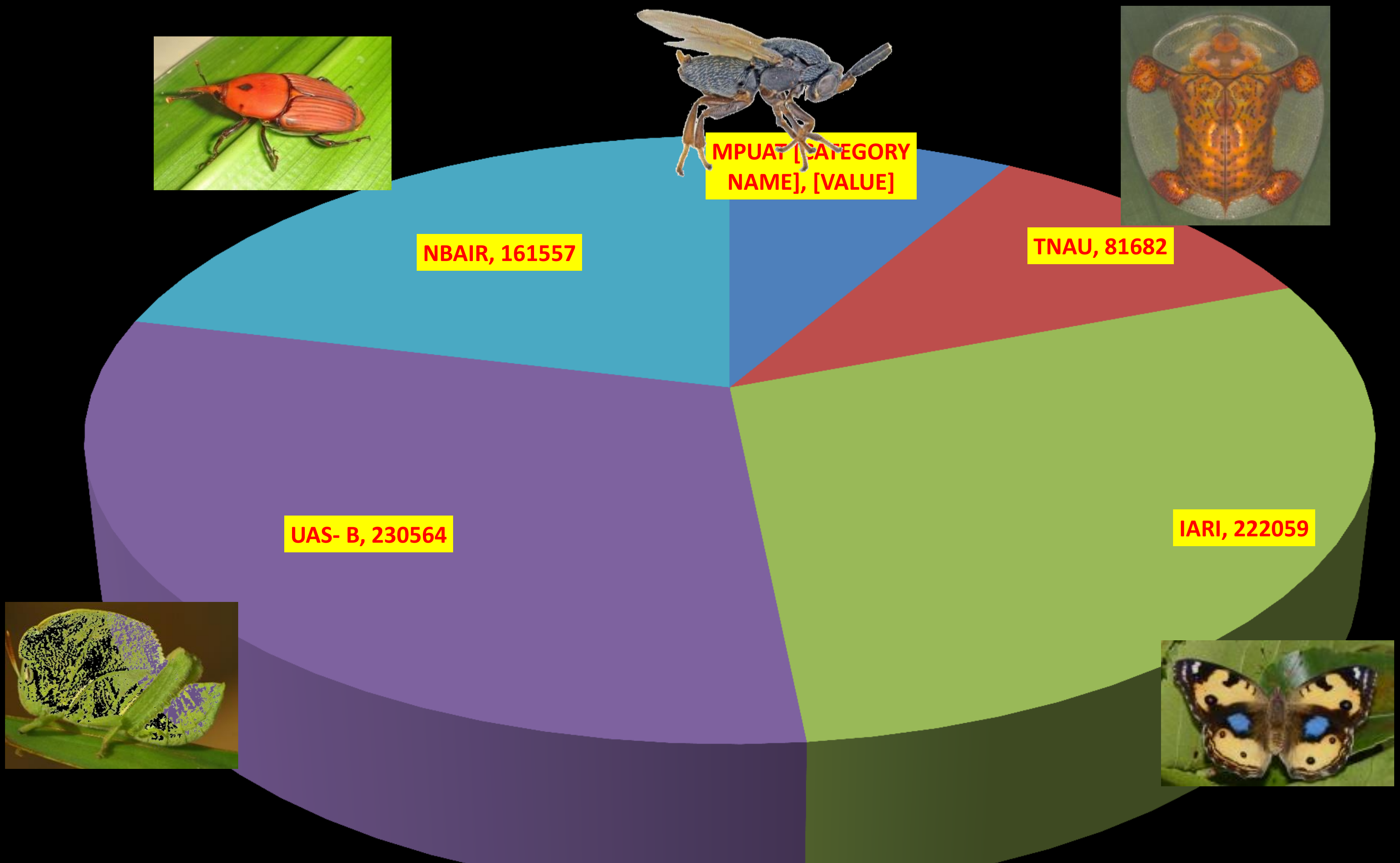
INSECT GENETIC RESOURCES

ICAR-National Bureau of Insect genetic Resources

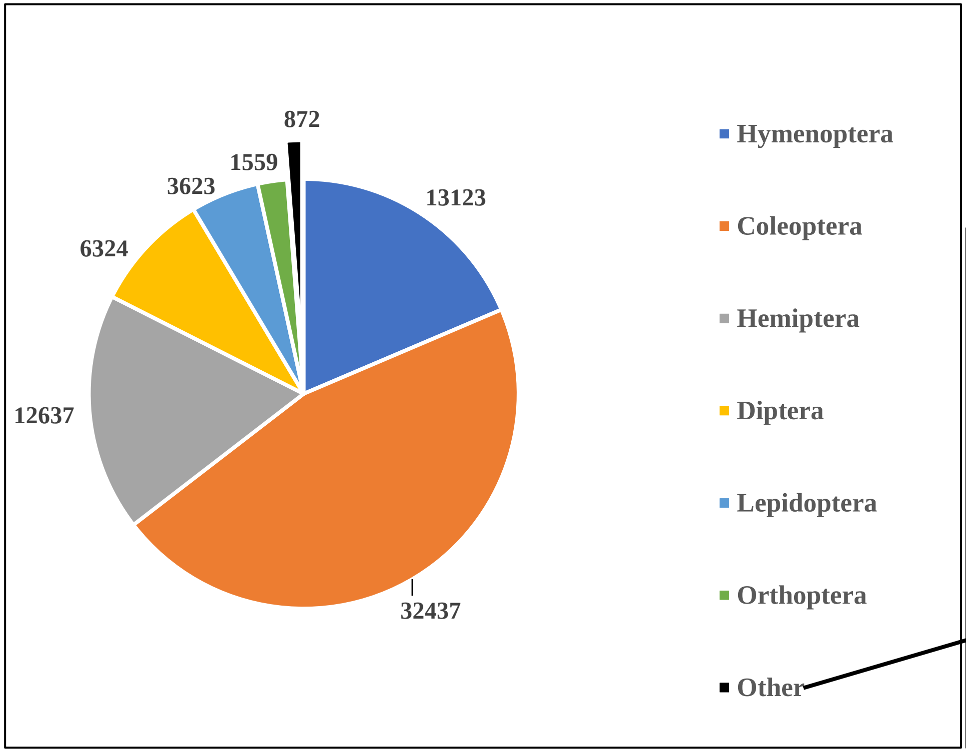
Bengaluru

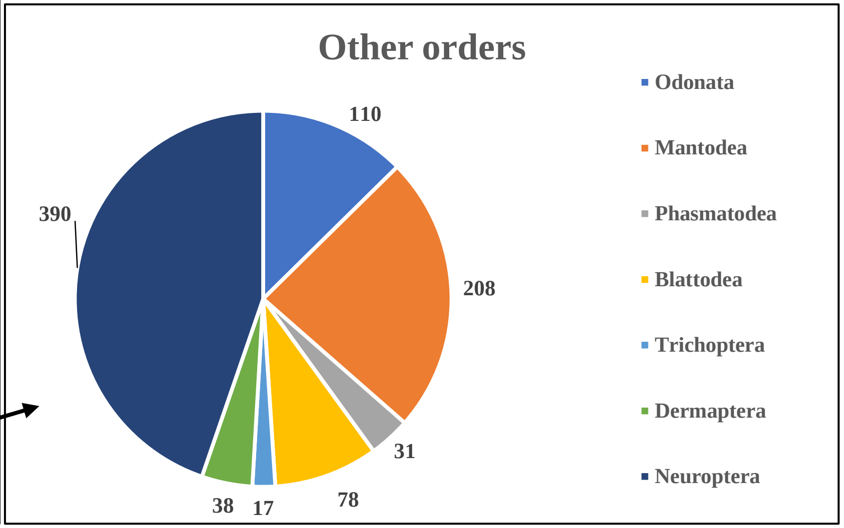
Number of insect specimens in Indian museums -Ex situ conservation



Total specimens in Indian museums 7,59,903

Museum holdings at ICAR-NBAIR, Bengaluru





ICAR- NBAIR Insect Museum Collection

- Total collection **~1,56,676** specimens + **242** types
- So far **203** new species described by NBAIR
- **~250 – 500** identification requests PER YEAR

III. ICAR-NBAIR database

- Total open access database websites developed and maintained- **22**
- Total species identification factsheets uploaded- **2,441**
- Total images digitized and uploaded- **12,398**


Brachycerocoris camelus


Ceroplastes stellifer


Pseudococcus jackbeardsleyi


Aleurocanthus arecae


Emphusis sp.

