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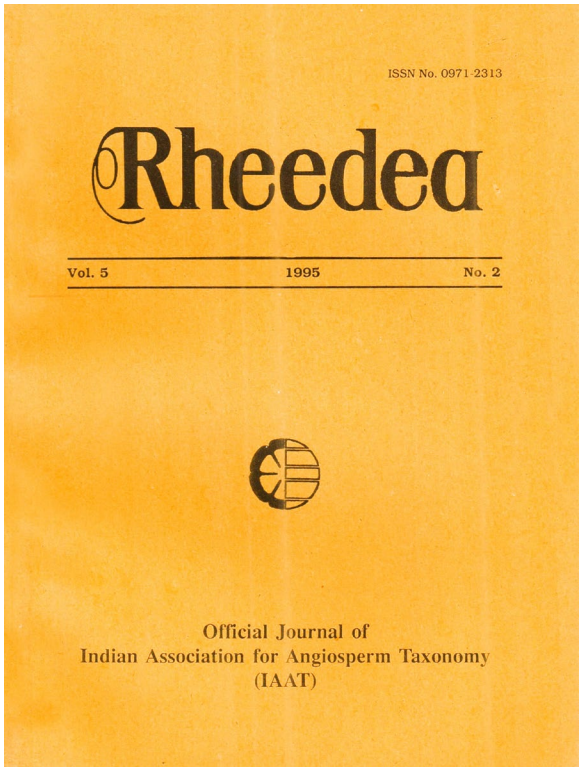

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Zingiberaceae in India : Phytogeography and Endemism

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Abstract

Zingiberaceae, the largest family in the Zingiberales, is among the ten largest monocotyledonous families in India. Members of the family yield spices, dyes, perfumes, medicines and ornamentals.

It occurs chiefly in the tropics with about 52 genera and 1400 species and has greatest concentration in the Indo-Malesian region of Asia. It is represented by 22 genera and 178 species in India, concentrated mainly in northeastern and the peninsular region. Two monotypic genera viz. *Paracautleya* and *Parakaempferia*, and about 70 species, are endemic to India. Several endemics are rare and threatened; some of these are now in the vulnerable category. The genus *Hedychium* is the largest, with 39 species and 4 varieties in India.

The present paper deals with phytogeographical distribution of all Indian Zingiberaceous taxa, with position of endemism.

INTRODUCTION

Zingiberaceae is a family of medicinal and economic significance that occurs chiefly in the tropical regions of the world. It comprises two subfamilies (Zingiberoideae & Costoideae), 4 tribes (Alpineae, Zingibereae, Hedychieae & Globbeae), 52 genera and about 1400 species (Burtt & Smith 1972, Wu 1991). The subfam. Zingiberoideae (with 48 genera and 1300 species) has greatest cencentration both by genera and by species in the Indo-Malesian region of Asia, while Costoideae (with 4 genera and 150 species) is mainly distributed in tropical America and Africa.

Zingiberaceae is among the ten largest monocotyledonous families in India. All the members of the family have not been subjected to critical taxonomic or biosystematic studies since Baker (1890). However, some notable woek has been done recently, on *Hedychium*

(Srivastava, 1984), *Alpinia, Curcuma* (Mangaly & Sabu, 1992, 1993), *Roscoea* and *Cautleya* (Kumar, 1993, 1994). Rao & Verma (1969, 1971, 1972) also made considerable contribution to this family while working on monocot flora of erstwhile Assam, while Mehrotra (1984) studied endemism in this famly in India. Our recent study on the family has added useful data on phytogeography and endemism of the Indian representatives.

The members of the family are more common in northeastern and peninsular India. If cultivated species are excluded, the northwestern the central gangetic plains and the plateau regions of India are comparatively poor in their representation. Out of 22 genera and 178 species of the family in India, two genera *(Parakaempferia* and *Paracautleya),* and about 70 species are endemic. The genus-wise representation of species with position of endemism and other phytogeographical analysis are presented here.

DISTRIBUTION AND ENDEMISM

Phytogeographic distribution of all species occurring in India, is provided in Table 1. The following account deals with short notes especially on endemism in respect of each genus represented in India. The species considered endemic to India, are taken here in strict sense to present political boundary of the country.

