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Chemical analysis and cultural significance of Havan samvidha plants used in Kumaun

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Abstract
Religious rituals hold significant importance in Indian culture, often imbuing daily activities with spiritual meaning. One such ritual is *Havan*, also known as Agnihotra, Homa, or Yagya, which uses specific wood pieces (Samvidha) based on Vedic knowledge. A study in Kumaun Himalaya identified 18 plant species from 16 genera and 13 families used for Havan Samvidha. Plain region (Haldwani) had the highest diversity with six species, followed by Bageshwar hill valley (five), and temperate areas like Almora and Someshwar with three and two species, respectively. In hilly areas, *Pinus roxburghii* (pine) and *Cedrus deodara* (deodar) are commonly used, while mango wood dominates in the plains and valleys due to its market availability. Temperate zones rely on local woods, while valley and Terai residents benefit from market-supplied varieties. The study also documented these plants chemical properties, medicinal uses, and cultural significance, preserving specimens for future reference.

Keywords: Havan practice, wood samvidha, medicinal properties, cultural significance

Introduction

Havan, a key Vedic practice for peace, happiness, and prosperity, was once a daily ritual integral to Vedic life. Its fumes purified the environment, replacing foul odors with beneficial organic compounds. Today, it is performed mainly during special occasions like ceremonies and festivals. Agnihotra (Havan) therapy is an ethnobotanical inhalation therapy derived from the ancient medical science of India, which is described as influencing the environment in a very vast way in our Vedas (Shivhare and Gour, 2019) [35]. In ancient times, medicinal plants were used in fumigation to treat diseases (Martolia *et al*., 2024) [22]. Worship (Puja) and Havan (Yagya) rituals are performed in accordance with the methods described in the Vedas, Upanishads, Dharmasindhu, Nirnayasindhu, Vishwamitra Karika, and Bodhayana's Brahmakarma Samuchaya, aiming to promote health and ecological balance. Vedic literature describes hundreds of types of Homa or Havan rituals, among which Agnihotra, Ganapathi Havan, Graha Shanti, Mrityunjaya Shanti, Sandhi Shanti, Vasthu Rakshoghna Homa, Tila Homa, and Puthrakamesthi are common. Agnihotra, a simple form of Homa, involves lighting a fire in a small rectangular copper pyramid using dried cow dung cakes and ghee as offerings. The ritual is accompanied by chanting mantras at sunrise and sunset (Golechha *et al*., 1987) [14]. As stated in the Param Sanhita Panchratra, Chapter 15, Shloka 20, Panchrtra indicates that Havan or Homa (sacrificial fire) can be performed using ghee, Samvidha, or fruits, and that it should be repeated ten times to ensure the mantra's effectiveness (Aiyangar, 1940) [2].

Samvidha refers to specific types of sacrificial wood used in Yagya rituals, chosen based on the ceremony's purpose. Defined in the Vacaspatyam Sanskrit dictionary, its significance is mentioned in ancient texts like the Atharvaveda and Rigveda. These hymns associate Samvidha with offerings to Agni, symbolizing faith, prosperity, and spiritual enlightenment. It is also linked to the Gayatri Mantra and identified as an embodiment of Lord Vishnu. During rituals like marriage, Samvidha, along with Kuśa grass, is offered into the sacred fire. Indian scriptures emphasize the spiritual and philosophical importance of selecting appropriate Samvidha for Yagya and other practices

In Vedic times, students in Gurukuls carefully gathered Samvidha, selecting only clean, naturally fallen twigs to ensure quality. The Vayu Purana and other hymns provide guidelines for choosing Samvidha, advising against wood from plants inhabited by insects, thorny growths, or nesting birds. Certain species, like Tamarind and Jackfruit, are excluded from Yagya rituals. This study also displays the medicinal and chemical properties of plants used as Samvidha.

