONE FUTURE

Ayurveda Day
आयुर्वेदोऽमृतानाम्
आयुर्वेद दिवस

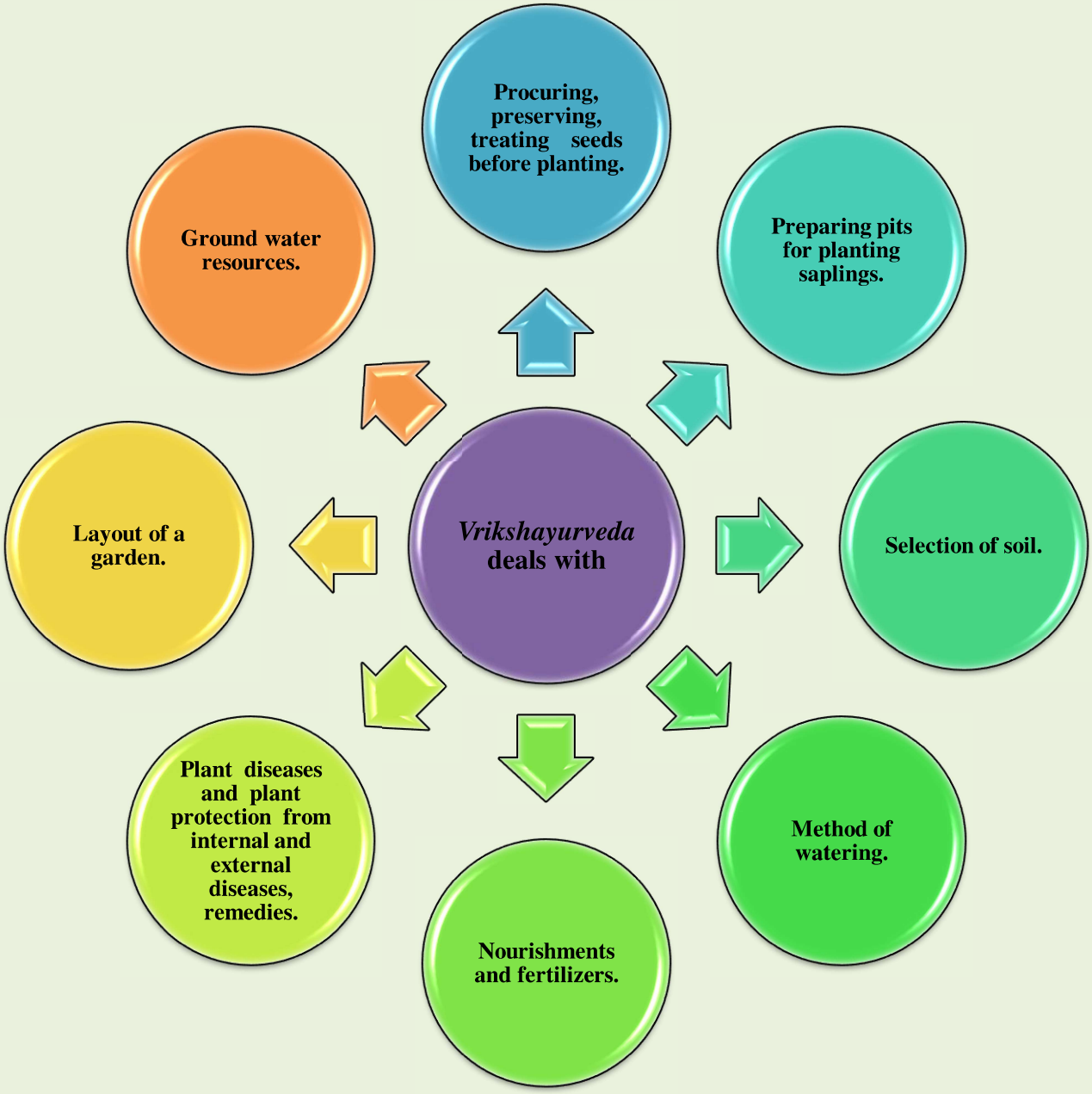
आज़ादी का अमृत महोत्सव

VRIKSHAYURVEDA FOR FARMERS

Basic Concepts and Techniques

NATIONAL MEDICINAL PLANTS BOARD
Plants For Health & Prosperity

National Medicinal Plants Board
Ministry of Ayush
Government of India


Vrikshayurveda deals with
Procuring, preserving, treating seeds before planting.
Preparing pits for planting saplings.
Selection of soil.
Method of watering.
Nourishments and fertilizers.
Plant diseases and plant protection from internal and external diseases, remedies.
Layout of a garden.
Ground water resources.

National Medicinal Plants Board Ministry of Ayush, Government of India, 2023

Compilation & Editing

Dr. (Prof.) Tanuja Manoj Nesari, Chief Executive Officer
Dr. Chandra Shekhar Sanwal, Deputy Chief Executive Officer
Dr. Rajeev Kumar Sharma (Chief Technical Advisor)
Dr. Chinmay Rath (Research Officer, Botany)
Dr. Bidhan Mahajon (Research Officer, Ayurveda)
Dr. Himanshu Dwivedi (Consultant, Research & Promotional Activities)

National Medicinal Plants Board,
Ministry of Ayush
Government of India
Indian Red Cross Society (IRCS),
Annexe Building, 1st & 2nd floor,1 Red Cross Road, New Delhi-110001,
Website : www.nmpb.nic.in
Tel : 011-23721840
E-Mail ID : info-nmpb@nic.in

Disclaimer:

The edited booklet on *Vrikshayurveda* for Farmers- Basic Concepts and Techniques is based on the available information, viz. research reviews, research findings, classical text, etc., therefore does not take any responsibility for any variation indicated in this publication.

Note: If there is any error, suggestions are welcome, and the errors will be rectified in the next edition

Preamble

Medicinal plants have been an essential source for traditional systems of medicine for treating and preventing various diseases since time immemorial. India has a rich documented history of conventional medications such as *Sushrut Samhita* and *Charaka Samhita*. About 8,000 herbal remedies have been utilized in India's Ayush systems and folklore medicines. Hence, traditional systems of medicine are still recognized as the preferred primary healthcare system in various rural populations due to affordability and effectiveness. The use of conventional medications for improving immunity and treating multiple other diseases has been approved by WHO. In the present scenario of the past COVID-19 pandemic, the demand for medicinal plants has increased tremendously with pharmaceutical advancements over the past three decades. Thus, the cultivation and commercialization of medicinal plants require a clear understanding of their demand and production systems. Further, cultivating medicinal herbs and providing quality raw materials is necessary to meet the demand of the pharmaceutical and ASU drug manufacturing industries.