1. **Alpinia** Roxb. (Species: 250; India: 11; Endemic:2).

A. smithiae is endemic to south India and *A. manii* is endemic to Andaman and Nicobar Islands. The non-endemic *A. abundiflora* occurs only in Tamil Nadu and Sri Lanka. *A. galanga* is widely cultivated. Rhizomes of three species are edible. The genus is important in medicine and ethnomedicine.

2. **Amomum** Roxb. (Species: 150; India: 16; Endemic: 6).

Among the endemics, four (viz. *A. cannaecarpum, A. ghaticum, A. holmesii* and *A. muricatum*) are confined to peninsular region. *A. pauciflorum* is endemic to north-eastern India and *A. kingii* to eastern Himalaya.

Of the 10 non-endemics, two occur in peninsular region and others in eastern Himalaya, north-eastern India, some extending to Andaman Islands (Tab. 1). *A. aromaticum* is of much economic importance (Jain, 1991).

3. **Boesenbergia** Kuntze (Species 20; India: 5; Endemic 1).

B. rubrolutea is the only endemic species reported from Khasi hills of Meghalaya in north-eastern India. The other four occur in peninsular region and Andaman Islands.

4. **Caulokaempferia** Larsen (Species: 7; India: 2)

None is endemic; both species occur in north-eastern India; *C. linearis* extends to Bangladesh and *C. secunda* spreads to Myanmar.

Table 1. Distribution of Zingiberaceae in India

Species	Remarks	Himalaya			Northeastern region							Peninsula					A. & N. Islands	Other state (Plains)
		NW	C	E	AR	AS	MG	MN	MZ	NG	T	AP	TN	KE	KR	MH		
Alpinia Roxb.																		
abundiflora Burtt & Smith	Extends to Sri Lanka											+						
aquatica (Retz.) Rosc.	Status?			+														
bracteata Roxb.				+	+													WB
calcarata (Haw.) Rosc.							+						+	+	+			WB, BH
conchigera Griff.	Distrib.?																	WB?
galanga (L.) Swartz														+		+	+	WB, BH
kingii Baker				+														
malaccensis (Burm. f.) Rosc.				+	+	+	+	+	+	+		+	+	+	+			BH, WB
manii Baker	Endemic																*	
mutica Roxb.															+	+		
nigra (Gaertn.) Burtt.					+	+	+	+					+			+		BH, WB
smithiae Sabu & Mangaly	Endemic													*				
zerumbet (Pers.) Burtt. & Smith						+	+							+				

Explanation of Abbreviation used in Table 1

AP – Andhra Pradesh, AR – Arunachal Pradesh, AS – Assam, BH – Bihar, C – Central Himalaya (covers Nepal), E – Eastern Himilaya (covers Sikkim & Darjeeling dt. of WB), KE – Kerala, KR – Karnataka, MG – Meghalaya, MH – Maharashtra, MN – Manipur, MZ – Mizoram, NG – Nagaland, NW – North Western Himalaya (covers from Kashmir – Kumaon), OR – Orissa, T – Tripura, TN – Tamil Nadu, * – Distribution of Endemic species, + – Distribution of non-endemic species.

		NW	C	E	AR	AS	MG	MN	MZ	NG	T	AP	TN	KE	KR	MH		
Amomum Roxb.																		
aculeatum Roxb.																	+	
aromaticum Roxb.			+	+	+	+				+	+							
cannaecarpum (Wt.) Benth.	Endemic												*		*			
compactum Soland. ex. Maton														+	+			
corynostachyum Wall.				+						+								
fulviceps Thw.					+	+	+											
ghaticum Bhat.	Endemic														*			
holmesii K. Schum.	Endemic												*					
hypoleucum Thw.													+					
kingii Baker	Endemic			*														
maximum Roxb.			+	+			+	+	+								+	WB
muricatum Bedd.	Endemic												*	*				
pauciflorum Baker	Endemic						*											
pterocarpum Thw.														+		+		
sericeum Roxb.				+			+											
subulatum Roxb.			+	+	+	+	+									+		
Boesenbergia Kuntze																		
albolutea (Baker) Sanj.																		
pulcherima (Wall.) Kuntze													+	+				
rotunda (L.) Mansf.													+	+			+	
rubrolutea (Baker) Kuntze	Endemic					*												
tillaefolia (Baker) Kuntze													+	+				
Caulokaempferia Larsen																		
linearis (Wall.) Larsen				+			+											
secunda (Wall.) Larsen				+			+											
Cautleya (Benth.) Royle ex HK. f.																		
cathcartii Baker	Extends to Myanmar		+	+			+			+								
gracilis Smith		+		+	+		+											