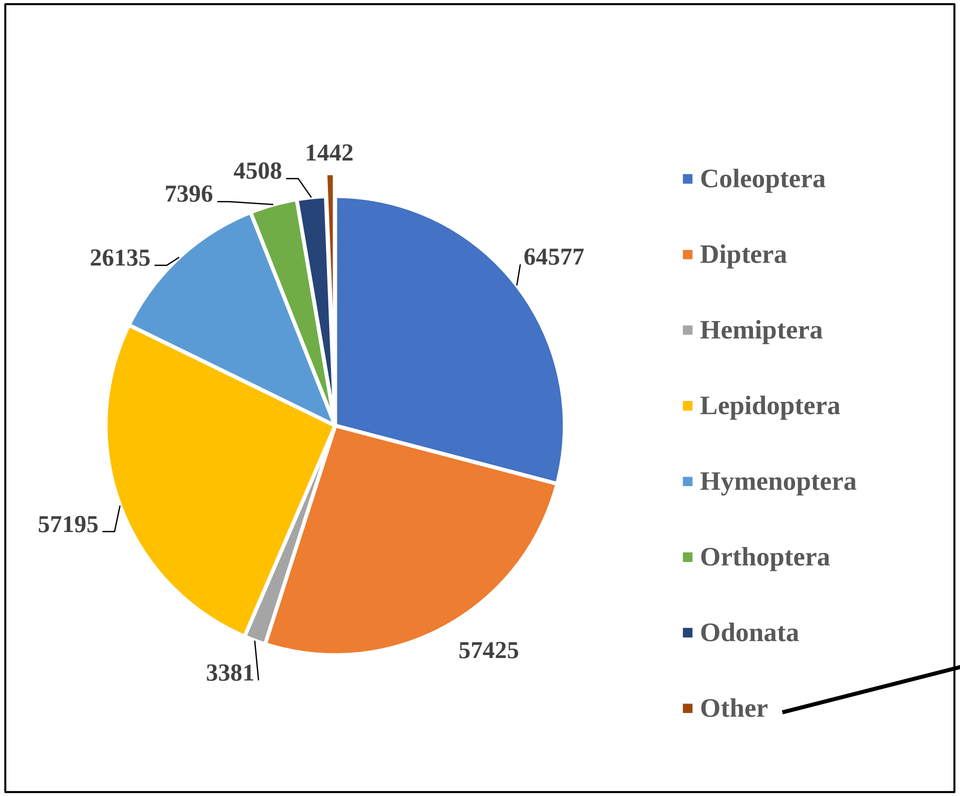

Hypsauchenia xylocopiformis

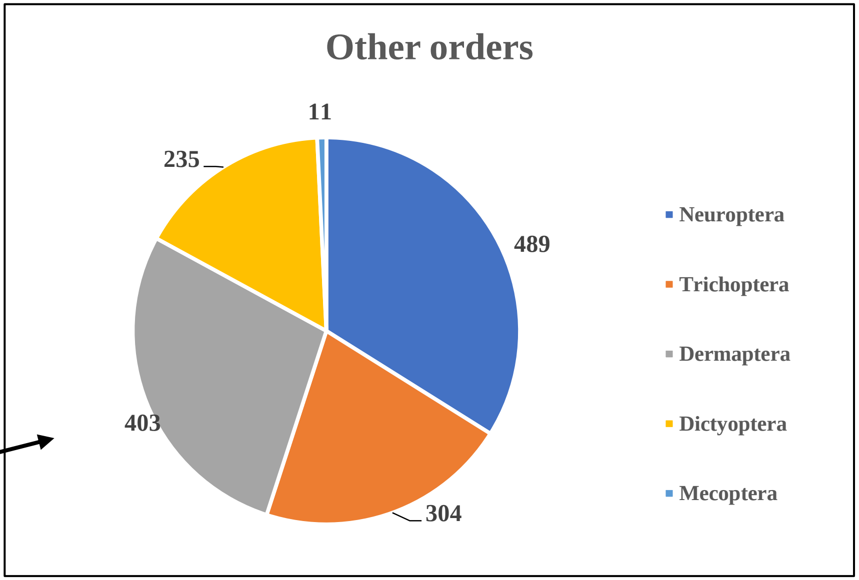

Formiscurra indicus


Chirodisca eximia


Insignorthezia insignis

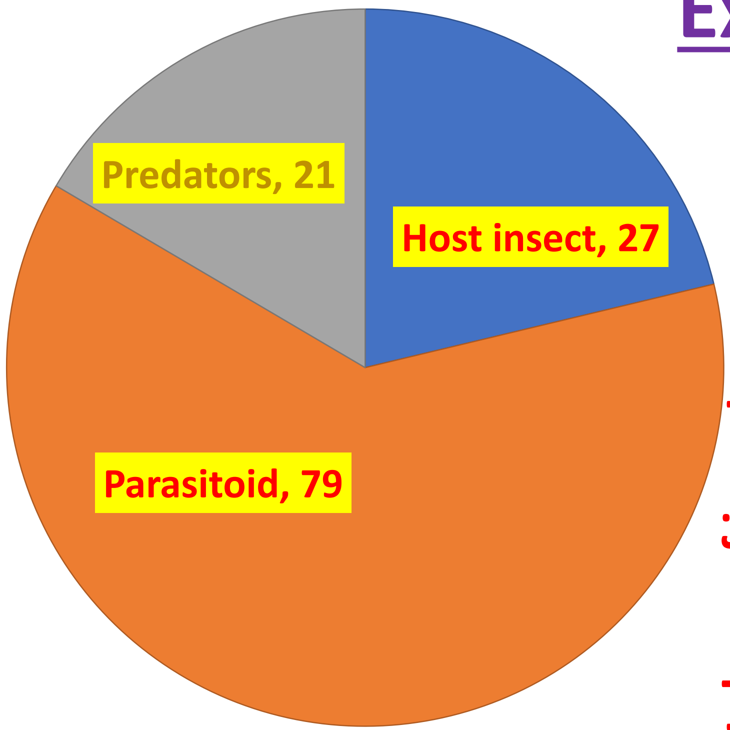