India has a rich biodiversity of medicinal plants extensively used in traditional medicines like Ayurveda, Unani, Siddha, and Sowa Rigpa. Conventional treatment systems have been used since time immemorial throughout the world to treat illness and the general well-being of civilization. Ancient medical systems such as Ayurveda (the holistic system of medicine from India), Unani, Traditional Chinese Medicine (TCM), and Tibetan medicine heavily rely on medicinal plants. They are still used extensively, particularly in the respective countries of their origin.

Vrikshayurveda'The Ayurveda for the plant life' deals with special reference to procurement, preservation and treatment of seeds and planting materials, preparation of pits for planting, selection of soil, method of irrigation and ways to locate groundwater, nourishment and fertilizers, plant diseases and plants protection, laying out of gardens and orchids and also the creation of agricultural and horticultural wonders.

It gives immense pleasure to present the booklet on *Vrikshayurveda* as part of the celebration of the 8th Ayurveda Day 2023.This review collates the core information regarding different *Vrikshayurveda*-based agro techniques such as irrigation, seed management, bio-fertilizers, pest control, etc.This booklet will disseminate knowledge about the basics and understanding of *Vrikshayurveda* and provide relevant information for the farmers' benefit and

new insights into fast-emerging research areas. The booklet will also open new avenues for collaboration among those interested in*Vrikshayurveda*.

Index

1. Introduction

Vrikshayurveda, which literally means 'the Ayurveda for the plant life' is known to have existed in ancient India as a special branch of knowledge.The text of *Vrikshayurveda* deals with the special reference to procurement, preservation and treatment of seeds and planting materials, preparation of pits for planting, selection of soil, method of irrigation and ways to locate groundwater, nourishment and fertilizers, plant diseases and plants protection, laying out of gardens and orchids and also the creation of agricultural and horticultural wonders (Ramachanran, 1984).

Consequently, in broad-spectrum, the text of *Vrikshayurveda* deals with the various aspects like- detection of underground water; spacing between trees; methods of propagation; preparation of pits for planting; seed treatments; nourishment; protection; and other relevant information.

2. History

As man'srelations with the jungleintensified, his apprehension for the health of the forests also grew. He started thinking about the trees' ailments and their causes and cures.In fact, the term "*Vrikshayurveda*" has been in use since ancient times. During 296–321BC,when Kautilyacompiled his book "*Arthasastra*", the term "*Vrikshayurveda*" was well-established and well-known. A very brief document on *Vrikshayurveda* was compiled as "*Brihat Samhita*" by the legend Varahamihira during 505–581 AD.

During the 6thCentury B.C., although "*Vrik Cikitsa*" had not become a separate branch of study, even when the science of Ayurveda flourished,however, references of plant treatment can be found in many *Samhitas* (Ramachanran, 1984).

2.1. Historical Background of *Vrikshayurveda*

Vrikshayurveda deals with various tree and plant species and ensures healthy growth and productivity. It comprises about 170 plant species, including herbs, shrubs and trees (Ranjana, 2017). The chapters of *Vrikshayurveda* deal with horticulture, home gardening, intercropping and storage, etc. The book also widely emphasizes plant procurement and preservation, soil

treatment, groundwater management, and fertilizers. Two ancient books are entirely dedicated to *Vrikshayurveda*. The text of *Vrikshayurveda*, written by Salihotra around 400 B.C., consists of twelve vast chapters, namely *Bhumi nirupana* (graphical representation of soil classification according to *Bhumi nirupana*), *Bijoptivithi* (illustrate the process of seed germination), *Padapavivaksa* (exposed to the medicated smoke which can serve as an antimicrobial agent), *Ropanavidhana* (method of cultivation), *Nisecanavidhi* (the life of plant), *Posana* (nurture),*Vidhi* (method), *Drumaraksa* (protection of trees from weather), *Taru Cikitsa* (methods of treatment of various ailments occurred in trees), *Upavanakriya*, *Nivasasannataru Subhasubha Laksana* (perfect dwelling), *Taru Mahima* (a little away from roof and window) and *Citrikarana* (make it blossom throughout the year).

2.2. Authors of*Vrikshayurveda*

In the last 15 years, the term "*Vrikshayurveda*" has become widely known amongst agriculturists in India and other countries.This bookis a dedicated text signifying the importance of agriculture science. *Vrikshayurveda* mainly deals with various species of trees and their healthy growth and productivity. Ancient India not only had medical science for humans but also one for plants called *Vrikshayurveda*.There are several texts on *Vrikshayurveda* are available.Chronologically, the last text available is "*Shivatatvaratnakara*" (in Kannada). (YL Nene, 2012)

Author	**Books of *Vrikshayurveda***
Chakrapani Mishra (courtier) (1577 AD)	*Vishvavallabha*
Sarangadhara (courtier) (1283–1301 AD)	*Upavanavinoda*
Varahamihira (scholar) (505–581 AD)	*Brihat Samhita*
Surapala (physician) (c. 1000 AD)	*Vrikshayurveda*
Someshvardeva (king) (1131 AD)	*Manasollasa*
Chavundaraya (scholar, poet) (1025 AD)	*Lokopakara*
Basavaraja of Keladi (king) (1698– 1725 AD)	*Shivatatvaratnakara*

3. Relevance of Vrikshayurveda

3.1. Relevance of *Vrikshayurveda*

The main aim of Ayurveda is "*Swasthasya Swasth Rakshanam, Aturasya Vikar Prashamanam Cha*'' means to maintain the health of healthy human beings and treat the diseased ones. The same principle is applied to plants in *Vrikshayurveda,* but the unawareness of such ancient texts is answerable for the degeneration of agricultural practices. With the help of ancient texts and model methods of agriculture, we can not only scientifically provide evidence of the aphorism of the text but also establish various novel modified techniques for the agricultural systems to build eco-friendly environments as well as to avert the health hazards caused by uncontrolled use of chemical fertilizers, pesticides can also be chopping down.

The traditional storage space treatment using cow's milk, cow dung, honey and *Vidanga* powder methodology adopted from Surapala's *Vrikshayurveda* is practical for storing seeds. Even Cow dung slurry is effective in increasing germination percentage and rate of growth speed. Applying *Panchgavya* can also give back to Mother Nature by promoting soil fertility, earthworm production, protecting crops from bacterial and fungal infections, etc. Thus,*Panchagavyam* is considered to be better than Urea as a nutrition supplement for seedlings (Komal K Bajaj, 2022).The proper interpretation and availability of *Vrikshayurveda* can also play an important role in intercropping and put forward for the use of organic fertilizers and can play a crucial role in building an eco-friendly environment. The scientific community should validate the sayings of *Vrikshayurveda* and the development of agriculture and the production of various medicinal plants used in various systems of medicine. Y.L. Nene avows that the methods described in *Vrikshayurveda* have the potential for more crop yield and can control crop mites. Apart from agricultural scientists, the personnel from Ayurveda, Forestry, Ecology and Pharmacognosy should emphasize the ancient science of *Vrikhsayurveda* and correlate with modern science with required validation.

