

# Wild Relatives of Crop Plants in India



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Crop wild relative (CWR) is a wild plant closely related to a domesticated plant, whose geographic origins can be traced to regions known as Vavilov Centers (named for the pioneering botanist Nikolai Vavilov). It may be a wild ancestor of the domesticated plant that is genetically related to cultivated crops. It was Nikolai Vavilov, the Russian botanist who first realized the importance of crop wild relatives in the early 20th century.



Nikolai Vavilov

CWR collectively constitute an enormous reservoir of genetic variation useful for plant breeding initiatives and critical to meeting the challenge of global food security through enhanced agricultural production. Their conservation and sustainable use is very important for improving agricultural production, increasing food security, and maintaining a healthy environment.

Cultivated plants have been derived from the wild relatives through the process of selection followed by hybridization for bringing desired improvement. Wild related species have contributed significantly towards improvement of crop plants such as paddy, wheat, potato, brinjal, tomato, sugarcane, etc. Wild relatives are economically important for edible, medicinal and other uses: *Allium*, *Cicer*, *Citrus*, *Coix*, *Crotalaria*, *Dioscorea*, *Piper*, *Prunus*, *Rubus*, *Saccharum*, etc.

### Value of CWR :

CWRs are essential components of natural and agricultural ecosystems and hence are indispensable for maintaining ecosystem health.

Genetic material from CWRs has been utilized by humans for thousands of years to improve the quality and yield of crops. They continue to evolve in the wild, developing traits – such as drought tolerance or pest resistance – that farmers and breeders can cross with domesticated crops to produce new varieties.

### Diversity of CWR in India :

Arora and Nayar (1984) classified the CWR into different groups based on their agri-horticultural importance. These, based on the crop groups and number of species (given in parenthesis), have been grouped as : cereals and millets (51), legumes (31), oilseeds (12), fibres (24), vegetables (54), fruits (109), spices and condiments (27) and others (26).

### Representation of CWR in India :

Species	Wild relative	Desirable trait	Area of collection
<i>Oryza nivara</i>	<i>O. sativa</i>	Grassy stunt virus resistance	Sultanpur (UP)
<i>Porteresia coarctata</i>	<i>O. sativa</i>	Salt tolerance	Sunderban (WB)
<i>Cajanus scarabaeoides</i>	<i>C. cajan</i>	General disease resistance	Gajapati (Orissa)
<i>Atylosia cajanifolia</i>		Higher pod and seed yield	Khandala, Western Ghats
<i>Pvrus communis</i>	<i>P. lacauemontii</i>	Larger fruit and hardness	Western Himalayas
<i>Piper lomaum</i>	<i>P. bababudani</i>	Larger sized of fruits	Western Ghats
<i>Abelmoschus esculentus</i>	<i>A. tuberculatus</i>	Resistance to mosaic virus	Central India
<i>Citrus limon</i>	<i>C. indicus</i>	General disease resistance	Nokrek (Meghalaya)

## The endemic Rare and Endangered diversity in wild relatives includes :

- *Oryza nivara* from eastern Uttar Pradesh
- *Vigna khandalensis* from Pune, Maharashtra
- *Atylosia cajanifolia* from Khandala region of Western Ghats
- *Abelmoschus tuberculatus* from northern plains
- *Citrus species* from NEH region
- *Carthamus lanatus* from Kashmir
- *Garcinia imbertii* from Agasthiyamala range, Chemuga Hill, Kerala
- *Solanum giganteum*, *Luffa hermaphrodita* and *Cucumis prophetarum* (rare species) from Aravali ranges, Rajasthan
- *Aegilops tauschii* (an endangered species) from stony alpine habitats in Lahul and Spiti, Kinnaur and Pangi regions in Himachal Pradesh
- *Syzygium bourdillonii* (species rediscovered after 100 years) from Thiruvananthapuram, Kerala

