DE GRUYTER
OPEN

herba polonica
Vol. 59 No. 4 2013
DOI: 10.2478/hepo-2013-0027

REVIEW ARTICLE

Development of organic cultivation of medicinal plants in the North India

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Summary

Out of 750,000 known plants in the world, a major part are medicinal and aromatic plants – a source of raw material for folk and documented systems of medicines worldwide. The folk and documented medicine in India use about 6,000 plants, although, less than 50 species have been scientifically studied and cultivated to any sizeable extent. The main factor behind the slow pace of domestication of medicinal plants is the absence of knowledge on cultivation practices and lack of suitable technology. About 90% of the medicinal plants for trade are harvested from the wild and the demand for traditional medicinal plants is increasing rapidly. Continuous exploitation of several medicinal plant species from the wild has resulted in their population decline. Hence, an effective strategy is needed for their sustainable utilization and conservation. Cultivation is the most effective way of conservation. Cultivation can also ensure production of standardized raw materials. Thereby, enhances the quality of the manufactured products. The methods and techniques of modern chemical agriculture cannot be adopted for the cultivation of medicinal plants as they should be free from harmful residues. Pesticides and other harmful chemicals have been detected in some herbal products. Hence, to ensure a safe, residue-free and reliable material for use in herbal drug industry, there is an urgent need to adopt strategies for cultivation of medicinal plants that are consistent with principles of good agricultural practices.

Key words: *Herbal drugs, herbal medicine, traditional medicine, conservation, organic farming*

INTRODUCTION

Thousands of higher plants have been reported to be of high medicinal value and constitute a major source of raw material for the folk and documented systems of medicines worldwide, like Ayurveda, Unani, Tibetan, and Chinese systems. Medicinal usage constitutes the most common human use of biodiversity. About three-quarters of the world's population use medicinal plants to cover all or part of their health care needs [1-3]. Medicinal plants and traditional medicines have developed renewed interest to developed nations due to globalization [4] and discovery of new biologically-active molecules by the drug industry [5]. People are coming close to nature and natural products derived from the herbs, shrubs and trees of great medicinal value because of the fact that herbal medicines have substantially fewer side effects and are within range because of their low costs and easy availability.

Herbal drugs are obtained from various plant parts like stem, bark, leaves, flowers, fruits, seeds, root and a variety of plant products like gum, oil, resins etc. Very low number of medicinal plants is cultivated. About 90% of the medicinal plants for trade are harvested from the wild sites [6]. Continuous exploitation of several medicinal plant species from the wild without proper replenishment resulted in the population decline of the concerned species [7-9]. Medicinal plant collectors prefer to uproot the entire plant in the field rather to gather the specific parts selectively which is a time-consuming process. As a result a number of important medicinal plants have disappeared from large patches in natural habitats. Other factors like overpopulation, pollution, urbanization, shrinking forest cover and overharvesting have worsen the situation.

Thus, proper conservation of medicinal plants is the need of the hour for their protection. Cultivation is the best and most reliable measure of conservation. Farmers can enhance their economic status by taking to the cultivation of medicinal plants. Local people in the villages can grow medicinal and aromatic plants in kitchen gardens and in waste lands around the village. This will reduce the pressure on the natural habitats because it takes a lot of time to go for wild harvesting in the forest for a particular species. Some viable approaches in this direction include: (i) providing authentic seed material of medicinal and aromatic plants to the villagers and farmers keeping in mind the altitude, climatic conditions and topography of particular area, (ii) encouraging them by giving technical guidance and (iii) providing proper market of the production. In this way, pressure on wild populations will be reduced and economic status of the growers will increase. Cultivation will also benefit some medicinal plants which are near to be extincted to revive their populations in natural habitats. Some studies have earlier been published by our group on the cultivation of medicinal and aromatic plants [10-13].