		NW	C	E	AR	AS	MG	MN	MZ	NG	T	AP	TN	KE	KR	MH		
petiolata Baker	Endemic	*																
robusta Baker	Endemic			*														WB
spicata (Smith) Baker		+	+	+														
Costus L.																		
lacerus Gagnep.			+	+			+			+								
speciosus (Smith) Baker		+	+	+	+	+	+			+	+	+	+	+	+	+	+	WB,BH,OR
Curcuma L.																		
amada Roxb.	Cultivated											+	+	+	+	+		WB,BH
amarissima Rosc.	Status?																	WB
angustifolia Roxb.		+	+			+	+			+								
aromatica Salisb.			+		+		+			+		+	+	+	+	+		BH,OR,WB
caesia Roxb.															+	+		BH,WB
coriacea Mangaly &Sabu	Endemic													*				
decipiens Dalz.	Endemic													*	*	*		
ecalcarata Sivar. & Indu.	Endemic													*		*		
ferruginea Roxb.	Endemic																	BH, WB
haritha Mangaly & Sabu	Endemic													*				
inodora Blatt.	Endemic														*	*		
kudagensis Velay. et al.	Endemic														*	*		
latifolia Rosc.	Status?																	WB
leucorrhiza Roxb.	Status?																	BH
longa L.	Cultivated	+		+		+	+					+	+	+	+	+		BH,WB
mangga Val. & Van. Zipp.																	+	
neilgherrensis Wt.	Endemic												*	*	*	*		
oligantha Trim.														+	+			
oligantha var. *lutea* (Ansari, Nair & Nair) Bhat															+	+		
petiolata Roxb.																		+
pseudomontana Grah.	Endemic												*	*	*	*		
purpurea Blatt.	Status?															+		

		NW	C	E	AR	AS	MG	MN	MZ	NG	T	AP	TN	KE	KR	MH		
raktakanta Mangaly & Sabu	Endemic													*				
reclinata Roxb.																		BH,OR,WB
rubescens Roxb.																		WB
sulcata Haines																		BH
vamana Sabu & Mangaly	Endemic													*				
zedoaria (Christm.) Rosc.					+	+	+		+				+	+	+	+		BH,WB
Curcumorpha Rao & Verma																		
longiflorus (Wall.) Rao & Verma	Extends to Malaysia			+	+	+	+	+	+									
Elettaria Maton																		
cardamomum (L.) Maton	Cultivated, in Wild												+	+	+	+		
Etlingera Giseke																		
linguiformis (Roxb.) Smith	Endemic			*	*	*	*											
loroglossa (Gagnep.) Smith	Endemic						*											
Globba L.																		
andersonii Clarke ex Baker	Endemic			*														
bracteolata Baker	Distrib.?																	E. India
bulbifera Roxb.				+										+		+	+	
cauarensis Baker	Status & Distrib.?														+			
cernua Baker														+				
clarkei Baker					+	+	+	+	+			+						
hookeri Clarke ex Baker																		
macroclada Gagnep.	Endemic			*														
marantina L.				+			+						+					
multiflora Wall. ex Baker				+	+	+	+	+		+								
ophioglossa Wt.				+									+		+			
orixensis Wt.	Endemic			*									*					