3.2. Causes and treatment of diseases

The disease of all types of trees is stated to be of two varieties such as- internal and external. The internal ones are those which are caused by *Vata*, *Pitta* and *Kapha,* and external ones are those which are caused by insects, cold weather, etc. Among these, diseases caused by *Vata* are due to the land that becomes arid on account of excessive supply of dry and pungent

matte. These diseases are the thinness and crookedness of the trunk, the appearance of knots on the trunk or leaves and the fruits being hard with less juice and less sweetness. The disease of Kapha types occurs in winter and spring if the trees are excessively watered with sweet, oily, sour or cold materials. These diseases are responsible for taking a long time to bear fruits, paleness, dwarfing of leaves, tastelessness and pre-maturity of fruits. The illness of *Pitta* types occurs at the end of summer if the cloud disappears and the trees are excessively watered with bitter, sour, salty and robust materials. These cause yellowness of leaves, untimely dropping of fruits, dryness, and paleness of leaves, flowers, and fruits. Due to the imbalance of *Kapha* elements, the trees ooze out even without wound. If the wrong treatment is given, a corresponding disease of *Vata* type occurs. Due to the *Vata* type of disease, day by day, the tree lose their leaves, flowers and fruits. An imbalance in *Vata*, *Pitta*, and *Kapha* develops due to faulty seeds, lack of treatment, and wrong treatment, rendering all the trees unproductive.

Sl.No	Causes	Treatment
1.	*Vataja Vyadhi*	● *Mamsa* (Flesh), *Meda* (Fat) and *Ghrita* (Ghee) to be given. ● Sprinkling of *Kunapajala*.
2.	*Pittaja Vyadhi*	● *Sheetha* (cold) and *Madhura dravyas*(sweet items) should be administered. ● *Madhuyastyadikwatha* consisting of *Kshira* (milk),*Madhu*(honey),*Yastimadhu* and *Madhuka* in the form of *kwatha*(decoction) should be given.
3.	*Kapha Vyadhi*	● Administration of *Panchamula kwatha* (decoction made from Panchamula). ● Decoction of properties *Kashaya* (astringent), *Katu* (pungent) and *Tikshna* (sharpness) should be given. ● *Sitasarshapakalka* (cold paste of mustard seeds) to be applied externally over the roots. ● *Tilabhutijala* (ash of sesame seeds mixed in water) should be sprayed on the plants.
4.	*Krimija Vyadhi*	● Sprinkling cold water on the tree's roots, stem and branches for seven days. ● The mixture of *Siddhartha*, *Vacha*, *Kusta,* and *Ativishalepa* (paste)

		should be applied externally over the infected site. ● Fumigation with *Vacha*, *Vidanga*, *Hingu*, *Ushna*, *Gomamsambu*, *Kapotha Mamsa*, *Saribhivisana*, *Bhallataka* to be done.
5.	Broken trees	● The broken parts should be firmly tied with the rope of *Dhanyavntha* or paddy. Besmear with the *Kalka* (paste) of *Ghrita*, *Madhu*, *Udumbara*, *Madira* and *Plaksha*. Soil should then be filled in the basin around the trees, *Mahishaksheera* (buffalo milk) and water should be sprinkled.
6.	Falling branches	● A paste of *Madhu* (honey) and *Ghritha* (ghee) should be applied and irrigation with milk mixed with water.
7.	Burn	● Branches caught in the fire-burnt part should be separated and cut off. Then irrigation should be done with *Dugdha* (milk) mixed with water be smearing with the lotus paste and irrigation with *Kunapajala*.
8.	Infertility	● The soil at the root is replaced by fertile soil and irrigated with milk and water. ● Irrigation with *Yava, Tila, Kulattha, Masha* and *Mudga* mixed water to be done.
9.	Lack of water	● Irrigation to be made with water mixed with milk, followed by fumigation with *Kulira* (*Karkataka*).
10.	*Mithyopachara* (Mistreatment effect)	● Paste of *Vidanga* mixed in *Panka* (mud) be applied and also to be irrigated with milk mixed with water.
11.	*Pandu* (Anaemia)	● Irrigation with *Yava*, *Godhuma*, *Kshoudra*, and *Paya* mixed water.

4. SURAPALA'S *VRIKSHAYURVEDA*:

The book on *Vrikshayurveda* was written after Salihotra by Surapaladuring 1000 CE. Surapala was a resident of Bundelkh and, which is located in central India. He carried out his diverse experiments in horticulture and botany. His text was forgotten and fell into oblivion for several centuries. The original Sanskrit manuscript was translated into English by Dr. Nalini Sadhale in the year 1996 and into Hindi by Dr. S.L. Choudhary in the year 2003.Surapala's book deals with various areas under discussion, such as planting a garden, the importance of various trees, collection, examination and treatment of seeds, selection of suitable land, soil characteristics, digging of planting pits, different methods of irrigation, plant nutrition, fertilizers, diseases of trees and their treatment, the wonders of horticulture, plant conservation, underground water resources etc. Surapal's *Vrikshayurveda* is a systematic composition starting with the glorification of trees and tree planting. It then proceeds to discuss various topics connected with the science of plant life, which are discussed below.

4.1. *TaruMahima* (Significance of the Plant's):

दशकूपसमा वापी, दशवापीसमो ह्रदः।
दशह्रदसमो पुत्रो, दशपुत्रसमो द्रुमः।।

The chapter '*Tharumahima'*states that ten wells are equivalent to one pond, ten ponds to one lake, ten lakes to one son and ten sons to one tree. A more convincing inference could never have arrived to emphasize the importance of trees and show how much love, honour and attention they were treated. '*Tarumahima'* announces that a man attains the highest conceivable perfection by planting trees. It was believed that the Almighty lives with those who plant trees that yield edible fruits. The glorification of trees refers to the merit of planting trees on the side of a road, in a field, and a garden. It mentions the significance of growing several specified trees.

4.2. *Nivasasannataru Subhasubhalaksana*(Merits and Demerits of the trees planted near the residence):

The next Chapter '*Nivasasannataru'* '*Subhasubhalaksana'*contains many fascinating points. Anidealresidence must have *Nygrodha* (*Ficus benghalensis*) in the east, *Udumbara* (*Ficus racemosa*) in the South, *Pippal* (*Ficus religiosa*) in the West and *Plaksha* (*Ficus lacor*) in the North. But they should never be planted too much near the house; their branches and leaves

should not reach the roof and windows. Also, it deals with the auspicious and inauspicious signs of trees planted adjacent to residential complexes. They are considered auspicious or inauspicious according to the direction in which they are grown. It proscribes planting trees in front of the house because the shade of trees should not fall over it. One should avoid thorny plants near the house, oozing milk, bearing wild fruits, and having hardwood. A person planting *Nili* and *Haridra* in the home may always meet with loss of progeny and prosperity.