A fundamental transition distant from today's wasteful and polluting farming systems is needed for the cultivation of medicinal plants. Chemical fertilizers

and synthetic pesticides were introduced in the early 1960's, which helped in increasing the yields of food crops and resulted in the "Green Revolution". However, they had adverse effects, which became evident [14]. Chemical fertilizers have adverse effects on the micro-flora and fauna of soil and deplete it of its natural potency to revive its nutrient capacity. Overuse of fertilizers and their subsequent leaching favours some species at the expense of others in the neighbouring fields and water-bodies leading to a reduction in diversity. Pesticides not only kill pests, but also other animals, such as pollinators and predators that are beneficial to agriculture. Over-use of pesticides in agriculture resulted in residues in vegetables and fruits above their levels of safety [15]. Thus, the awareness concerning harmfulness of modern agriculture thus got its momentum. To revive the good old agricultural practices and get rid of chemical fertilisers and pesticides which have ruined natural resources and soil microorganisms in the last few decades [16], hundreds of farmers have switched to organic farming [17] which is nothing new to India. Until 1960's, organic was the only means of farming, which is still successfully practiced in the mountains and hilly areas of the North India and is again gaining wide attention among all stake holders such as farmers/growers, processors, traders and certification bodies, including government and some non-government organizations. In this regard, a project "Empowerment of Rural Communities to Export Organic Spices" was initiated by the Spice Board of India in which 1500 tribal families got benefitted [18]. In 2001, the Government of India implemented the National Programme for Organic Production (NPOP) concerned with an accreditation programme for certification bodies and norms for organic production based on IFOAM standards, as well as promotion of organic farming. Regulatory body of NPOP is Agricultural and Processed Food Products Export Development Authority (APEDA) under Ministry of Commerce.

Organic farming is required not only for the cultivation of food crops but also for medicinal plants [19]. Medicinal plants should be free from pesticidal residues. Pesticides, which are mainly applied on crops for the protection of plants against a range of pests, have been found in crude medicinal plants as well as in other plant products like gums, resins and essential oils [14, 20, 21]. Such plants cannot be used for manufacturing of medicine. A few reports are there which indicate that some herbal products of Indian origin sold via the Internet that claims Good Manufacturing Practices contain detectable amounts of heavy metals like lead, mercury and arsenic [22]. Hence, to ensure a safe and reliable material for use in herbal drug industry, there is an urgent need to adopt strategies for cultivation of medicinal plants that are consistent with principles of good agricultural practices.

In India, the Central Institute of Medicinal and Aromatic Plants (CIMAP) is working in the area of development of cultivation technology, germplasm multiplication and conservation. Similarly, the National Medicinal Plants Board (NMPB) under its Contractual Farming Scheme provides subsidies for intensive cultivation of priority medicinal plant species. However, with certain preconditions including

promotion of organic farming. The Dutch company IHC/VanderStelt procures organically cultivated medicinal plants from India and distributes them in The Netherlands and Germany. KIT Royal Tropical Institute (Amsterdam, The Netherlands), Centre for Sustainable Development (Dehradun, India) and IHC/VanderStelt jointly support the organic cultivation of medicinal and aromatic plants in the northern state of Uttaranchal [23].

Modern methods, like prediction of germination potential [24] etc. are nowadays applied in medicinal plant research and contribute to the progress of the field cultivation. However, often a relatively low yield of active components and difficulties in standardization are bottlenecks in medicinal plants exploitation. In order to enhance the production of bioactive components efforts have been made worldwide by adopting biotechnological methods and a more natural agro-technological approach. The factors such as soil and climatic conditions, growing techniques, irrigation, as well as fertilization affect the content and composition of secondary metabolites in medicinal plants. Plant nutrition is one of the most important factors that increase plant production due to its impact on the primary metabolism which is, in turn, linked with secondary metabolism. This may be achieved by inoculation of the roots with microorganisms like mycorrhizae, plant growth promoting bacteria, organic manures and inorganic fertilizers. Till now, there have been so many studies reporting the effects of agricultural practices on the secondary metabolites in medicinal and aromatic plants [25-30]. At the Herbal Garden, Jamia Hamdard (Hamdard University), New Delhi about 150 species of important medicinal and aromatic plants are cultivated purely on organic farming basis (tab. 1). The agro-technologies and bioprofiles of nearly half of the species have been evaluated and are ready to be published for the benefit of people involved and interested in the cultivation and propagation of medicinal and aromatic plants. A list of these plants has been given below (tab. 2).

