

## CAN TINY ELECTRONS EVER DESTABILIZE A PLASMA SYSTEM

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**It is a common practice to assume boltzmann electron density distribution for describing the normal fluid mode of acoustic wave dynamics in plasmas. This article describes the role of finite but weak electron inertia to reveal hidden acoustic instability when the plasma ions' drift exceeds the acoustic phase velocity.**

### INTRODUCTION

Plasma is a fourth state of matter and is usually defined as a collection of statistically large number of free electrons, ions, radicals and neutrals. How much large ? It is normally determined by the ideal plasma gas approximation that states that the the number of free plasma particles in one Debye sphere must be greater than unity. How much greater ? This has concern with the relative average content of internal energy in the form of inter-particle coulomb interactions at given plasma gas density and temperature. It is, in general, a quite aggressive state of matter to be easily controlled and confined. Depending on the degree of ionization of the plasma gas, it is classified as a *full ionized plasma*, *weakly ionized plasma* and *partially ionined plasma*. In fully ionized plasma assumed to have 100% ionization of the plasma gas, the coulomb collisions play an important role over the binary interactions. In weakly ionized plasma, the binary interactions dominate over the coulomb collisions. In partially ionized plasma, binary interactions and coulomb interactions are comparable.

According to the strength of the colomb coupling between the charge particles, plasma is further

classified as the *ideal (uncorrelated or uncoupled) or non-ideal (correlated or coupled) plasmas*. Depending of the correlation strength, the non-ideal plasma is further classified as the weakly *correlated plasmas* and the *strongly correlated plasmas*. The coulomb correlation strength is measured by a parameter defined as the ratio of the average coulomb potential energy of a charge particle and the plasma thermal energy.

Traditionally, the plasma was widely defined to behave as an electrically quasi-neutral collection of thermodynamically free charge particles. This definition to hold good, requires that the plasma size should be larger than the electron Debye length. In plasma state, the free charge particles forget about their individual behaviours and follow collective motions. However, even the non-neutral space charge clouds exhibit the collective motions and behave like usual quasi-neutral plasmas. The necessity of quasi-neutrality, as one of the basic plasma conditions, is no more needed. It is advised to adopt an appropriately broader classification of plasmas into quasi-neutral and non-neutral. Plasma ions, in plasma sheath region, are in motion with an intermediate region of transonic transition layer.

It is an interesting point to note that the plasma is quite rich in collective degrees of freedom. In presence of force fields, the plasma becomes richer in collective modes of plasma dynamics. In ideal

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plasma limit, the plasma behaves as a collisionless continuum. Hence fluid model approximation of the plasma gas is well satisfied even for collisionless plasma cases. Moreover, the collective degrees of freedom are always present in the plasma in the form of thermal noise. However, as and when any source of free energy is available, some of these degrees of freedom may be excited to allow them to grow to physically measurable limit.

The basic process of plasma production is based on the ionization of neutral atoms through which the bounded electrons are set free. This is, in fact, important to state that the plasma is a good conductor and has enormous amount of internal energy in the form of kinetic thermal motions. According to Bohr's atomic theory, an atom consists of a central core of positive nucleus and the electrons are bounded and orbit around it. The electrons occupy various energy levels characterized by the principal quantum number 'n'. The amount of energy possessed by an electron orbiting in an orbit characterized with 'n' is given by Bohr's energy expression  $E(n) \propto n^{-2}$ . It simply shows that the valence electrons are loosely bound and inner electrons are tightly bound to the nucleus in a neutral gaseous atom. If a neutral gas undergoes ionization, the free electrons and free ions are left behind in a new state. Plasma exists in discharge tubes, electrical bulbs, lighting discharge, space and stellar atmospheres. One can find details about plasma properties in basic books by Krall and Trivelpiece<sup>1</sup>, Davidson<sup>2</sup> and Chen<sup>3</sup>, or by others.

#### BASIC CONCEPT OF TRANSONIC PLASMA

Most of the earlier studies of plasma waves are based on the static approximation of force-field free plasma or otherwise in the presence of forces of different origins. However, the study of stability behaviours of wave dynamics in a dynamic equilibrium of plasma flow motion is still in infancy state. Of course, there is now revival of interest in the stability behaviours of plasmas associated with

supersonic flow motions. In fact, the idea of transonic flow motion is quite popular in gas and fluid dynamics. The supersonic neutral gas flow motion is produced by the basic principle of *de Laval nozzle effect* and is brought about by the geometrical modifications of the cross section of the containing chamber. Similar effect of transonic transition in plasma flow motion occurs naturally in confined plasma near the confining boundary wall.

This is important to note that the quasi-neutral plasma is never in physical contact with the boundary wall confining it. A non-neutral space charge layer known as '*plasma sheath*' is formed at the inner surface of the boundary wall. Two-layer theory of plasma sheath as a boundary layer considers of '*pre-sheath*' and '*Debye sheath*' layers. The scale length of the pre-sheath layer is of the order of plasma size. The length of Debye sheath layer is of few tens of Debye length. In fact, according to our hypothesis, there is an additional layer too, termed as '*transonic plasma layer*' in between sheath and pre-sheath. This is of the order of a few Debye lengths<sup>4</sup>. Transonic plasma is defined as a plasma in flow motion with hydrodynamic equilibrium where the flow velocity suffers a transition from sub-sonic to super-sonic. This kind of plasma in motion, however, is quite unique and has a good scope of acoustic wave turbulence due to active role of weak but finite electron inertia to destabilize the transonic equilibrium flow.

In transonic plasma layer, the inertia lies approximation of the electrons to fully describe the plasma sound wave loses its utility. This has been pointed out in our own publications on inertia-induced acoustic excitation theory of transonic plasma<sup>5</sup>. We suggested and put forth a hypothesis of phenomenological model of transonic plasma dynamics in terms of wave turbulence. Should one then not state that the transonic plasma offers a

good physical site for experimentations of the importance of tiny particles like electrons to destabilize the plasma in transonic equilibrium ?

The basic studies of stability behaviours of the transonic plasma layer have wide range applications in fusion research, space and astrophysical research, aeronautics, inertial fusion research and plasma-based technology.

### ACTIVE INERTIAL ROLE OF TINY ELECTRONS

Inertial quality, as based on experimental observations, of an object is normally treated as an intrinsic resistive property of the matter of the object. By virtue of definition and physical reality, it is indeed so. To induce and drive motion in such objects, some minimum force is required to, at least, overcome the inertial resistance in response to externally applied forces. The mass of the objects measures the inertial strength of the objects. For example, the mass of electrons in plasma is quite less than that of the ions by three orders of magnitude and hence in any low frequency wave phenomena of ion inertial space and time scales, the electron inertia is ignored. In this asymptotic limit of inertial less electrons, the ion acoustic waves are free to move without any dissipation and/or amplification in any unbounded quasineutral homogenous plasma in either static or moving state. Of course, in moving state of plasma, the ion acoustic waves suffer Doppler frequency shift in the direction of plasma motion. On the time scale of the electron inertia, high frequency electrostatic oscillations are produced and the ions are assumed to form static background.