4.3. *VatikaVidhiYojana- Upavanakriya* (Garden layout):

It deals with instructions for the organization, cultivation and preservation of gardens. After selecting the most suited ground, the first endeavour must be to build a '*Latagrha'*. For this house, one must choose a creeping plant that yields sweet-scented blossoms and flowers in great profusion. Similar creepers should also be erected in the garden. The next step is the construction of an artificial hillock, '*Kridaparvata'* along with a grotto, a valley, and a large body of crystal-clear water with a fountain in the centre. *Swans* should render added charm by swimming along the pool. Next would come the building of a '*Kadaligrha'*. It is a kind of rest house erected in the middle of the miniature lake. This section also explains the garden layout. The garden needs to be situated to the West and East of the house, but never to the South, South-West or South-East, which may lead to quarrels, distress and adversity.

4.4. *Bhumi Nirupana* (Selection of the soil):

The chapter mainly deals with the classification of the soil. It is divided into classes according to fertility and the accessibility of water. The first class is named '*Jangama*', representing places with scanty water and less vegetation. The next category is called '*Anupam*', comprising rich and fertile lands with irrigation facilities surrounded by thick, towering trees. The third name, '*Sadharana*' is assigned to ordinary lands that are neither very fertile nor infertile. These three classes are broken up further into six sub-divisions based on the colour and flavour of mud. It mentions six types of soil based on their colour and six types based on their taste. It also states the qualities of an ideal land contrasted with an evil land. It favours the *Sadharana* land as compared with the *Jangala* and *Anupa* land. The earth is said to have acquired different colours and flavours due to the irruption and disruption of age-old rocks whose clay and sand contain enormous amounts of chemicals and minerals.

Present-day agricultural conceptions of selecting soil and cultivating trees and lesser plants appear to be based on farming principles that are not different from those followed by our ancient agriculturists. It explains ideal soil as bluish like sapphire, soft like parrots's feathers, white like conch, jasmine, lotuses or the moon and yellow like heated gold or blooming *Champaka* is the land recommended for planting. However, it also asserts that trees can be made to grow even on an unfavourable land by determination (*Nischaya/Sankalpa*), spending money (*Nidhi*) and putting in hard labour (*Icchashakti*) and through the blessings of gods and kings (*Shasananithi and Rajyaprabhava*).

Another sound illustration compares Mother Earth to the human body in this section. Just as the blood vessels carry the blood through the surface and internal parts of the body, there are also various water fountains in the upper and lower layers of the earth. It also cautions against leaving an inch of territory barren and uncultivated. It says that all land can be made fertile and cultivable by dexterous human labour, etc., and above all, by the blessings of God Almighty. At present, Israel appears to be the only country that has put into practice the advice of *Sarngadhara* in full.

4.5. *Padapa Vivechana Vistara-'Padpavivaksa'*

The Chapter '*Padpavivaksa'* deals with whether plants have life and senses. After discussion finally, it is concluded that plants have life and senses. The only difference between man and tree is that while the tree has its head rooted deep in the earth and the branches spread in the air, man keeps his head high up and walks on his branches, his legs. Plants and trees can also suffer from hunger and thirst; they also need sleep. The names and types of creepers and trees that go to sleep soon after sunset are carefully noted. It also deals with the method of propagation of plants. It describes four *Swarupa* (category) of *Padapa* (plants), *Vanaspati* (which bears fruits without blossoming), *Druma* (which bears flowers and then fruits), *Lata* (which spreads through its tendrils) and *Gulma* (which has multiple branches). Surapala mentions methods for the propagation of plants by seeds (*Bija*), and by scion (*Kanda*). It describes separate lists of plants that grow out of seeds (*Bija*) and scions (*Kanda*), seeds and scions, bulbous roots, and seeds and bulbous roots.

4.6. *Bijotpathi Vidhi* and *Bijopachara*

The Chapter "*Bijoptivithi'* is a significant for explaining the grading and preservation of seeds. Before planting, the seeds should be mixed with ashes and exposed to treatment by medicated smoke. This procedure ensures the overall growth and health of the plants. The rules of cultivation in the book go very well with the latest methods adopted by modern specialists for growing more food. The roots of sesame plants and others of the bean family carry root modules containing bacteria. These bacteria imbibe nitrogen and produce nitrogen salts, rich and nutritious food for plants. These should not be removed from the fields after the harvest but ploughed along with the stubble when the field is being made ready for the next sowing. The seeds should be treated with various substances before sowing for a healthy yield. It explains pre-sowing seed treatment techniques with organic materials as follows:

1. Seeds from fully ripened natural fruits should be sprinkled with milk, dried for five days, and fumigated with *vidanga* and *ghrtha*.
2. The seeds are sprinkled with milk, placed in ghee, *tila*, *brihati*, ash and *sarsapa* paste, rubbed with cow dung, and fumed with *majja,* germinating immediately.
3. Seeds sprinkled with milk rubbed with cow dung dried in the shade followed by applying honey and *vidanga* paste, will germinate without fail.
4. According to the experts, when seeds are sprinkled with milk and dried well in the shade, followed by a paste made from *brihati, tila, kamalnaala* (stem of lotus) and *ghee*, such seeds are best for germinating.
5. Seeds of *Makand*, *Jambu* and *Panasa* should be treated like above when fresh. Seeds of *Kshirika* and *Bakula* should be treated as above, and the tip of the seed should be cut and sown slightly obliquely.
6. Seeds of *Urvaru* are kept in a pipe-like structure made from leaves and sprinkled with Jaggery water, then kept on land followed by continuous heat for three days.
7. Water mixed with milk should be sprinkled on the seeds, leading to germination. During this phase, weeds of undesirable grasses, small plants and layer covering of grasses should be carefully removed.

4.7. *Ropanavidhanam* (Plantation procedure)

This section explains the *Pakshas*, *Nakshatras* and *Lagna* which are favourable for sowing seeds. It explains a proper field with heaps of flowers, sesamum, *Masha* and others scattered throughout, to be ploughed to serve as fertilizing elements. It considers a distance of fourteen, sixteen and twenty cubits (hastas) between two trees as respectively bad, good and excellent. It advises four/five cubits between *Gulmas* and two/three cubits between *Puga* and similar trees. A greater distance exposes to the danger from storms, whereas a lesser distance causes malnourishment. For plantation, it requires a pit measuring one cubit in length, breadth and depth, then the pits to be dried and filled with cow dung, ash, *asthi* (bones) and other materials. It is to be filled with good clay and irrigated with *Kunapajala*.

