Notes on Naturalized Taxa of Plant Genetic Resource Value in Himachal Pradesh

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Several exotic species were observed to be part of the natural flora in parts of Himachal Pradesh in the Western Himalayan region of India. This paper highlights 56 species occurring in this region at different altitudes and diverse habitat range, identified for potential use as weedy race/close relatives of crops, having economic potential in terms of edible, forage, aesthetic, soil conservation value, etc. The available information on nativity, habitat, distributional range, genetic resource value, other uses and authors' own observations during explorations has been included to observe the potential of these taxa.

Key Words: Exotic, Himachal Pradesh, Naturalized, Plant Genetic Resources

Introduction

Introduction of species for agriculture, horticulture, forestry, etc. or accidentally through human delivery systems as well as natural migration of species from adjacent areas due to landmass connections with isoclimatic conditions had resulted in tremendous influx of many exotic species in Western Himalaya. All introduced taxa may not enter into series of steps *viz*. establishment-naturalization-invasiveness, as the thumb rule goes that one out of ten introduced taxa become naturalized while one among the ten naturalized taxa may become invasive (Williamson and Fitter, 1996). Chatterjee (1947) reported about 38% of Indian flora comprised foreign elements. More than 500 new records were reported in India in 20th century (Sharma, 2000). Eradication attempts on various naturalized and invasive species have miserably failed. Hence, it would be appropriate to suggest making use of those naturalized taxa, usually left uncared though rendering the services which can be immediately exploited in contrast with the wild flora. Dekkar (2005) emphasized the need for preserving and exploiting germplasm of best adapted invasive and weedy species, which may provide novel solutions to the problems associated with human altered earth's habitats in future. Leaving this aside, it is quite common that being unaware of occurrence of these taxa in the region, researchers make request for their germplasm from foreign countries. Therefore, the purpose of this paper is to record notes on such taxa of exotic origin occurring in Himachal Pradesh and finding out the means of harnessing the desirable traits.

Materials and Methods

Based on exploratory studies undertaken during 2003-09 supplemented with literature (Collet, 1902; Parker, 1956; Bor, 1960; Raizada, 1976; Nair, 1977; Chowdhery and Wadhwa, 1984; Polunin and Stainton, 1984; Dhaliwal and Sharma, 1999; Kaur and Sharma, 2004; Singh and Sharma, 2006), information on more than 150 exotic taxa naturalized during the last two centuries in HP was gathered. As there is a difference of opinion about defining the terms, the authors followed the definition given by ICUN (McNeely, 2001) which stated that "naturalized species are alien species that reproduce consistently and sustain populations over more than one lifecycle without direct intervention by humans (or in spite of human intervention); they often reproduce freely, and do not necessarily invade natural, semi-natural or human-made ecosystems". Therefore, causal escapes, those undergoing naturalization and invasive plants (based on Reddy, 2008) were not taken in to account. Further screening of taxa was made based on their genetic resource value, potential value, new alternate uses, etc. Hence, those taxa already cultivated as ornamental but naturalized for which no potential alternate use noticed (in fact majority are under this group) were not taken into account. The species identity was verified with the help of regional and national floras, published literature and herbarium records. Vouchers of herbarium specimens pertaining to the shortlisted taxa were deposited in the National Herbarium of Cultivated Plants, National Bureau of Plant Genetic Resources (NBPGR), New Delhi and NBPGR, Regional Station, Shimla.