Materials and methods

Study area

To document the various types of Havan Samvidha (wood used in sacred fire rituals Agnihotra) utilized in the Kumaun region, the present study was conducted across both hilly and plain areas of the region. The study aimed to analyse the chemical elements and the diversity of plants used in fire rituals and understand the traditional practices associated with them. For the hilly areas, the survey focused on three key locations: Almora, Someshwar, and Bageshwar. These regions were chosen for their rich biodiversity and the prevalence of traditional practices involving Havan Samvidha. In the plains, various localities within Haldwani town were selected for the study. During the study, various temples, sacred sites, family deity rituals, daily temple practices, and funeral rites were observed across different locations in Kumaun.

Field survey

Field visits were conducted at regular intervals and across seasons, during which interviews were held with villagers, family priests, and temple priests, who perform Havan and chant mantras. Through these interactions, data on the plants and plant parts used in Havan rituals as well as their medicinal uses were gathered. Information was collected not only from the priests but also from local experts, herbal healers, and individuals with traditional knowledge of

medicinal plant uses, allowing for a deeper understanding of folklore surrounding the medicinal applications of these plants. This participatory approach helped build connection with community stakeholders and enriched the study by incorporating diverse perspectives on the plants used in religious practices in the Kumaun region.

Data mining

A structured questionnaire survey was prepared to gather comprehensive information on the plant species whose wood is burnt in various Havan rituals. The survey was designed to capture not only the botanical names and types of wood employed but also the specific rituals and ceremonies in which each type is used. Participants were asked about the medicinal properties associated with these plants, drawing on traditional knowledge of their healing potential and other uses. The questionnaire also sought information on the local availability and seasonal accessibility of these plants within the region, as well as any challenges in sourcing them. Questions included the names of specific rituals and occasions-such as weddings, funerals, temple worships, or seasonal festivals-where particular types of wood are traditionally used. This approach allowed for the identification of plant resources that hold both spiritual and medicinal importance and also emphasized the connections between cultural practices and ecological conservation.

Detailed information on various types of wood used in different rituals and their cultural significance was systematically recorded. Knowledge was gathered directly from temple priests, family priests, and native healers, with careful translation to maintain accuracy and cultural context.

Collection and preservation of wood specimens as Havan Samvidha

It involved systematic fieldwork to ensure accurate documentation of plant species traditionally used in rituals. With guidance from temple priests, native herbal healers, and knowledgeable local individuals, plants utilized in Havan ceremonies were identified, documented, and gathered from both hilly and plain areas of Kumaun. Each Havan Samvidha specimen (dry wood) was carefully stored in a rectangular box (Figure 1) and preserved in the Biodiversity Conservation Laboratory at the Department of Botany, SSJU Campus, Almora, Uttarakhand.

Result

During the field survey, a total of 18 plant species, belonging to 16 genera across 13 families, were identified as being used for making Samvidha-sacrificial offerings used in sacred fire rituals (Havan). Most commonly, the dry twigs of these plants are used as Havan Samvidha and burnt during the rituals. However, some hardwood species, such as *Cedrus deodara* (Deodar), *Pinus roxburghii* (Chir Pine), *Mangifera indica* (Mango), *Butea monosperma* (Flame of the Forest), *Santalum album* (Sandalwood), and *Prunus cerasoides* (Wild Himalayan Cherry), are utilized as chopped wood for these purposes. In addition, grasses like *Cynodon dactylon* (Durva grass) and *Desmostachya bipinnata* (Kusa grass) are directly offered during the rituals, reflecting their unique spiritual and cultural significance. An herbarium collection was also made from both the hilly and plain areas of Kumaun.