Small herbs or seedlings should be propagated/ transplanted during the daytime, and their roots should be smeared with honey, ghee and *Vidanga*. Plant material should be covered with soil and made underground in the pit. The same procedure should be followed for large plants, except the timing is specifically *Pradoshakala* or evening. Bhillota (*Bhallataka*) should be planted in all directions to protect trees from diseases. While explaining the auspicious trees, it mentions that the trees of *Asoka, Punnaga, Sirisa, Nimba* and *Campaka are* to be planted first. *Karamarda* and *Vamsa* are considered auspicious in the East, *Paravata* in the South, *Badara* and *Kapittha* in the North, and *Dhatri* in the West. Other plants are to be planted along with those of other groups by providing a prescribed distance so their leaves do not touch each other. It recommends plantation of trees in a garden in an artistic form of a *mandapa, nandyavarta, swastika, caturasra, sarvatobhadra, vithi, nikunja* or *punjaka*. In the middle of the plantation, trees bearing flowers and fruits are to be planted. At the same time, other plants should be produced out of their *parita* (round); these plants should be grown in pairs.

4.8. *VrksharopanaUddeshya* (Plantation objectives)

This section emphasises the economic, religious and other advantages of trees. Trees are to be carefully protected from moist dew, wind-storm, intense sunlight, fume smoke, fire, insects and other adversely affecting factors relating to man, animals and nature. The protective measures include smearing with the paste of *Tila* and *Vidanga*, sprinkling with milk, water and *Kunapambu,* and fumigating with Ghrita. It explains *KunapaJala* as a pig's excreta, fat, flesh, and blood mixed with water, stored underground for a fortnight. One should collect *Ashvasthi,*

Mrtashuka, Matsyamamsa, Mesha Chagalasrnga, Upala or *Vasa, Majja* and *Mamsa* of *SrngaPashu* and should be stored. These items are mixed and cooked in water. Then, this mixture is filled in *Snigdhabhanda* (unctuous vessels). It should be mixed with a sufficient quantity of *Dhanyatusha* (paddy husk). Powdered *Tilapinyaka* and *Madhu* (honey) should be added. Further, *Masha* and *Ghrtha* are to be poured. The pot should be kept in a warm place.

4.9. *SinchanaVidhana - NiscanaVidhi* (Irrigation methods):

The chapter' *Niscana Vidhi*' deals with irrigation and fertilization methods and directions for them. The amount of water to be given to each plant at every stage is very accurately calculated. There is also information on the problems that might arise from the danger and disease that plants are liable to if water stagnates around them.

For the growth of young trees/seedlings, they should water every seventh day along with a small quantity of *Matsyamamsa* (fish) and *Tila* (sesame). Young trees are to be constantly protected from sunlight till the leaves of newly planted trees appear like *Paravala* (strengthening). The irrigation frequency and duration depend on the trees in *Jangala* or *Anupa Desha*. In the case of *Jangala Desa*, irrigation should be arranged regularly. In the case of *Anupadesha,* irrigation should be done one in five days. It also recommends watering firmly rooted trees according to the season. During *Varsha* (rainy), *Sharadritu* (autumn) and at the stage when the soil gets dried, concerning irrigation, the text mentions two treatments:

(a) Juice extracted from medicinal herbs and fruits (*Aushadhiphalasambhutarasa*) mixed with cow urine (*mutra*), fat (*vasa*), and milk (*dugdha*).
(b) *Kunapajala*, excreta and *Mamsa* lead to a better yield.

4.10. *Utpadhana Vrddhi Vidhi* (Measures for High yield):

This section of *Vrikshayurveda* deals with using fertilizers and manures as nutrient supplements. For *Syama*, *Kadamba* and *Nagakesara* trees, the text recommends nourishing with *Dadhi* (curd), *Kola*, *Tila*, and *Sidhu*. For flower-bearing trees in general, it prescribes watering with the decoction of *Jambupatra*, *Usira* and *Musta* mixed in the *Sura*. For *Eladiganadravyas* (belonging to the family of *Ela*), it is recommended that irrigation should be made with *mamsajala* (flesh water). For *Ketaki*, irrigation should be done with *Mamsajala* mixed with excrement. Creepers should be pierced at the root with the sting of a scorpion, followed by

fumigation with *Sapharimamsa* mixed with G*hritha*and watered with *Mushakavasa* (fat of rat). This procedure should be followed to increase the production of flowers and fruits.

4.11. *PadapaKudristinivarana* (Protection against Evil Sight on Plants)

This part explains the harmful effects of sighting the trees (particularly in the flowering/fruiting stage) with evil intentions. It also mentions the measures for preventing and eliminating adversaries relating to plants caused by '*Kudristi'* (evil sight).

4.12. *Padapa Rakshana Vidhanam-Drumaraksa*(Plant protection):

The Chapter *Drumaraksa* is full of advice on how the plants and trees could be saved from the torments of adverse weather conditions, destructive solid winds and 'Fibre' storms. Certain herbs are used as medicines, which, when rubbed on the broken branch from where a dry twig is removed, save the rest of the whole tree from drying up. If a healthy tree or plant did not blossom, treating it with fumigation was successfully tried.

The text recommends spraying dadhi (curd) mixed with *Shali* (rice) in the field to dispel hail damage. This application instantaneously eliminates the adverse effects of hailstorms (*Karakavrusti*) over the area. For protection from the mist, the tree should be wrapped with *Vastra* (cloth) and *Nirvapayet* (warmed up), with *Agni*(fire), spraying the ash or fumigating with smoke. For preventing the worms, insects, rats, etc., from destroying the field, it mentions *Mantra* (hymn) to be written on a banana leaf with lac ink, and the same is to be put into a pit of triangular shape (*trikonake*) in the middle of the field.

4.13. *Rogavijnaniyam*

This chapter deals with the several general aetiology responsible for the destruction of trees breaking down and uprooting heavy force of stormy wind, fire, injury by cutting implements, defects in the seed, excessive irrigation, heat, defects in the soil, defect of season, shadowing by other plants, shelter of the birds, climbers twinning excessively and weeds, etc.

4.14. *VicitraVidhanam*(Horticultural wonders):

It explains the botanical wonder (vicitra), which is of the most excellent practical and scientific interest to modern botanists. The prescriptions laid down are to be tested under controlled experimental conditions. It summarily lists the botanical marvels as maintenance of

flowering and fruiting stage round the year (*sadapushpatva/ sadaphalatva*), acquiring or blending specific smell/aroma (*gandhasamutpatti*), production of fruits without seed, creation of other tastes *rasanyata*), transforming the colour of the flower (*varnaparvartana*) changing flower as a whole (*puspaparivritti*), changing fruit as a whole (*phalanyata*), changing of fragrance (*gandhaparvartana*), suppression of smell (*gandhabandhana*), producing flowers on climber (*vallaripuspata*), transformation of trees into creepers (*latatva*), dwarfing of trees (*vaamantva*), cross-breeding and hybridization (*misrata*), upholding prolonged fruiting and late ripening (*phalacirapakata*) withholding the ripening stage of fruits (*apakaphala*) destroying harvest (*nasha*), prolonging life span (*dirghayu*), regrowth (*punarnavinikarana*),enhancement of size of flowers, fruit seeds, instantaneous production of fruits (*tatkalaphalata*), developing plants from other plants (*viyonijanana*).