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Results and Discussion

A total of 56 taxa were short-listed as having potential use as genetic resource. Unlike invasive species most of the species included were confined to disturbed sites or not expanding their range, although for some, resident time may determine whether they became invasive or not. In this regard, the species *Nicotiana plumbaginifolia*, *Solanum viarum*, *Melilotus albus*, *Asclepias curassavica* and *Acacia farnesiana* reported by Reddy (2008) being invasive in India, had no longer attained that status in HP. Occurrence of *Cyclanthera brachystachya* as naturalized exotic species in Shimla hills is the first report of its kind in India. Taxa having value as genetic resources (Table 1) are being discussed below:

A. *Genetic resource for crop improvement*

It is well known that most of the domesticated species have wild/weedy forms. Populations of five such crops of exotic origin were found in naturalized state. Apart from morphological variability, they are known for wider adaptation, stability and tolerance to abiotic stresses particularly frost. Another 14 taxa naturalised are relatives of crop species, of these, contributing traits were known only for a few. Apart from above, there are some species within the genera wherein the cultivated plants fall, whose relationship with the latter is not yet established. For example, *Stevia ovata* Willd., a native of America, is found naturalized in HP but its relation with cultivated *S. rebaudiana* Bertoni is unknown. Similarly, *Solanum asperolanatum* Ruiz & Pav. [syn. *S. hispidum* Pers.], a native of Tropical America is a recent entry to HP up to 1800 m, but its relation with other species is relatively unknown.

B. *Edible*

Ten taxa of edible value were observed under the present study. Their edibility has been proved in other areas of their occurrence. Apart from their use as famine food, ample scope exists in developing at least a few as commercial crops. In this context, research is underway for popularization of *Diospyros lotus*, *Physalis peruviana*, *Rubus fruticosus*, *Lepidium sativum* and *Nigella sativa* in western Himalaya. Also, there are added advantages in utilizing them to generate sustained income by farmers, provide variety to diets, etc.

C. *Forage*

Ten species having forage value particularly some temperate grasses and forage legumes were found naturalized in HP. Even though researchers have paid attention to these forages, popularization among end users is still awaited. Few grasses demonstrate a vast array of adaptations to climatic, edaphic or biotic factors, or various combinations of these like *Lolium*, *Festuca*, etc. and hence, in some cases, it is difficult to find out the nativity. Inter-specific hybridization is frequently reported in grasses, in some cases even potential for gene movement across the genera is established (Levy and Feldman, 2002).

D. *Aesthetic and others*

The plants of aesthetic value included those taxa having ornamental value but nowhere cultivated in HP for that purpose. Observations of nature of plants supplemented with information on past history and their utility in other countries will give clue for new uses thereby it will change the mindset of people from uncared ones to asset. There were many plants introduced for specific purpose, in the due course, remained neglected but new uses pave their way for use as crop, for instance, *Jatropha curcas* for bio-fuel, *Tagetes minuta* for bio-insecticidal, *Silybum marianum* and *Cichorium intybus* for medicinal purposes.

Majority of the short-listed species have more than one use. This is a welcome situation in the sense that they serve manifold purposes spatially as well as temporally. Apart from above there are plants which can suit as biostimulants, greenmanure, mulch, etc. It would be too early to ascribe them as genetic resource. *Lepidium sativum* is an example of a naturalized weed (of wheat fields) entering into domestication process in sub-Himalayan region of HP. Areas of multiple introductions often lead to secondary centre of diversity (Pickersgill, 1998). This is visualized in peach, apricot, and many cultivated grasses in western Himalaya. An area which needs study is impact of the spontaneous introgression of naturalized flora with the wild relatives occurring in the region especially in genera such as *Medicago*, *Chenopodium* and *Lolium*.

Conclusions

Seeking the best in naturalized exotic plants has not gained sufficient impetus in contrast to their customary

