Review Article

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Rare, Threatened and Endangered Medicinal Plants of South Gujarat: Status and Conservation

Avani N. Thakar[1*] and Archana Mankad[2]

1. Gujarat Medicinal Plants Board, Department of Health & Family Welfare, Block No. 19, 3rd Floor, Dr. Jivraj Mehta Bhavan, Gandhinagar- 382010

2. Department of Botany, Bioinformatics and Climate Change Impacts Management, School of Science, Gujarat University, Ahmedabad- 380 009.
E-mail: avaniyajnik@gmail.com

*Corresponding Author

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Abstract

Medicinal Plants play a sizable role in fulfilling the demand for traditional medicine market both nationally and internationally. South Gujarat is rich in medicinal plants diversity. But now a day's many medicinal plants become rare. The RET (Rare, Endangered and Threatened) medicinal plants which have been identified by IUCN are to be conserved by both *in-situ* and *ex-situ* methods. The creation of Medicinal Plant Conservation Areas (MPCAs) in all the Agro-climatic zones will go a long way for conservation of Bio-diversity. Says of these plants are distributed throughout the greater part of south Gujarat but now are listed amongst endangered species in many areas in the state. Hence, their conservation is urgently required. Day by day due to overexploitation and other reasons like introduction of new species, Urbanization, Industrializations etc. plants are facing problems for their existence in their natural habitat. In this scenario

conservation becomesserious need for its protection as well as for proper multiplication in certain ecological areas.

Plant *in vitro* regeneration is a biotechnological tool that offers a potential solution for the propagation of endangered and superior genotypes of medicinal plants which could be released to their natural habitat or cultivated on a large scale for the pharmaceutical product of interest. Tissue culture protocols have been developed for a wide range of medicinal plants, which includes endangered, rare and threatened plant species.

Keywords: RET (Rare, Endangered, Threatened), *Ex-situ* conservation,*In-situ* conservation

The RET (Rare, Endangered and Threatened) medicinal plants which have been identified by IUCN are to be conserved by both *in-situ* and *ex-situ* methods. There are about 498 registered pharmacies in Gujarat. These pharmacies get part of medicinal plants, raw material from outside the State and remaining from forests unofficially through unorganised forest produce gatherers. This leads to depletion of already dwindled medicinal plants resource in the State. Consequently, some of the species have been rare; others endangered and threatened (RET), (Source: - Gujarat Medicinal Plants Board (GMPB), Gandhinagar). Some of the species have reached to such a threshold that there is a rarity of seed and planting material for raising of seedlings also.

Additional utilization of the plant resources, deforestation, population pressure on nature forest fire etc.aremain reasons for loss of species from certain ecological areas. Because of rich potential to treat many disorders, the medicinal plants becoming not only suitable but also need for proper safety. Security of the plant species against the changeable environmental as well as diseases etc. is determining factors for its presence and survival in nature. (Patel DK, 2015). IUCN identifies the resulting categories: extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern, data deficient and not evaluated. Species with small populations that are not at present endangered or vulnerable but are at risk are called rare. (Singh *et al.*, 2006).*In vitro* techniques have been gradually applied for mass propagation and germplasm conservation to ensure the survival of endangered plant species, rapid mass propagation for large scale re-vegetation and for genetic manipulation studies. Tissue culture protocols have been developed for numerous plants but there are many other species, which are over exploited in

pharmaceutical industries and need conservation.(Sharma *et al*. 2014).

Gujarat is a forest lacking state, covers around 10% notified forest land to its geographical area.Accordingly, the state has been divided into six zones, *viz.*, South Gujarat, South East Gujarat, Central Gujarat, North Gujarat, Saurashtra and Kutch. Owing to the diverse agro-climatic conditions and varied forest types in the state, out of 2205 recorded Angiospermic plants, 1315 (59.6%) plants have been identified with medicinal value. Out of all these, 102 species are of conservation-concern and 76 are naturally rare. (Pandey *et al.* 2005).

Fig. 1: Different bio- geographic zones of Gujarat (Source: Chandrakar, 2014)

The status and distribution of threatened and rare medicinal plant species observed in different types of habitats and ecosystems of South Gujarat, India, under the CREB (Conservation of Rare and Endangered Biodiversity) (GES, MSU & GUIDE, 2002).

