

Alien flora of Doon Valley, Northwest Himalaya

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This communication is an attempt to prepare an up-to-date account of alien/exotic flora of the Doon Valley. Both herbaceous and woody species are considered and their origin, habit, and families are investigated along with the socio-economic and ecological relevance of a few species. During this study, 308 woody and 128 herbaceous exotic species were identified and enlisted from various localities and 37.61% of these are of American origin. Interestingly, the statistical ratio of alien species was 45.69% for woody flora, while it was investigated 19.4% for herbaceous species. This relative proportion of exotic and native elements is irrespective of 28.8% endemic dicot species in Indian Himalaya and 40% exotics in the entire Indian flora. However, the occurrence of the present share of alien species and their naturalization cannot be considered safe for native and endemic flora. This is especially true of Doon Valley, which is part of the mega Himalayan 'hotspot' belt and is globally designated for priority of conservation activities in India.

Keywords: Alien flora, Doon Valley, woody and herbaceous species.

INDIGENOUS flora of the Doon Valley in Northwest Himalaya in the Indian subcontinent, have been subjected to dramatic alteration due to the deliberate and incidental introduction of alien species from various parts of the world. Since the Doon Valley is part of the mega Himalayan 'hotspot' belt¹, globally designated for priority of conservation activities in India, the occurrence of 45.69% woody and 19.4% herbaceous alien species and the naturalization of some of them cannot be considered safe for native and endemic flora from an ecological and socio-economic perspective. Most of the introduced herbaceous and shrubby taxa multiply in a limited period of time and destroy the endemic and native flora. Any change in floristic composition is bound to alter the primary productivity of plant species in time and space. Therefore, investigation of alien/exotic species has become an imperative issue as invasion is considered a serious ecological and socio-economic problem in the Indian subcontinent and also at a global level.

Geographically, the Doon Valley lies between lat. 30°00'N and 30°30'N and long. 77°36'E and 78°18'E, covering an area of about 2244.78 sq. km. The mean annual

temperature of the valley during the last 42 years (1961–2002) is 19.62°C, while the average annual rainfall is 1950.24 mm (P. S. Negi, unpublished). The temperature ranges from a minimum of -2.4°C in January to a maximum of 43.8°C in June. The relative humidity is well over 50%, except during May and June. The soil is generally medium loam, overlying boulder deposits of great depth. Within the valley, the elevation ranges between 315 and 1000 m, while the northern ranges show elevations of up to 2500 m amsl. Botanically, the Doon Valley is of great interest because it has suitable climatic conditions for both temperate and tropical aliens and therefore, many exotics are naturalized and propagated luxuriantly as permanent denizens.

Both herbaceous and woody species are considered and their origin, habit and families are investigated along with socio-economic and ecological relevance of a few species. For three years (January 2001–October 2004), detailed and extensive floristic surveys were conducted to document and enlist exotic species from various botanical gardens, arboreta, avenues, estates, parks, private gardens, orchards, road sides, waste lands, fallow lands, river terraces and dry channels, forest lands and other relevant localities. Identity of exotics was confirmed by matching the specimens with authenticated herbarium specimens at the Forest Research Institute (FRI), Dehra Dun and the Botanical Survey Dehra Dun (BSD). The living specimens in the FRI arboretum and Chandbagh Estate (Doon School) have been used for on-the-spot identification and confirmation of the taxa. During identification, relevant literature^{1–21} of regional and global importance was consulted and cited. The basic characteristics and other relevant information about cultivated and naturalized exotics were cross-checked and updated from important publications (W. A. Roger and V. B. Sawarkar, unpublished, **13**, 22–33). All species are arranged alphabetically according to their botanical names along with that respective families, habits and origins. Naturalized and widely cultivated exotics are marked by asterisks in the enumeration.

Human influence on the floristic composition of the Valley is reflected in spatial variation in the relative proportion of exotic and native elements. During the present investigation, a total of 674 woody species were collected and identified. Of these, 308 woody taxa were identified as exotics and 128 herbaceous species as alien. Origin-wise status of exotics is shown in Figure 1a, while detailed accounts of botanical name, family, habit and nativity are presented in Table 1. Interestingly, the statistical ratio of alien species was 45.69% for woody flora, while it was investigated 19.4% for herbaceous species². This relative proportion of exotic and native elements is irrespective of 28.8% endemic dicot species in the Indian Himalaya and 40% exotics in the entire Indian flora²⁵. Two species, i.e. *Alternanthera philoxeroides* and *A. pungens* were not recorded in the herbaceous flora of Dehra Dun² and are additions to the existing regional literature of the Doon Valley.

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Table 1. Exotics of the Doon Valley (enumeration)