Plants as Havan Samvidha used in hilly areas of kumaun

Information on various plants used as Samvidha in fire rituals was gathered during surveys in the hilly regions of Almora, Someshwar, and Bageshwar in Kumaun, along with their specimens. Among these, the Bageshwar region reported the highest diversity, with five prominent species frequently used as Havan Samvidha (Figure 2). These include *Cynodon dactylon* (Doob grass), *Ficus benghalensis* (Banyan), F. *religiosa* (Peepal), *Mangifera indica* (Mango), and *Pinus roxburghii* (Chir-pine), presenting the region's rich tradition of employing diverse flora in rituals. In Almora, additional species such as *Cedrus deodara* (Deodar), *Thuja occidentalis* (Thuja), and *Tinospora cordifolia* (Giloy) were documented as significant contributors to Samvidha preparation (Figure 3). Meanwhile, the Someshwar region yielded two specific plants: *Prunus cerasoides* (Padam wood) and *Desmostachya bipinnata* (Kush grass), both of which are integral to fire rituals in the area (Figure 4).

Plants as Havan Samvidha used in plain areas of kumaun

During the field survey conducted in the Haldwani plain region of Kumaun, six plant species were identified as commonly used for Havan Samvidha in local fire rituals (Figure 5). These important plants of the region are- *Aegle marmelos* (Bilva), *Butea monosperma* (Dhak), *Calotropis gigantea* (Aak), *Ficus racemosa* (Gular), *Prosopis cineraria* (Shami), and *Senegalia catechu* (Khair). Information on these plants was gathered from various localities with in Haldwani, reflecting the area's cultural and ecological practices.

Uses, chemical constituents and social beliefs associated with various Havan Samvidha plants (Figure 2 to 5)

1. ***Achyranthes aspera*** **L.: Vernacular name- Apamarga; Family- Amaranthaceae**

Chemical properties: α-L-rhamnopyranosyl-(1_4) -(β-Dglucopyranosyluronicacid) -(1_3)-oleanolic acid, α-L rhamnopyranosyl-(1_4) -(β- Dglucopyranosyluronicacid) -(1_3)-oleanolic acid-28-O-β-D- glucopyranoside and α-Lrhamnopyranosyl-(1_4) -(β-Dglucopyranosyluronic acid) -(1_3) oleanolic acid-28-O-β-Dglucopyranosyl-(1_4)-β-Dglucopyranoside (Dayal, 2007) [5].

Uses: Achyranthes aspera leaves, commonly used in Ganesh Patra pooja on Ganesh Chaturthi, are simple, hairy, and short-stalked. Using 21 leaves is considered auspicious.

2. ***Aegle marmelos*** **(L.) Correa: Vernacular name- Bilva: Family- Rutaceae**

Chemical properties: Tannins (gallotannic acid) and oxalates (Kaur and Kalia, 2016). Leaves has antidiabetic, antiamoebic, antimicrobial, antihistaminic, anticancer, and anti-inflammatory properties (Venthodika *et al*., 2021) [40].

Uses: Its leaves are devoutly offered to Lord Shiva. Used in Yagya rituals, Bilva wood Samvidha is believed to bring wealth (Venthodika *et al*., 2021) [40].

3. ***Butea monosperma*** **(Lam.) Kuntze; Vernacular name- Dhak/ Palash: Family- Fabaceae**

Chemical properties: 3methoxy-8,9 methylenedioxypterocarp-6-ene, 21- methylene-22-

hydroxy-24-oxooctacosanoic acid Me ester, 4-pentacosanylphenol and pentacosanylβ Dglucopyranoside (Shukla *et al*., 2022) [36].

Uses: The wood of plash is used to make 'Shruva' or 'Sucha'. Shruva is used for offering ghee in the sacred fire during the Agnihotra. About 2g of its seed's ash with cold water is given once daily for three days post-menstruation as a contraceptive (Mishra, *et al*., 2020) [23].

4. *Calotropis gigantea* (L.) W. T. Aiton; Vernacular name- Aak: Family- Apocynaceae

Chemical properties: Calotropterpenyl ester, and pentacyclic triterpinoids, namely two unknown calotropursenyl acetate and calotropfriedelenyl acetate, akundarol isovalerate, mundarol isovalerate and quercetin-3- rutinoside (Ansari *et al*., 2001; Akhtar *et al*., 1992) [3].