		NW	C	E	AR	AS	MG	MN	MZ	NG	T	AP	TN	KE	KR	MH		
pauciflora King ex Baker	Endemic																*	WB
platystachya Baker	Status?														+			
racemosa Smith			+			+	+		+									
schomburgkii Hook. f.																		WB
sessiliflora Sims		+																
siamensium (Koenig) Rao & Verma						+											+	
Hedychium Koen.																		
acuminatum Rosc.							+											OR,UP
angustifolium Ker-Gawler						+	+											
aurantiacum Wall.	Endemic						*											
burtii Srivastava & Jain	Endemic						*											
calcaratum Rao & Verma	Endemic						*											
chrysoleucum Hook.	Endemic												*					
coccineum Smith						+	+	+		+								OR,UP
var. *angustifolium* (Roxb.) Baker	Endemic			*			*			*								
coronarium Koen.				+		+	+						+	+	+	+		
dekianum Rao & Verma							+						+					
densiflorum Wall.			+	+	+		+											UP,WB
elatum Br. ex Ker-Gawler			+	+			+											UP,WB
ellipticum Smith				+			+		+									
var. *asraoii* Srivastava & Jain	Endemic						*											
elwesii Baker	Endemic						*											
flavescens Rosc.							+					+	+					
gardnerianum Ker-Gawler			+	+	+		+											WB
gomezianum Wall.					+													
gracile Roxb.				+			+											WB
gracillimum Rao & Verma	Endemic				*		*											

		NW	C	E	AR	AS	MG	MN	MZ	NG	T	AP	TN	KE	KR	MH		
gratum Wall. ex. Baker	Endemic									*								
greenii Smith				+			+			+								
griffithianum Wall.							+											
hookeri Cl. ex Baker	Endemic						*											
longifolium Rosc.			+	+			+											
var. *squarrosum* (Wall.) Srivastava & Jain	Endemic					*	*											
longipedunculatum Sastry & Verma	Endemic				*					*								
leteum Baker							+											
marginatum Clarke	Endemic									*								
pynursulaenum Jain & Srivastava	Endemic						*											
radiatum Rao & Hajra	Endemic				*													
robustum Rao & Hajra	Endemic				*		*											
rubrum Rao & Verma							+			+								
speciosum Wall.							+											
spicatum Smith		+	+															
stenopetalum Lodd.					+	+		+		+			+					
tenuiflorum (Wall. ex. Baker) K. Schum.	Endemic						*											
thyrsiforme Smith			+	+							+							
urophyllum Lodd.	Endemic						*											UP, WB
var. *flavum* (Roxb.) Srivastava & Jain							+			+								
venustum Wt.	Endemic										*							
villosum Wall.					+	+	+	+	+	+								
wardii Fischer	Endemic				*		*											
Hemiorchis Kurz *patlingii* King			+	+			+											

		NW	C	E	AR	AS	MG	MN	MZ	NG	T	AP	TN	KE	KR	MH		
rhodorrhachis K. Schum.	Extends to Myanmar						+											
Hitchenia Wall.																		
careyana Benth.				+	+	+	+	+										
caulina (Garah.) Baker	Endemic														*	*		
Hornstedtia Retz.																		
costata (Roxb.)K. Schum.	Extends to Bangladesh			+						+								
fenzlli (Kurz) K. Schum.	Endemic															*		
Kaempferia L.																		
angustifolia Rosc.				+														
evansii Blatt.	Endemic												*					
galanga L.	Cultivated						+						+			+		
involucrata King ex Baker	Endemic			*	*	*	*											
rotunda L.	Cultivated				+	+	+		+		+			+		+		
scaposa (Nimmo) Benth.	Endemic														*	*		
sikkimensis King ex Baker				+														
siphonantha King ex Baker	Endemic																*	
Mantisia Sims																		
saltatoria Sims	Extends to Bangladesh				+		+		+									
spathulata (Roxb.)Schult.	- Do -			+		+	+		+									
wengeri Fischer	Endemic								*									
Paracautleya Smith																		
bhattii Smith	Endemic														*			
Parakaempferia Rao & Verma																		
synantha Rao & Verma	Endemic					*												
Rhynchanthus Hook. f.																		
longiflorus Hook. f.	Extends to Myanmar								+									