Museum holdings at IARI, New Delhi





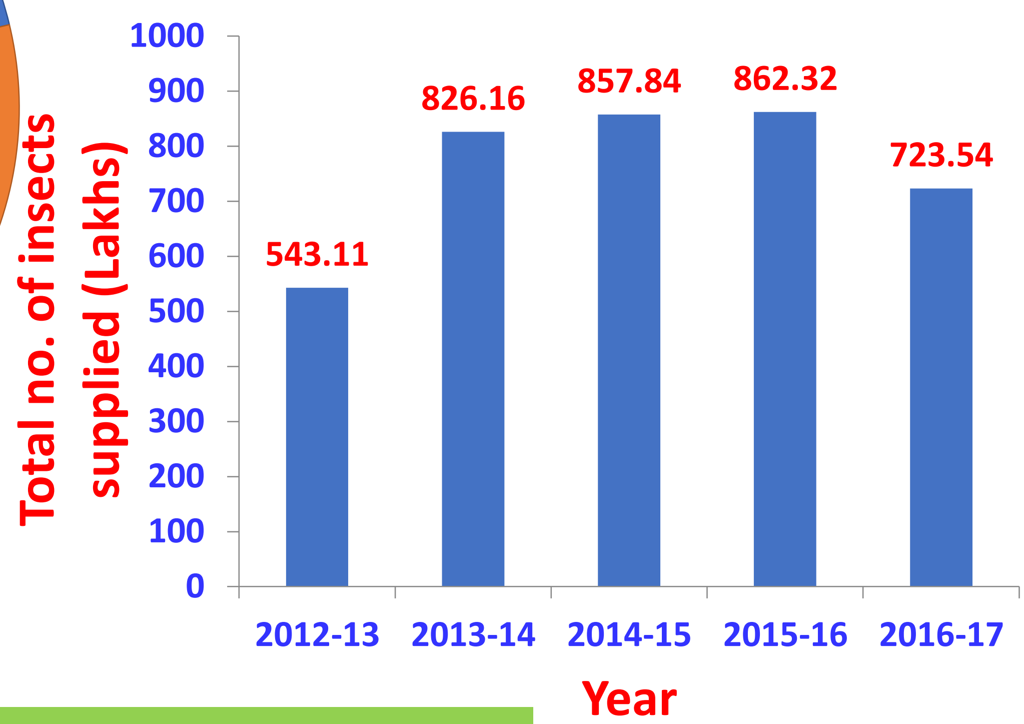
LIVE INSECT RESOURCES
&
INSECT DERIVED RESOURCES

Ex situ conservation



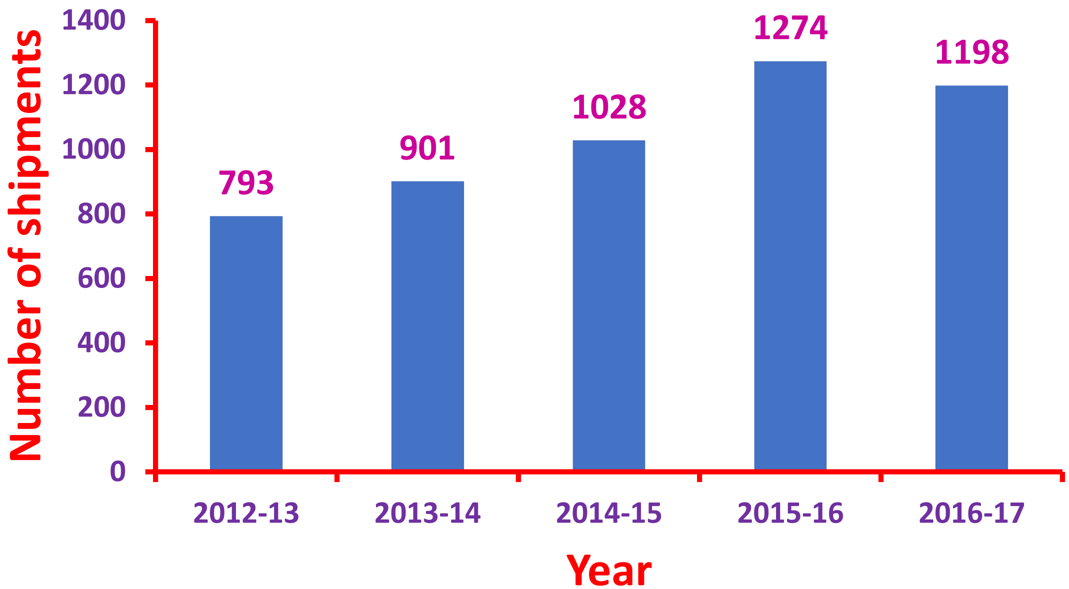
Total number of insects supplied during last 5 years

