SHORT COMMUNICATION

Naturalization of *Solanum chacoense* Bitter: An Exotic Species in the Shimla Hill, Himachal Pradesh

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Solanum chacoense Bitter is native to South America, but has also naturalized in some other countries outside its original habitat due to its invasive weedy nature. It has naturalized in the Shimla, Himachal hill forest after its escape from the wild potato germplasm collection at the Central Potato Research Institute, Shimla (Himachal Pradesh). It is an important source of genes for charcoal rot, late blight, various types of nematode etc. and could be an important genetic resource in future.

Key Words: Exotic species, Naturalization, *Solanum chacoense*, Shimla hill, Wild potato

The process of naturalization of plant species in new areas away from their original habitats presents an interesting case history, showing thereby what might have happened during the early spread of economically useful species of plants. It was around 1936 that a set of wild relatives of potato was planted at Agriculture Research Institute field station at Phagli (Shimla), for their potential use in the breeding of resistant varieties for the Indian subcontinent, but during that time there was not much known about these species in the absence of targeted evaluation of these species. Since then one of the wild potato species, namely, *Solanum chacoense* Bitter, escaped to the Shimla woods and now it can be seen in all parts of Shimla hills. It flowers and bears berries in abundance with a high percentage of viable seed setting. It also bears small sized tubers underground. The author believed that the monkeys (*Macaca mullata*) and langurs (*Semnopithecus entellus*) consume the mature berries near maturity and it is through their faecal matter seeds are dropped on the ground in different parts and after the break of dormancy the seeds germinate in high percentage, may be that the digestive enzymes help in high per cent germination. This is because the station at Phagli (Shimla) is located at an elevation of 1925 m and from there it has spread upward up to an elevation of 2100 m and laterally it has not gone into the areas beyond the disconnected forest areas. Moreover there are frequent vertical rather than lateral movements of monkeys and langurs, and that too, in forest areas only. It also appears that it has a direct relationship with their continuous presence in the area. Nayar and Gohal (1970) have suggested the spread by birds, which, if accepted then the spread of this species cannot be confined to a particular area of forest, because its distribution has not gone beyond Bolleaugunja and Dhalli in Shimla town due to discontinuity of forest.

S. chacoense is an important source of resistant genes for charcoal rot disease of potato, which occurs widely in areas with high temperature. It also has resistance to late blight disease, which is among the most injurious diseases of potato crop, because of its sudden spread and very high damage to the foliage and causing severe rot of tubers. When the fungal spores gain entry in the tubers, they may cause rotting of tubers even during the storage conditions. Generally two strains of *S. chacoense* are seen growing in the forests, one with purple pigmented stems and the other with green stems. *S. chacoense* is native to southern Bolivia, northern Argentina, south-west Uruguay, southern Paraguay, low lands of south-central Chile, and southern Brazil; at elevations ranging from near sea level to more than 2000 m and on sandy slopes even up to 2200 m. It generally grows in areas with very high rainfall (over 1000 mm/year) and prefers soils rich in organic matter, well drained with pH from 6.0-6.5. It can tolerate shade of trees and low temperatures up to 5°C as well as cloudy weather for extended periods (Terzioglu & Ansin, 2001). In its native areas, it occupies a wide range of habitats. In Shimla, it grows well under the trees of *Cedrus deodara* and has association with *Prinsepia utilis, Mirabilis jalapa, Physalis nicandra, Achyranthes aspera, Fagopyrum cymosum, Girardinia heterophylla, Bidens pilosa, Ficus palmata,*

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Fig. 1. *S. chacoense* colonistaion in Shimla forests