There are many cases where the collisional dissipations can allow certain instabilities to proceed, which would not otherwise occur<sup>5</sup>. The example of collisional Rayleigh-Taylor (R-T) instability in collisional plasma is well known, which is driven by the combined effects of external

gravity and density gradients but requires ion-neutral collisions to proceed. This is to note that the dissipative effects normally introduce damping of the wave energy. However, in certain situations as mentioned above it helps to allow the growth of the wave energy. Likewise, it is recently reported<sup>6</sup> that the consideration of weak but finite electron inertia facilitates to drive a new kind of resonance instability of ion acoustic wave fluctuations in plasma with drifting ions. Here the electron inertia in collaboration with ion drift motion causes the linear growth as well as the Doppler frequency shift in the usual ion acoustic wave motion. Destabilizing threshold requires that the plasma ion flow velocity must exceed the phase velocity of the ion acoustic wave.

The electron inertia induced ion acoustic wave instability is governed by electron fluid compression due to finite but weak electron inertial delay effect. As a consequence of it screening of the acoustic wave potential fluctuations generated by the compression and rarefaction of the ionic fluid is reduced. In fact, this novel effect is masked by the Boltzman approximation of the electron density distribution under asymptotic limit of inertia-less electrons. But as shown and discussed by Dwivedi & Ram Prakash<sup>6</sup>, the practical significance of asymptotic limit of inertia-less electrons is judged in plasmas with drifting motion of ion on the ion inertial space and time scales. It is reported that the ions with drift velocity exceeding the phase velocity of the ion acoustic wave fluctuations in association with electron inertia produce the resonantly growing solution of the ion acoustic wave fluctuations at Doppler shifted (down) eigen mode frequency.

The Basic process of ion acoustic wave excitation in field free transonic plasma is governed by the inertia-induced acoustic excitation theory<sup>5,6</sup>. The inertia induced acoustic excitation theory has been extended and generalized to ideal collisional plasmas

in turbulent equilibrium as well<sup>7</sup>. Two separate cases of ion flow motion and dust grain motions are considered. It is indeed found<sup>7</sup> that the *modified ion acoustic mode* and the *so-called (ion) acoustic mode*—both become unstable due to active role of finite but weak inertia of the respective plasma thermal species. Proper mass domain of the dust grains for instability to occur is estimated.

The inertia-induced acoustic excitation theory offers a new way of physical understanding of the sheath driven low frequency instability producible in double plasma device. Physical situations for practical realization of this instability occur in transonic zone of the plasma sheath and also in solar wind plasmas. It is shown<sup>8</sup> by graphical analysis that the resonance growth of short scale acoustic wave fluctuations is indeed more likely to occur in the transonic region of dynamic equilibrium of the flowing plasmas. The transonic plasma of finite width is supposed to exist around the sonic point in real space as well as in Mach number space. Considering this specific situation in mind, it is theoretically shown<sup>9</sup> that the usual nonlinear normal acoustic mode (ion acoustic soliton) can undergo qualitative as well as quantitative changes in presence of background plasma conditions of linear wave turbulence.

By this simple example of the non-linear ion acoustic wave description in an unstable plasma medium, the traditional notion of unstable condition of linear normal mode as a non-existential condition of its non-linear counter part is rebutted.

In a simple fluid model approach of theoretical description of the *scrape-off layer* (SOL), it is emphasized that the electrons can satisfy the Boltzmann distribution quite closely yet the electrons can have finite flow motion comparable to acoustic speed<sup>10</sup>. It is thus reasonable to judge the practical significance of the asymptotic limit of inertia less electrons for the derivation of Bohm condition. Very recently simple calculations are performed by including finite but weak effect of

electron inertial dynamics for static Debye sheath scale analysis<sup>11</sup>. This is to report and apprise the readers that the reduction in Bohm threshold for sheath formation is noted. This is emphasized that the universal character of the Bohm condition needs further review. This is hypothesized that the Debye sheath edge should behave as a turbulent zone with finite extension.

## SUMMARY AND CONCLUSIONS

In summary, the role of inertia-induced acoustic excitation theory of our own offers a unique quality to the transonic plasma physics. There arises a good scope of the acoustic turbulence theory for transonic plasma. Our theory predicts that even tiny electrons have a peculiar ability to destabilize the ion acoustic wave in transonic plasma condition. Normally, the electrons exhibit their inertial dynamics only at electron plasma oscillation frequency. However, in presence of transonic plasma ions, the low frequency response of even tiny electrons introduces qualitative changes in linear and nonlinear behaviours of the ion acoustic wave propagation in transonic plasma equilibrium. Thus, one may conclude, a future scope of a new chapter of *plasma acoustic spectroscopy* is opened<sup>12, 13</sup>.

## ACKNOWLEDGEMENT

I am thankful to Dr. C. B. Dwivedi, Associate Professor of the same institute, for encouraging me to write this article. I also duly acknowledge the financial supports of the Council of Scientific and Industrial Research (CSIR) through the Senior Research Fellowship (SRF) award.

## REFERENCES

1. N. A. Krall and A. W. Trivelpiece, '*Principles of Plasma Physics*', McGraw-Hill Book Company, 1932.
2. R. C. Davidson '*Methods in Nonlinear Plasma Theory*', Academic Press-New York and London, 1972.

3. F. F. Chen, '*Introduction to Plasma Physics and Controlled Fusion*', Plenum Press New York and London, **1**, 1988.
4. Y. P. Biokh, J. Felsteiner Y. Z. Slutsker and P. M. Vaisberg, *Phy. Plasmas* **9**, 3311, 2002.
5. C. B. Dwivedi, *Pramana-J, Phys.* **55**, 849, 2000.
6. C. B. Dwivedi and Ram Prakash, *J. Appl, Phys.* **90**, 3200, 2001.
7. P. K. Karmakar and C. B. Dwivedi, '*Inertia-induced excitation theory for transonic transion in an ideal collodial plasma flow motion*', *Phys. Plasmas*, 2005 (communicated.)
8. P. K. Karmakar, U. Deka and C. B. Dwivedia, *Phys. Plasmas* **12**, 032105, 2005.
9. U. Deka, A. Sarma, Ram Prakash, P. K. Karmakar and C. B. Dwivedi, *Phys, Scr.* **69**, 303, 2004.
10. Peter C. Stangeby. *The Plasma Boundary of Magnetic Fusion Devices*, (Institute of Physics Publishing Ltd., London. U. K.) chap. 1,p.33, 2000.
11. J. J. Nakarmi, D. S. Air, U. Deka and C. B. Dwivedi, *Phys.* 2003 (communicated.)
12. P. Mora, *Phys. Rev, Lett*, **90** 185002-1, 2003.
13. J. P. Goedbloed, R. Keppens and S. Poedts, *Space Sci Rev.* **107**, 83, 2003.

### DO YOU KNOW ?

- Q3. Do birds of the same size lay similar sized eggs ?
- Q4. How many hearts does Octopus have ?
- Q5. What was the code name of the first atom bomb dropped on Hiroshima ?
- Q6. Why does the human brain carry innumerable folds ?