Species	Family	Habit	Origin
<i>Abelmoschus esculenta</i> (L.) Moench	Malvaceae	Herb	Probably Africa
<i>Acacia auriculiformis</i> A.Cunn.ex Benth.	Mimosaceae	Tree	Australia
<i>Acacia benthami</i> Rochbr.	Mimosaceae	Tree	South Africa
<i>Acacia confusa</i> Merr.	Mimosaceae	Tree	Philippines
<i>Acacia karo</i> Heyne	Mimosaceae	Tree	South Africa
<i>Acacia robusta</i> Burch.	Mimosaceae	Tree	South Africa
<i>Acalypha australis</i> L.	Euphorbiaceae	Herb	China and Japan
<i>Acanthospermum hispidum</i> DC.	Compositae	Herb	Brazil
<i>Adenanthera microsperma</i> Teijem.	Mimosaceae	Tree	Indonesia (Java)
<i>Adenocalymma alliaceum</i> Miers.	Bignoniaceae	Climber	South America
<i>Adenostemma houstonianum</i> Mill.	Compositae	Herb	Tropical America
<i>Agathis robusta</i> (Moore) F.M. Baily	Araucariaceae	Tree	Australia
<i>Agave americana</i> L.*	Agavaceae	Shrub	America
<i>Ageratum conyzoides</i> L.*	Compositeae	Herb	America
<i>Ailanthus altissima</i> Swingle*	Simaroubaceae	Tree	China
<i>Aleurites fordii</i> Hemsl.	Euphorbiaceae	Tree	China
<i>Aleurites moluccana</i> Willd.	Euphorbiaceae	Tree	Malaysia
<i>Allamanda cathartica</i> L.*	Apocynaceae	Climber	Brazil
<i>Alternanthera ficoides</i> (L.) R. Br.	Amaranthaceae	Herb	Brazil
<i>Alternanthera philoxeroides</i> (Mast.) Griseb.	Amaranthaceae	Herb	America
<i>Alternanthera pungens</i> Kunth	Amaranthaceae	Herb	Tropical America
<i>Amaranthus caudatus</i> L.	Amaranthaceae	Herb	Uncertain
<i>Amaranthus cruentus</i> L.	Amaranthaceae	Herb	Uncertain
<i>Anethum graveolense</i> L.	Apiaceae	Herb	South and Southwest Asia
<i>Anethum scandicina</i> (Weber) Mansf.	Apiaceae	Herb	Europe
<i>Annona reticulata</i> L.	Annonaceae	Tree	Tropical America
<i>Anthemis cotula</i> L.	Compositae	Herb	Europe, Asia
<i>Antigonon leptopus</i> Hk. & Arn.	Polygonaceae	Shrub	America
<i>Antirrhinum majus</i> L.	Scrophulariaceae	Herb	Europe, Syria, America
<i>Apium graveolens</i> L.	Apiaceae	Herb	Europe
<i>Apium leptophyllum</i> (Pers.) F. Muell.	Apiaceae	Herb	America, Australia
<i>Araucaria angustifolia</i> (Bertal.)	Araucariaceae	Tree	Brazil
<i>Araucaria bidwilli</i> Hk.	Araucariaceae	Tree	Australia
<i>Araucaria columnaris</i> Forst.	Araucariaceae	Tree	New Caledonia
<i>Araucaria cunninghamii</i> Sweet	Araucariaceae	Tree	Australia
<i>Arenaria serpyllifolia</i> L.	Caryophyllaceae	Herb	Iran
<i>Argemone mexicana</i> L.*	Papaveraceae	Herb	West Indies
<i>Argemone ochroleuca</i> Sweet	Papaveraceae	Herb	Mexico
<i>Aristolochia littoralis</i> Parodi	Aristolochiaceae	Herb	South America
<i>Asclepias curassavica</i> L.Z.*	Apocynaceae	Herb	Tropical America
<i>Azadirachta indica</i> A.Juss.*	Meliaceae	Tree	Myanmar
<i>Bambusa glaucescens</i> (Willd.) Sieb.	poaceae	Bamboo	China
<i>Bambusa guadua</i> Humb. & Bonpl.	poaceae	Bamboo	USA
<i>Bambusa longispiculata</i> Gamble	poaceae	Bamboo	Burma
<i>Bambusa vulgaris</i> Schrad.ex Wend.	poaceae	Bamboo	Unknown
<i>Bauhinia carrao</i> F.V. Muell.	Caesalpiniaceae	Tree	Australia
<i>Bauhinia corymbosa</i> Roxb.	Caesalpiniaceae	Climber	China
<i>Bauhinia galpinii</i> N.E.Br.*	Caesalpiniaceae	Shrub	South Africa
<i>Bauhinia hookeri</i> F.V. Muell.	Caesalpiniaceae	Tree	Australia
<i>Bauhinia picta</i> DC.	Caesalpiniaceae	Tree	Colombia
<i>Beaucarnea stricta</i> Lam.	Liliaceae	Tree	Mexico
<i>Bignonia anguis-cati</i> L.	Bignoniaceae	Creeper	Central America
<i>Bischofia javanica</i> Bl.	Bischofiaceae	Tree	Indonesia
<i>Bixa orellana</i> L.*	Bixaceae	Tree	Brazil
<i>Boerhaavia erecta</i> L.	Nyctaginaceae	Herb	Tropical America
<i>Bolusanthus speciosus</i> Harms	Papilionaceae	Tree	South Africa
<i>Bougainvillea glabra</i> Chois.*	Nyctaginaceae	Climber	Brazil
<i>Bougainvillea spectabilis</i> Willd.*	Nyctaginaceae	Shrub	Brazil
<i>Brachychiton acerifolium</i> F. Mull.	Sterculiaceae	Tree	New South Wales
<i>Brassica campestris</i> L.*	Brassicaceae	Herb	Mediterranean region
<i>Brassica juncea</i> (L.) Czern.	Brassicaceae	Herb	Continental Asia

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Table 1. (Contd...)

Species	Family	Habit	Origin
<i>Brassica oleracea</i> L.*	Brassicaceae	Herb	Western and Southern Europe
<i>Brassica tournefortie</i> Gouan	Brassicaceae	Herb	Mediterranean region
<i>Breynia vitis-idaea</i> (Burn. f.) Fisch.	Euphorbiaceae	Shrub	West Indies
<i>Broussonetia papyrifera</i> Vent.*	Moraceae	Tree	China/Japan
<i>Brugmansia suaveolens</i> (Humb & Bonpl ex Willd) Bercht. & Presl	Solanaceae	Shrub	Brazil
<i>Brunfelsia americana</i> L.*	Solanaceae	Shrub	West Indies
<i>Brunfelsia calycina</i> Benth.	Solanaceae	Shrub	Brazil
<i>Brunfelsia densifolia</i> Krug.	Solanaceae	Tree	Tropical America
<i>Brunfelsia latifolia</i> Hort.	Solanaceae	Shrub	Brazil
<i>Brunfelsia pauciflora</i> Benth.	Solanaceae	Shrub	Tropical America
<i>Byrsonia crassifolia</i> H.B.K.	Malpighiaceae	Tree	Mexico
<i>Caesalpinia ferruginea</i> Mart.	Caesalpiniaceae	Tree	Brazil
<i>Caesalpinia pulcherrima</i> (L.) Swa.	Caesalpiniaceae	Shrub	Brazil
<i>Caesulia officinalis</i> L.	Compositae	Herb	Southern Europe
<i>Calliandra brevipes</i> Benth.	Mimosaceae	Shrub	Brazil
<i>Calliandra haematocephala</i> Hassk.	Mimosaceae	Shrub	Mexico
<i>Calliandra houstoniana</i> Slandl.	Mimosaceae	Tree	Mexico
<i>Callistemon citrinus</i> (Cvurh) Skeel*	Myrtaceae	Tree	Australia
<i>Callistemon viminalis</i> Cheel*	Myrtaceae	Tree	Australia
<i>Callitris columellaris</i> F. Muell.	Cupressaceae	Tree	Australia
<i>Camellia japonica</i> L.	Theaceae	Shrub	Japan
<i>Camellia sinensis</i> (L.) Kuntze*	Theaceae	Shrub	China
<i>Campsis radicans</i> (L.) Seem	Bignoniaceae	Shrub	North America
<i>Carica papaya</i> L.*	Compositae	Shrub	Tropical America
<i>Carthamus lanatus</i> L.	Compositae	Herb	Southwest Asia
<i>Casimiroa edulis</i> La Llave.	Rutaceae	Tree	Mexico
<i>Cassia biflora</i> L.	Caesalpiniaceae	Shrub	Mexico
<i>Cassia javanica</i> L.*	Caesalpiniaceae	Tree	Indonesia (Java)
<i>Cassia multijuga</i> Rich.	Caesalpiniaceae	Tree	America, Malaysia
<i>Cassia nodosa</i> Buch.-Ham.*	Caesalpiniaceae	Tree	Myanmar, Malaysia
<i>Cassia occidentalis</i> L.	Caesalpiniaceae	Tree	South America
<i>Cassia spectabilis</i> DC.	Caesalpiniaceae	Tree	Tropical America
<i>Cassia splendida</i> Vog.	Caesalpiniaceae	Tree	Brazil
<i>Castanospermum australe</i> A. Cunn.	Papilionaceae	Tree	Australia
<i>Casuarina cunninghamiana</i> Miq.	Casuarinaceae	Tree	Australia
<i>Casuarina littoralis</i> L.*	Casuarinaceae	Tree	Australia
<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	Herb	West Indies
<i>Celtis sinensis</i> Pers.*	Ulmaceae	Tree	China
<i>Centaurea cyanus</i> L.	Compositae	Herb	Mediterranean region
<i>Cephalostachyum pergracile</i> Munro	Poaceae	Bamboo	Myanmar
<i>Cephalotaxus harringtonia</i> Koch	Cephalotaxaceae	Tree	Japan
<i>Cestrum nocturnum</i> L.*	Solanaceae	Shrub	West Indies, America
<i>Chamaerops humilis</i> L.	Arecaceae	Shrub	Europe
<i>Chemopodium ambrosioides</i> L.	Chemopodiaceae	Herb	America
<i>Chorisia speciosa</i> A. St. Hill.	Bombacaceae	Tree	Brazil
<i>Chrysanthemum coronarium</i> L.	Compositae	Herb	Mediterranean region
<i>Chrysophyllum oliviforme</i> Lam.	Sapotaceae	Tree	Tropical America
<i>Cichorium intybus</i> L.	Compositae	Herb	Europe, North Africa and Continental Asia
<i>Cinnamomum camphora</i> Nees & Eberm.*	Lauraceae	Tree	China
<i>Cistus maximus</i> (Burm.) Merr.*	Rutaceae	Tree	Malaysia
<i>Clerodendrum splendens</i> G. Don	Verbenaceae	Climber	Angola
<i>Clerodendrum ugandense</i> Prain	Verbenaceae	Climber	Africa
<i>Consolida ambigua</i> (L.) Ball & Heywood	Ranunculaceae	Herb	Mediterranean region
<i>Cordia abyssinica</i> R. Br.	Boraginaceae	Tree	Sudan
<i>Cordia alba</i> R. & Sch.	Boraginaceae	Tree	Mexico
<i>Coreopsis tinctoria</i> Nutt.	Compositae	Herb	North America
<i>Coriandrum sativum</i> L.*	Apiaceae	Herb	Mediterranean region
<i>Coronopus didymus</i> (L.) Smith	Brassicaceae	Herb	South America
<i>Cronton bonplandianum</i> Baillon*	Euphorbiaceae	Herb	South America