Uses: Flowers play a significant role in Homa rituals dedicated to Lord Shiva. Additionally, a paste made from these flowers is traditionally applied to affected areas of the body to treat skin diseases, particularly scabies, as documented by (Mishra *et al*.,2020) [23].

5. *Cedrus deodara* (Roxb. ex. D. Don) G. Don; Vernacular name- Deodar: Family- Pinaceae

Chemical properties: Wikstromal, matairesinol, dibenzylbutyrolactol,1,4-diaryl butane, benzofuranoid neo lingam (Chaudhary *et al*., 2011) [12].

Uses: The name Devadaru combines "Deva" (divine, deity) and "daru" (tree). Sacred to Lord Shiva, forests of Devadaru were favored by ancient sages. The tree is also valued for treating ailments such as inflammation, insomnia, cough, fever, urinary issues, itching, tuberculosis, eye disorders, mental disorders, and skin and blood diseases (Sharma *et al*., 2016, 2018) [31, 32].

6. *Cynodon dactylon* (L.) Pers.: Vernacular name- Doob Grass: Family- Poaceae

Chemical properties: Phenolic phytotoxins viz. ferulic, syringic, paracoumaric, vanillic, para hydroxyl benzoic and orthohydroxy phenyl acetic acid (Surendra *et al*., 2008) [39].

Uses: Durva grass, used as Samvidha in fire rituals and offerings to Lord Ganesha, is praised in scriptures for its spiritual and health benefits. It is traditionally used to treat diabetes, inflammation, kidney problems, urinary disorders, gastrointestinal issues, constipation, abdominal pain, and for blood purification (Chandel and Kumar, 2015).

7. *Desmostachya bipinnata* (L.) Stapf: Vernacular name- Kush Grass: Family- poaceae

Chemical properties: Sesquiterpene alcohol, Monoterpene hydrocarbon Sesquiterpene, hydrocarbon, Monoterpene Sesquiterpene alcohol (Kumar *et al*., 2010) [19].

Uses: In worship rituals dedicated to Lord Shiva. Goddess Parvati is sometimes described as personally gathering Samvidha made of Kush grass and flowers, with her companions assisting at other times. Kush grass is also noted for its antimicrobial, anti-inflammatory, analgesic, antipyretic, gastrointestinal, and anticancer properties (Snafi, 2020) [4].

8. *Ficus benghalensis* L.: Vernacular name- Banyan / Vat Virish; Family- Moraceae

Chemical properties: Tannins, leucocyanidin-3-O-β-D-glucopyrancoside, leucopelargonidin-3-O-β-D-glucopyranoside, leucopelargonidin-3-O-α-L-rhamnopyranoside, 5,7-dimethylether-leucopelargonidin-3-0-alpha-L-rhamnoside (Murugesu *et al*., 2021) [25].

Uses: In the Vat Savitri fast, the Banyan tree symbolizes the Trimurti-Lord Brahma, Lord Vishnu, and Lord Shiva-representing creation, preservation, and destruction of the universe.

9. *Ficus racemosa* L.: vernacular name- Gular; Family-Moraceae

Chemical properties: Cycloartenol, euphorbol and its hexacosanoate, taraxerone, tinyatoxin; bark euphorbol and its hexacosanate, ingenol and its triacetate, taraxerone (Murti *et al*., 2011) [24].

Uses: Wood is used as 'Samvidha' during funeral's rituals. 10g of bark paste is applied on the swellings due to sprain (Mishra *et al*., 2020) [23].

10. *Ficus religiosa* L.: Vernacular name- Peepal; Family- Moraceae

Chemical properties: Eugenol, itaconic anhydride, 3-methyl-cyclopenetane-1,2-dione, 2- phenylethyl alcohol, and benzyl alcohol (Makhija *et al*., 2010) [21].