Total 127 insect live cultures are being maintained at NBAIR



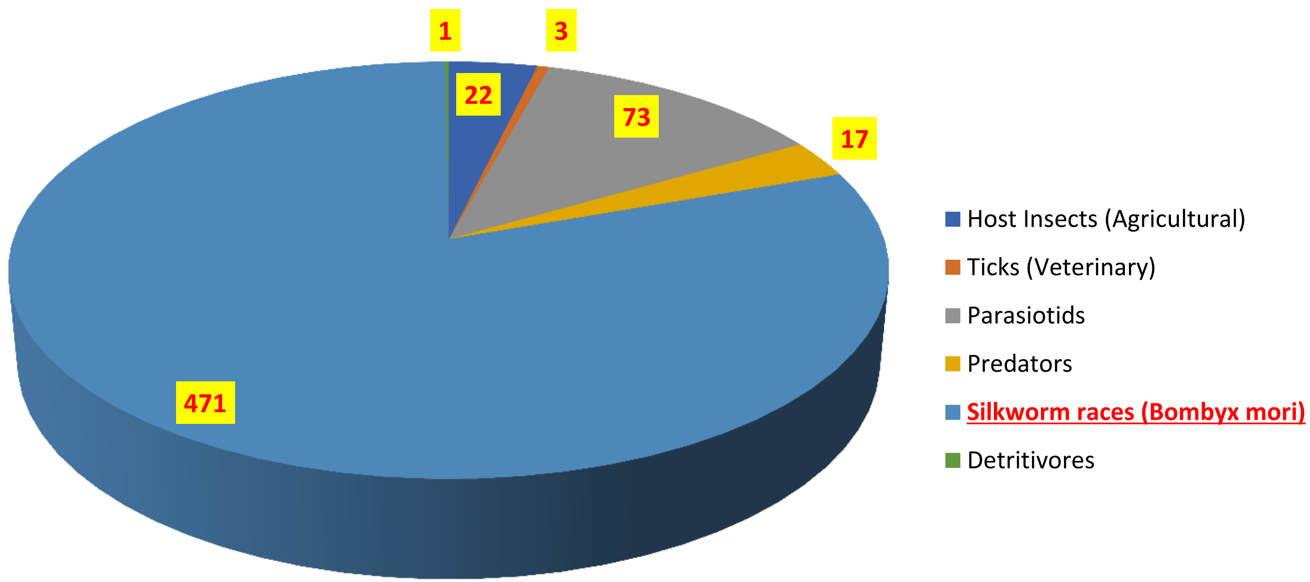
Insect derived resources maintained:

Entomofungal pathogens:	210 isolates
EPNs:	90 isolates
Bt:	284 isolates
TOTAL:	584



Total no. of shipments(Host insects and natural enemies) supplied to different organizations

Insects registered under AGIS (Arthropod Germplasm Information System)- Passport information & National Accession Numbers



Eri Silkworm

- ***26** eco-races of Samia ricini have been identified . These 26 Eri silkworm germplasms are maintained at <u>Central Eri, Muga Research &Training Institute, Central Silk Board. Ladoigarh, Assam</u>*




Inputs: Dr Velayudhan,
Eri P_2 Basic Seed Farm, CSGRC, Hosur

List of Ecoraces of *Samia ricini* (DONOVAN)

No.	Acc. No.	Race name	Donor	Origin	Class	Parentage
1	SRI-001	Borduar	RERS,MEG	ASM	O[RCU]	OR
2	SRI-002	Titabar	RERS,MEG	ASM	O[RCU]	OR
3	SRI-003	Khanapara	RERS,MEG	ASM	O[RCU]	OR
4	SRI-004	Nongphoh	RERS,MEG	ASM	O[RCU]	OR
5	SRI-005	Mendipathar	RERS,MEG	ASM	O[RCU]	OR
6	SRI-006	Dhanubhanga	RERS,MEG	ASM	O[RCU]	OR
7	SRI-007	Chuchuymiang	CMERTI,ASM	NAL	N	OR
8	SRI-008	Lahing	CMERTI,ASM	ASM	N	OR
9	SRI-009	Barpathar	CMERTI,ASM	ASM	N	OR
10	SRI-010	Diphu	CMERTI,ASM	ASM	N	OR

List of Ecoraces of *Samia ricini* (DONOVAN)

No:	Acc. No:	Race name	Donor	Origin	Class	Parentage
11	SRI-011	Diphu	CMERTI,ASM	ASM	N	OR
12	SRI-012	Adokgiri	CMERTI,ASM	MEG	N	OR
13	SRI-013	Lakhimpur	CMERTI,ASM	ASM	N	OR
14	SRI-014	Dhemaji	CMERTI,ASM	ASM	N	OR
15	SRI-015	Kokrajhar	CMERTI,ASM	ASM	N	OR
16	SRI-016	Imphal	CMERTI,ASM	MAN	N	OR
17	SRI-017	Cachar	CMERTI,ASM	ASM	N	OR
18	SRI-018	Dhakuakhana	CMERTI,ASM	ASM	N	OR
19	SRI-019	Genung	RERS,MEG	MEG	N	OR
20	SRI-020	Jonai	CMERTI,ASM	ASM	N	OR
21	SRI-021	Dhansiripar	CMERTI,ASM	NAL	N	OR