Zone-I South Gujarat:

The south Gujarat situated between 21° 14'-22° 49' N north latitude to 72° 22'-74° 15' East longitude. Zone I covers the districts of Dangs, Navsari and Valsad. As the zone receives moderately high rainfall varying from 1500 to 2000 mm/annum, the forest type of the zone is predominantly moist deciduous.South Gujarat has 70% of the 1315 medicinal plantspeciesfound

in the state.In terms of density of species diversity (No. of species per 100 sq.km.), the Zone ranks first in the state with 13.17 species/ 100 sq.km.(Pandey *et al*. 2005).

Table:1Conservation concern species of Zone 1

Sr. No.	Scientific Name	Family	Habit
1	*Droseraindica*L.	Droseraceae	Herb
2	*Evolvulusnummularia*	Convolvulaceae	Herb
3	*Habenariacommelinifolia*(Roxb.) Lindl.	Orchidaceae	Herb
4	*Habenarialongicorniculat a*Grah.	Orchidaceae	Herb
5	*Platantherasusannae*(L.) Lindl.	Orchidaceae	Herb
6	*Sapium insigne Trimen. var. malabarica*	Euphorbiaceae	Tree
7	*Wahlenbergiamarginata*(Thunb.)A.DC.	Campanulaceae	Herb
8	*Zingiberrosium*Rosc.	Zingiberaceae	Herb

(*Source: Pandey et al., 2005. Medicinal plants of Gujarat, GEER Foundation, Gandhinagar*).

Zone -II South East Gujarat:

Zone II consists of Surat, Bharuch and Narmada districts. Compared to Zone I, this zone receives less rainfall which varies from 1000 to 1500 mm / annum. The forest type encountered in this zone is predominantly moist deciduous towards the northern parts. The floristic clement found in the zone II are more or less similar to the species of zone I. In terms of Density of species diversity (No. of species/100 sq.km.), the zone ranks second in the state with 6.00 species / 100 sq.km.(Pandey *et al*. 2005).

Table:2The following six conservation concern species are restricted to zone II.

Sr. No.	Scientifi c Name	Family	Habit
1	*Bruguieragymnorhiza (L.) Sovigy*	Rhizophoraceae	Tree
2	*Derris scandensRoxb. Benth.*	Fabaceae	Climber
3	*DioscoreabelophyllaVoight ex. Haines.*	Dioscoreaceae	Climber
4	*EulophiaherbaceaLi ndl.*	Orchidaceae	Herb
5	*Peperomiapellucida L.*	Piperaceae	Herb
6	*Salix tetraspermaRoxb.*	Salicaceae	Tree

(*Source: Pandey et al., 2005. Medicinal plants of Gujarat, GEER Foundation, Gandhinagar*).

There are three medicinal plants occurring in zone I & IIthat are enlisted in red data list of IUCN 2001 i.e. *Dalbergialatifolia*, *Santalum album* and*Saracaasoca*. The focussed conservation programme for such species is certainly going to be a positive step towards the saving of these threatened and valuable species.(Pandey *et al.* 2005).

Table: 3 List of threatened medicinal plant species of South Gujarat (Zone I & Zone II) *(Source: Singh A. P., 2003)*

Trees					
No	**Local**	**Botan ical Name**	**No.**	**Local Nam e**	**Botan ical Name**
1	Harde	*Terminaliachebula*	9	Ragatrohido	*Tecomeau ndula ta*
2	Arjun	*Terminaliaarju na*	10	Kadv oSargvo	*Moringaconcan ens*
3	Ashok	*Saracaasoca*	11	Kapilo	*Mallotushillipinensis*
4	Kanchna r	*Bauhiniavariegata*	12	Bhilamo	*Semecarpsa naca rd im*
5	Sivan	*Gmelinaarborea*	13	Salai	*Boswelliaserrata*
6	Chandan	*Sant alumalbum*	14	Vai-varno	*Cratevanurvala*
7	Patla	*Stereospermumsuaveolens*	15	Biyo	*Pterocarsmar supium*
8	Tetu	*Oroxylumindicum*			