Table 1.

Facts and figures about Jamia Hamdard Herbal Garden (JHHG), New Delhi, India

Total medicinal plant species			180
	Pteridophytes		05
	Gymnosperms		11
	Angiosperms		164
		Herbs	70
		Shrubs	44
		Climbers	15
		Trees	35
Species under organic cultivation			150
Agro-technologies developed			71

Table 2.

Indian traditional medicinal plants under organic cultivation in Jamia Hamdard Herbal Garden (JHHG), New Delhi, India

S. No.	Botanical Name	Family	English Name	Local Name	Part(s) Used	Medicinal Properties/Uses
1	*Abrus precatorius* L.	*Fabaceae*	Indian liquorice	Ratti, Ghumchi	Leaves, seeds	Swellings, purgative, emetic, aphrodisiac, nervous disorders
2	*Acorus calamus* L.	*Araceae*	Sweet flag	Bach/Vach	Rhizome	CNS stimulant, carminative, tonic
3	*Adhatoda vasica* Nees	*Acanthaceae*	Malabar nut	Vasaka, Arusa	Leaves	Expectorant, bronchitis
4	*Aloe barbadensis* Mill.	*Xanthorrhoeaceae*	Aloe	Kumari, Ghikanvar	Leaves	Purgative, cosmetics
5	*Alpinia galanga* (Linn.) Sw.	*Zingiberaceae*	Greater galangal	Bara kulanjan	Rhizome	Rheumatism, Stomach disorders, tonic
6	*Althaea officinalis* L.	*Malvaceae*	Marshmallow	Gul khera	Roots	Demulcent, emollient, (Herbal cough remedy).
7	*Ammi majus* Linn.	*Apiaceae*	Bishop's weed	Atri lal	Fruits	Leucoderma, vitiligo
8	*Andrographis paniculata* (Burm. f.) Wall. Ex Nees	*Acanthaceae*	King of bitters	Kalmegh	Stem, leaves, inflorescence	Tonic, fever, worms, dysentery
9	*Anethum graveolens* L.	*Apiaceae*	Dill	Sowa, Sotapa	Fruits	Condiment, carminative
10	*Artemisia annua* L.	*Asteraceae*	Sweet worm-wood	---------	Aerial part	Malaria, fevers
11	*Asparagus adscendens* Roxb.	*Asparagaceae*	Asparagus	Sufed musli	Roots	Demulcent, diarrhea, aphrodisiac
12	*Asparagus racemosus* Willd.	*Asparagaceae*	Wild asparagus	Shatawari, Satmuli	Roots	Demulcent, diuretic, aphrodisiac
13	*Bacopa monniera* (L.) Pennell	*Scrophulariaceae*	Thyme leaved graticula	Brahmi	Whole plant	Diuretic, Nerve tonic, cardiotonic, insanity
14	*Balanites aegyptiaca* (L.) Delile	*Balanitaceae*	Egyptian balsam	Hingot	Seeds, oil	Steroid hormones, oral contraceptives
15	*Barleria prionites* L.	*Acanthaceae*	Barleria or porcupine flower	Kala Bansa	Bark juice, leaves, roots	Diaphoretic, diuretic, febrifuge
16	*Caesalpinia crista* L.	*Caesalpiniaceae*	Molucca bean	Karanjwa	Seeds	Tonic, antipyretic, intermittent fevers
17	*Cannabis sativa* L.	*Cannabaceae*	Hemp	Bhang	Leaves, flowers	Sedative, anti-spasmodic, analgesic, stomachic