List of Ecoraces of *Samia ricini* (DONOVAN)

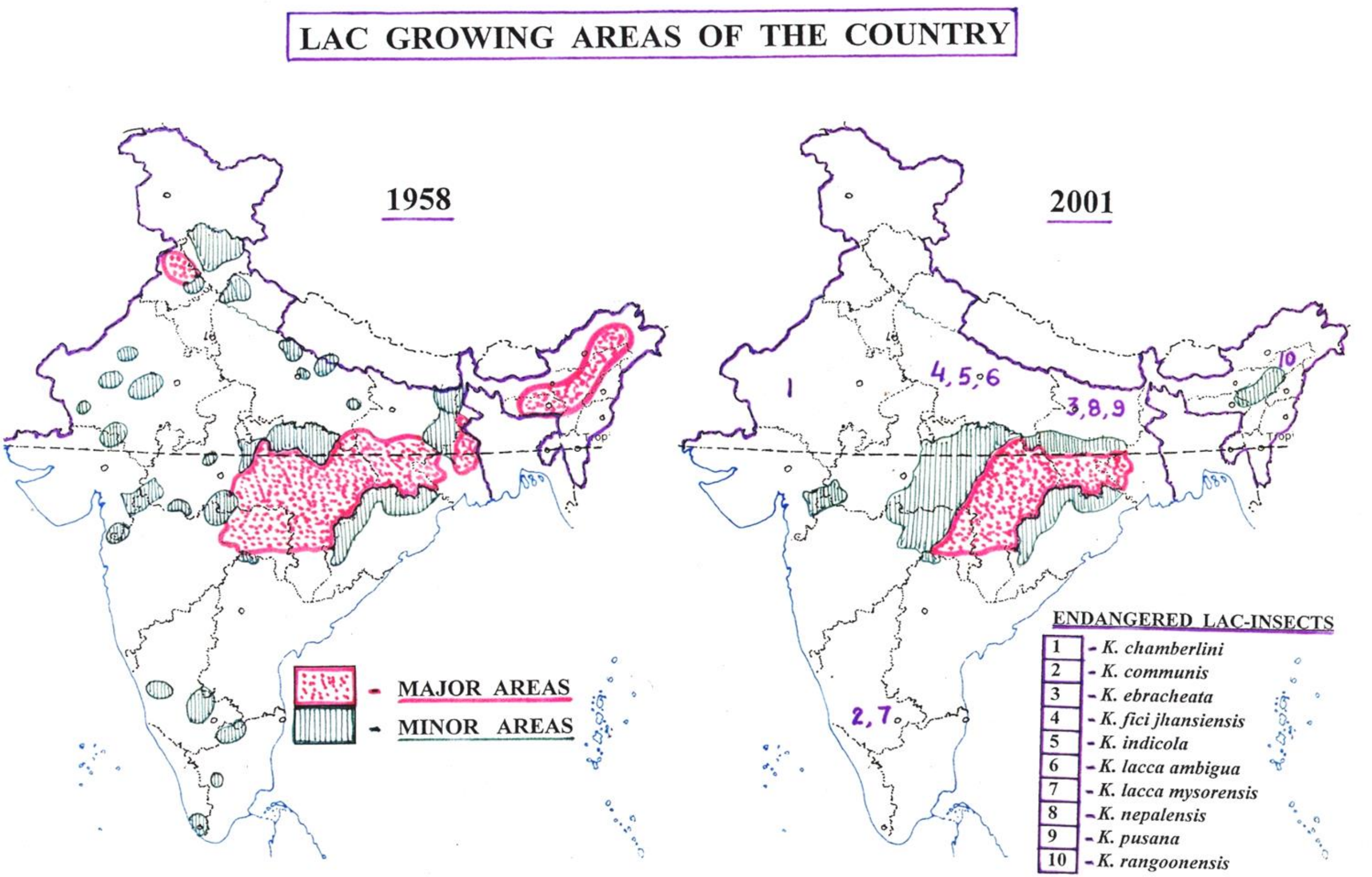
No.	Acc No.	Race name	Donor	Origin	Class	Parentage
21	SRI-021	Sadiya	CMERTI,ASM	ASM	N	OR
22	SRI-022	Tura	CMERTI,ASM	MEG	N	OR
23	SRI-023	Jona Kachari	CMERTI,ASM	ARP	N	OR
24	SRI-024	Barpeta	CMERTI,ASM	ASM	N	OR
25	SRI-025	Ambagaon	CMERTI,ASM	ASM	N	OR
26	SRI-026	Rongpipi	CMERTI,ASM	ASM	N	OR

Lac Insects

- The lac insect genetic resources in the country are in a dramatic state of decline. There is danger of disappearance of local populations, with the consequent loss of their inherent genetic adaptation to their local environments.
- Conservation is of particular concern in regions of rapid agricultural change, where indigenous stocks and farming methods are being replaced.
- Not long ago, cultivation of lac was carried practically through out the country. Area under lac cultivation over the years has eroded due to varied reasons and changing socio-economic conditions. As a result, many species of lac insects reported from these places have either become extinct or are in the 'waiting list' of extinction.
- Of the 26 species of lac insects - ***Kerria lacca*** is exploited for commercial production of lac. ***K. chinensis*** in the north-eastern states and ***K. sharda*** in coastal regions of Orissa and West Bengal are also cultivated to a certain extent. Potential of other lac insect species reported from the country remains to be exploited.
- Some of the insect fauna associated with the lac insects are species-specific (exclusive to the lac ecosystem) and hence, loss of even one species of lac insect posses a danger of losing many other related species.