Uses: People tie threads around the trunk of the Peepal tree while praying for their problems to be resolved by the deities believed to reside within it. In the Bhagavad Gita, Lord Krishna declares, "Among trees, I am the Ashvattha" (Ashvattha is the Sanskrit name for the Peepal tree). The tree is revered not only for its divine associations but also because it is believed that Goddess Lakshmi resides beneath it.

11. *Mangifera indica* L.: Vernacular name- Mango; Family: Anacardiaceae

Chemical properties: A and mangiferolate B, and 29-hydroxy-mangiferonic acid. Halogenated amide includes 3-chloro-N-(2-phenylethyl) propenamide. Long-chain hydrocarbons include N-triacontane, N-tetracosane, and 9,12-tetradecadiene-1-ol-acetate. Terpenoid saponins include indicoside A and B. Amino acids include alanine, glycine, and γ-aminobutyric acid (Singh *et al*., 2015; Anjaneyulu and Radhika, 2000) [6, 37].

Uses: The tree is considered sacred by Hindus, with all parts-roots, bark, leaves, flowers, and fruit-used for both medicinal and religious purposes. Its leaves are offered to gods during prayers, particularly in marriage ceremonies, earning it the name Kalpavraksha (wish-fulfilling tree). Mango leaves are also integral to marriage rituals and the celebration of Gaudi Padwa (the Marathi New Year). Young leaves are consumed raw and are believed to treat ailments such as burning sensations, diarrhea, dysentery, hemorrhoids, hiccups, hyperdipsia, ulcers, kidney stones, and wounds. The paste of the leaves is used for conditions like hair blackening, piles, jaundice, vomiting, urinary issues, and liver disorders (Khandare, 2016) [18].

12. *Pinus roxburghii* Sarg.: vernacular name- chir; family- pinaceae

Chemical properties: 1,5-dihydroxy3,6,7-trimethoxy-8-dimethylallyloxy-xanthone and 1-hydroxy-3,6-dimethoxy-2-β-Dglucopyranoxanthone (Rawat *et al*., 2006) [30].

Uses: Used for decorating Vedi (Havan kund) and house gate in marriage ceremony, beneficial effects in the treatment of cough, ulceration and genito-urinary disorders (Rawat *et al*., 2019) [29].

13. *Prosopis cineraria* (L.) druce; vernacular name- shami: family- fabaceae

Chemical properties: Ombuin and a triterpenoid glycoside. Vitamin K1, n-octacosyl acetate, the long chain aliphatic acid. Presence of glucose, rhamnose, sucrose starch (Bahuguna and Shukla, 2010; Garg *et al*., 2013; Singh *et al*., 2013) [7, 13, 38].

Uses: Worship on the occasions like marriage and birth of a male child (Pareek *et al*.,2015) [27]. The tree is also worshipped as Lord Shani. In the festival of the Desahra, the tree is worshipped in all over the India. Its leaves are helpful in the treatment of the asthma, cough, bronchitis, dysentery, leucodermas, leprosy, and muscle infection (Agrawal, 2017) [1].

14. *Prunus cerasoides* Koidz.; vernacular name- paiyya/padam; family- rosaceae

Chemical properties: Dihydrotectochrysin, pinocembrin, dihydrowogonin, chrysin, naringenin, kaempferol47, aromadendrin, quercetin, taxifolin, 7-hydroxy-5, 2´, 4´trimethoxy flavanone (Carasinone), 2´-hydroxy 2, 4, 4´, 6'- tetramethoxy chalcone (Carasidin), 2´,4´ dihydroxy-2,4,6´- trimethoxy-chalcone (Carasin) (Jangwan, 1989) [17].

Uses: Wood is used in Homa during Gruha pratistha puja. Decoction of the bark with the leaf paste applied as a poultice against bone injury (Mishra *et al*., 2020) [23].