Prunus puddum (*P. cerasoides*), *Strobilanthes dalhousianus* and various species of grasses. *Solanum chacoense* plants form rosettes or sub-rossettes, erect or spreading, glabrous or sparsely pubescent over all parts. Stems are 30-70 cm, angular, and are usually light green or occasionally irregularly pigmented, branches winged, flowers white (Fig.1). It has single locus homomorphic self-incompatiblity, which is gametophytic type and is operative at late stylar stage (Franklin-Tong & Franklin, 2003). However, in some clones of *S. chacoense* (e.g. CPC1760), a pseudo-self incompatibility also occurs. Such sporadic self incompatibility may be due to partial breakdown of the self incompatibility which may not be owing to gene 'F' responsible for fertility. Though there are scanty in-depth studies on this plant species, of about 110 tuber bearing *Solanums*, *S. chacoense* has probably the greatest potential for use in potato improvement programmes. Plants of this species are little attacked by aphids, *Myzus persicae*, an important insect vector responsible for spread of potato virus, PVX; has resistance to *Empoasca fabae* (leaf hopper); seldom damaged by Colorado potato beetle (*Leptinotarsa decemlineata*); has some resistance to potato viruses, PLRV (potato leaf roll virus) and PVY (potato virus Y); and has resistance to *Synchytrium endobioticum* (potato wart or black scab) as well as to *Corynebacterium sepedonicum* (ring rot). It also shows resistance to various types of nematode (Anonymous, 1975, 1978). Evaluation studies conducted at the International Potato Centre (CIP), Lima, Peru indicated that *S. chacoense* possesses resistance to broad spectrum diseases and has a high degree of resistance to bacterial wilt caused by *Pseudomonas solanacearum*, a serious potato disease all over the world (Ochao, 1990).

It is note worthy to mention here that *S. chacoense* has been introduced widely outside its natural range of habitats (Reinhard *et al.*, 2010) and because of its better adaptability and aggressive weedy nature, it has spread and acquired as a weedy status. It is more so when neither wild nor cultivated potato is known to spread outside of its native range. *Solanum chacoense*, however, has become established in eight sites around the world, in Himachal Himalaya (Shimla) in India, eastern China, England, New Zealand, the United States, Central Peru, and east-central Argentina. A literature review reveals that although *S. chacoense* possesses traits typical of an invasive species, yet all populations, in these sites, appear to be confined to their site of introduction. In fact, the spread of this species in Shimla appears to be due to congenial climatic conditions and its ability to defend itself against enemies, as well as it has large ecological tolerance, which enables it to live in other ecosystems and compete with the indigenous taxa (Reinhard *et al.*, 2010). In Shimla, the species can be seen growing in frequent large colonies on the hill slopes, along the road, and water channels and near the cultivated fields

on grassy bunds (Fig. 2). It bears large number of berries producing number of viable seeds. Usually the plants forming colonies are found growing luxuriantly and are invariably free from diseases and pests. Recently it was also reported that plants of *S. chacoense* contained acetylated glycoalkaloids (leptine) providing high resistance against the potato beetle (Wink, 1988). So, no insect-pest can be seen feeding on its foliage. Taxonomically, *S. chacoense* contains one subspecies, *S. chacoense* ssp. *subtilis* (Bitt.) Hawkes, and three varieties viz. *S. chacoense* var. *angustisectum* Hassl., *S. chaconse* var. *latisectum* Hassl. f. *glabrescens* and *S. chacoense* var. *latisectum* f. *plurijugum* Hassl. This species is self-incompatible and can be readily crossed with many varieties of cultivated diploid potato species namely *S. phureja* and *S. goniocalyx*. But it cannot be crossed directly with *S. tuberosum*, however its colchicines induced tetraploids are crossable.

Fig. 2. *S. chacoense* plant with tuber

In conclusion, it is pointed out that this naturalized species in Shimla hill has become a weed and has no other worth than its potential use in breeding, when it has been evaluated for several useful traits by now. While *S. chacoense* is an important source of genes responsible for resistance to a number of diseases and insect-pests, it has not been much used in the breeding of improved varieties, because of two reasons. Firstly, it is a diploid species and the cultivated potato is tetraploid and hence direct crosses were not possible Secondly, it contains a new glycoalkaloid or high glycoalkaloids posing a health hazard. This has been the case with a variety called Lenape, which had *S. chacoense* as one of the parent and was found to exceed the safety levels of glycoalkaloids and had to be withdrawn from the commercial cultivation (Wink, 1988). The use of this species in breeding was limited in the conventional methods, which is not the case, now, when new biotechnological breeding tools are available. So, the naturalized species may serve as an important genetic resource in the years to come.

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