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Table 1. (Contd...)

Species	Family	Habit	Origin
<i>Cryptomeria japonica</i> L.f.	Taxodaceae	Shrub	Japan, China
<i>Cunninghamia lanceolata</i> Lam.	Taxodaceae	Tree	China
<i>Cupressus arizonica</i> Greene*	Cupressaceae	Tree	Mexico
<i>Cupressus cashmeriana</i> Royle ex Carrie	Cupressaceae	Tree	China (Tibet)
<i>Cupressus funebris</i> Endl.	Cupressaceae	Tree	China
<i>Cupressus goveniana</i> Gord	Cupressaceae	Tree	California
<i>Cupressus lusitanica</i> Mill.	Cupressaceae	Tree	Mexico
<i>Cupressus sempervirens</i> L.	Cupressaceae	Tree	Cyprus
<i>Cupressus torulosa</i> D.Don*	Cupressaceae	Tree	Bhutan
<i>Cyclanthera pedata</i> Schrad.	Cucurbitaceae	Herb	South America
<i>Cycas revoluta</i> Thunb.*	Cycadaceae	Tree	Japan
<i>Dalbergia cultrata</i> R. Grah.*	Papilionaceae	Tree	Burma
<i>Dalbergia melanoxylon</i> Guill. & Pers.	Papilionaceae	Tree	Sudan
<i>Datura metel</i> L.*	Solanaceae	Shrub	Tropical America
<i>Delonix regia</i> (Bojer ex. Hk.) Rafin*	Caesalpiniaceae	Tree	Madagascar
<i>Dendrocalamus gigantens</i> Munro	Poaceae	Bamboo	Malaya, Myanmar
<i>Dendrocalamus longispathus</i> Kurz	Poaceae	Bamboo	Myanmar
<i>Dendrocalamus membranaceus</i> Munro	Poaceae	Bamboo	Myanmar
<i>Dendrocalamus strictus</i> Nees*	Poaceae	Bamboo	Myanmar
<i>Desmodium tortuosum</i> (Sw.) DC.	Papilionaceae	Herb	America
<i>Dianthus chinensis</i> L.	Caryophyllaceae	Herb	Eastern Asia
<i>Dichrostachys cinerea</i> (L.) W.&A.	Mimosaceae	Shrub	Congo
<i>Dipterocarpus tuberculatus</i> Roxb.	Dipterocarpaceae	Tree	Burma
<i>Dolichandrone platycalyx</i> Baker	Bignoniaceae	Tree	Uganda
<i>Dombeya cayuseii</i> Andr.	Sterculiaceae	Shrub	Madagascar
<i>Dombeya masterjii</i> Hk.f.	Sterculiaceae	Shrub	Tropical Africa
<i>Duabanga grandiflora</i> Roxb.ex DC.	Lythraceae	Tree	Malaysia
<i>Duboisia myoporoidea</i> R. Br.	Solanaceae	Tree	Australia
<i>Duranta repens</i> L.	Verbenaceae	Shrub	Mexico
<i>Echites umbellata</i> Jacq.	Apocynaceae	Climber	USA (Florida)
<i>Enterolobium contortisiliquum</i> Morang	Mimosaceae	Tree	Brazil
<i>Erigeron karvinskianus</i> DC.	Compositae	Herb	Central America
<i>Eriobotrya japonica</i> Lindl.	Rosaceae	Tree	Japan, China
<i>Eruca sativa</i> Mill.	Brassicaceae	Herb	Mediterranean region
<i>Eryngium foetidum</i> L.	Apiaceae	Herb	South America
<i>Eucalyptus alba</i> Reinw. ex Bl.	Myrtaceae	Tree	Australia
<i>Eucalyptus camaldulensis</i> Dehn.*	Myrtaceae	Tree	Australia
<i>Eucalyptus citriodora</i> Hk.*	Myrtaceae	Tree	Australia
<i>Eucalyptus deglupta</i> Bl.	Myrtaceae	Tree	Indonesia
<i>Eucalyptus drepanophylla</i> F. & M.ex Benth.	Myrtaceae	Tree	Australia
<i>Eucalyptus grandis</i> Maiden	Myrtaceae	Tree	Australia
<i>Eucalyptus maculata</i> Hk.	Myrtaceae	Tree	Australia
<i>Eucalyptus microcorys</i> F. Muell	Myrtaceae	Tree	Australia
<i>Eucalyptus paniculata</i> Sm.	Myrtaceae	Tree	Australia
<i>Eucalyptus propinqua</i> Deane & Maiden	Myrtaceae	Tree	Australia
<i>Eucalyptus punctata</i> DC.	Myrtaceae	Tree	Australia
<i>Eucalyptus resinifera</i> Sm.	Myrtaceae	Tree	Australia
<i>Eucalyptus robusta</i> Sm.	Myrtaceae	Tree	Australia
<i>Eucalyptus sideroxylon</i> A. Cunn.	Myrtaceae	Tree	Australia
<i>Eucalyptus tereticornis</i> Sm.	Myrtaceae	Tree	Australia
<i>Eucalyptus torelliana</i> F.Muell	Myrtaceae	Tree	Australia
<i>Eugenia uniflora</i> L.	Myrtaceae	Tree	Brazil
<i>Eupatorium adenophorum</i> Spreng.*	Compositae	Herb	Central America
<i>Eupatorium odoratum</i> L.*	Compositae	Herb	South America
<i>Eupatorium riparium</i> Regel*	Compositae	Herb	Mexico, West Indies
<i>Euphorbia cotinifolia</i> L.	Euphorbiaceae	Shrub	Mexico, South America
<i>Euphorbia geniculata</i> Orteg.*	Euphorbiaceae	Herb	Tropical America
<i>Euphorbia heterophylla</i> L.	Euphorbiaceae	Herb	Mexico
<i>Euphorbia leucocephala</i> Lotsy	Euphorbiaceae	Shrub	Mexico
<i>Euphorbia milii</i> Des Moulins	Euphorbiaceae	Shrub	Madagascar
<i>Euphorbia prostrata</i> W. Ait	Euphorbiaceae	Herb	Tropical America