## TRADITIONALIZING NON-TRADITIONAL PULSES : A CASE STUDY IN A TRIBAL VILLAGE OF SOUTHERN ORISSA

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**An effective marketing strategy should be evolved for promoting the sale of the non-traditional pulses at seasonable rates so that the cultivation and processing of these pulses can lead to the growth of rural industries.**

### INTRODUCTION

Out of about 13,000 legume species, less than 20 are used as human food. Only a few of these are consumed in any particular country or region. The most common legumes in India are chickpea, greengram, blackgram, pigeonpea, lentils and khesari. The legumes in dry form yield almost as many calories per unit of weight as cereals. The protein content of these pulses ranges from 17-25 percent, about double that of the cereals and slightly higher than meat, fish etc. Legumes commonly eaten are low in fat and they are fairly good source of thiamine, niacin, calcium and iron. That is why the pulses are referred to as 'meat of the poor'. India is the largest producer of pulses in the world; the annual yield is nearly 12 million tones<sup>1</sup>. The per capita availability of pulses has been reduced considerably because of population increase and stagnation in the production of pulses. Though the pulses production in India has increased from 8.4 MT to 13.27 MT in 2001-2002<sup>2</sup>, yet it is not sufficient to meet the scarcity of pulses in the lower income group population. To overcome this problem it is felt necessary to encourage the cultivation of some locally grown less known pulses which we refer as non-traditional pulses (MTPs). These pulses are mainly grown by the tribal and marginal farmers in some states like Orissa, Madhya

Pradesh, Andhra Pradesh, Tamilnadu and Bihar. A few major varieties of NTPs like Kandulo (*Atylosia cajanifolia*), Bailo (*Phaseolus lunatus*), Jhudungo (*Vigna unguiculata*), Katting (*Phaseolus calcaritus*), Khudi chana (*Lathyrus sativus*), Simbo (*Dolichus lablab*), and Godi chana (*Vicia bithynica*) are cultivated in the western and southern parts of Orissa and the photographs of some of the NTPs are given in plate-1. A survey conducted by Regional Research Laboratory, Bhubaneswar indicated that the production of such pulses in Orissa is nearly about 1, 05,000T per annum cultivated in an area of 2,08,000 Ha which is far below the average yield<sup>3</sup>. Due to lack of proper agro and post harvest technologies, these local pulses have not been commercialized so far.

### COMPARISON BETWEEN TRADITIONAL AND NON-TRADITIONAL PULSES

Non-traditional pulses are mainly grown in marginal and wasteland by the tribal people. Depending upon the climatic factors, the non-traditional pulse production has been fluctuating for years. The major cause for low production of the non-traditional pulses in India are ecological factor, lack of appropriate agro-technology for pulse-production and post-harvest technology, basic research and socio-economic constraints along with non-availability of quality seed in required amounts. After surveying the along with non-availability of quality seed in required amount. After surveying

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the present cultivation and processing practices adopted by the farmers, the Laboratory has tried to differentiate between traditional and non-traditional pulses as indicated in table-1.

**Table-1 : Comparative Study of Traditional Pulses with Non-traditional Pulses.**

Traditional Pulses	Non-Traditional Pulses
Grown : Mostly as Rabi and rarely as Kharif	Grown : Mostly as Kharif and rarely as Rabi
Sowing Period : October-November	Showing period : June-July
Cultivation period : Growth 4-5 months	Cultivation period : 6-7 months
Plant types : Mainly shrubs and herbs	Plant types : Climbers and twiners
Grown as : Commercial crops	Grown as : Fence crops
Harvesting period : February-March	Harvesting period : November-December
Dehusking : Easier removal of husk	Dehusking : Relatively difficult
Consumption : In <i>dhal</i> form	Consumption : Mostly in green stage as vegetable
Taste : Not bitter in taste	Taste : Slightly bitter, unpleasant odour.

### NEED FOR TRADITIONALIZING THE NON-TRADITIONAL PULSES

RRL, Bhubaneswar has made a detailed survey in some major NTP producing districts of Orissa on various aspects like cultivation, processing and marketing. It was observed that districts like Kalahandi, Nuapara, Bolangir, Rayagada, Phuldani and Ganjam produce half of the total non-traditional pulses of the total production in the state and the share about 55% of the total area for cultivation of NTPs. It is seen that the western and southern zones of Orissa wherein a major fraction of tribal population inhabit are the highly potential NTP grown areas.

Non-traditional pulses can utilize the limited soil moisture and nutrients better than cereal crops. But to increase the pulse production there is a need for appropriate agronomic practices such as proper soil conditioning, land shaping, proper sowing time,

adequate seed rate, proper method of sowing, application of efficient *Rhizobium* culture and fertilizers, control of weed infestation and insect pests. Proper agro-technology may increase the production of these pulses in our country to reduce the scarcity of pulses.

November to January are generally the harvesting months for most of these pulses and the sun availability and solar intensity are low during this season. Since the standard practice of moisture reduction from the freshly harvested pulses is only the sun drying, inevitable under-drying of grains occurs. Tribal people generally use gunny bags and earthen pots for storage of pulse, which cannot check the absorption of moisture by these hygroscopic grains. So, the drying and storage losses accounted together upto 10-15%. Moreover due to high protein content, these pulses are more prone to insect and microbial infestation. Therefore most of these pulses are consumed by the tribal growers in the freshly harvested form and the rest is sold hurriedly to the pulse traders at low prices without fetching any financial benefit.

Tribal people use traditional chhakis (hand driven), low efficient dahl mills (non-standard), dhinki to produce splitted dahl with dehusking, which cause a major loss. These traditional milling practices are subjected to higher broken percentage with very low splitted dahl yield.

To overcome all these problems and to improve the production of non-traditional pulses and popularize these pulses, RRL has standardized the agro-practices and developed various equipments and techniques.

### ITP DEVELOPED BY RRL, BHUBANESWAR

In the above context, Regional Research Laboratory has developed an Integrated Technology Package (ITP) for cultivation and efficient processing of non-traditional pulses

sponsored by Technology Mission on Oil Seeds, Pulses and Maize (TMOP & M), Ministry of Agriculture and Co-operation, New Delhi. The Integrated Technology Package includes standardization of agro-technology practices, post-harvest processing techniques and equipments for some non-traditional pulses.

### STANDARDIZATION OF AGRO-TECHNOLOGY

Standardization of agro-technology for large-scale cultivation of non-traditional pulses is an important aspect to enhance the productivity of

### DEVELOPMENT OF POST-HARVEST EQUIPMENTS

Various post-harvest equipments like biomass fired mechanical dryers, Rotary biomass fired dryer, solar dryer, an improved storage bin have been developed and the existing dhal mills have been modified by RRL, Bhubaneswar for efficient processing of these pulses.