		NW	C	E	AR	AS	MG	MN	MZ	NG	T	AP	TN	KE	KR	MH	
Roscoea Smith																	
alpina Royle		+	+	+													
auriculata K. Schum.	Endemic			*													
brandsii (King ex Baker) K. Schum.	Endemic						*										
purpurea Smith		+	+	+	+	+	+										
wardii Cowley	Endemic					*	*										
Zingiber Boehm.																	
capitatum Roxb.			+	+		+	+										
cernuum Dalz.	Endemic														*	*	
chrsanthum Rosc.		+		+	+		+						+				
clarkei King ex Benth.	Endemic			*													
elatum Roxb.																	WB
intermedium Baker	Endemic						*										
liqulatum Roxb.	Endemic											*					
marginatum Roxb.	Status?						+										
neesanum (Graph.) Ramamoorthy	Endemic														*	*	
nimonii (Graph.) Dalz.	Endemic												*		*	*	
officinale Rosc.	Cultivated	+	+	+	+	+	+	+	+			+	+	+	+	+	BH, OR,WB
purpureum Rosc.(syn. *cassumunar* Roxb.)					+	+	+	+				+	+	+	+	+	BH, WB
roseum (Roxb.) Rosc.		+															
rubens Roxb.	Endemic						*	*									
spectabilis Griff.																	BH, WB
squarrosum Roxb.																+	WB
wightianum Thw.													+				
zerumbet (L.) Rosc. ex Smith					+	+	+			+	+		+				BH,WB

12. **Hedychium** Koenig (Species: 60; India: 39+4 vars.; Endemic: 17).

The genus comprises generally ornamental plants, and is distributed mainly in northeastern India. 15 species are endemic to northeast region; only *H. venustum* and *H. chrysoleucum* Hook. are endemic to south India (Table 1). The other species which occur in south India are *H. coronarium* and *H. flavescens;* the former is cultivated throughout the Tropics.

The genus is of considerable economic significance in medicine and ethnomedicine, and as ornamental.

13. **Hemiorchis** Kurz (Species: 3; India: 2)

Two species, viz *H. pantilingii* and *H. rhodorrhachis* occur in Sikkim and northeastern India, the former extends to Nepal, and latter to Myanmar.

14. **Hitchenia** Wall. (Species: 3; India: 2; Endemic: 1).

H. caulina is endemic in Peninsular India, the other species *H. careyana* occurs in northeast India but extends south-eastwards. *H. caulina,* the Indian Arrowroot, is used in making paper; its tubers are edible.

15. **Hornstedtia** Retz. (Species: 60; India: 2; Endemic: 1).

Four species were believed to occur in India; two are now treated under *Etlingera.* Of the remaining two, *H. fenzlli* is endemic in Andaman & Nicobar Islands, and *H. costata* occurs in eastern Himalaya and Bangladesh.

16. **Kaempferia** L. (Species: 70; India: 8; Endemic: 4).

K. evansii and *K. scaposa* are endemic to Peninsular India; of the other two, *K. incolucrata* is endemic to northeastern region, and *K. siphonantha* to Andman and Nicobar Idlands. The other non-endemic species occur mainly in northeast India.

The genus is of economic use in medicine and body ornamentation.

17. **Mantisia** Sims (Species: 3; India: 3; Endemic: 1).

Only *M. wengeri* is believed to be indigenous and is endemic to Mizoram, in northeastern India. *M. saltatoria* and *M. spathulata* are grown for ornament, but have naturalised in eastern Himalaya and northeastern India; and extend to Bangladesh.

18. **Paracautleya** Smith (1977) (Monotypic, Endemic).

The only species *P. bhattii* is endemic to south India.

19. **Parakaempferia** Rao & Verma (1969) (Monotypic, Endemic).

The only species *P. synantha* is endemic to northeastern India.

20. **Rhyncanthus** Hook. f. (Species: 5; India: 1).
R. longiflorus is found in northeastern India and extends to Myanmar.

21. **Roscoea** Smith (Species: 15; India: 5; Endemic: 3).
R. auriculata is endemic to Sikkim, and the other two viz. *R. brandisii* and *R. wardii* are endemic to northeastern India. The two nonendemics were believed to occur in Himalaya only, *R. alpina* has recently been reported from Tamil Nadu (Parthsarathy & Mahadevan, 1988).

22. **Zingiber** Boehm. (Species: 80; India: 18; Endemic: 7).
The four species endemic to peninsular India are: *Z. cernuum, Z. ligulatum, Z. neesanum* and *Z. nimonii*. *Z. clarkei* is endemic to eastern Himalaya and *Z. intermedium* & *Z. rubens* are confined to northeastern India. Nonendemics occur in tropical Himalaya, northeastern region, south India and A. & N. Islands.

The genus is economically very important in medicine, ethno-medicine and home-remedies. *Z. officinale* (ginger) is widely cultivated.