Shrubs					
No.	**L oca l Name**	**Botanical Name**	**No.**	**Local Name**	**Botanical Name**
1	Vavding	*Embeliar ibes*	5	Ankol	*Alagiumsal vifolium*
2	Arni	*ClerodendronPhlomidi s*	6	Bharangmool	*Clerodendronserratum*
3	Danti	*Baliospermummontanu m*	7	Mindhan	*Randiadumentorum*
4	Dhavdi	*Woodfordiafruticosa*	8	Kadayo	*Sterculiaurens*

Climbers					
o.	**Local Name**	**Botan ical Name**	**No.**	**Local Name**	**Botan ical Name**
1	Galo	*Tinos po racordifolia*	7	Malkangni	*Cela stru sp anicu lata*
2	Patha	*Cycleapeltata*	8	Garni	*Clitoriaternatea*
3	Shatawari	*Asparagusracemosus*	9	Hadsankad	*Cissusquadrangularis*
4	Vachhnag	*Gloriosasuperba*	10	Shikakai	*Acacia concina*
5	Dodi	*Leptadeniareticulata*	11	Vidarikand	*Puerariatuberosa*
6	Anantmoo l	*Hemidesmusindicus*	12	Kadv aParvar	*Trichos an thescucumerina*

Table: 4List of Naturallly Medicinal Plants of Zone I & II

Sr. No.	Scientific Name	Family	Habit	Criteria	Zone I	Zone II
1	*Abelmoshusangulosus W & A*	Malvaceae	Herb	x	√	√
2	*Abelmoshusmoschatus Medic*	Malvaceae	Herb	x	√	√
3	*Aegicerascorniculata (L.) Balanco.*	Myrsinaceae	Tree	x		√
4	*Aeginetiaindica L.*	Orobanchaceae	Herb	x	√	√
5	*AntidesmaghesaembillaGaertn. Fruct.*	Euphorbiaceae	Tree	x	√	
6	*BarleriagibsoniDalz.*	Acanthaceae	Herb	x	√	√
7	*Bombaxceibavar.alba*	Bombacaceae	Tree	x	√	
8	*Buddlejaasiatica Lour*	Buddlejaceae	Shrub	x	√	√
9	*Canscoraconcanensis CL.*	Gentianaceae	Herb	x	√	
10	*CasearíaellipticaWilld.*	Flacourtiaceae	Tree	x	√	√
11	*CasearíaesculentaRoxb.*	Flacourtiaceae	Tree	x	√	√
12	*CasearíagraveolensDalz.*	Flacourtiaceae	Tree	x	√	√
13	*Centipeda minima (L.) R. Br.*	Asteraceae	Herb	x		√
	Centrantheraindica (L.)	Scrophulariaceae	Herb	x	√	
14	*Gamble.*					
15	*Clematishedysarifolia DC.*	Ranunculaceae	Climber	x	√	√
16	*Cochleariacochlearioides (Roth) Santp.*	Brassicaceae	Herb	x		√
17	*Cynoglossummeeboldii Brand.*	Boraginaceae	Herb	x	√	√
18	*Didymocarpuspygmaea CL.*	Gesneriaceae	Herb	x	√	√
19	*DiospyroschoroxylonRoxb.*	Ebenaceae	Tree	x		√
20	*DiospyrosmontanaRoxb.*	Ebenaceae	Herb	x		√
21	*Droseraindica L.*	Droseraceae	Tree	x	√	