#### Dryer

To minimize the drying losses which are generally practiced in conventional open sun drying method and to store the pulses at a adequate

**Table-2 : Optimal Agro-technological Parameters for Better Yield of NTPs.**

Sl. No.	Agro-technological parameters	Recommendations
1.	Land Preparation (i) Soil texture (ii) Weed control (iii) Fertilizer application	Sandy/Sandy Loam/Black Cotton type soil with acidic in nature Herbicide (Basaline is used, 600 ml/ha) Urea : 45 kg/ha, SSP : 70 kg/ha, MOP : 75 kg/ha
2.	Sowing (i) Time of sowing (ii) Seed requirement (iii) Fungicide application (iv) Rhizobium application (v) Line to line spacing (vi) Plant to plant spacing	June-July 50 kg/ha Bavisting & Thiram in a ratio of 1 : 1 @ 2.5 gm/kg of seed 500 gm/ha 15 cm (approx) 15-20 cm (approx)
3.	Plant protection (i) Intercultural practices (ii) Insecticide application	Two mannual weeding required after 45 days of sowing Ekalux and Dethane M-45 sprayed in plants before podding
4	Harvesting	November-January

such pulses. For extension-promotion, awareness and lab to land technology transfer programme, cultivation trails of non-traditional pulses were undertaken at RRL, Bhubanewar. The land preparaton, irrigation, adequate amount of seed, recommended dosages of fertilizers, *Rhizobium* application, seed treatment, sowing time, and weed control, etc were standardized to increase the yield and the major parameters for improved yield of these pulses are illustrated in Table-2

moisture level for a longer period a number of biomass fired dryers of capacities ranging from 250 kg-1000 kg per batch, a solar dryer of 100 kg batch capacity have been developed. The tribal farmers can afford to purchase the low cost dryers with a very nominal drying cost of *i.e* Rs. 15 to Rs. 20 per quintal.

#### Improved Storage Bind

For safe storage of non-traditional pulses and to check the insect and microbial infestation an improved storage bin of 1000 kg capacity has been developed. The storage bin is made up of GI sheets



with provision for effective aeration and fumigation and removal of moisture during storage period. To check the attack of insects and rodents, conical structure attachments are provided at the leg supports of the storage bin.

### Modified Dhal Mills

Seed coat of non-traditional pulses are hard in comparison to traditional pulses. So dehusking of the NTPs is a major problem in the existing dhal mills. RRL has procured a Mini dhalmilling machine of CFTRI design and incorporated modifications to suit the milling of these pulses. The machine consists of an inverted emery cone fixed to a vertical shaft with chuck-nut arrangement to adjust the clearance. The emery cone is enclosed

## TECHNIQUES DEVELOPED

### Premilling Treatment Techniques

To facilitate the easy removal of the seed coat and to reduce the broken and dust percentage during milling of NTPs, various premilling treatment techniques like water soaking, oil treatment, chemical treatment and alternate wetting and drying techniques were standardized in the laboratory. Milling of these pretreated pulses indicated the following results as shown in **Table-3** and hence recommended for better dhal yield.

### Storage Pest Management Practices

To increase the food sustainability, it is required to improve the storage practices by controlling the insects and fungal pathogens found during storage.

**Table-3 Recommended Premilling Treatment for Some Non-traditional Pulses.**

Type of Treatment	Kandulo			
Water treatment	% Dahl	% Husk	% Broken	% Unsplitted
	83.2	11.98	0.783	3.62
Chemical treatment	Bailo			
	% Dahl	% Husk	% Broken	% Unsplitted
	88.2	6.04	0.45	5.33
Oil treatment	Judungo			
	% Dahl	% Husk	% Broken	% Unsplitted
	79.82	14.62	0.85	4.5
Water treatment	Simbo			
	% Dahl	% Husk	% Broken	% Unsplitted
	79.86	16.78	2.34	1.02
Oil treatment	Katting			
	% Dahl	% Husk	% Broken	% Unsplitted
	72.5	16.0	2.4	9.1

in a steel wire mesh segmented cone strengthened by radial frames fixed on the main frame of the machine. In the modification, the emery cone segment has been replaced by a metallic cone and chequered mild steel strips of different lengths having 8-10 mm thickness have been welded radially over the metallic cone to facilitate easy dehusking of NTPs. The modified dahl mill indicated better yield splitted dahls with less broken percentage.

Stored fungi and insects cause severe damage to the stored commodities. For control of the post harvest fungal and insect deterioration of foodstuffs, many synthetic chemicals are generally used but such chemicals have been banned due to their residual toxic effects on consumer's health. Plants and their products use to prove their fruitfulness in providing less phytotoxic, easily biodegradable and host metabolism stimulatory fungicides and insecticides<sup>4,5</sup>. This inspires to exploit the volatile

natural products of higher plants as safe biological control measures for herbal fumigant fungicide. So various herbal plant parts like leaves, stem and oil of Hyptis, Patchouli, Tulsi, Cinnamon, Citronella and Turmeric etc. were tested against the stored fungi and insects found during storage of non-traditional pulses. Use of natural biocides has no bad impact on environment and human and animal health.

#### TRIBAL VILLAGE IN GANJAM DISTRICT OF ORISSA : A CASE STUDY

To popularize the agro and post harvest technologies of NTPs among the tribal and marginal cultivators, Laboratory has established a Demonstration Centre at a Govt. assisted tribal colony in village-Dabikibelapanka, Surada block, Ganjam district. For transferring the agro-technology from lab. to land, the farmer beneficiaries of the adopted village have taken up cultivation of a few varieties of non-traditional pulses in about 50 acres of land since 2002 with the agro-technical inputs provided by the lab. By adopting the improved agro-technology such as proper soil conditioning, land shaping, *Rhizobium* and fertilizer application, seed rate, high yielding varieties of seeds, sowing time, irrigation, weed control, insecticide and pesticide application etc there has been a substantial increase in yield of NTPs. The production data for last two years NTP cultivation are shown in **Table-4**, which indicates the yield as more than the average production of such pulses.

**Table-4 : Yield data for 2002-2004 at Adopted Tribal Colony, Surada Block**

Pulses cultivated	Average Yield (Q/Ha) 2002-2003	Yield (Q/Ha) 2002-2003	Yield (Q/Ha) 2003-2004	Remarks
Kandulo	7.5	9.2	9.5	Better than average
Bailo	7	8.05	8.4	-do-
Katting	5	5.8	7	-do-
Simbo	4.3	5.4	6.1	-do-
Jhudungo	4.5	5.6	6	-do-

To create awareness through extension promotion activities demonstration and training programmes were regularly conducted by the laboratory at the demonstration centre, with the participation of farmer beneficiaries from Ganjam and Phulbani districts. Live demonstration of various post-harvest equipments such as biomass fired dryers, solar dryer, improved storage bin, different types of milling machines like cleaner cum grader, hand operated dehusking machine, motorized dehusking machine, semi automatic mini dhal mill etc along with the operational features were imparted to the farmer beneficiaries. They were also informed about the importance of various techniques on long storage of NTPs without application of chemical insecticides by adopting biocontrol measures and use of standardized premilling treatment techniques for better yield of dahl during processing of NTPs.

Use of different techniques like premilling and storage practices and use of improved equipments have encouraged the tribal and marginal farmer to take up large scale cultivation and efficient processing of these pulses. In turn this has improved the socio-economic conditions of the farmer beneficiaries.