(Contd...)

Table 1. (Contd...)

Species	Family	Habit	Origin
<i>Euphorbia pulcherrima</i> Willd.ex Klotz.*	Euphorbiaceae	Shrub	Mexico
<i>Euphorbia tirucali</i> Brandis*	Euphorbiaceae	Shrub	Kenya
<i>Evolvulus nummularius</i> (L.) L.	Convolvulaceae	Herb	America
<i>Flindersia australis</i> R.Br.	Flinderiaceae	Tree	Australia
<i>Foeniculum vulgare</i> Mill.*	Apiaceae	Herb	Southern Europe
<i>Fraxinus udheii</i> Lingelsh.	Oleaceae	Tree	Mexico
<i>Fumaria indica</i> (Hassk.) Pugsly	Fumariaceae	Herb	Pakistan, Afganistan
<i>Galinsoga parviflora</i> Cav.	Compositae	Herb	Tropical America
<i>Galphimia gracilis</i> Bartl.	Malpighiaceae	Shrub	Mexico
<i>Gardenia angusta</i> Merr.	Rubiaceae	Shrub	Japan
<i>Gardenia jasminoides</i> Ellis	Rubaceae	Shrub	China
<i>Gardenia spathulifolia</i> Stapf.& Hutch.	Rubiaceae	Shrub	Uganda
<i>Geijera parviflora</i> Lindl.	Rutaceae	Tree	Australia
<i>Gigantochloa atter</i> Kurz	Poaceae	Bamboo	Malaysia
<i>Gigantochloa verticillata</i> Munro	Poaceae	Bamboo	Malaysia
<i>Ginkgo biloba</i> L.	Ginkgoaceae	Tree	Japan
<i>Gleditsia macarantha</i> Desf.	Caesalpiniaceae	Tree	China
<i>Gleditsia sinensis</i> Lam.	Caesalpiniaceae	Tree	China
<i>Gleditsia tricanthos</i> L.	Caesalpiniaceae	Tree	USA
<i>Gnaphalium pensylvanicum</i> Willd.	Compositae	Herb	America
<i>Gomphocarpus physocarpus</i> Mey.	Asclepiadaceae	Shrub	East Africa
<i>Gomphrena celosioides</i> Mart.	Amaranthaceae	Herb	South America
<i>Gomphrena globosa</i> L.	Amaranthaceae	Herb	Tropical America
<i>Gossypium hirsutum</i> L.*	Malvaceae	Herb	Central America
<i>Grevillea robusta</i> A.Cunn.*	Proteaceae	Tree	Australia
<i>Gymnocladus canadensis</i> Lam.	Caesalpiniaceae	Tree	North America, China
<i>Haematoxylon campechianum</i> L.	Caesalpiniaceae	Tree	Mexico
<i>Hamelia patens</i> Jacq.	Rubiaceae	Shrub	Brazil
<i>Helianthus annus</i> L.*	Compositae	Herb	North America
<i>Helianthus cucumerifolius</i> Torr.	Compositae	Herb	North America
<i>Hibiscus hawaii</i> Hort.	Malvaceae	Shrub	Hawaii Island
<i>Hibiscus arnottianus</i> Gray	Malvaceae	Shrub	Hawaii (USA)
<i>Hibiscus cannabinus</i> L.	Malvaceae	Herb	Tropical America
<i>Hibiscus mutabilis</i> L.	Malvaceae	Shrub	China
<i>Hibiscus rosa-sinensis</i> L.*	Malvaceae	Shrub	China
<i>Hibiscus syriacus</i> L.	Malvaceae	Shrub	Syria, Uncertain
<i>Homalium tomentosum</i> Benth.	Flacourtiaceae	Tree	Burma
<i>Hydrangea macrophylla</i> (Thunb.) Ser.	Saxifragaceae	Shrub	China, Japan
<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	Herb	Tropical America
<i>Ipomoea arborescens</i> Sweet.*	Convolvulaceae	Tree	USA
<i>Ipomoea cairica</i> (L.) Sweet	Convolvulaceae	Twiner	Africa
<i>Ipomoea fistulosa</i> Mart.ex Choisy*	Convolvulaceae	Tree	USA
<i>Ipomoea hederifolia</i> L.	Convolvulaceae	Twiners	Tropical America
<i>Ipomoea quamoclit</i> L.	Convolvulaceae	Twiners	Tropical America
<i>Isora coccinea</i> L.	Rubiaceae	Shrub	China
<i>Isora macrothyrsa</i> Teijsm. & Binn.	Rubiaceae	Shurb	Indonesia
<i>Jacaranda mimosaeifolia</i> D.Don*	Bignoniaceae	Tree	Brazil
<i>Jasminum mesnyi</i> Hance.*	Oleaceae	Shurb	China
<i>Jatropha curcas</i> L.*	Euphorbiaceae	Shrub	Tropical America
<i>Jatropha gossypifolia</i> L.*	Euphorbiaceae	Shrub	Tropical America
<i>Jatropha integerrima</i> Jack.	Euphorbiaceae	Shurb	China
<i>Joanesia princeps</i> Vell.	Oleaceae	Tree	Brazil
<i>Juniperus bermudiana</i> L.*	Cupressaceae	Tree	Bermuda
<i>Juniperus chinensis</i> L.	Cupressaceae	Shurb	China
<i>Juniperus communis</i> L.*	Cupressaceae	Tree	Yugoslavia
<i>Juniperus deppeana</i> Steud.	Cupressaceae	Tree	Mexico
<i>Juniperus oxycedrus</i> L.	Cupressaceae	Tree	Syria
<i>Juniperus phoenicea</i> L.	Cupressaceae	Tree	Algeria
<i>Juniperus procera</i> Hochst.	Cupressaceae	Tree	Kenya
<i>Juniperus scopulorum</i> Sarg.	Cupressaceae	Tree	USA
<i>Khaya senegalensis</i> A.Juss.	Meliaceae	Tree	Mozambique
<i>Kigelia africana</i> (Lam.) Benth.	Bignoniaceae	Tree	Rhodesia
<i>Koelreuteria paniculata</i> Laxn.	Sapindaceae	Tree	China
<i>Lagerstroemia floribunda</i> Jack.	Lythraceae	Tree	Malaysia, China