PHYTOGEOGRAPHICAL ANALYSIS

High endemism in genera indicates possible centre of origin or speciation. The two monotypic genera viz. *Paracautleya* and *Parakaempferia* are endemic to India.

It is seen that about 50% or more species of the following genera occurring in India are endemic:

Cautleya (2/5), *Curcuma* (12/28); *Etlingera* (2/2), *Hedychium* (17/39) *Hitchenia* (1/2), *Hornstedtia* (1/2), *Kaempferia* (4/8), *Paracautleya* (1/1), *Parakaempferia* (1/1) and *Roscoea* (3/5). Considering genus-wide, about 10% or more of total endemic taxa (67) are contributed each by *Amomum* (6), *Curcuma* (12), *Globba* (6) and *Zingiber* (7). The genera *Caulokaempferia, Costus, Curcumorpha, Elettaria, Hemiorchis* and *Rhynchanthus* have no endemics in India.

Regions rich in endemics:
The northeastern India, including the hilly regions of Sikkim and Darjeeling, are richest in endemics in the family Zingiberaceae. About 85 species belonging to 19 genera occur here, 31 of them confined to this region only.

The next region of rich endemism is the Peninsular region with about 23 species; here too most of these are confined to south India. Four endemic species occur in Andaman and Nicobar islands. Only 1 species is confined to northwestern India. Eight endemic species occur in several regions within India.

Speciation and possible centre of origin:

Taking a global view, the following picture emerges:

Two genera *Paracautleya* and *Parakaempferia* are endemic to India.

In *Cautleya,* all its 5 species occur in India, and 2 are endemic here and other 3 to the Indian region (i.e. including Bangladesh, Nepal and Myanmar).

In *Curcuma,* 28 out of 50 species occur in India, and 12 are endemic. Another 6 or 7 are endemic to Indian region.

In *Mantisia* all its 3 species occur in India; one is endemic, other two extend to Bangladesh.

In *Hedychium,* 39 species (and about 4 varieties) out of about 60 species, occur in India. 17 are endemic to India and another about 12 are endemic to the Indian region (Srivastava, 1984).

In *Hemiorchis,* out of 3 known species, 2 occur in India and both are distributed to the Indian region.

In addition to the 2 monotypic genera, therefore, these 5 genera also seem to have had their centre of origin in the Indian region.

Thus 7, out of 22 genera occurring in India seem to have their primary or secondary centres of origin and speciation in India.

Rare taxa and status of threat

While discussing endemism in India, Mehrotra (1984) indicated rare and endangered status of most of the endemic taxa of Zingiberaceae. This was based on a very general assessment of literature and material then available in herbaria. It needs to be critically evaluated on basis of several regional and local floras and recent field work.

Four volumes of Red Data Book on Indian plants have been published so far, covering about 1000 species. Only the following 2 species of Zingiberaceae figure there, viz. *Amomum pterocarpum* Thw. (under *A. microstephanum* Baker), and *Paracautleya bhattii* Sm. This certainly is imcomplete.

Our recent study has also revealed that several species are in critical stage of survival in northeastern India (Table 2).

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Table 2. **Endangered Taxa in N. E. India**

	Species	*Distribution*
1.	*Boesenbergia rubrolutea* (Baker) Kuntze	Meghalaya
2.	*Hedychium aurantiacum* Wall.	Meghalaya
3.	*Hedychium gratum* Wall. ex Baker	Nagaland
4.	*Hedychium hookeri* Cl. ex Baker	Meghalaya
5.	*Hedychium marginatum* Cl.	Nagaland
6.	*Hemiorchis rhodorrhachis* Schum.	Meghalaya
7.	*Mantisia wengeri* Fischer	Mizoram
8.	*Parakaempferia synantha* Rao & Verma	Assam
9.	*Rhynchanthus longiflorus* Hook. f.	Mizoram
10.	*Zingiber intermedium* Baker	Meghalaya

Confined to very small areas of one state and facing immediate danger of extinction, these species need urgent conservation.

Epilogue

Despite significant economic importance, rich endemism, and threat of extinction of many members, the family Zingiberaceae has not received adequate attention of plant scientists in the Indian region. Intensive field and laboratory studies are suggested.

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