Table 1. Some naturalized exotic taxa as potential genetic resource in HP

Sl. No.	Botanical name (Family)†	Native region	Area/habitat	Genetic resource value	Additional uses (if any)
A.	**Weedy or apparently wild form**				
1	*Eruca vesicaria* (L.) Cav. subsp. *sativa* (Mill.) Thell. (Brassicaceae)	South America	Up to 1800 m; roadsides	Tolerant to abiotic stresses	High erucic acid for plastic industries
2	*Medicago sativa* L. (Fabaceae)	Mediterranean	Kangra	Tolerant to abiotic stresses	–
3	*Prunus armeniaca* L. (Rosaceae)	China, Siberia	1500–3000 m; probably extended distribution	Variability in colour and size of fruit, flesh colour, chilling hour requirement, time of ripening, kernel taste, etc.	As rootstock for cultivated apricot
4	*P. persica* (L.) Batsch (Rosaceae)	China	700–3000 m; near human habitations	Variability in colour and size of fruit, time of ripening and degree of stone attachment with pulp, resistance to leaf curl and gummosis	As rootstock for cultivated peach
5	*Ricinus communis* L. (Euphorbiaceae)	South America	Up to 2000 m; grasslands, riparian and disturbed sites	Variability in pigmentation, plant habit and size of capsule	Red-leaved types useful as ornament
B.	**Crop Relatives**				
1	*Abelmoschus manihot* (L.) Medik. subsp. *manihot* (Malvaceae)	China	Shimla and Kinnaur (up to 1000 m)	Crossable with okra; resistant to yellow vein mosaic virus (Dhankhar *et al*., 2005)	–
2	*Avena fatua* L. (Poaceae)	Europe; western & central Asia	Lahaul & Spiti; weed of wheat fields; extended distribution	Progenitor of cultivated oat (Holden, 1976)	–
3	*Carthamus oxyacanthus* Bieb. (Asteraceae)	Lahore westwards to Caucasus	Areas bordering Punjab (400–700 m); field weed	Progenitor of safflower (Ashri and Knowles, 1960)	–
4	*Cyclanthera brachystachya* (Ser.) Cogn. [syn. *C. explodens* Naud.] (Cucurbitaceae)	Central America	Shimla (1700–2300 m); becoming weedy	Can contribute earliness in *meetha karela* (*C. pedata*)	Fruit-vegetable; suit for bush farming
5	*Fragaria vesca* L. subsp. *vesca* (Rosaceae)	Europe & West Asia	1500–2500 m; extended distribution	Crossed with cultivated strawberry (Marta *et al*., 2004); resistant to *Xanthomonas fragariae* (Maas *et al*., 2000)	Fruit value
6	*Jatropha gossypiifolia* L. (Euphorbiaceae)	Brazil	Up to 700 m; early colonizer of disturbed lands	Crossed with *J. curcas* L. (Sujatha and Prabhakaran, 1997)	Ornamental
7	*Nicotiana plumbaginifolia* Viv.* (Solanceae)	Mexico & West Indies	Up to 2300 m	Crossable with tobacco (Nikova *et al*., 2004); resistant to black shank disease (Nagarajan and Reddy, 1982)	–
8	*Paspalum dilatatum* Poir. (Poaceae)	South America	Hill stations; grasslands, fresh water wetlands	A genepool for kodo millet	Forage; soil binder
9	*Raphanus raphanistrum* L. (Brassicaceae)	Southwest Asia, North Africa, Europe	Up to 1500 m; weed of wheat fields	Contributed to the evolution of cultivated radish (Gill, 1995)	–
10	*Rosa foetida* Herr. (Rosaceae)	South West Asia	Lahaul	Yellow flower colour is incorporated into garden roses (de Vries and Dubois, 1978)	Ornamental
11	*Solanum lycopersicum* L. var. *cerasiforme* (Alef.) Fosberg [syn. *Lycopersicon esculentum* var. *cerasiforme* (Dunal) Alef.] (Solanaceae)	South America	Up to 2500 m; near human habitations	Progenitor of cultivated tomato (Rick, 1976); contributes to disease resistance	Fruit as vegetable; salad; processing value
12	*S. viarum* Dunal* (Solanaceae)	Brazil	1000–2000 m; grasslands, forests, riparian habitats	Crossable with brinjal (Prabhu *et al*., 2009); resistant to *Fusarium* wilt, bacterial wilt and tolerant to frost (Rana *et al*., 2006).	Solosodine rich hence ommercial value