15. *Senegalia catechu* (L.F.) P.J.H. hurter & mabb.; vernacular name- khair: family- fabaceae

Chemical properties: flavonoids, tannins, and phenolic compounds, especially catechin/epicatechin, epigallocatechin, taxifolin, procyanidin, quercetin, taxifolin (Kumari *et al*., 2022) [20].

Uses: Wood is used during various religious ceremonies. During the funeral, if the dead one is burnt with the wood from this tree, it is believed that the soul of dead one will rest in peace (Bhattarai *et al*., 2020) [8].

16. *Santalum album* L.: vernacular name- chandan; family- santalaceae

Chemical properties: α- and β-santalol, (Biradar *et al*., 2009) [9].

Uses: Sandalwood used as Samvidha in fire rituals, symbolizing the divine presence of the supreme being within the fire. It is widely utilized in aromatherapy for its antidepressant properties, influencing cognition, psychological and physical well-being, and finds application in fragrances, incense, cosmetics, personal care products, meditation, and spiritual practices (Heuberger *et al*., 2006) [15].

17. *Thuja occidentalis* L.: vernacular name- thuja; family- cupressaceae

Chemical properties: Camphene Fenchone Limonene Myricene α-Terpine Terpinolene Thujone (85% α-thujone and 15% β-thujone) is the main compound (0.76–2.4%) (Caruntu *et al*.,2020) [10].

Uses: Used as Samvidha in Havan and well known for its aroma for making incense, in folk medicine it has been used to treat bronchial catarrh, enuresis, cystitis, psoriasis, uterine carcinomas, amenorrhea and rheumatism (Naser *et al*., 2005) [26].

18. *Tinospora cordifolia* (Willd.) Hook. f.: vernacular name- giloy; family-menispermaceae

Chemical properties: Clerodane furono diterpene glucoside (amritoside A, B, C, and D) (Sharma *et al*., 2019) [33].

Uses: Hindu mythological term that it refers to the heavenly elixir that have saved celestial beings from old age and kept them eternally young. For the treatment of fever, the juice of its leaves is taken thrice a day for three days (Jadav, 2023) [16].

Discussion

A total of 70 informers were interviewed during the field survey, providing good knowledge into the ceremonial and medicinal applications of these woods. Additionally, data on their chemical composition was obtained from secondary sources, including research journals, books, and web search. These plants not only hold ritualistic importance but also emphasize the local biodiversity and traditional ecological knowledge of the region. These are varied in their use based on the local traditions and availability in different regions of Kumaun. Their selection for Havan Samvidha demonstrates a harmonious blend of spirituality, culture, and the sustainable use of natural resources.

The plain region (Haldwani), being a prominent urban center in the Kumaun, offered a contrasting perspective on the types of Havan Samvidha used and their availability compared to the hilly areas. By including both hilly and plain regions, the study aimed to provide a comprehensive understanding of the Havan Samvidha practices across the diverse landscapes of Kumaun. This approach not only emphasized the ecological significance of the plants but also emphasized the cultural and spiritual connections that communities maintain with their natural environment.

During the specimen collection, special attention was given to capturing details on both the ritualistic significance and therapeutic claims associated with each plant. Once collected, the plant materials were thoroughly dried to prevent mold and decay, a process essential for long-term preservation. Each specimen was carefully spread out in a well-ventilated area, ensuring they were fully dried without direct sunlight to preserve their natural characteristics and prevent discoloration. After drying, the specimens were placed in air-tight boxes to maintain their integrity and prevent exposure to moisture, dust, or pests. This approach enabled the creation of a high-quality herbarium collection, cataloguing not only the botanical aspects of each plant but also their cultural and medicinal significance.