## Challenges in the way :

- CWR are neglected and threatened in wild
- *Rhynchosia bracteata* (Rare) : Disease resistance in Cicer
- *Atylosia cajanifolia* (Endemic) : Higher pod and seed yield in *Cajanus cajan*
- *Sesamum mulayanum* (Vulnerable) : Disease resistance against powdery mildew
- Importance of CWR and their useful traits are not well recognized
- Proper identification and management plans to be designed for protection of CWR

## The wild relatives have been identified as source of the following desirable traits in improvement of crop plant :

- (i) Resistance to diseases and pests: paddy, chickpea, maize, pigeon pea, sesame, brinjal, lady's finger and potato.
- (ii) High vegetative vigour: sugarcane and potato
- (iii) Higher protein value: oat, pigeon pea.
- (iv) Higher oil content: coconut, sesame, and oil palm



Larger seed and oil yield from *Sesamum prostratum*



Resistance to black Sigatoka and Fusarium wilt from *Musa acuminata* ssp. *burmannica* in banana (Fiscalant et al., 2002)



Better culm yield from *Saccharum arundinaceum*

Grassy stunt virus resistance from *Oryza nivara* in rice



Resistance from Powdery mildew and salinity from *Helianthus debilis*



Salinity tolerance from *Lycopersicon chrysanthum*

(v) Greater fibre strength: cotton and jute

(vi) Tolerance to environmental stress (salt, heat/ frost, drought): pigeon pea and soybean



*Zea mays*      *Z. diploperennis*

Immunity to major diseases



*Solanum melongena*



*S. incanum*

Resistance to borer



*Lycopersicon esculentum*      *L. pimpinellifolium*

Resistance to fusarium, wilt, bacterial cancer

Crops	Wild relatives	Traits
<i>Avena sativa</i> (Barley)	<i>Avena sterilis</i>	Grain yield
<i>Cajanus cajan</i> (Arahar dal)	<i>Atylosia cajanifolia</i>	Higher pod and seed yield
<i>Triticum aestivum</i> (Wheat)	<i>Triticum turgidum</i>	High kernel weight
<i>Saccharum officinarum</i> (Sugarcane)	<i>Saccharum spontaneum</i>	Higher culm yield
<i>Oryza sativa</i> (rice)	<i>Oryza longistaminata</i>	Drought tolerant
	<i>Oryza coarctata</i>	Salt tolerant
<i>Hordeum vulgare</i> (Barley)	<i>Hordeum spontaneum</i>	Drought tolerant
	<i>Hordeum bulbosum</i>	Disease, drought, salt, frost tolerant
<i>Cicer arletinum</i> (Chickpea)	<i>Cicer reticulatum</i>	Drought and heat tolerant
	<i>Cicer echinospermum</i>	
<i>Helianthus annus</i> (Sunflower)	<i>Helianthus paradoxus</i>	Salt tolerant
	<i>Helianthus agrophyllus</i>	Drought tolerant

### Pressure on CWR :

The natural populations of many CWRs are increasingly at risk.

- They are threatened by habitat loss through the destruction and degradation of natural environment or their conversion to other uses.
- Deforestation is leading to the loss of many populations of important wild relatives of fruit, nut, and industrial crops.
- Populations of wild relatives of cereal crops that occur in arid or semi-arid lands are being severely reduced by over grazing and resulting desertification.
- Spread of Invasive species
- Pollution
- Climate change

**Conservation strategy :**

- Ex-situ conservation : Conservation outside natural habitat (Botanical garden; gene bank; seed bank). This mode makes it easily accessible for use.
- In-situ conservation : Conservation in natural habitat. In this mode more variation is conserved and at low cost.

**Conclusion :**

For utilization of wild relatives, there should be –

- Identification of wild gene pool of the crop,
- Availability of sufficient material for screening and evaluation, and
- Appropriate method for gene transfer.

The key to successful crop improvement is a continued supply of genetic variability and beneficial traits contained in this diversity<sup>1</sup>, and wild relatives of modern crops are the source of much of this novel diversity, providing genes with improved nutritional quality, resistance to pests and diseases, as well those with traits adapted to drought and extreme temperatures.

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