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Sl. No.	Botanical name (Family)†	Native region	Area/habitat	Genetic resource value	Additional uses (if any)
C.	**Edible Value**				
1	*Allium tuberosum* Rottler ex Spreng. (Amaryllidaceae)	China	Kinnaur (1400–1800 m); probably extended distribution	Leaves as vegetable and condiment	Dried leaves as spice
2	*Canna indica* L. [syn. *C. edulis* Ker Gawl.] (Cannaceae)	Andes Region	700–2100 m; only near human habitations	Tuber value	Ornamental
3	*Diospyros lotus* L. (Ebenaceae)	South West Asia	1000–2200 m; probably extended distribution	Dried fruit taste like date fruit	Rootstock for persimmon
4	*Helianthus tuberosus* L. (Asteraceae)	North America	1500–2300 m; in forest edges, orchards, riparian habitats	Tuber value; crossable with sunflower and imparts disease resistance (Kalloo, 1993)	Ornamental
5	*Lepidium sativum* L. (Brassicaceae)	Egypt & West Asia	Up to 2500 m; weed of wheat fields	Leafy vegetable	Medicinal value for joint pain
6	*Nigella sativa* L. (Ranunculaceae)	West Asia	Weed in Sirmour	Seed as spice	Medicinal; insecticidal
7	*Opuntia ficus-indicae* (L.) Mill. (Cactaceae)	Mexico	Up to 2300 m; rocky places, grasslands	Fruit value; cladode as vegetable	Hedge, ornamental
8	*Physalis peruviana* L. (Solanaceae)	Tropical America	Up to 2000 m; forest edges, disturbed sites	Fruit value	Ornamental
9	*Plantago lanceolata* L. (Plantaginaceae)	Europe & West Asia	Shimla (1500–2300 m); probably extended distribution	Leafy vegetable	–
10	*Rubus fruticosus* L. agg. (Rosaceae)	Europe	Kinnaur & Shimla (1800–2500 m); scrublands and other disturbed sites	Fruit value	Ornamental
D.	**Forage value**				
1	*Broussonetia papyrifera* Vent. (Moraceae)	China	Up to 1800 m	Leaves as forage	Soil conservation in moist areas
2	*Desmanthus virgatus* (L.) Willd. (Fabaceae)	America	Up to 1000 m	Leaves as forage	Hedge
3	*Lolium temulentum* (L.) var. *arvense* Lilj. (Poaceae)	Mediterranean	Kullu and Kangra (1000–2000 m); due to multiple introduction	Plants as forage	–
4	*Medicago polymorpha* L. (Fabaceae)	Europe	Up to 2000 m; extended distribution	Plants as forage	Green manure
5	*Melilotus albus* Desr.* (Fabaceae)	Europe	Up to 4000 m	Plants as forage	Green manure
6	*M. indicus* (L.) Ali (Fabaceae)	Europe	Up to 2000 m; extended distribution	Plants as forage	Green manure
7	*Phleum pratense* L. (Poaceae)	Temperate Europe	Kullu; probably as a result of multiple introduction	Plants as forage	–
8	*Trifolium dubium* Sibth. (Fabaceae)	Europe	Up to 2000 m	Plants as forage	–
9	*T. incarnatum* L. (Fabaceae)	Europe	Up to 1500 m	Plants as forage	–
10	*T. tomentosum* L. (Fabaceae)	Europe	Sirmour	Plants as forage	–

Contd.

Table 1 Contd.