#### CONCLUSION

The demonstration center, which has been established in a tribal populated area of Orissa, should be sustained and kept active in long run by utilizing the facilities in the centre for the benefit of the local area. An effective marketing strategy should be evolved for promoting the sale of the non-traditional pulses at reasonable rates, so that the cultivation and processing of these pulses can lead to the growth of rural industries. In this respect efforts are on RRL, Bhubaneswar to organize buyer-seller meet by involving local

co-operative societies, small and medium scale pulse traders and state govt. agencies to popularize and marketing of the non-traditional pulses all over the state, which will improve the net annual production of pulses in the state.

## REFERENCES

1. Post-harvest technology in pulse crop. B. Baldev in L. M. Jeswani and B. Baldev, *Advances in pulse Production Technology* Indian Council of Agricultural Research.
2. Department of Agriculture and Cooperation, Ministry of Agriculture, *Agricultural Statistics at A Glance*, August, 2004.
3. Project Report on Development of Improved Techniques and Equipment for Post-harvest Processing of Non-traditional Pulses. Report No. T/D & PE/388/May-2002. Submitted to (TMOP & M) Department of Agricultural and Co-operation Ministry of Agriculture, Government of India.
4. B.S. Bajaj, and A.K. Ghosh, *Antifungal Antibiotics in perspective*. In : *Advances in Mycol. Plant Pathol.*, Sagar Printers New Delhi, 279309, 1975.
5. C. H. and Fawcetta, D. M. Spencer, *Ann. Rev. Phytopathol.* **8**, 403-18, 1970.

## DO YOU KNOW ?

- Q7. How many species (life forms) disappear from earth every year ?
- Q8. What is the highest wind speed ever recorded ?

## MANAGING AGRICULTURAL PESTS THROUGH ENTOMOPATHOGENIC VIRUSES

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Entomopathogenic viruses, particularly baculoviruses (BV) have been shown to be highly effective against major pests, however their use is still limited suggesting a need to identify the factors that limit their adoption. A number of BV insecticides have been successfully developed and examining these cases closely may help identify key factors. One important factor in successful BV adoption has been where chemical control is not feasible, either because of pest resistance, residues problems or environmental considerations. BV tends to be more successful on high value crops. This is linked to the often-higher costs of producing BV. Thus, developing more cost effective production and consistent quality control remain important research goal.

### INTRODUCTION

Insect viruses have been seen as entomopathogenic agents that have considerable potential for development as biological pesticides. Active development programmes in many countries including India are underway. However their use as practical biopesticides is still only a fraction of that seen for *Bacillus thuringiensis* (Bt) products. While they can be said to have made significant progress in specific niche markets they have yet to establish a major presence. The baculoviruses (BV) like nucleopolyhedrovirus (NPV) and also some granuloviruses (GV) are the most studied of viruses. The BV have the greatest potential of some 14 groups of viruses that are known to infest insects and alone have been developed into commercial biopesticides in Europe, USA and Asia. However, we should remember that they still represent significantly less than 1 per cent of the world-wide insecticide use and probably represent only 20 per cent of the total market for microbial biopesticides. To understand the reasons both for the success of BV and their limited overall impact, it is necessary to look at the biology of these viruses and development process for biopesticides.

### BACULOVIRUSES : MODE OF ACTION

All baculoviruses are obligate pathogens killing insect by initiating systemic tissue infections. In this they contrast with entomopathogenic bacteria such as Bt whose primary mode of action is toxin mediated. BV primarily infests the larval stages, though in hymenoptera infestations it can also occur in adults. To initiate BV infestation, the viruses need to be ingested. Leaf feeding Lepidoptera, where a route of infection is apparent, do host many BVs. The tendency of many Lepidoptera to lay many eggs in clusters and complete feeding on a single plant also contributes to the ease with which infestation can spread from larva to larva. In highly mobile pests such as locusts or sucking pests like aphids the difficulty of establishing consistent transmission may help to account for the failure of BV to become evolutionarily established in this group. Also, it may be noted that among Lepidoptera that feed by boring, BVs are less common and often more difficult to utilise as control agents.

BV once ingested quickly enters the cells of the midgut epithelium to initiate a primary cycle of multiplication. The infection stage of the virus is an occlusion body (OB), also called the polyhedral occlusion body or polyhedra. In NPV, this is a

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large protein crystal upto 15 microns in size in which many (upto 200) individual infectious viral particles, or virions, are embedded. In GVs, a different morphology is seen, here there is a single virone embedded in a much smaller OB up to 0.4 microns. NPVs are clearly identifiable under a higher microscope and GV just visible. The OB is a protective structure that confers on the viron a high degree of stability that gives the GV an ability to persist in favourable environments, such as soil, for many years. In the insect midgut the alkaline soluble OB crystal protein (polyhedrin) dissolves releasing the virions to attack the host. Once the virions have initiated a primary infection in the midgut cells, the virus undergoes a cycle of multiplication in the nuclei of these cells. The progeny of this primary replication are naked virions and no OBs are produced in the midgut cells during this primary phase of infection. These progeny virions appear 12-24 hours post infection and pass through the basal lamellae of the midgut into the body of the insect to infect other tissues. In Hymenoptera, the picture is different as here infection is confined to the midgut cells and OBs are produced in these cells. The virions produced in the midgut cells pass into the haemocoel initiating widespread secondary infections in the tracheole cells, haemocytes, hypodermis, fat body, etc. In infected insects viral replication is widespread and > 90% of susceptible cells may be involved. In these secondary sites of infection there is massive production of the OB form of the virus with up to  $4 \times 10^7$  OBs per mg body weight being recorded. In an insect such as *H. armigera*, the OB production is up to  $4 \times 10^9$  OBs per larvae. The comprehensive infection of body tissues invariably results in the death of the host 5-7 days after infection. During the latter part of this cycle 4-5 days after infection the host stops feeding, infective OBs start to appear in the faeces. In the last stage of infection virally coded enzymes such as chitinases and proteases that help to digest the host tissues and skin are

often produced. The larva thus develops a fragile skin that ruptures easily releasing OBs into the host plant to infect new larvae.

## BV PRODUCTION

BV mass production is exclusively through *in vivo* replication in whole insects. BVs like all viruses need host cells to replicate in cell lines. They have been developed for a number of NPVs and GVs but are currently only suitable for small-scale production<sup>1</sup>.

Mass production in insects is conceptually simple. Larvae are grown to an appropriate size, usually on artificial diet, they are then fed diet sprayed with BV. The insects are incubated for 5-7 days on this diet to allow the BV infection to develop and OBs to multiply, they are then harvested at, or just prior to death<sup>2</sup>. The infected cadavers are subsequently macerated in water to release the NPV, then the suspension filtered to remove skin and hard body parts that could jam sprayers. The resultant suspensions can then be used directly or formulated further. Such is the efficacy of viral replication in host insects that enough virus to apply to a hectare of crop ( $0.5-2.0 \times 10^{12}$  OBs) can be produced from 200-500 infected larvae.