Inputs: Dr K K Sharma, ICAR-IINRG

Lac growing areas of the country showing distribution of endangered species of lac insects



Conservation

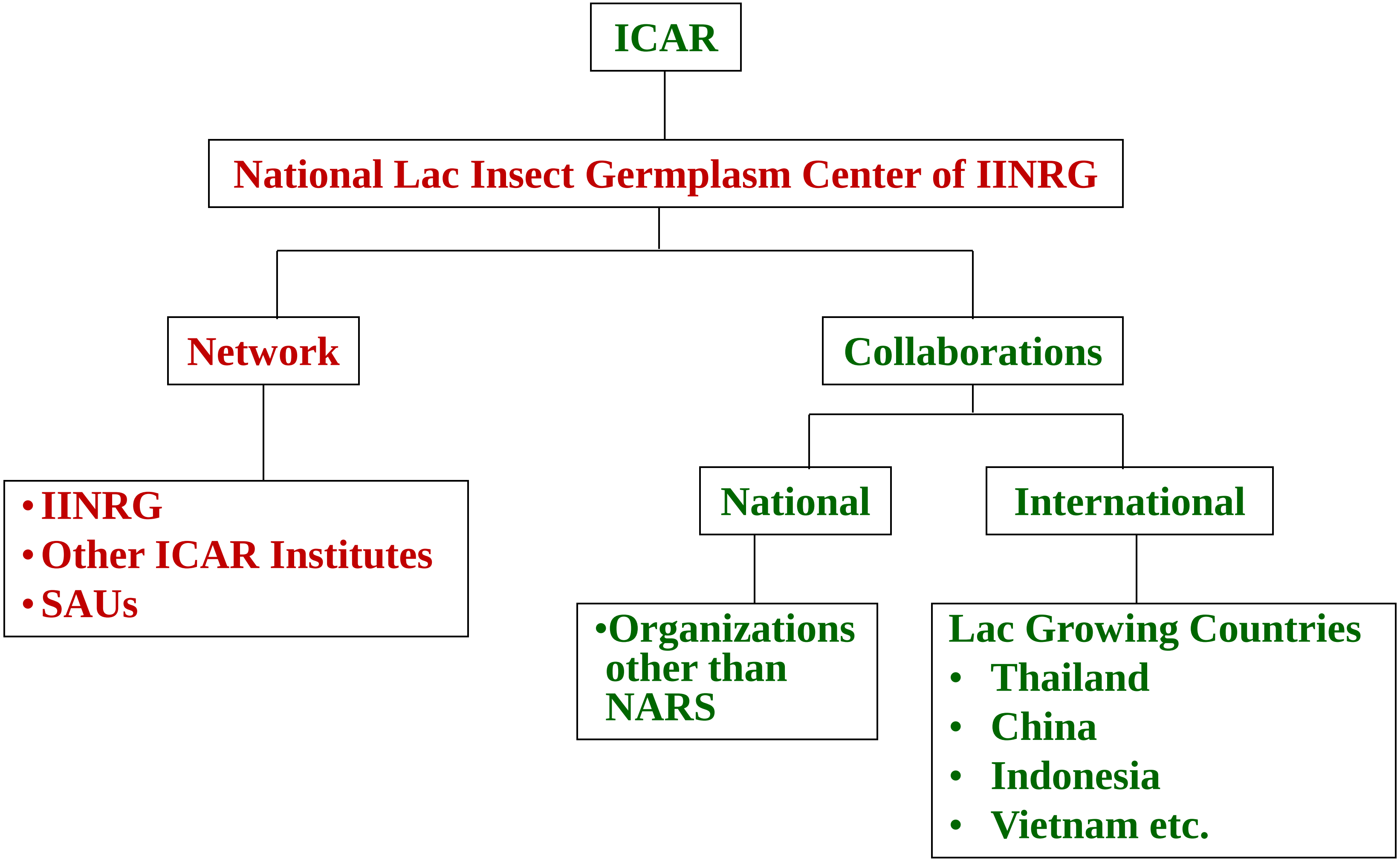
Ex-situ conservation

- National Lac Insect Germplasm Center (NATLIGEC) of the IINRG maintains 72 lines of lac insects which include 14 cultivated, 29 natural populations, 22 cross bred / inbred / selected, one exotic and six un-coded lines collected from survey of 66 districts of 16 states.
- But, maintenance and conservation of lac insects is a laborious process as they have to be maintained live under protected conditions on potted plants due to their phyto-succivorous habit and associated pest complex.

In-situ Conservation

- Recent studies have shown an integrated approach of *in-situ* and *ex-situ* conservation to be more effective. While *ex-situ* conservation of lac insects is being taken care of, *in-situ* conservation has largely remained neglected.
- Since, IINRG is the only institute looking after all aspects of lac insects, efforts for conservation (especially *in-situ* conservation) of lac insects would require concerted efforts of partners from within and outside the country to work in a network mode.

Implementation plan: Proposed Flow Chart of the Lac Insect Genetic Resources Management System (LIGRMS)



Honey Bee Genetic resources

Apis mellifera lingustica

Apis cerana indica

Apis florea

Apis andreniiformis

Apis labriosa

Apis dorsata

Out of 9 important *Apis* species 6 are found in India

Inputs: Dr R K Thakur, AICRP on honeybees and pollinators

DIVERSITY OF STINGLESS BEES IN INDIA

SN	Species	Distribution
1	*Lepidotrigona arcifera* (Cockrell)	Sikkim, West Bengal, Assam
2	*Tetragonula laeviceps* (Smith)	Karnataka , Andaman island
3	*T. bengalensis* (Cameron)	West Bengal
4	*T. gressitti* (Sakagami)	Arunachal Pradesh
5	*T. iridipennis* (Smith)	Throughout India
6	*T. ruficornis* (Smith)	Uttar Pradesh
7	*Lisotrigona cacciae* (Nurse)	Madhya Pradesh
8	*L. mohandasi* Jobiraj and Narendran	Kerala
9	*L. revanai* Viraktamath and Sajan Jose	Maharashtra
10	*L. chandrai* Viraktamath and Sajan Jose	Kerala

Genetic resources of Stingless bees in Nagaland

Tetragonula iridipennis

T. canifrons

T. atripes

T. laeviceps

T. ventralis

T. ruficornis

Different Stingless bee species

Genetic Resources of Bumble bees (*Bombus* spp.)