Sl. No.	Botanical name (Family)†	Native region	Area/habitat	Genetic resource value	Additional uses (if any)
E.	**Aesthetic value**				
1	*Acacia decurrens* (Wendl.) Willd. (Fabaceae)	Australia	1500–2200 m	Lean season ornamental	Crossable with *A. meansii*; tannin value
2	*Asclepias curassavica* L.* (Asclepiadaceae)	West Indies	Up to 1500 m; in wet areas	Lean season ornamental; cut flower value	–
3	*Briza minor* L. (Poaceae)	Mediterranean	Kullu (1000–1800 m); weed of wheat fields	Ornamental grass	–
4	*Cymbalaria muralis* Gaertn. (Scrophulariaceae/Plantaginaceae)	Europe	Shimla (1800–2300 m); in walls	Hanging baskets	–
5	*Dahlia imperalis* Roezl. (Asteraceae)	Central America	1500–2500 m; in disturbed sites	One of the parents for present day dahlias	Ornamental
6	*Senna* × *floribunda* (Cav.) H.S. Irwin & Barneby [syn. *Cassia floribunda* Cav.] (Fabaceae)	Mexico	Up to 1500 m	Ornamental hedge value	–
F.	**Others**				
1	*Acacia dealbata* Link. (Fabaceae)	Australia	1300–2100 m	Windbreak, shelterbelt; afforestation in wasteland	Tannin value; ornamental
2	*A. farnesiana* (L.) Willd.* (Fabaceae)	Tropical America	Along riversides to 1200 m	Gum; perfume value	–
3	*Agave cantala* (Haw.) Roxb. (Asparagaceae)	Tropical America	Up to 2400 m	Soil conservation; fibre value	Hedge
4	*A. vivipara* L. [syn. *A. angustifolia* Haw., *A. wightii* J.R. Drumm. & Prain] (Asparagaceae)	Tropical America	Up to 1500 m	Soil conservation	Hedge, flower stalks as famine food
5	*Ailanthus altissisima* (Mill.) Swingle [syn. *A. glandulosa* Desf.] (Simaroubaceae)	China	Up to 1800 m; along roadsides	Soil erosion control	Silkworm rearing
6	*Chenopodium ambrosioides* L. (Chenopodiaceae)	Mexico	Up to 3000 m; disturbed sites, weed	Aromatic oil	–
7	*Chrysanthemum coronarium* L. (Asteraceae)	Mediterranean	Kinnaur Dt. (2500–3100 m)	Ornamental	Vegetable
8	*Cichorium intybus* L. (Asteraceae)	Europe	Shivalik hills; in fallow fields	*Kasni* leaves as having medicinal properties i.e. in the treatment of kidney and liver problems (exploited in South India)	Fodder; leafy vegetable
9	*Matricaria chamomilla* L. (Asteraceae)	Europe & West Asia	Mandi (2000–2300 m); extended distribution	Medicinal value as stimulant, carminative	Ornamental
10	*Parkinsonia aculeata* L. (Fabaceae)	Northern Mexico to southern USA	Shivalik hills; in fallow lands	Afforestation in sandy, denuded soils and drought-prone areas	Ornamental hedge
11	*Silybum marianum* Gaertn. (Asteraceae)	Mediterranean	Kangra (500–1200 m); roadsides	Seed act as blood purifier	Ornamental
12	*Tagetes minuta* L. (Asteraceae)	South America	Up to 2200 m; in disturbed places	Bio-insecticidal	–
13	*Triadica sebifera* (L.) Small [syn. *Sapium sebiferum* (L.) Roxb.] (Euphorbiaceae)	China & Japan	Kangra ; wetlands, grasslands	Seeds yield tallow	Ornamental tree

† Taxa with asterisk mark (*) mentioned as invasive in India (Reddy, 2008) were observed not that status in HP.

treatment as 'annoyance' in India. This paper attempts to address such naturalized taxa which can be explored as genetic resource of direct value in comparison with wild flora because many of them are cultivated elsewhere and introduced intentionally. Ample scope exists in promotion of few such species as new crops. Alternate uses are highlighted since original intended use was not well appreciated in the region. Overall, this assessment will help in generating primary database on naturalized taxa for the benefit of scientists and policy makers in developing management strategies. Validation of potential value of aforementioned taxa may reveal whether more germplasm needs to be introduced in the region further. This would also gives clue on the phenotypic plasticity of these exotic plants.

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