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Table 1. (Contd...)

Species	Family	Habit	Origin
<i>Lagerstroemia indica</i> L.	Lythraceae	Shrub	China
<i>Lagerstroemia thorelli</i> Gagnep.	Lythraceae	Tree	Vietnam
<i>Lagerstroemia tomentosa</i> Presl	Lythraceae	Tree	Myanmar
<i>Lagerstroemia turbinata</i> Koehne	Lythraceae	Tree	Vietnam
<i>Lantana camara</i> L.*	Verbenaceae	Shrub	West Indies, America
<i>Lens culinaris</i> Medik.	Papilionaceae	Herb	Southern Europe
<i>Lepidium virginicum</i> L.	Brassicaceae	Herb	America
<i>Leucanea leucocephala</i> (Lam.) de Wit.	Mimosaceae	Shrub	Mexico
<i>Ligustrum lucidum</i> Ait. f.	Oleaceae	Shrub	China
<i>Liquidambar farmosa</i> Hance	Hamamelidaceae	Tree	China
<i>Liriodendron tulipiflora</i> L.	Magnoliaceae	Tree	USA
<i>Litchi chinensis</i> Sonn.*	Sapindaceae	Tree	China
<i>Livistona australis</i> Mart.	Arecaceae	Tree	Australia
<i>Livistona chinensis</i> R. Br.	Arecaceae	Tree	China
<i>Lonchocarpus neuroscapha</i> Benth.	Papilionaceae	Tree	Brazil
<i>Lonicera japonica</i> Thunb.	Caprifoliaceae	Shrub	China
<i>Luehea endopogon</i> Kurz	Tiliaceae	Tree	Brazil
<i>Lycopersicon lycopersicum</i> (L.) Karsten	Solanaceae	Herb	America
<i>Maclura pomifera</i> Schne	Moraceae	Tree	USA
<i>Magnolia grandiflora</i> L.*	Magnoliaceae	Tree	North America
<i>Magnolia liliflora</i> Desr.	Magnoliaceae	Shrub	Japan
<i>Magnolia soulangiana</i> Hort.	Magnoliaceae	Tree	China
<i>Malva parviflora</i> L.	Malvaceae	Herb	South Europe
<i>Malvastrum coromandelianum</i> (L.) Garske	Malvaceae	Shrub	South America
<i>Malvaviscus arboreus</i> Cav.	Malvaceae	Shrub	Tropical America
<i>Manihot dichotoma</i> Ule	Euphorbiaceae	Shrub	Brazil
<i>Manihot esculenta</i> Crantz.	Euphorbiaceae	Tree	Tropical America
<i>Manihot tweediana</i> Muell.-Arg.	Euphorbiaceae	Tree	Brazil
<i>Markamia platycalyx</i> Sprague	Bignoniaceae	Tree	Uganda
<i>Medicago polymorpha</i> L.	Papilionaceae	Herb	Europe
<i>Melaleuca styphelioides</i> Sprague	Bignoniaceae	Tree	Uganda
<i>Melia azedarach</i> L.*	Meliaceae	Tree	Iran
<i>Melia birmanica</i> Kurz	Meliaceae	Tree	Myanmar
<i>Melocalamus compactiflorus</i> Daral	Poaceae	Bamboo	Myanmar
<i>Mentha piperita</i> L.	Lamiaceae	Herb	Europe
<i>Michelia figo</i> Spreng.*	Magnoliaceae	Tree	China
<i>Millettia brandisiana</i> Kurz	Papilionaceae	Tree	Myanmar
<i>Millingtonia hortensis</i> L.f.	Bignoniaceae	Tree	Myanmar, Malaya
<i>Mimosoa pudica</i> L.	Mimosaceae	Herb	Tropical America
<i>Montanoa grandiflora</i> (DC.) Hemsl.	Compositae	Herb	Mexico
<i>Muehlenbeckia platyclados</i> (Muell.) Meissn.	Polygonaceae	Shrub	Solomon Isles
<i>Mussaenda erythrophylla</i> Schum. & Thonn.	Rubiaceae	Shrub	Tropical Africa
<i>Mussaenda luteola</i> Delile	Rubiaceae	Shrub	Kenya, Egypt
<i>Mussaenda philippica</i> Rich.	Rubiaceae	Shrub	Philippines
<i>Nandina domestica</i> Thunb.	Nandanaceae	Shrub	China, Japan
<i>Nerium oleander</i> L.	Apocynaceae	Shrub	China
<i>Nicotiana plumbaginifolia</i> Viv.	Solanaceae	Herb	Central and South America
<i>Nicotiana rustica</i> L.	Solanaceae	Herb	Central and South America
<i>Nicotiana tabacum</i> L.*	Solanaceae	Herb	Central and South America
<i>Nigella sativa</i> L.	Ranunculaceae	Herb	Southeast Europe
<i>Ochrosia elliptica</i> Labill.	Apocynaceae	Tree	Australia
<i>Oenothera rosea</i> W. Ait.*	Onagraceae	Herb	Mexico
<i>Olea europaea</i> L.	Oleaceae	Tree	Mediterranean region
<i>Opuntia vulgaris</i> Mill.*	Cactaceae	Shrub	South America
<i>Oxalis corymbosa</i> DC.	Oxalidaceae	Herb	Tropical America
<i>Oxalis richardiana</i> Babu	Oxalidaceae	Herb	Mexico, West Indies
<i>Oxytenanthera abysinica</i> Munro	Poaceae	Bamboo	Zambia
<i>Oxytenanthera albociliata</i> Munro	Poaceae	Tree	Burma
<i>Pahudia martabanica</i> Prain	Caesalpiniaceae	Tree	Burma
<i>Papaver rhoes</i> L.	Papaveraceae	Herb	Eurasia, Africa
<i>Parkinsonia aculeata</i> L.*	Caesalpiniaceae	Tree	Mexico
<i>Parthenium hysterophorus</i> L.*	Compositae	Herb	America
<i>Paspalum dilatatum</i> Poir.	Poaceae	Herb	Tropical America

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Table 1. (Contd...)