S.NO	Name of the species	S.NO	Name of the species
1	*B. asiaticus* Morawitz, 1875	10	*B. testivus* Smith, 1861
2	*B. trifasciatus* Smith, 1872	11	*B. waltoni* Cockerell, 1910
3	*B. himalayanus* Skorikov, 1914	12	*B. rotundiceps* Friese, 1916
4	*B. lemniscatus* Skorikov, 1912	13	*B. miniatus* Bingham, 1897
5	*B. semenovianus* Skorikov, 1914	14	*B. pressus* Frison, 1935
6	*B. simillimus* Smith, 1852	15	*B. flavescens* Smith, 1852
7	*B. haemorrhoidalis* Smith, 1852	16	*B. breviceps* Smith, 1852
8	*B. keriensis* Morawitz, 1886	17	*B. parthenius* Richards, 1934
9	*B. melanurus* Lcpclciticr, 1836	18	*B. cornutus* Frison, 1933

Genetic Resources of Bumble bees

S.NO	Name of the species	S.NO	Name of the species
19	*B. lunicatus* Smith, 1852	34	*B. genalis* Friese, 1918
20	*B. lucorum* Linnaeus, *******	35	*B. grahami* Frison, 1933
21	*B. subtypicus* Skorikov,1914	36	*B.nobilis* Friese, 1905
22	*B. pyrosoma* Morawitz, 1890	37	*B. tanguticus* Morawitz, 1887
23	*B. hypnorum* Linnaeus, 1758	38	*B. skorikovi* Popov, 1927
24	*B. rufofasciatus* Smith, 1852	39	*B. tibetanus* Morawitz, 1887
25	*B. personatus* Smith, 1879	40	*B. turneri* Richards, 1929
26	*B. avinovicllus* Skorikov, 1914	41	*B. abnormis* Tkalu, 1968
27	*B. kashmirensis* Friese, 1909	42	*B. luteipes* Richards, 1934
28	*B. branickii* Radoszkowski,1893	43	*B. mirus* Tkalcu, 1986
29	*B. novus* Frison, 1933	44	*B. luteipes* Richards, 1934
30	*B. ferganicus* Radoszkowski, 1893	45	*B. sibiricus* Fabriclus, 1781
31	*B. oberti* Morawitz, 1883	46	*B. funerarius* Smith, 1852
32	*B. lepidus* Skorikov, 1912	47	*B. biroi* Vogt, 1911
33	*B. ladakhensis* Richards, 1928	48	*B. morawitizianus* Popov, 1931

Geographical ecotypes of *Apis cerana*

***Apis cerana himalaya* - Naga and Mizo hills, Brahmaputra valley and Khasi hills, Foot hills of North East Himalaya**

***Apis cerana cerana*- Central and North India**

***Apis cerana indica*- South India**

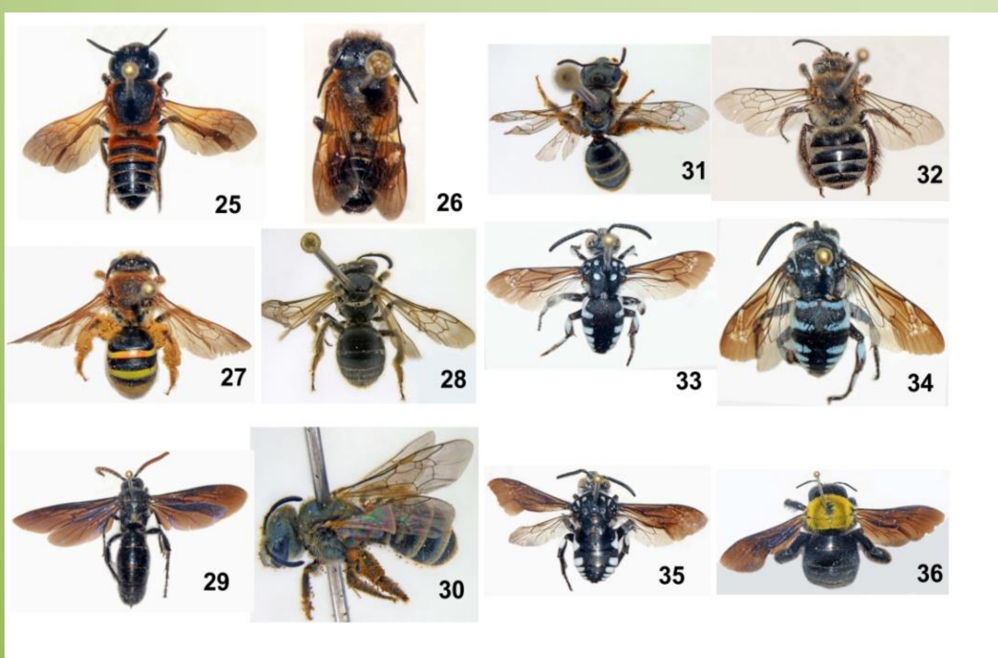
Bumble Bee species diversity

Bombus orientalis

***Khasi hills* of Meghalaya**

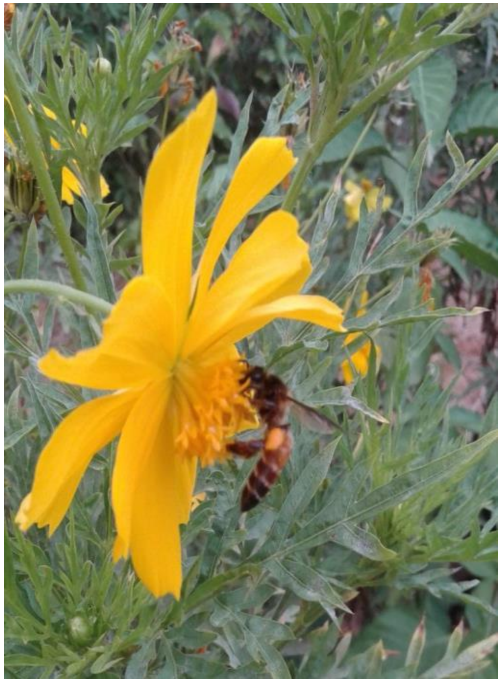
In situ Conservation strategies for pollinators- NBAIR

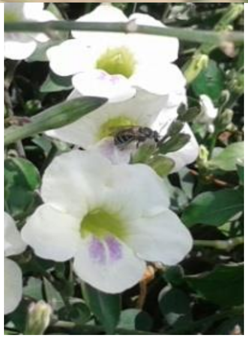
- Habitat manipulations
- Conservation of beneficials – including natural enemies and pollinators –
- Effect of pollinator friendly non-crop plants in enhancing pollination and yield in selected crops
- Pollinator – nesting sites – bee colonies



Conservation of native bees - NBAIR

- Apis and Non-apis bees belonging to the families viz., Apidae, Megachilidae and Halictidae conserved - by maintaining almost 300 species of flora in the pollinator garden
- Various nesting structures like pithy stems of *Ceasalpinia pulcherrima*, bamboo trap nests - to conserve the native non-apis solitary bees.