## FORMULATIONS AND APPLICATIONS

One of the great advantages of BV as compared to other biological control approaches is the ease with which they can be used by farmers. They are sprayed and applied in the same way and using the same equipment as existing chemical pesticides. They can be used as direct replacements for chemical pesticides though they work better if incorporated into a properly developed IPM system. The OB of BV is an inherently stable particle that can be formulated easily and retain infectivity for a long time without any special formulation. BV can be formulated as simple aqueous suspension, wettable powder and oil formulations.

## SPECIFICITY AND SAFETY

An important characteristic of the baculoviruses is their high degree of host specificity. BVs, as a genus, only infect insects and a few other arthropods. Most of the 370 recognized NPV species infect only a few closely related host species at most. This specificity confers the important property of making them safe for man, domestic animals, non host insects and plants but this also limits the spectrum of target pests. Research has shown that the chances that BV, even mutated BV, being able to replicate in a plant or vertebrate is effectively zero. BVs do not attack or replicate in the insect predators or parasitoids that are important in the natural control of many pest species<sup>3</sup>.

## PERSISTENCE

The persistence of NPV on the crop once applied has been the subject of some research. It is a drawback of NPVs that their persistence can be reduced by two major factors—ultra violet light and plant surface chemistry. The UV in sunlight, especially high intensity tropical sunlight, is a potent inactivator of viral DNA. Work on the *S. littoralis* NPV showed rapid deactivating effect of sunlight on unshaded NPV. Although a range of UV protectants was tested, none was superior to a simple unpurified suspension of insect derived NPV. Since then more effective chemical UV protectants have appeared but their very cost makes their inclusion in NPV formulations currently uneconomical.

However, the limiting effects of UV inactivation should not be overestimated. If the BV is infectious enough, then even BV with short persistence can produce acceptable results. One should also remember that short persistence time also

characterize many chemicals and other biopesticides like Bt. Plant chemistry can also have a significant impact on BV efficacy.

## CURRENT USE OF BIOPESTICIDES

Currently BV use is largely restricted to niche markets, where resistance and or residue problems make chemicals ineffective or unacceptable. In Thailand, uptake has primarily been on vegetables and fruit crops, often for export, where both factors operate. The drive to reduce chemical residues on crops for export to developed countries may indeed create major new opportunities for BV products<sup>4</sup>. This will undoubtedly be further increased as older chemical pesticides are banned for use on these export crops by importers responding to public pressure.

The future scale of BV use will be effected by many factors, including competition from new, safer chemicals, however then banning of old chemicals and more stringent residue regulations will create significant new opportunities. In addition, the introduction of insect resistant GM crops may open new sectors either as supplementary sprays for controlling secondary pests or for treating refugia of non-GM crops.

## REFERENCES

1. B.C. Black, L. A. Brennan, P. M. Dierks, and L. E. Gard. The Baculoviruses. Plenum, New York, 1997.
2. A. T. Cherry, M. Parnell, D. Grzywacz, and K. A. Jone, *Invertebrate Path* **70**. 50-58, 1997.
3. D. Grzywacz, D. Mckinley, K. A. Jones, G. J. Moawad, *Invertebrate Path*. **69**. 151-156, 1997.
4. F. Moscardi, *Ann Ento*. **44**, 257-289, 1999.

## ***SOMETHING TO THINK ABOUT***

### **THE IMPORTANCE OF SELF-ESTEEM**

H. S. Roy

Nearly a quarter century ago, a psychological experiment reported in the media had caused wide spread interest in educational institutions. Two psychologists had subjected students of a particular class and separated them into two groups, A and B both of which received identical instruction in identical surrounding but separately. The researchers claimed that their tests had indicated that students in Group A were potentially high achievers. Subsequently, when actual result indicated that Group A did indicate significantly better academic grades, school authorities wanted to know how the psychologists correctly predicted this. The latter then revealed that their test was a sham and the students were actually segregated at random. The results, therefore, indicated that Group A did better because the students in this group were expected to do better and their self esteem was boosted so that they made more sincere efforts.

It has been long believed that it is better to subject children to positive feedbacks in school and avoid negative remarks. Rewards, recognitions or even simple appreciation boost their sense of self-worth which leads to enhance quality and quantity in output. On the other hand, punishments and criticisms demotivate children and their grades worsen.

Those with a high level of self-esteem are supposed to be more civilised in manner and behaviour. The Nawabi culture of Lucknow took this to an extreme, the nobles trying to out do each

other in courtesy, politeness and generosity. Those who were lower do in the scale of nobility or even the common folk in the street emulated this.

Conversely, neighbourhood bullies and antisocials have been long thought to be of low self-esteem, their aggressive behavior being an attempt to compensate for the inferiority complex. Sexual offenders, habitual drunkards, the soccer hooligan and criminals may also be in the same category.

Assuming that self-esteem was important for psychological health and a prerequisite for better social order, serious attempts were made in the U. S. at one time to initiate social programmes for raising self-esteem in young people to reduce crime, teenage pregnancy, drug abuse, school drop-outs and general under achievement. It had almost become a national preoccupation.

Some recent findings (see Scientific American, January 2005, p. 84), however, have now challenged several of the commonly held notions. There are two central problems which need to be discussed first.

There may be an error in establishing a cause and effect relationship. It is possible that better academic performance does not arise out of high self-esteem. It may be the other way around which should imply that there are other factors underlying better academic performance. At best they may go parallel. If lack of opportunities for normal sexual behaviour was the cause for persons becoming sexual offenders or gay then all celebrity actors,

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sportspersons and millionaires would go straight. There are, however far too many exceptions.

The article published in the journal goes on to say that bullies and sex-offenders do not necessarily suffer from inferiority complex. Though it is generally accepted that high self-esteem helps individuals to initiate new relationships more easily and make them generally more happy, it does not always boost performance in any field. In fact artificially boosting self-esteem may actually lower academic performance and bring in undesirable behaviour. This is seen in many of our present day leaders who think very highly of themselves, perhaps very sincerely.

People enjoying high self-esteem are often prejudiced and they may carry poor opinion about others who are gentle and self effactive. Aggressive people have inflated opinion about themselves and think of the gentle folk as worthless.

The second problem in this area concerns the method of measurement of self-esteem which is necessarily based on some kind of self report procedure. Some more objective, procedures have been developed keeping in mind the dilemma of causality and a problem remains. The opinion of individuals regarding how they are perceived by others is not corroborated by opinions of room-mates and friends. Self-esteem and looks are also perhaps not related because results based on guesses by others who are shown photographs yield no

correlation. In cases whether some positive correlation that do show up it may be merely because those with higher self esteem may have taken special care to groom themselves for the photographs. In that count, Einstein could be perceived as one with low self-esteem!

Tests on some 23000 students in U. S. school showed that self-esteem in 10th grade students was weakly predictive of academic achievement in the 12th grade, but the latter correlated very well with the performance in the 10th grade.

High esteem may actually be a problem for an individual in a society or even in family life e.g. a high ego can be threat to marriage. Attempts to boost self-esteem in school students may backfire and grades can tumble.

Around the world, persons' overall satisfaction with life tends to go hand in hand with level of self-esteem and financial satisfaction. Occupational, academic or interpersonal successes perhaps cause both happiness and self-esteem and the latter may be a helpful attribute in persistence in the face of failure. The society, however, would suffer if individuals of high self-esteem are taken as role models because they may be for preferential treatment.