22	*EhretialaevisRoxb.*	Ehretiaceae	Herb	x	√	√
23	*EranthemumpurpurscensNees.*	Acanthaceae	Herb	x	√	
24	*Erucasativa Gars.*	Brassicaceae	Herb	x		√
25	*FicusarnottianaMiq.*	Moraceae	Tree	x	√	√
26	*Ficusheteropjylla L.*	Moraceae	Tree	x	v	√
27	*Heterophragmaquadriloculare K. Schim*	Bignoniaceae	Tree	x	√	v
28	*Hibiscus furcatusRoxb.Ex. DC.*	Malvaceae	Herb	x	v	
29	*Hibiscus surattensis L.*	Malvaceae	Herb	x	√	√
30	*Homoniaretusa (Grah. Ex Wt.) Muell.*	Euphorbiaceae	Shrub	x		√
31	*Hypoxisaurea Lour.*	Hypoxidanaceae	Herb	x	√	
32	*LeucasMartinicensis Jacq.R.Br.*	Lamiaceae	Herb	x	√	√
33	*Lobelia nicotinifolia Roth. Ex. R. Br.*	Lobeliaceae	Herb	x	√	
34	*Nelsoniacanescens (Lam.) Spr.*	Acanthaceae	Herb	x	√	
35	*PavettacrassicaulisBremek.*	Rubiaceae	Shrub	x	√	√
36	*Pavoniaarabia var. arabicasteud.*	Malvaceae	Shrub	x	√	
37	*Peristyalusstocksii (Hk.f.) Kranz.*	Orchidaceae	Herb	x	v	
38	*Pimpinellaheyneana (Wall.Ex. DC.) Kurz.*	Apiaceae	Herb	x	√	√
39	*PimpinellatomntosaDalz.*	Apiaceae	Herb	x	√	
40	*Saracostemmaacidum (Roxb.) Voigt.*	Asclepiadaceae	Shrub	x		√
41	*SebestaniachamaeleaMuell. Arg.*	Euphorbiaceae	Herb	x		√
42	*Sessilidiffusum (Roxb ex. Sm.) Samt.*	Apiaceae	Herb	x		√

43	Soymidafebrifuga (Roxb.) A. Juss.	Meliaceae	Tree	x	√	√
44	SpermadictyonsuaveolensRoxb	Rubiaceae	Shrub	x	√	√
45	Swertia minor (Griseb.) Knobl.	Gentianaceae	Herb	x	√	
46	SynbrellanodifloraGaertn.	Asteraceae	Herb	x	√	
47	Tremaorienalis (L.) Bl.	Ulmaceae	Tree	x	√	√
48	Wendlandiaheynei (R.&S.) Santp.	Rubiaceae	Tree	x	√	
49	ZingiberzerumbetRosc.ex. Sm.	Zingiberaceae	Herb	x	√	
50	Zizyphusxylopyra (Retz.) Willd.	Rhamnaceae	Tree	x	√	√

N.B.: Criteria

Factor X - Natural factors due to which occurrence may be naturally low

(*Source: Pandey et al., 2005. Medicinal plants of Gujarat, GEER Foundation, Gandhinagar)*

Table: 5List of Endangered Medicinal Plants of South Gujarat

Botanical Name	Family	Local Name	Habit	Zonal Distribution	
				I	II
AlbiziaamaraBoivinvaramara	Mimosaceae	Shirish	Tree	0	1
Anogeissusserica	Combretaceae	dhav	Tree	0	0
Rhizophoramucronata	Rhizophoraceae	Karod	Tree	0	1
Tamarixaphylla	Tamariaceae	Tamarix galls	Tree	0	1

(Source: Digital flora of Gujarat state, Forest Department & Anonymous 2015)

Table: 6 List of Critically Endangered Medicinal Plants of South Gujarat

Botanical Name	Family	Local Name	Habit	Zonal Distribution	
				I	II
Buteamonosperma	Fabaceae	Khakharo	Tree	1	1
Sterculiaguttata	Sterculiaceae	Hirik (H)	Tree	1	0
Strrculiavillosa	Sterculiaceae	Sardol,Udal	Tree	1	0
Salix tetrasperma.	Salicaceae	Baishi (H)	Tree	0	1
Toona ciliate	Meliaceae	Toona	Tree	1	0

(**Source:** Digital flora of Gujarat state, Forest Department& Anonymous 2015)

Conservation and Development of rare, endangered and highly utilized medicinal plants is very much needed due to the over-exploitation of natural resources. For the development of this sector, Govt. of India established National Medicinal Plants Board (NMPB) with the Department of Ayurveda, Yoga &Naturopathy, Unani, Sidhha and Homoeopathy (AYUSH). As per the guidelines of NMPB, Govt. of Gujarat has also established State Medicinal Plants Board (SMPB). Promotion of *ex-situ* and *in-situ* cultivation and conservation of medicinal plant is essential aim of the board. (Source: GMPB,Gandhinagar)

Preservation of species:

All the naturally occurring medicinal plants need to be conserved in nature. As per the expert's opinion, the following 10 species must be preserved in nature with special attention. These selected species are - 1. Harde*(Terminaliachebula)* 2.Kadayo (*Sterculiaurens*), 3. Arjun *(Terminaliaarjuna)* 4. Sevan *(Gmelinaarborea)* 5.Bhilamo *(Semecarpusanacardium)* 6. Kanchnar *(Bauhinia variegata)* 7. Patala *(Stereospermumpersonatum)* 8. Guggal *(Commiphorawightii)* 9. Bharangmool *(Clerodendronserratum)* 10. Malkangni *(Celastruspaniculatus*). (Action plan of GMPB).