Role of native bees in enhancing the pollination of tomato – In situ conservation

- Potential of two buzz pollinating native bee species

  1. Blue banded bee, *Amegilla zonata* (Anthophorinae: Apidae)

  2. Sweat bee, *Hoplonomia westwoodi* (Nominae: Halictidae)
- *A. zonata* pollinated flowers - fruit weight (63.79g), Number of seeds (177.12)
- *H. westwoodi pollinated* flowers – fruit weight (46.96g), number of seeds (140.50)

Bruise marks made by blue banded bee *A. zonata* in the anther cone of tomato indicating successful pollination

Potential non-apis bees for pollination

- **Native bees viz., *Amegilla zonata, Hoplonomia westwoodi* with an ability to buzz pollinate the crops could be a viable alternative to the exotic introductions in the polyhouses.**
- Megachilids viz., ***Megachile lanata* (Megachilinae: Megachilidae), *M. anthracina*** have immense potential to be used for pollination in pulse crops like pigeon pea and field bean.

Ceratina binghami

Nest built by leaf cutter bee, *Megachile lanata*

Hoplonomia westwoodi

Proposed Action Plan – Delhi Declaration

DD Point No. 1

- ✓ **Promotion of utilization of natural enemies for sustainable pest management (SPM)**
  - **Parasitoids for SPM in rice, sugarcane, maize, coconut, papaya and brinjal.**
  - **Predators for SPM in grapes, custard apple, ornamentals, polyhouse crops.**
  - **EPN for management of root grubs in sugarcane, arecanut, groundnut, soybean.**
  - **EPFs and Bt (Insect derived resources) for pests of pulses and cruciferous vegetables.**

  - **Evaluation of new and potential beneficials for pest and disease management**

Sugarcane woolly aphid

- **Large scale management of sugarcane woolly aphid in different states like Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Telengana, etc. was achieved by <u>CONSERVATION</u> & releases of parasitoids (*Encarsia flavoscutellum*) and predators (*Dipha* and *Micromus*) leading to absolute control of the pest and savings of more than 1000 crore INR (14.98 million US$)**












CONSERVATION & AUGMENTATION STRATEGIES - Biological control of rice pests in Trichur, Kerala

- **ADAT-Panchayat – conservation strategies adopted in 2500/3000 ha**
- ***Utilisation of Trichogramma***
- **Ecosystem preserved**

Biocontrol of Spiralling white fly

Spiralling white fly, *Aleurodicus dispersus* – 1995 -

- **Serious pest first reported from Kerala, spread to all other states**
- ***Encarsia* (?) *haitiensis* and *E. guadeloupae* – from Minicoy Island of Lakshadweep brought to main land and have established well**

Recent Invasive-Rugose spiraling whitefly on coconut

Management of soil pests with entomopathogenic nematodes
Insect derived resource – conservation and utilisation

Whitegrubs in cardamom field

Yellowing due to grub damage

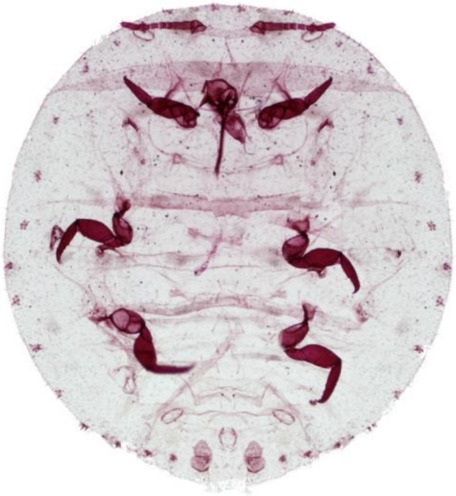
Yellowing in arecanut

DD – Points No. 2, 3 & 4

- ✓ Collection of traditional methods of pest management and utilization of insects as food and feed.
- ✓ Local names of insects and associated knowledge in different states.
- ✓ Insitu and exsitu conservation strategies would be developed for beneficial insects.
- ✓ Trait discovery and enhancement in beneficials for chemical and abiotic stresses.

DD Points 4 -7

- ✓ Characterization of Insect genetic resources
- ✓ Nanotechnological approaches in pheromone technology for enhanced manipulation of insect behavior.
- ✓ Computation tools for identifying potential molecules for pest management.
- ✓ Global exchange of insect genetic resources for taxonomic research and management of Invasive alien species (IAS), within the perspective of ABS guidelines.
- ✓ Collaboration with Quarantine agency (DPPQ&S) for interception of invasives
- ✓ Capacity building on identification of pests for officials from quarantine and state horticulture and agriculture Depts for strengthening international and domestic quarantine.
- ✓ Preparation of electronic databases, pamphlets, brochures (in local languages) and short documentaries for creating public awareness.



Collaborative projects – for collection documentation & digitisation of IGRs

- Dead insect exchange / export for taxonomic research on insect germplasm
- Collaboration with 16 international taxonomists – Form B approved by NBA
- Live insect exchange: ICAR – CABI collaborative project

Best practices for exchange of invertebrate biological control genetic resources

- Collaborations to facilitate information exchange about what invertebrate biological control agents are available and where they may be obtained;
- knowledge sharing through freely available databases that document successes (and failures);
- cooperative research to develop capacity in source countries
- Transfer of production technology to provide opportunities for small-scale economic activity.

Excerpt from:

Best practices for the use and exchange of invertebrate biological control genetic resources relevant for food and agriculture (Mason et al., 2017; BioControl DOI 10.1007/s10526-017-9810-3)


Magnification: 0.9 x
2 mm
THANK YOU