Species	Family	Habit	Origin
<i>Passiflora edulis</i> Sims.	Passifloraceae	Herb	Brazil
<i>Passiflora incarnata</i> L.	Passifloraceae	Herb	America
<i>Passiflora suberosa</i> L.	Passifloraceae	Climber	West Indies
<i>Peltophorum africanum</i> Sond.	Caesalpiniaceae	Tree	Uganda
<i>Peltophorum terocarpum</i> Baker. ex Heyne	Caesalpiniaceae	Tree	Sri Lanka
<i>Peltophorum vogetianum</i> Walp.	Caesalpiniaceae	Tree	Brazil
<i>Peperomia pellucida</i> (L.) H.B.K.*	Piperaceasae	Herb	Tropical America
<i>Pereskia aculeata</i> Mill.	Cactaceae	Climber	Tropical America
<i>Pereskia grandiflora</i> Hort. ex Pfeiff.	Cactaceae	Climber	Brazil
<i>Persia americana</i> Mill.	Lauraceae	Tree	Mexico
<i>Persia owdenii</i> (Par.) Koster	Lauraceae	Tree	Mexico
<i>Petrea volubilis</i> Vell.	Verbenaceae	Shrub	Mexico
<i>Phoenix canariensis</i> Hort.	Arecaceae	Tree	Canary Isles
<i>Phoenix dactylifera</i> L.	Arecaceae	Tree	West Asia and North Africa
<i>Phoenix reclinata</i> Jack.*	Arecaceae	Tree	Tropical Africa
<i>Phoenix senegalensis</i> Van Houtte	Arecaceae	Tree	South Africa
<i>Physalis angulata</i> L.	Solanaceae	Shrub	America
<i>Physalis heterophylla</i> Nees	Solanaceae	Shrub	North America
<i>Physalis peruviana</i> L.	Solanaceae	Shrub	Tropical America
<i>Pilea serpyllifolia</i> (Poir) Wedd.	Urticaceae	Herb	Mexico
<i>Pinus canariensis</i> Sin.	Pinaceae	Tree	Canary Island
<i>Pinus caribea</i> Mor.	Pinaceae	Tree	Cuba
<i>Pinus densiflora</i> Sieb. & Zucc.	Pinaceae	Tree	Japan
<i>Pinus elliotti</i> Engl.	Pinaceae	Tree	USA
<i>Pinus halpensis</i> Mill.	Pinaceae	Tree	Cyprus
<i>Pinus hartwegii</i> Lindl.	Pinaceae	Tree	Mediterranean region
<i>Pinus kesiya</i> Role.	Pinaceae	Tree	Myanmar
<i>Pinus merkusii</i> Junn. & Diur.	Pinaceae	Tree	Myanmar
<i>Pinus oocarpa</i> Schiede	Pinaceae	Tree	Mexico
<i>Pinus patula</i> Schidé & Deppe	Pinaceae	Tree	Mexico
<i>Pinus radiata</i> D. Don	Pinaceae	Tree	USA
<i>Piptadenia rigida</i> Benth.	Mimosaceae	Tree	Brazil
<i>Pithecellobium dulce</i> Benth.*	Mimosaceae	Tree	Mexico
<i>Plantus occidentalis</i> L.	Platanaceae	Tree	America
<i>Plantus orientalis</i> L.	Platanaceae	Tree	Europe, Asia
<i>Plumbago auriculata</i> Lam.*	Plumbaginaceae	Shrub	South Africa
<i>Plumeria alba</i> L.	Apocynaceae	Tree	America
<i>Plumeria rubra</i> L.*	Apocynaceae	Tree	Mexico
<i>Podocarpus gracilior</i> Pilger*	Podocarpaceae	Tree	Kenya
<i>Podocarpus latifolius</i> R. Br.	Podocarpaceae	Tree	Kenya
<i>Podocarpus macrophyllus</i> Pilger	Podocarpaceae	Tree	Japan, China
<i>Podocarpus nerifolia</i> D. Don.	Podocarpaceae	Tree	China
<i>Polyalthia longifolia</i> (Sonn.) Thw.	Annonaceae	Tree	Sri Lanka
<i>Polygonum chinense</i> L.	Polygonaceae	Herb	Southeast Asia
<i>Populus deltoides</i> Marsh.*	Salicaceae	Tree	USA
<i>Portulaca grandiflora</i> Hk.	Portulaceae	Herb	Brazil
<i>Portulaca oleracea</i> L.	Portulaceae	Herb	North America
<i>Portulaca pilosa</i> L.	Portulaceae	Herb	Tropical America
<i>Prosopis chilensis</i> Stuntz	Mimosaceae	Tree	Mexico
<i>Prosopis juliflora</i> (S.w.) DC*	Mimosaceae	Tree	America
<i>Prunus persica</i> (L.) Batsch.*	Rosaceae	Tree	China
<i>Prunus yedensis</i> Mats	Rosaceae	Tree	Japan
<i>Psidium cattleianum</i> Sabine	Myrtaceae	Shrub	Brazil
<i>Psidium guajava</i> L.*	Myrtaceae	Shrub	Tropical America
<i>Pterocarya stenoptera</i> DC.	Juglandaceae	Tree	China
<i>Pterospermum semisagittatum</i> Buch. – Ham.	Sterculiaceae	Tree	Myanmar
<i>Punica granatum</i> L.*	Punicaceae	Tree	Iran, Afghanistan
<i>Pyrostegia venusta</i> (Ker-Gawl) Miers.	Bignoniaceae	Climber	Brazil
<i>Pyrus pyrifolia</i> (Burm. f.) Nakai*	Rosaceae	Tree	China
<i>Quisqualis indica</i> L.	Combretaceae	Climber	Malaysia
<i>Rhus lancea</i> L.f.*	Anacardiaceae	Tree	Tropical Africa
<i>Richardia scabra</i> L.	Rubiaceae	Herb	South America
<i>Ricinus communis</i> L.*	Euphorbiaceae	Shrub	South Africa

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Table 1. (Contd...)