S. No.	Botanical Name	Family	English Name	Local Name	Part(s) Used	Medicinal Properties/Uses
18	*Carissa carandas* L.	*Apocynaceae*	Karanda	Karaunda	Fruits	Pickles, jams
19	*Cassia angustifloia* Vahl	*Caesalpiniaceae*	Indian senna	Sena	Leaves, fruits	Laxative, cathartic, purgative
20	*Catharanthus roseus* (L.) G. Don	*Apocynaceae*	Periwinkle	Sada bahar	Roots, leaves	Anti-cancerous properties
21	*Centella asiatica* (L.) Urban	*Hydrocotylaceae*	Asiatic pennywort	Brahmi	Whole plant	Diuretic, tonic, hypotensive, CNS & skin diseases
22	*Cichorium intybus* L.	*Asteraceae*	Chicory	Kasni	Roots	Fever, vomiting, diarrhoea, diuretic, spleen enlargement, stomachic
23	*Cissus quadrangularis* L.	*Vitaceae*	Veldt grape	Hadjor	Stem	Healing of fractured bone
24	*Clerodendron phlomidis* L.f.	*Lamiaceae*	–	Arni	Leaves, Roots, root bark	Guinea worms, gonorrhea, demulcent, nervous disorders
25	*Clitoria ternatea* L.	*Fabaceae*	Butterfly pea	Shankpushpi, Aparjit	Seeds, roots	Purgative, cathartic, diuretic
26	*Coleus forskohlii* (Willd.) Briq.	*Lamiaceae*	Coleus	Patharchur	Tubers	Hypertension, asthma, cardiac problems, vasodilatation
27	*Cymbopogon citratus* (DC.) Stapf	*Poaceae*	Lemon grass	Sugandh rohisha	Leaf volatile oil	Cold, cosmetics, herbal tea
28	*Datura stramonium* L.	*Solanaceae*	Thorn apple	Dhatura	Leaves, seeds	Expectorant, demulcent, asthma, CNS stimulant
29	*Dioscorea bulbifera* L.	*Dioscoreaceae*	Potato yam	Rat alu	Bulbs	Asthma, bronchitis, piles, dyspepsia, tumours, source of diosgenin
30	*Dioscorea floribunda* Mart. & Gal.	*Dioscoreaceae*	Medicinal yam	Kham alu	Bulbs	Source of steroid hormone diosgenin
31	*Dracaena sanderiana* Sander ex Mast.	*Asparagaceae*	Ribbon Plant	Lucky bamboo	Whole plant extract	Antibacterial, antifungal
32	*Emblica officinalis* Gaertn	*Euphorbiaceae*	Indian gooseberry	Amla, Aonla	Fruits, flowers, bark	Diuretic, carminative, cooling, astringent
33	*Glycosmis pentaphylla* (Retz.) DC.	*Rutaceae*	Orangeberry	Ban nimbu	Fruits	Fever, liver complaints, vermifuge
34	*Glycyrrhiza glabra* L.	*Fabaceae*	Licorice	Mulhatti	Roots	Tonic, laxative, gastric ulcers
35	*Gymnema sylvestre* R. Br.	*Asclepiadaceae*	Periploca of the woods	Gudmar	Leaves	Jaundice
36	*Jatropha curcas* L.	*Euphorbiaceae*	Barbados nut	Jangli arand, Bagbherenda	Seeds	Purgative, important source of bio-diesel