4.15. *Upavanaprakriya- Citrikarana* (Laying out of a garden):

The chapter '*Citrikarana'* depicts some wonderful techniques and feats which leave the modern scientist stunned. The ancient scholars possessed systematized knowledge of unparalleled performances and manipulations, conducted to afford fragrance to nonfragrant flowers and colour to a colourless one, to make a plant bloom throughout the year irrespective of the seasons, bring forth premature maturity to plants and fruits, and change the shape and form of trees.

This section contains instructions on how to make and maintain the gardens.The house is to be surrounded by trees of dense leaves and covered with creepers of *Atimuktaka*. The garden should have a water reservoir: a *puskarini, sarovara, tadaga*, a *dirghika* and a *vapi*. In the middle of the garden, an abode (*vesma*) and at places, *mandapas* (pavilion) are to be planned. A *kupa* to be dug for making its water clean, tasteful and fragrant, the text advises administering the compound of *Anjana, Mustaka, Usira, Kosataka, Amalaka,* and the fruit of *Kataika*.

4.16.*Kupasthala* (Underground water)

This chapter deals with examining land for digging a well (*Kuparthambhumipariksa*). It says that the veins of water running underneath the earth are to be ascertained in planning the digging of a well. These are to be noticed in the presence of ant hills near trees of *Vetasa*, *Jambù, Nirgundi, Badara, Palasha Kakodumbara*, *Vibhitaka* and *Kovidara*. When digging the earth, the indications are to be noted in the form of the nature of clay, gravel stone, frogs and other aquatic

animals. If the soil is blue and contains *Maunjika*, *Kasa* and *Kusa* and has gravels or is black and pungent in taste, there is plenty of tasty water.The groundis copper-coloured, red-brown, pale white or blue; the water underneath is astringent, blackish, salty and sweet.

5. Positive outcomes of methods of *Vrikshayurveda* in present times

5.1. Positive outcome of Methods of *Vrikshayurveda* in present times

In recent years, there has been much interest, experiments and innovations in using animal products in traditional agriculture. Valmiki Sreenivasa Ayangarya, a trained mathematician who published a short note, "*Herbal kunapa*" in the journal Asian Agri-History in 2004, first reported excellent results when *Kunapajala* was applied to mango and coconut. He further tried an "*Herbal kunapa*" on various fruits and plants and got amazing results. *Valmiki* published a report on "*Manujala*" in which he used vegetable organic wastes and fermented those in human urine. He again observed excellent effects on the growth of several fruit and vegetable plants.

Valmiki continued experimenting with *Kunapajala* in Arunachal Pradesh in Northeast India in the tea plant (Ayangarya, 2005). He developed "*Herbal kunapa*" and called it *Sasyagavya*. He prepared 5,000 to 10,000 liters of *Sasyagavya*daily and applied it to the soil, and the tea plants started looking healthy. He prepared *Kunapajala* by fermenting aerobically safari fish (mentioned in *Vrikshayurveda*) in cow urine. He sprayed tea bushes at 1 % concentration of the ferment, which he named Indsafari, to most effectively control the attack by tea mosquito helopeltis with a 10-day interval schedule. Foliar sprays with Indsafari at 1% concentration also controlled the loopers on shade trees commonly grown in tea gardens. Valmiki found Indsafariboth insecticide and growth promoter. In addition, Valmiki prepared *Kunapajala* from poultry (chicken) bird flesh and called it *Kukkutakunapa* and used it very effectively in increasing kiwifruit and got a yield of 120 kg per tree.

Agriculturists praised these *Vrikshayurveda* manures when they saw their incredible field results. They are convinced about the efficacy of *sasyagavya,* which uses green weeds and cowdung as raw materials. Even Sir Albert Howard, in his book An Agricultural Testament, has admitted the superiority of traditional Indian methods of agriculture over European methods. He avers that the usage of chemical fertilizers has resulted in disaster and farmer suicides in

Vidarbha, Andhra Pradesh, and north India, which are a direct outcome of this system of agriculture. Indian agriculture and horticulture stand at the crossroads today. Chemical fertilizers and pesticides are petroleum derivatives. But with the depletion of oil reserves all over this planet within the next 20-25 years, this agriculture system cannot last. In a recent study by the scientists at the University of Lancaster and Britain's Institute of Grassland and Environmental Research, Professor Richard Bardgett and his team have found that not only can organic nitrogen be directly taken up by plants, but also it is used differently by different species, enabling nitrogen sharing and biodiversity.

5.2.Ingredients suggested for plant disease management

In addition to *Kunapajala* mustard, honey, milk, neem bark, *vidanga*, and hair/nails/horns etc. are also frequently recommended in the text of *Vrikshayurveda*. Their fundamental properties are given below.

A. *Kunapajala*:

*Kunapajala*is a liquid ferment from animal wastes that contain animal flesh, dung, urine, bones, marrow, skin, and the fermented product contains basic constituents such as amino acids, sugars, fatty acids, keratins, macro- and (almost all) micronutrients in available form. Naturally, plants responded very well to the nourishment provided by *Kunapajala* and flourished with excellent growth, flowering, and fruiting. To prepare *Kunapajala* first cook the items 1-4, and 7 (mentioned in the table below) together in 5 L or more water. After the liquid has cooled, transfer to a 200 L container, add items 5, 6, and 8–10 (mentioned in the table below), and water to make up the volume to 100 L. Stir the mixture twice daily for 1–3 months; stir for the longer,results the better. Twelve hours before straining, stir the mixture so that the supernatant can be easily removed. The strained liquid should be filtered further depending upon needs. For spraying, fine filtering will be necessary. Make the final volume 200 L.

The author has always seen the positive effects of *Kunapajala* on the growth, flowering, and fruiting of plants. An alternative method is anaerobic fermentation. After all the ingredients are placed in the container, it is sealed and placed in a large pit and buried for three months (Sadhale, 1996). Substitution of a non-available ingredient with a similar one is acceptable. To keep the *Kunapajala* supply always continued, the new *Kunapajala* batch must be prepared

every two weeks. Total batches will depend upon the size of the farm/garden/plantations, etc. For the purpose of spraying field crops, the *Kunapajala* batch of 200 L will have to be subjected to mixing/grinding/and fine filtering to avoid clogging of spray nozzles. Three applications of *Kunapajala* to seasonal vegetables will be needed: one in the nursery, one at the growth stage, and one before flowering. Four soil drenches in one year or six spray applications in a year would be adequate for fruit trees. However, changes in schedules must be made based on experience.