Species	Family	Habit	Origin
<i>Rivina humilis</i> L.	Phytolaccaceae	Herb	America
<i>Rorippa nasturtium – aquaticum</i> (L.) Hayek	Brassicaceae	Herb	Europe, North Asia
<i>Rosa cathayensis</i> Bailey*	Rosaceae	Climber	China
<i>Rosa laevigata</i> Michx.*	Rosaceae	Climber	China, Japan, America
<i>Roylea coccinea</i> Juss. ex Murr.	Lamiaceae	Herb	Tropical America
<i>Roystonia regia</i> (H.B.K.) Cook	Arecaceae	Tree	Cuba
<i>Ruellia tuberosa</i> L.	Acanthaceae	Herb	West Indies
<i>Russelia equisetiformis</i> Sch. & Cham.	Scrophulariaceae	Shrub	Mexico
<i>Sabicea blackburniana</i> Glaz.	Arecaceae	Tree	Bermuda Island
<i>Salix babylonica</i> L.	Salicaceae	Tree	China, Babylon
<i>Sapindus mukorossi</i> Gaertn.	Sapindaceae	Tree	China
<i>Sapium sebiferum</i> Roxb.*	Euphorbiaceae	Tree	China
<i>Schefflera actinophylla</i> Harms	Araliaceae	Tree	Australia
<i>Schefflera arboricola</i> Hayata	Araliaceae	Shrub	Taiwan
<i>Schizolobium parahyba</i> (Vell.) Blake	Caesalpiniaceae	Tree	South America
<i>Scoparia dulcis</i> L.	Scrophulariaceae	Herb	Tropical America
<i>Sechium edule</i> (Jack.) Sw.	Cucurbitaceae	Herb	Tropical America
<i>Selenicerus grandiflorus</i> Briff. & Rose	Cactaceae	Shrub	Jamaica, Cuba
<i>Sesamum orientale</i> L.*	Pedaliaceae	Herb	Probably Africa
<i>Sesbania sesban</i> (L.)	Papilionaceae	America	South Africa
<i>Siegesbeckia mariannum</i> (L.) Gaertn.	Compositae	Herb	America
<i>Silene alba</i> (Mill.) Krause	Caryophyllaceae	Herb	Europe, Africa and Asia
<i>Solanum hispidum</i> Pers.	Solanaceae	Shrub	Tropical America
<i>Solanum torvum</i> Sw.*	Solanaceae	Shrub	South America
<i>Solidago canadensis</i> L.	Compositae	Herb	North America
<i>Spathodea campanulata</i> Beauv.	Bignoniaceae	Tree	Uganda
<i>Spiraea prunifolia</i> Sieb. & Zucc.	Rosaceae	Shrub	China
<i>Spiraea cantoniensis</i> Lour.	Rosaceae	Shrub	China
<i>Stellaria media</i> (L.) Merr.*	Caryophyllaceae	Herb	Europe
<i>Stenolobium stans</i> Seam	Bignoniaceae	Shrub	West Indies
<i>Sterculia rupestris</i> Benth.	Sterculiaceae	Tree	Australia
<i>Swietenia macrophylla</i> King	Meliaceae	Tree	Honduras
<i>Swietenia mahagoni</i> (L.) Jack.	Meliaceae	Tree	West Indies
<i>Tabebuia pentaphylla</i> Hemsl.	Bignoniaceae	Tree	West Indies
<i>Tagetes erecta</i> L.	Compositae	Herb	Mexico
<i>Tagetes minuta</i> L.	Compositae	Herb	South America
<i>Talinum paniculatum</i> (Jacq.) Gaertn.	Portulacaceae	Herb	America
<i>Tamarindus indica</i> L.	Caesalpiniaceae	Tree	Ethiopia, Central Africa
<i>Taxodium distichum</i> L.	Taxodaceae	Tree	Florida
<i>Taxodium mucronata</i> Tenore	Taxodaceae	Tree	Mexico
<i>Tecoma gaudichandii</i> DC.	Bignoniaceae	Shrub	Colombia
<i>Tecoma stans</i> (L.) H.B.K.	Bignoniaceae	Tree	South Florida, South America
<i>Terminalia calamansanai</i> Rolfe	Combretaceae	Tree	Myanmar
<i>Terminalia oliveri</i> Brandis	Combretaceae	Tree	Myanmar
<i>Terminalia sericea</i> Burch. ex DC.	Combretaceae	Tree	South Africa
<i>Tetraclinis articulata</i> Mast.	Cupressaceae	Tree	Algeria
<i>Tetrapanax papyrifera</i> (Hk.) Koch	Araliaceae	Tree	China
<i>Thecagonum ovatifolium</i> (Cav.) Babu	Rubiaceae	Herb	Japan, Asia
<i>Thevetia peruviana</i> (Pers.) K. Schum.	Apocynaceae	Shrub	America
<i>Thuja occidentalis</i> Bailey	Cupressaceae	Tree	Canada/USA
<i>Thuja orientalis</i> L.*	Cupressaceae	Tree	China
<i>Tipuana speciosa</i> Benth.	Papilionaceae	Tree	Argentina
<i>Torenia fournieri</i> Linden ex Fourn.	Scrophulariaceae	Herb	Cochinchina
<i>Trachycarpus fortunei</i> (Hk.) Wendl.	Arecaceae	Tree	China, Japan
<i>Trifolium hybridum</i> L.	Papilionaceae	Herb	Europe, Asia
<i>Trifolium resupinatum</i> L.	Papilionaceae	Herb	Europe, Asia
<i>Tristania conferata</i> R.Br.	Myrtaceae	Tree	Australia
<i>Urena lobata</i> L.	Malvaceae	Shrub	Africa
<i>Verbena bonariensis</i> L.	Verbenaceae	Shrub	Tropical America
<i>Vigna faba</i> L.	Papilionaceae	Herb	West Asia
<i>Vitis heyneana</i> Roem. & Schult.	Vitaceae	Climber	China
<i>Washingtonia filifera</i> Wendl.	Arecaceae	Tree	Arizona, California
<i>Wisteria sinensis</i> Sweet	Papilionaceae	Climber	China
<i>Xanthium strumarium</i> L.*	Compositae	Herb	Europe