S. No.	Botanical Name	Family	English Name	Local Name	Part(s) Used	Medicinal Properties/Uses
37	*Lepidium sativum* L.	*Brassicaceae*	Garden cress	Halon, Halim	Leaves, seeds	Stimulant, diuretic, tonic, aphrodisiac
38	*Linum usitatissimum* L.	*Linaceae*	Flax	Alsi	Leaves, flowers, seeds	Gonorrhoea, nervine & cardiac tonic, diuretic, emollient
39	*Majorana hortensis* Moench	*Lamiaceae*	Sweet marjoram	Murwa	Leaves and flower heads, essential oil	Sprains of paralytic limbs, carminative, stimulant
40	*Matricaria chamomilla* L.	*Asteraceae*	German chamomile	Babuna	Flower heads	Tonic, gastric stimulant
41	*Mentha aquatica* L.	*Lamiaceae*	Water mint	Tivra	Volatile oil	Headache, cholera
42	*Mentha arvensis* L.	*Lamiaceae*	Field mint	Pudina	Leaves, volatile oil	Carminative, refrigerant, stimulant
43	*Mentha piperita* L.	*Lamiaceae*	Peppermint	Vilaiti pudina	Leaves, volatile oil	Carminative, vomiting, headache, rheumatic pains, cough drops
44	*Moringa oleifera* Lamk.	*Moringaceae*	Drumstick tree	Soanjna	Seed oil	Gout, acute rheumatism
45	*Nerium indicum* Mill.	*Apocynaceae*	Oleander	Kaner	Roots, dried leaves	Ringworm, cardiac stimulant
46	*Nyctanthes arbor-tristis* L.	*Nyctanthaceae*	Tree of sorrow	Harsinghar	Leaves, seeds	Laxative, diuretic, fevers, cholagouge, expectorant
47	*Ocimum basilicum* L.	*Lamiaceae*	Sweet basil	Ban-tulsi	Leaves	Dysentery, chronic diarrhoea
48	*Ocimum sanctum* L.	*Lamiaceae*	Holy basil	Tulsi	Leaves, seeds	Bronchitis, asthma, cold, digestion, urinary complaints
49	*Plantago major* L.	*Plantaginaceae*	Broadleaf plantain	Lahuriya	Seeds	Inflammation of GIT & GUT
50	*Plantago ovata* Forsk.	*Plantaginaceae*	Blonde psyllium	Isabagol	Seeds	Dysentery, digestive disorders
51	*Pluchea lanceolata* Oliver and Hiern	*Asteraceae*	Indian camphorweed	Rasna	Aerial part	Cooling effect
52	*Plumbago zeylanica* L.	*Plumbaginaceae*	Leadwort	Chitrak	Roots, milky juice	Appetizer, skin-diseases, diarrhoea, scabies, CNS stimulant
53	*Polianthes tuberose* L.	*Agavaceae*	Tuberose	Rajnigandha, Gulshaba	Bulbs	Diuretic, emetic, gonorrhoea