Formulation of *Kunapajala*:

Item	Quantity
(1) Animal flesh (fresh or stale, not rotting)	2 kg
or Eggs (fresh or old)	25
or Soybean meal or nuggets plus Paneer	1 kg + 1 kg
or Fish meal	2 kg
or Paneer	2 kg
(2) Marrow (crushed bones) or Tofu2 from soybean	0.5 kg / 1 kg
(3) Rice husk or any grain husk	1 kg
(4) Available oilcake	1 kg
(5) Cattle dung	10 kg
(6) Cattle urine	15 L
(7) Black gram (optional)	0.5 kg
(8) Honey	0.25 kg
(9) Ghee	0.25 kg
(10) Milk	1 L

Note: Developed by YL Nene and SL Choudhary (AAHF).

B. Mustards

When black mustard (*Brassica nigra*) seeds are broken, the enzyme myrosinase is released and acts on a glucosinolate known as sinigrin to give allyl isothiocyanate. Likewise, the white mustard [Brassica- *Synapsis alba*] seeds yield sinalbin. Both species possess the property of insect antixenosis [a resistance mechanism employed (usually by a plant) to deter or prevent pest colonization intended to parallel antibiosis]. They are antifungal, acaricidal, insecticidal, and

nematicidal. White mustard is preferred over black because of low volatility and pungency, compared to black mustard, and has an extended residual effect.

C. Honey

Honey is antimicrobial, used for treating wounds in plants and animals; contains proline, which induces systemic resistance in plants, increases contents of cytokinins and auxins, and protects against stresses – salt, drought, etc. Proline-rich peptides are antimicrobial; honeybee apidaecin is a unique antibacterial peptide derivative found in immune honeybee lymph.

D. Milk

Milk is a sticker (on leaves) and growth promoter. Bovine milk contains several proteins, such as lactoferrin, lactoperoxidase, glycolactin, angiogenin-1, lactogenin, alpha-lactalbumin, lactoglobulin, and casein. Milk proteins contain amino acids such as proline, which, as stated before, are known to induce general disease resistance in plants. Lactoferrin present in bovine milk, has antifungal, antibacterial, antiviral, and anti-nematode properties.

E. Neem

Neem contains many antimicrobial chemicals. Seeds are the primary source of active ingredients of neem. The bitter taste of neem is due to an array of complex compounds called limnoids or limonoids (triterpenoids). So far, nine limnoids have been isolated and identified in neem seeds, viz., salanin, salannol, salannol acetate, diacetylsalanin, 14-epoxy azaradion, gedunin, nimbine, D-acetyl nimbenin, and azadirachtin. Of these, azadirachtin is the most active compound. The neem derivatives do not kill but modify the biological processes of harmful insects detrimentally. The actions include antifeedant effect, larval repellent, oviposition deterrent, growth and metamorphosis inhibiting effects, effect on fecundity and egg sterility, attractants, etc. Neem bark also has antibacterial and anti-insect properties.

F. *Vidanga* (Bidanga)

The text of *Vrikshayurvedas* has recommended fruits of *Vidanga/Bidanga* (*Embeliaribes*) as an anthelmintic material. Embelin (2, 5-dihydroxy-3-undecyl-p-benzoquinone) is found to be

the active principle of Embeliaribes and reported to possess a broad spectrum of biological activities, including antibacterial and insecticidal properties.

G. Hair, nails, and horns

These contain keratin, which has large amounts of the sulfur-containing amino acid cysteine required for the disulfide bridges that confer additional strength and rigidity by permanent, thermallystable cross-linking. When burnt, keratin emits a sulfurous smell as it consists of sulfur in high amounts. Smoke from nails, etc., releases sulfur that controls diseases and pests.

H. *Panchamula*

Panchamula consists of a powdered mixture from the dried roots of five plants. Rabbing (parching) for paddy disease management. The word rab in Marathi (possible origin: in Sanskrit *raksha* means ash, which is raakh in Marathi; rab may be the corrupt form of raakh) signifies burning. Rabbing (parching) paddy nursery soil controls most seedling and adult paddy plant diseases in the field. This is a practice of burning refuse to parch the soil reserved for raising nurseries before the advent of monsoon (Nene, 2012).

6. Practice/techniques mentioned in *Vrikshayurveda*

6.1. Glimpses of practices mentioned in *Vrikshayurveda*

- Seeds sprinkled with milk, smeared with mustard and ash of sesame and *Brihati* rubbed with cow-dung sprout in no time.
- Seeds sprinkled with milk, rubbed with cow dung, dried and profusely smeared with honey and *vidanga* definitely make sprout.
- Trees grown from such seeds bear forever abundant flowers and fruits of excellent quality.
- Trees smoked heavily by a mixture of ghee, *Vidanga*, milk water, and honey quickly become full of flowers and fruits.
- A cold mixture of fish, flesh and seasame should be given every seven days to grow a young sapling.
- The mango trees are nourished well and are loaded with sweeter and bigger fruits if treated with water mixed with ripe fruit of *Ankota*, ghee, honey and marrow of a boar.

- Cold fish washings significantly benefit the yield of mango.
- The coconut trees may become loaded with huge fruits and free from diseases if smeared at night with fermented extracts.
- A tree that normally produces tasteless fruits starts producing sweet fruits if thickly smeared at the root with the paste of a mixture made out of *Vidang*, *Yashtimadhu*, *Yava*, milk and jaggery.

7. Fumigation of plants in *Vrikshayurveda*

7.1. Fumigation of Plants in *Vrikshayurveda*

The practice of exposing plants, bushes, and trees to smoke (fumigation) in combination with other practices has been mentioned frequently in different treatises of *Vrikshayurveda*. Ingredients of smoke, produced by burning materials obtained from plants and animals, are organic chemicals that could be growth promoters and antimicrobials. This paper quotes 53 verses from different treatises of *Vrikshayurveda* in which the smoking of plants is recommended. Based on published literature, analysis reveals several different kinds of antimicrobials and some growth promoters such as karrikins. The significance and relevance of this information to present-day agriculture is elaborated and discussed. The author believes there is scope to validate these past practices and recommend them for adoption by farmers if found suitable.

Materials used for fumigation in *Vrikshayurveda*.