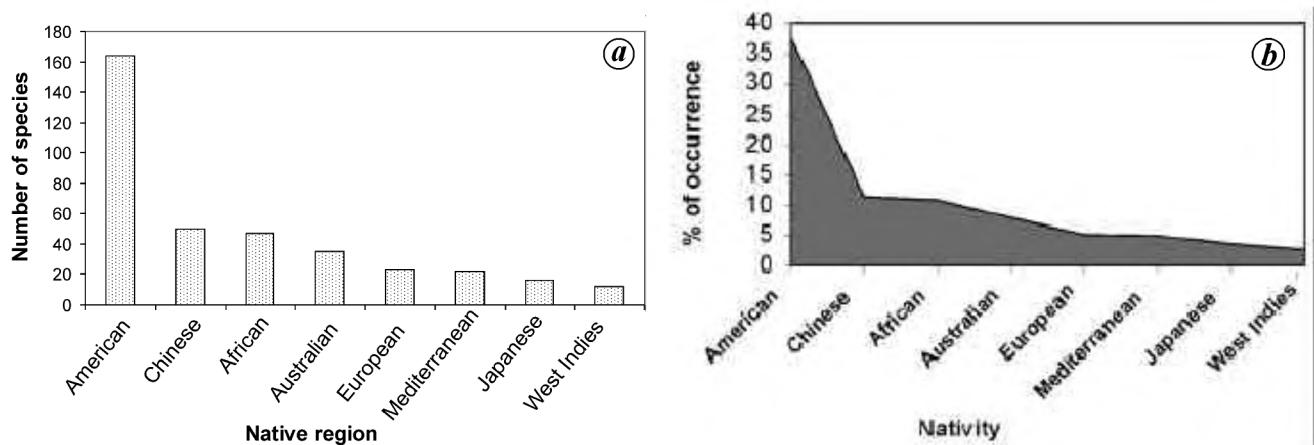


Figure 1. Status (a) and composition (b) of exotics in the Doon Valley.

It is demonstrated that 37.61% of the aliens are of American origin followed by China (11.46%), Africa (10.77%), Australia (8.02%), Europe (5.27%), the Mediterranean region (5.04%), West Indies (2.75%) and Japan (3.66%). The overall floristic composition of exotics in the Doon Valley is shown in Figure 1 b. The composition of exotics varies in the western part of India (Gujarat), where the dominance of American and African elements, is followed by Europe, the Mediterranean region, Australia, West Indies, China and Madagascar³⁴.

The significant ratio of exotics (45.69% woody and 19.4% herbaceous) and the ever-increasing spatial coverage of some of the herbaceous and shrubby taxa are a matter of serious concern to Himalayan biodiversity and its ecological and socio-economic structure. Although aliens are generally considered harmful, they do sometimes play a beneficial role in ecological restoration, soil conservation and in generating new socio-economic prospects. Field survey and investigation reveal that deliberate introduction of a few exotics like *Eucalyptus* spp. (Figure 2 a), *Casuarina* spp., *Prosopis juliflora*, *Leucaena leucocephala*, *Dendrocalamus* spp. and *Pinus* spp. has significantly catered to the demand of fuel, fodder and timber. Exotics like *Grevillea robusta*, *Callistemon* spp., *Cassia* spp. (Figure 2 b), *Cycus revoluta*, *Acacia* spp., *Juniperus*, *Phoenix* spp., *Bougainvillea* spp., *Brunfelsia calycina* (Figure 2 c) and *Magnolia grandiflora* (Figure 2 d) have contributed largely to the aesthetic beauty in the valley. Species like *Jacaranda mimosaeifolia* (Figure 2 e) and *Petrea volubilis* (Figure 2 f) are also reported as dominant ornamental species in parks and old gardens, while fruits of *Litchi chinensis* (Figure 2 g) and juice of *Camellia sinensis* have become popular at the local, national and international level.

Since many exotics like *Araucaria angustifolia*, *Cryptomeria japonica*, *Cupressus cashmeriana*, *Cycus revoluta*, *Delonix regia*, *Ginkgo biloba*, *Juniperus bermudiana*, *J. procera*, *Khaya senegalensis* and *Pinus merkusii*, grow luxuriantly in the valley and are traded internationally for their specific and multifarious utility. Sustainable exploitation

of these species may help in socio-economic amelioration. These woody taxa were introduced from different parts of the world during the colonial period and are presently important contributors to the exotic flora of the valley (Table 1).

However, some herbaceous and shrubby exotics like *Aggeratum conyzoides*, *Erigeron* spp., *Eupatorium* spp., *Lantana camara*, *Mikania micrantha*, *Parthenium hysterophorus* and *Malvastrum coromandelianum* have turned harmful to mankind and their invasion and propagation has caused ecological havoc to indigenous floristic composition. The colonizing attributes of *Croton bonplandianum*, *Xanthium strumarium*, *Galinsoga parviflora* and *Argemone mexicana* have also created socio-ecological problems and health hazards. *A. philoxeroides* and *A. pungens* may be considered a contribution to regional floristic work.

The rapid multiplication capability and the wide range of adaptation of aliens are discernible through their status of spatial distribution in the Doon Valley and other parts of the Indian subcontinent. The study in historical and the present perspective reveals that *C. bonplandianum* was introduced in 1897 in East Pakistan from South America through ship mud. It was further propagated along railway lines and to Calcutta and is now common in the valley with natural elements. It also invaded and was established in many parts of India³⁵. *Eupatorium odoratum* first arrived in Kerala^{36,37} and was found abundantly in the study area, especially along shady ravines, river terraces, moist places, and fallow land. Its quick propagation has made it a serious menace for native elements in the study area and in the southwest and northeast warm, humid regions of India³⁰. *Eupatorium riparium* and *Eupatorium adenophorum* are also closely associated with this invasion and are luxuriant in the valley.

L. camara (Figure 2 h) was introduced as an ornamental hedge plant in the Indian Botanical Garden, Calcutta in 1809. However, it is now reported as a serious invader. Its multiclimate adaptability and fast-replicating characteristics have created problems for indigenous floristic composition in the valley and throughout the country.



Figure 2. *a*, *Eucalyptus* spp. & *Lantana camara* L.; *b*, *Cassia nodosa* Buch. Ham. ex Roxb.; *c*, *Brunfelsia calycina* Benth; *d*, *Magnolia grandiflora* L.; *e*, *Jacaranda mimosifolia* D. Don.; *f*, *Petrea volubilis* Jacq.; *g*, *Litchi chinensis* Sonn; *h*, *Lantana camara* L.

L. camara is also a useful exotic as it provides valuable shelter and food for peasants and is used as fuel wood, raw material for paper pulp and biomass resource for grassfires in electricity generation.

Parthenium hysterophorus was first reported in 1956 in the western part of peninsular India³⁸, but now it has become a dominant weed of the study area, especially along road sides, foot paths, railway tracks and abandoned fields. Field study reveals that it has spread over a larger area of the valley in a short period of time and will become a dangerous invader of grasses and other herbaceous flora of native origin.

P. hysterophorus, *L. camara* and *E. odoratum* are also found to cause many allergic problems. They are not used as fodder and therefore their spatial coverage reduce the carrying capacity of graziers³⁹. These exotics have been naturalized and are distinguishable from local flora only by their known history.

Ageratum conyzoides introduced from tropical America, expanded at an alarming rate, especially in agricultural fields, along footpaths, road sides and in gardens of heavy peat content. Its dominance in fire-burn areas makes it appear a permanent denizen of India. It is harmful to native floristic composition and also creates allergic problems.

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