Those who feel exploited and aggrieved may rise by sincere efforts alone. Remember the words of Jesus, "Blessed are the meak for they will inherit the kingdom of heaven".



## ***SHORT COMMUNICATION***

### **WHY IS THERE NO CAMEL GOD ?**

D. Balasubramanian\*

One of the pithiest proverbs that I know of is “Beauty is in the eyes of the beholder”. Alas, how true, not only with humans but also with animals and other forms of life. The majestic tiger and the leaping jaguar are symbols of grace and elegance but you would rather enjoy them from a distance. The ass and the camel, long derided for their looks, do more for man than these princes of the forest. Indeed, I suspect there is no animal that is more misunderstood or maligned than the camel all because it looks so ugly. The apocryphal story is that while creating animal after animal, the Lord God took a short rest and since work still had to go on, he asked a committee of lesser Gods to keep going with the work. The committee met and discussed the issue threadbare and, as happens with most other committees, decided to satisfy the whims of every member. The resultant product was the camel.

Then there is another version by Rudyard Kipling in his *Just So Stories* on how the camel got its hump. While every other animal rallied around to help man, the camel was supposed to have idled away in the desert with a supercilious air about him ; whenever the other animals went to invite him to join them, all he would do was to dismiss them with a snort that sounded suspiciously like “Humph”! When everyone complained about this to the Great Spirit, the Great Spirit put a great lump of fat on the back of the camel as

a punishment and that is how it got the hump (we call it a hump so as to be polite, says Kipling!).

In a more serious vein, beauty is indeed skin deep because there is no better example in the living world of an animal adapting to the environment as exquisitely as the camel. Look at its habitat—hot, dry, waterless deserts. The ground is not firm because of the desert sand and also very hot in the afternoon sun. The temperatures in the desert can rise to as high as 51°C, as it often happens in Libya and the Northern Sahara. No other animal can brave it as well as the camel. Look at its walking style. It uses the entire foot while walking and its hooves are covered with a thick sole that helps it move on hot and moving sands. It can cover 100 km a day quite easily and can even gallop at a speed of 15 kmph if needed. The thick sole, the size of an *uthappam* or a pizza and often as thick as  $\frac{1}{4}$  th of an inch, effectively insulates the heat from under the camel’s foot. Its walking stance and gait is best suited for these inhospitable terrains.

Water is a very precious commodity not to be found for miles on end in the deserts. While other animals such as the desert lizard, the desert rat and so on beat the heat and save water by being nocturnal or burrowing themselves in the shade, our friend the camel does not. Contrary to the popular notion, it does not have a satchel or a bag where it stores water. Instead, it distributes water all over its body tissues in an even and democratic fashion. It excretes very little water from its body

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when the conditions are harsh; and controls the amount of urine it passes per day. On a particularly arid day the camel may excrete no more than half-a-litre, which is ten times less than when it has access to water. Again, its dung is far drier than that of other animals particularly cattle and livestock.

Another interesting thing about the camel that people in deserts have noticed is how slow it breathes. Its breathing rhythm is almost half as that of man—for a good purpose too because every time you breathe, you breathe in dry air in the desert but when you breathe out you lose a lot of body water ; so it makes sense to control the breathing rhythm the way the camel does.

Also it perspires very little, which is yet another strategy to conserve water in its body. All this is well when the going is tough—that is when the tough get going. But when it gets to an oasis where there is a por of water the camel plunges into action. In one long gulp it can drink as much as 50 litres of water—a full three buckets which no doubt add to its body weight, making it even more languorous that it normally is.

What is in the hump ? Pure and simple fat. And here again, there is fundamental difference between camels and us. The camel seems to know more thermochemistry and energetics of oxidation than we humans do. When we humans store energy in our body we do it in the form of glycogen which is a carbohydrate, largely made up of glucose as the building block. When we go on a weight-reducing or a slimming diet we burn or oxidize glycogen. It is estimated that for each gram of glucose ( $C_6H_{12}O_6$ ) burnt we get about 4,000 calories of energy. On the other hand, the fuel that the camel stores is fat, which is made of hydrocarbons. When one gram of hydrocarbon ( $C_6H_{12}$ ) is burnt, we get almost 10,000 calories. Thus, gram for gram, it is better to store fat than carbohydrates if you want a better supply of fuel for the body.

There are other advantages too. Unlike glycogen or carbohydrates, fats do not like water. They are hydrophobic. Thus, they can be packed tighter than carbohydrates which are wet and fluffier. Fats are also lighter since their specific gravity is less than that of carbohydrates. The camel exploits all these in one shot. It has chosen the fuel which can be packed drier, lighter and tighter and more potent gram for gram, and packs it neatly in the hump. This is why it can go on for as long as five or six days without any feeding. All it has to do is to commandeer the fat reserves, oxidize them to get energy and simply melt off the hump during such food-ration days.

In comparison, look at what happens in slimming clinics. When on a stavation diet, the dieter loses as much as 5 or 8 kg during the first week but much of it is water that is lost when the glycogen is used as fuel. After the glycogen is burnt off, the body calls on the fat stored in the adipose tissue and the weight now lost is far less than in the first week. The dieter loses interest or questions the integrity of the slimming clinic. All because fat packs more energy per gram, and is drier than sugars.

Even the colour of the camel is adapted for the desert. Unlike cattle which come in a variety of colours the camel comes essentially in one colour, aptly called the camel colour, shades of brown or that of coffee with milk, ideal for the desert sun. Had it been black, it would have absorbed much more of the heat and light. The buffalo is black and suffers, hence its great attraction for ponds and marshes where it immerses itself to cool off.

As if all this is not enough, the camel even plays around with its own body temperature during the course of the day. Unlike us homeostatic animals, who keep a constant body temperature of  $37^{\circ}C$  day in and day out, the camel takes some liberties. When the day time heat is blazing the camel increases its body temperature to as much as  $41^{\circ}$  or  $42^{\circ}C$ , temperatures at which we would be in

delirium. The apparent reason for that is simple—the smaller the temperature difference between the body and the surrounding air, the less is the water lost by way of sweating and so on. And when the night temperature goes down to 23°C or even lower, the camel reduces its body temperature to as low as 35°C.

Now comes a further, interesting special feature of the camel. Dr R Hamers and associates, of Vrije University at Brussels, Belgium, have found that the immune mechanism with which the camel fights off invaders is somewhat different from those of other animals. All of us generate antibody molecules in our cells called immunoglobulins. These are elicited specifically against invading micro-organisms, viruses and antigens so as to neutralize and get rid of these from our system. Our antibody molecules consist of two small chains and two large chains bound together in the form of a Y. The small chains are thought to be responsible for recognising the foreign body and to provide variability and versatility to our immunoglobulin molecules to cope with a variety of antigens. Hamers and associates find that the camel lacks the light chains, and yet they are just as functional as our antibody molecules are. Their heavy chains are able to bind antigens and mount an immune response in just the same way as our light chain-heavy chain combine does.