Sacred texts also provide detailed information about the horoscopic and periodic characteristics of Havan Samvidha, offering detailed guidance on their use based on zodiacal

considerations. A particular hymn mentions the use of Gular (Ficus racemosa), Shami (Prosopis cineraria), Durva (Cynodon dactylon), and Kusa (Desmostachya bipinnata) as essential Samvidha types for conducting Havan. When combined with curd, Khair (Senegalia catechu), and clarified butter (ghee), these materials are believed to harmonize the energies of the nine planets (Navagraha), promoting spiritual well-being and mitigating negative astrological influences. Moreover, specific trees are associated with different planets, each believed to embody the energy of a particular celestial body (Soma, 1992) [28].

Plants used in Havan are regarded as sacred, with most, except Chandan and Shami, being cultivated in the region. Many individuals grow these plants in courtyards, kitchen gardens, pots, and parks, both for decoration and use in religious rituals. This practice contributes positively to the conservation and environmental preservation of these species. In this study, photographs of Chandan and Shami trees were obtained from two farmers in the area who have preserved these plants on their private land upon special request.

During the survey, it was also observed that local residents shared those certain important plants used for Havan Samvidha, which are not naturally found in their area, are often sourced through personal networks. They rely on relatives, friends, and priests from regions where these plants are available to obtain them. This exchange not only ensures the continuity of traditional rituals but also reflects the community's collective efforts to preserve cultural practices. Such practices display the interconnectedness of communities in maintaining the availability of sacred plants for religious and spiritual purposes.

Conclusion

Yagya rituals use specific types of Samvidha tailored to their purpose, reflecting a deep understanding of nature and spirituality in Vedic traditions. While some ancient knowledge has been lost, scriptures preserve insights for revival. In hilly regions, pine and deodar are commonly used, while mango wood is preferred in plains and valleys like Bageshwar. Local availability influences the choice of Samvidha, with diverse woods accessible in markets. Preserved specimens offer valuable resources for studying the ecological, medicinal, and cultural significance of these plants in Havan rituals.

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Fig 1: Preservation and detailed documentation of Havan Samvidha specimens in the laboratory

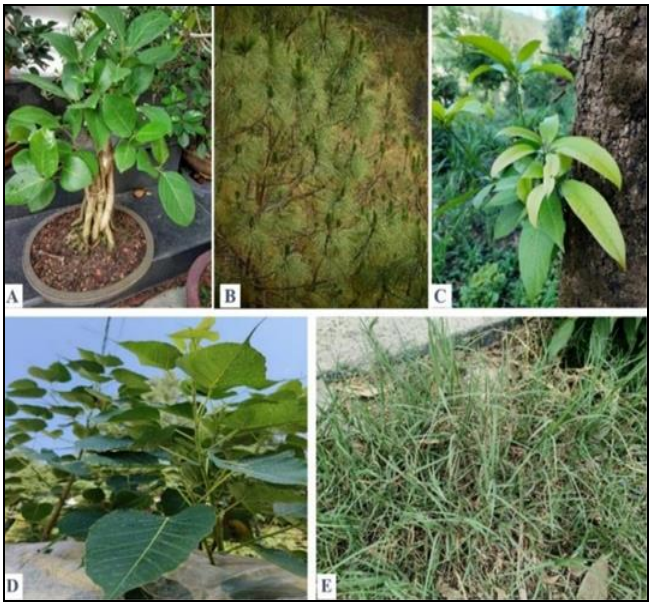

Fig 2: Havan Samvidha plants used in Bageshwar region: A- F. *benghalensis*; B- C. *deodara*; C- M. *indica*; D- F. *religiosa*; E- C. *dactylon*

Fig 3: Havan Samvidha plants used in Almora region: A- T. *cordifolia*; B- T. *occidentalis*; C- C. *deodara*

Fig 4: Havan Samvidha plants used in Someshwar region: A- D. *bipinnata*; B- P. *cerasoides*

Fig 5: Havan Samvidha plants used in Haldwani region: A- F. *racemosa*; B- P. *cineraria*; C- B. *monosperma*; D- A. *marmelos*; E- C. *gigantea*; F-S. *catechu*

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