Item	Details
Cow products	Ghee, milk water, curd
Animal wastes	Flesh: Hare, human, pig, fish, horned animal Bones: Hog, cow, dog Shell: Crab Excreta (dung): Cat, hare, cow, hog Horn: Buffalo Shellac: Lac Urine: Goat, cow Fish: Shafari
Herbs and trees	White mustard seeds, flowers of arjuna tree, bidanga (*Embelia ribes*), turmeric powder, *Triphala, Amlaki* (*Emblica officinalis*), *Haritaki* (*Terminalia chebula*), *Bibhitaka* (*Terminalia bellirica*), sesame, barley, *Ramatha* (*Ferula assafoetida*), *Vacha* (*Acoruscalamus*), *Usana* or *Krishna(Piper nigrum*), plantain leaf, Indian bdellium (*Guggula*; *Commiphora wightii*), long pepper (*Piper longum*), aconite (*Aconitum*

	napellus), *Bhallataka* (*Semecarpus anacardium*), costus root (*Saussurea lappa*), *Koshataki* leaves (*Luffa acutangula*), *Shipha* (haldi; *Curcuma domestica*), *Indrabeeja* (*Citrullus colocynthis*), leaves of *Kadali* (*Musa paradisiaca*), *Unmatta* (*Datura metel*), *Vatarika* (garlic), *Mallika* (*Jasminum sambac*), *Sinduvara* (*Vitex negundo*), *Masha* (black gram), *Yava* (barley), husk of a cereal, *Nirgundika* (*Vitex negundo*), *Sarpi* (*Sansevieria roxburghiana*), *Kubera* (*Ficus microcarpa*), *Netra* (*Opuntia elatior*), seed of *Asana* (*Pterocarpus marsupium*), *Sita* (*Pueraria tuberosa*), *Nimbu* (*Citrus aurantifolia*), *Musta* (*Cyperusrotundus*)
Natural products	Honey, soil
Prepared products	*Kunapajala*, fermented herbals, incense

8. Conclusion

The harmful effects of chemical fertilizers and pesticides have led the world to look towards ancient cultivation & conservation methods of medicinal plants. Organic manures are considered safe and yield 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 improve the soil pH, which impacts plant growth and soil microbial activity. The traditional farming method includes various areas where we can research and adopt them in the present scenario. The research on *Langali* (*Gloriosa superb* L.) showed that *Kunapajala*-treated plants exhibited excellent results in terms of the general growth of the plants and fruiting when compared to the control group and chemical fertilizer group. Even though the yield of the tuber was not significant enough, one of its active principles 'Colchicine' (methanol extract) was found in higher amounts in *Kunapajala* treated plants. *Vrikshayurveda* is the safest cultivation practice to obtain high yields and improve the quality of drugs. It offers a relatively painless and smooth transition from chemical to organic agriculture.

Some critics opine that Surapala gave several impractical suggestions, untested methods, and fanciful ideas that do not make sense. Indeed, caution, discretion, further study and research should accompany enthusiasm to accept the book. Still, the present report of various case studies gives positive aspects of *Vrikshayurveda*.

Using synthetic manure in agricultural fields is a severe problem in modern farming systems, both economically and environmentally. The case of Punjab with over-exploitation of land through overdose of fertilizers is a worrisome phenomenon. It is urgent to introduce organic manure in agricultural fields to protect the agricultural ecosystem. Therefore, a balanced fertilization strategy that combines chemical, organic or bio-fertilizers must be developed and evaluated.

There is a growing recognition, nationally and internationally, of the need to incorporate these systems' contributions. The *Vrikshayurveda* has mentioned every possible measure to maintain ecological balance to maintain nature's harmony. Recently, there has been increased demand towards the natural and traditional holistic healing systems. At this juncture, there is a need to develop an appropriate cultivation methodology by integrating the knowledge of traditional and contemporary sciences, which consecutively aid in sustainable agriculture and their conservation. The ignorance of our ancient texts is responsible for the degeneration of agricultural practices. With the help of ancient texts and model methods of agriculture, we can not only scientifically prove the text's sayings but also establish some novel modified methods for the agricultural systems.

The present scenario is very suitable for developing the ancient sciences as there is a considerable demand for the conservation and sustainable utilization of wood and nonwood forest products and the medicinal plant sciences. The proper interpretation and availability of *Vrikshayurveda* can also play an essential role in intercropping and put forward for the use of organic fertilizers and can play a crucial role in buildingan eco-friendly environment. Greater incorporation of suitable traditional techniques during the development of nursery protocol and currently available practices will produce quality planting material better suited for large-scale plantation programs aligned to nature and better productivity (Ranjana, 2017).

Notably, all the developed countries are interested in the Ayurvedic System of Medicine. It is also clear that *Vrikshayurveda* is the safest cultivation method from which we can obtain maximum yield without using chemical fertilisers, leading to quality medicine production. Cultivation of medicinal plants can decrease the dependency on the wild populations, thus helping preserve plant species from extinction and promoting socio-economic growth. Cultivating medicinal plants in the traditional method will help obtain good quality and quantity

of herbal raw materials. It is the need of the hour that we should take necessary action to encourage *Vrikshayurveda*, a cultivation method which provides genuine herbs (Hudar et al, 2022).

Now,it is high time for us to bring back the sure of *Vrikshayurveda* into the application, as there is rampant use of chemical fertiliser pesticides to boost the growth of plants, mainly the quantity and not the quality. As a result, many diseases like cancer and hormonal imbalance have found their way into our society. The highest rate of cancer in India is in Haryana, Punjab, due to the haphazard use of chemical fertilisers and pesticides, so if we incorporate the methods told by *Vrikshayurveda* in agriculture, we can cut down the incidence of such deadly diseases (Meshram & Meshram, 2019).

References

1. Ramachanran, C. K. (1984). VRIKSHAYURVEDA (arboreal medicine in ancient India). *Ancient Science of Life*, 4(2), 110.
2. Ranjana Mishra, (2017). SurapalaVrikshayurveda: A treatise on agricultural technologies. *International Journal of Historical Insight and Research*, 3(2):6-30.
3. Nene, Y. L. (2012). Potential of some methods described in Vrikshayurvedas in crop yield increase and disease management. *Asian Agri-History*, 16(1), 45-54.
4. Komal K. Bajaj, Vishal Chavhan, Nishikant A. Raut, Shailendra Gurav (2022). Panchgavya: A precious gift to humankind, *Journal of Ayurveda and Integrative Medicine*, 13(2): 100525.
5. NamithaHudar, Mahesh CD, Shivamanjunath M.P, Seema Pradeep. (2022)Vrikshayurveda: Ancient Science Of Life For Trees.*International Journal of Emerging Technologies and Innovative Research*, 9 (11): 207-213.
6. Meshram, S. A., &Meshram, A. A. (2019). Vrikshayurveda-A Boon. *Journal of Ayurveda and Integrated Medical Sciences*, 4(06): 186-189.
7. Sadhale, Nalini (Tr.). (1996). Surapala's Vrikshayurveda (The Science of Plant Life by Surapala). Agri-History Bulletin No.1. Asian Agri-History Foundation, Secunderabad 500 009, India.
8. Ayangarya, Valmiki Sreenivasa. (2005). INDSAFARI – An organic pesticide for tea. Asian Agri-History 9:317–319.
9. Sadhale, Nalini. (Tr.) (1996). Surapala’s Vrikshayurveda (The Science of Plant Life by Surapala). Agri-History Bulletin No. 1. Asian Agri-History Foundation, Secunderabad 500 009, India. pp.104.
10. Nene, Y.L. (2012). Potential of some methods described in Vrikshayurvedas in crop yield increase and disease management. Asian Agriculture History. 16(1):45–54 (8).

****