Amba forests, Dharampur forest is site for threatened and endangered plants

Radermacheraxylocarpa, *Gmelinaarborea*and other indigenous species plants like *Dolichandronefalcata*should be propagated as species specific site for conservation. Amba forest has many rare plants which are still conserved in the area these includes *Spondiasacuminata*(wild mango – a threatened plant for Gujarat), The riverine track was surprisingly dominated by *Dolichondronefalcata*– a Bignoniaceae member. It is a rare species and needs to be further propagated in the region. (Anonymous, 2015 GEC, Final Report)

1. *Ex situ* conservation

The ex-situ conservation would involve raising of plantations, Nurseries, distribution of seedlings, distribution of seeds, Medicinal plants gardens, maintaining a gene pool, a germplasm banks, propagation by tissue culture etc. Engagement of large number of stakeholders in production and generation of important medicinal plants.Raising of plants, Nurseries, distribution of seedlings, distribution of seeds, establishment of Medicinal plants gardens, etc.are being taken up on large scale under the promotional schemes of GMPB in south Gujarat.

Table: 7 Action plan for *Ex- situ* conservation of Gujarat Medicinal Plants Board

No.	**Name of Project**	**Implementing Agency**	**Year**	**Achievements**
1	Model Nursery	Vaghai Botanical Garden, Dang	2016	Total 9 RET species have been conserved as well as 8 species raised in the garden.
2	Nursery raising	Government AyurvedicUdhyan, Saputara, Dang.	2015	Total 13 RET species have been conserved as well as 5 species raised in the garden.

3	Model Nursery	Government AyurvedicUdhyan,	2016	Total 4 RET species have been conserved as well as
		Rupvel, Navsari.		10 RET species have been raised in garden.
4	Nursery raising	Government AyurvedicUdhyan, Jitnagar. Rajpipla.	2015	Total 20 RET species have been conserved as well as 10 species have been raised in garden.
5	Ex-situ conservation of Rare, Endangered, Threatened and Highly utilized medicinal plants in Ayurvedic Gardens in Gujarat.	Government AyurvedicUdhyan, Jitnagar, Rajpipla.	2016	5 RET Species have been raised in 4 hector.
6	Establishment of AyurvedicUdhyans in jails, Temple trusts, NGOs land, Municipal Corporation Gardens and other institutional land of Gujarat.	Zandu Foundation for Health Care, Village. Ambach. Ta. Pardi, Dist. Valsad.	2015	Total 8 RET species have been raised in Garden.
7	Establishment of Herbal Garden in Schools and Ayurvedicdispensaries/hospitals of Gujarat.	ZanduFoundationfor Health Care, Village. Ambach. Ta. Pardi, Dist. Valsad.	2015	Total 5 Endangered and threatened medicinal species have been raised in 20 school Herbal Garden in Valsad district.

2. In-situ conservation

The best option for long term conservation of medicinal plants is *in-situ* conservation. *In-situ* conservation involves conservation of medicinal plants in its natural habitats by arranging protection through declaration of protected areas of different types (conservation areas, national parks,

reserve forest/ shrub lands/ grasslands or medicinal plant hotspots). *In-situ* conservation helps to conserve millions of species through the security of natural areas and is the primary means for the maintenance of these resources in the absence of other dependable options.(Chandrakar, 2014). In south Gujarat one National park, one Arboretum and two wildlife sanctuaries has been established, which help in the conservation of medicinal plant diversity in their natural habitats.

Under the Promotional schemes of GMPB Asoka Plantation, Dashmoola plantation etc. is being taken up on large scale under these schemes in south Gujarat.