S. No.	Botanical Name	Family	English Name	Local Name	Part(s) Used	Medicinal Properties/Uses
54	*Psoralea corylifolia* L.	*Fabaceae*	Babchi	Babchi	Seeds (Resin)	Leucoderma, leprosy, skin diseases
55	*Rauvolfia serpentina* (L.) Benth. Ex Kurz	*Apocynaceae*	Indian snakeroot	Sarap-gandha, Chota-chand	Roots	Insanity, insomnia, schizophrenia, CNS disorders
56	*Rauvolfia tetraphylla* L.	*Apocynaceae*	Wild snake root	Bara-chandrika	Bark	Chronic skin infections
57	*Rourea minor* (Gaertn.) Alston	*Connaraceae*	---------	Vidhara	Roots	Diabetes, rheumatism
58	*Ruta graveolens* L.	*Rutaceae*	Garden rue	Sadab	Leaves, oil	Skin diseases, vitiligo, anthelmintic, antispasmodic
59	*Santalum album* L.	*Santalaceae*	White sandal wood	Safeed chandan	Roots, wood	Cooling, diaphoretic, diuretic, expectorant, fevers
60	*Saraca asoca* (Roxb.) de Wilde	*Caesalpiniaceae*	Asoka tree	Ashok	Stem bark	Astringent, antipyretic
61	*Sarcostemma acidum* (Roxb.) Voigt	*Asclepiadaceae*	Moon plant	Somlata	Stem	Insect repellent
62	*Silybum marianum* (L.) Gaertn.	*Asteraceae*	Holy thistle, Milk thistle	---------	Seeds, Flowers	Anti-diabetic, liver diseases
63	*Solanum nigrum* L.	*Solanaceae*	Black nightshade	Makoi	Leaves, fruits	Liver ailments, dropsy
64	*Tamarix aphylla* (L.) Karst.	*Tamaricaceae*	Athel tamarisk	Farash	Flowers, dried bark	Kidney stone, urine retention, against wound and injuries
65	*Tecoma stans* (L.) H. B. & K.	*Bignoniaceae*	Yellow elder	Pila-kaner	Roots	Diuretic, vermifuge, tonic
66	*Tinospora cordifolia* (Willd.) Miers ex Hook. f. & Thoms.	*Menispermaceae*	Gulancha tinospora	Guduchi, Giloe	Dried stem	Dysentery, joints pain, arthritis
67	*Tylophora indica* (Burm. f.) Merr.	*Asclepiadaceae*	Emetic swallow wort	Antamul	Leaves	Fevers, rheumatic arthritis
68	*Urginea indica* (Roxb.) Kunth	*Liliaceae*	White squill, sea onion	Jangli piyaz	Bulbs	Expectorant, stimulant, cardio tonic, bronchitis, epidermal carcinoma, asthma
69	*Vetiveria zizanioides* (L.) Nash	*Poaceae*	Vetiver	Khas- khas	Root paste	Stimulant, diaphoretic, refrigerant, swellings
70	*Viola serpens* Wall.	*Violaceae*	Violet	Banafshah	Whole plant, flowers	Demulcent, biliousness, lung troubles, blood purifier
71	*Withania somnifera* (L.) Dunal	*Solanaceae*	Indian ginseng	Asgand	Roots, leaves	General weakness, diuretic, antibiotic, antibacterial

ACKNOWLEDGEMENTS

The authors are highly thankful to the workers at the Herbal Garden, Hamdard University, New Delhi for their tireless efforts in cultivating the medicinal plants year after year.

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ROZWÓJ EKOLOGICZNEJ UPRAWY ROŚLIN LECZNICZYCH W PÓŁNOCNYCH INDIACH

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Streszczenie

Spośród 750 000 znanych roślin na świecie większość stanowią rośliny aromatyczne i lecznicze – źródło surowca dla medycyny ludowej i naukowej na całym świecie. W medycynie ludowej i naukowej w Indiach używa się około 6000 roślin, chociaż opracowano naukowo i uprawia się na mierzalną skalę mniej niż 50 z nich. Głównym powodem wolnego tempa udomowiania roślin leczniczych jest brak wiedzy na temat sposobów uprawy i brak przydatnej technologii. Około 90% roślin leczniczych przeznaczonych na sprzedaż otrzymuje się ze stanowisk naturalnych i popyt na tradycyjne rośliny lecznicze gwałtownie wzrasta.

Nieustanna eksploatacja niektórych gatunków w miejscach ich naturalnego występowania spowodowała zmniejszenie ich populacji. Potrzeba zatem efektywnej strategii ich zrównoważonego użycia i ochrony. Najbardziej efektywną metodą ochrony jest uprawa. Uprawa może także zapewnić produkcję wystandaryzowanego surowca, zatem podnosi także jakość produktu przetworzonego. Metody i technologia nowoczesnego rolnictwa z użyciem środków chemicznych nie mogą być zastosowane w uprawie roślin leczniczych, ponieważ powinny one być pozbawione szkodliwych substancji. W niektórych produktach ziołowych wykryto pestycydy i inne szkodliwe substancje chemiczne. Zatem, by zapewnić bezpieczny, wolny od dodatków innych szkodliwych substancji chemicznych surowiec dla produkcji leków ziołowych, istnieje paląca potrzeba wdrożenia sposobów uprawy roślin leczniczych spójnych z zasadami dobrej praktyki rolniczej.

Słowa kluczowe: *leki ziołowe, leczenie ziołami, medycyna tradycyjna, przechowywanie, ekologiczna uprawa*