Table: 8Action plan for *in- situ* conservation of Gujarat Medicinal Plants Board

No.	**Name of Project**	**Implementing Agency**	**Year**	**Achievements**
1	Raising of Ashoka Van in Navasari, Valsad and Dangs District of Gujarat.	Forest Department of Gujarat.	2011-12	200 Ha. Ashoka, Baheda, Harde, Malkangani species has been raised.
2	Dashmoola plantation in south Gujarat.	Forest Department of Gujarat.	2007-08	Afforestationin500haareahasbeendone.InValsad200ha,inSurat150haandin Rajpipla150haplantationhasbeendone. Endemicspeciesof medicinalplantsconserved- *Stereospermumpersonatum*

The species of medicinal plants covered under *in-situ*resourceaugmentation inforestrange/division under Dashmula project asshownbelow;all these species of Dashmoola group are rare, endangered and threatened.

Table: 9**Species of Dashmoola**

No.	Species	CommonName
1	*Aeglemarmelos,*	Bael
2	*Gmelinaarborea,*	Sivan
3	*Stereospermumpersonatum*	Patala
4	*Oroxylumindicum*	Tetu
5	*Clerodendrummultiflorum*	Arani
6	*Desmodiumgangeticum*	Salparni
7	*Urariapicta*	Pithawan

(Source: Gujarat Medicinal Plants Board)

Sacred places

Sacred groves are small or large patches of vegetation protected on the basis of cultural and traditional practices on the religious background. Vansda National Park is richly dotted with sacred places. Botanical Garden, Waghai; Gir Water falls adjoining to Vansda National Park.Bio-diversity Conservation centre at Botanical Garden. (Anonymous, 2012).

Table:10 Medicinal Plants Hotspots in South Gujarat

Zone	Locations	Districts	No. of species	Whether part of any protected Area	Remarks
Zone 1	Forest areas around villages *Shamgahan, Malegaon, Saputara, Jakhana*	*Dangs*	>200	No	High Medicinal Plant Diversity Distinguished Species composition due to higher al titudes and moist conditions
	Forest areas around villages Bardipada, Mahal, Gadhvi etc.	Dangs	>175	Yes (Purna Wildlife Santuary)	High Medicinal Plant Diversity
	Forest area around villages Navtad, Sadaddevi etc.	Ta.Vansda Dist. Navsari	>180	Yes (Vansda National Park)	High Medicinal Plant Diversity

Zone II	Forest areas of compartment Nos. 282, 287, 292, 292	Ta.Dediapada Dist. Narmada	>200	Yes (Shoolpaneshwar sanctuary)	High Medicinal Plant Diversity
	Forest areas of com. Nos. 477,481,482, 483, 484, 485, 486, 504	Ta.Umarpada Dist. Surat	>325	No	High Medicinal Plant Diversity
	Forest areas of compartment Nos. 687, 695	Ta.Rajpipla Dist. Narmada	-	No	High Medicinal Plant Diversity
	Forest areas around villages Motatadpada, Bardipada	Ta.Songarh Dist. Surat	200	Yes (Purna Wildlife sanctuary)	High Medicinal Plant Diversity
	Forest areas around villages Unai-Padamdungari	Ta.Vyara Dist. Surat	200	Yes (Purna Wildlife sanctuary)	High Medicinal Plant Diversity
	Forest areas of compartment Nos. 618, 694, 698, 699, 700	Ta.Mandavi Dist. Surat	-	No	High Medicinal Plant Diversity

(*Source: Pandey et al.,2005. Medicinal plants of Gujarat, GEER Foundation, Gandhinagar)*

Conclusion

Medicinal plants play a vital role in health care system. The dedicated medicinal plants are used by various tribal's and local people to cure different ailments. Hence, there is an immense need for conservation of diversity of medicinal plant wealth for the present and fore coming generations, by adapting the proper strategy with most suitable method of conservation. (AkshayK *et.al*., 2014)The focussed conservation programme for such species is certainly going to be a constructive step towards the saving of these threatened and valuable species.

Conservation of this species has become an immediate requirement of the country. Conservationcannotworkwithouttheinvolvement ofthepeople;therefore,community based conservationprogrammesmustbe conductedtoconservethebiodiversity.

If actions are not adapted, after a couple more years, there will be no species left to conserve.

(Croteau, *et al.,* 2000). For the conservation of RET species, rapid multiplication and rehabilitation in its natural habitat is necessary. To overcome this threat, a reliable method of quick multiplication like tissue culture and methods of *in-situ* as well as *ex-situ* conservation could well provide a viable solution to the problem. (Zahoor A *et al.,* 2012)

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