This is not just a trivial aside, but raises the possibility that one can now produce human

antibodies that are functional. Genetic engineering methods can now hopefully make do with just producing the heavy chains, do away with the light chains and yet be of therapeutic use, because if they can work for the camels, why not see if they work for us ?

There is yet another way in which camel seems to have helped us. This information comes to us from Dr D D Kosambi's beautiful, short book entitled *Ancient Indian History : Its Culture and Civilization*. This famous mathematician-Indologist claims that the camel might help us date the Rigveda. He writes that the Rigvedic Sage Vasa Asvya thanks the Dasa kings Balbhuta and Taruksha and blesses them with various gifts including a hundred camels. Noting that the camel was not domesticated until at least 1200 BC, Kosambi wonders whether this incident might not offer a clue to dating the *Rigveda*.

Surely, with all these attributes, the camel deserves far more respect from us than it has received so far. Should one not confer on it the title "body beautiful" or at least "body handsome" since if beauty were skin deep, shouldn't handsome be what handsome does too? In our culture, many other animals such as the mouse, the lion and the buffalo have been chosen by gods as their Vahanas (Vehicles). So many animals are deified including the goat, the wild bore and even the turtle, but as yet there is no Camel God. What an injustice—little wonder that Kipling's camel grunted "Humph"!

## KNOW THY INSTITUTIONS

### NATIONAL REMOTE SENSING AGENCY, BALANAGAR, HYDERABAD

The National Remote Sensing Agency (NRSA), an autonomous organisation under the Department of Space, India, ranks among the premier organisations in the world in operationalising remote sensing technology for use at the grassroot level.

Established in 1974, NRSA has crossed several milestones in 3 decades of its service to the nation in carving a niche in the area of resource mapping and building up a vibrant remote sensing programme. Its recent achievement has been acquiring the ISO 9001:2000 certification.

With dedicated facilities and a human resource base of about 950 employees, NRSA is in the forefront of civilian remote sensing applications both in India and abroad. NRSA is distributed between Balanagar, Hyderabad (data archival, processing, analysis and dissemination, training facility), Hyderabad airport (housing the 2 aircraft of NRSA), Shadnagar (earth station-data reception facility) and Dehradun (Indian Institute of Remote Sensing-NRSA's training facility).

#### Remote Sensing Services

The data received from various satellites at earth station is archived, processed and analysed. The value-added product is then supplied to users on demand. Several national and regional level projects and studies are also carried out.

Establishing satellite ground stations for reception of data from the Indian Remote Sensing (IRS) satellites is another of NRSA's area of focus, in order to meet national and international requirements. While its own earth station has been upgraded with an indigenous 7.5 m antenna for data reception, another 15 ground stations and a

mobile station have been made operational all over the globe.

The last two years have been eventful for NRSA. The two satellites launched recently have been beaming down valuable data. This data has immense potential in the areas of natural resources mapping as well as in high-resolution cartography applications.

#### What is Remote Sensing ?

The complex remote sensing technology can be understood with this simple analogy. When we look at the world through our eyes, we don't actually come into contact with it, our eyes record the shape, size and color of an object and pass on the information to the brain. Based on information already available with it, the brain then recognizes the object. Here what we are actually doing is 'sensing' things 'remotely' from a distance. Our eyes are the 'sensors' that record information to pass in on to the brain.

Similar is the technology of remote sensing—obtaining information about a body without actually coming into contact with it. So we can think in this way that our body is a 'satellite', which moves and collect information through our eyes that are the 'sensors'.

Just as our eyes need objects to be illuminated by light so that we can see them, sensors also need a source of 'light' to illuminate the Earth's surface. Different forms of light or electromagnetic energy are utilized for this purpose. Whenever light falls on an object, part of it is absorbed, part of it is allowed to pass through and the remaining is either reflected or scattered. The light that is reflected back to us gives us information about the object. Similarly, a sensor on a satellite collects

information that is reflected from an object on the Earth. Each object gives a unique reflection, so different objects on the earth like trees, houses, water bodies, mountains etc. can be identified based on this unique spectral signature.

The satellites are capable of mapping objects on the earth like the cities, as well as dynamic processes such as vegetation changes and river course changes, disasters like floods/cyclone, volcanoes and forest fires.

Once a satellite is launched and placed in its orbit, its sensor starts taking picture of the Earth and continuously provides output data. This data is transmitted by the satellite and is received at the ground station. The information or data received this way is in a 'raw' form and needs to go through several levels of processing before we can understand it and derive useful information out of it.

The whole process of ordering data has been made user-friendly, with all the functionalities being made available on NRSA's website for easy browsing of data by the users. The distribution of data products to users has increased in value by 40% when compared to last year.

The aerial services have covered Dubai and mapped the distributed islands of Maldives. Value-added data has been made available to Indian users for applications like town planning and municipal GIS. The sophisticated Airborne Laser Terrain Mapping-Digital Camera (ALTM-DC) system has been established. This can give elevation information to an accuracy of less than a meter, which is useful for various engineering applications and 3D modeling.

### **Applications of Remote Sensing**

In a country like India with diversity in geography and population, it is essential to put satellite data to effective use and ensure that the advantages percolate to the grassroot levels for overall development. Demonstration of operational

Remote Sensing Application Projects through development of methodologies and conducting national as well as regional-level projects in various resource sectors in close collaboration with the user agencies is one of the major goals of NRSA. Management of natural resources, developmental planning, environmental monitoring and disaster management are some of the key areas of concern, besides a host of applications that are being carried out in order to optimally utilize the potential of satellite data. Specific application projects are undertaken based on user requirement.

Operational projects are being carried out in diverse areas such as crop acreage and production estimation, soil mapping, wasteland mapping of India, urban studies, land degradation studies, geological surveys, environment impact assessment studies, snow melt runoff forecast, irrigation command monitoring, mineral targeting, geological surveys, watershed development and planning, forest resources assessment, biodiversity characterisation, potential fishing zone mapping (operational technology transferred to INCOIS), Integrated Mission for Sustainable Development (locale-specific land and water resources development action plans, covering 25% of India), IGBP and several others.

The drinking water potential zone mapping has already covered 8 states of the country. With the help of the ground water maps that were provided, over 67,000 wells were dug, registering a success rate 90%.

### **Decision Support for Disaster Management**

A Decision Support Centre for Disaster Management has been established at NRSA, covering disasters such as drought (drought bulletins for 14 states or district-level and detailed assessment for A.P. and Karnataka), flood/cyclone (covering all major river basins of India annually, reaching inundation information and damage assessment to users in fast track for rescue and relief), landslide hazard zonation (for Uttaranchal

and HP areas), forest fires, earthquakes, etc. NRSA has extensively covered the tsunami of December 26th, 2004, and assessed the damage and also carried out risk analysis.

### **Training**

A dedicated centre, Indian Institute of Remote Sensing (IIRS) at Dehradun takes care of the long and short-term training requirements in remote sensing/GIS/Geoinformatics/allied areas for Indian/foreign participants. Tailor-made courses are available for decision-makers. Over 5000 participants have been trained since inception. IIRS also supports UN-affiliated Centre for Space Science & Technology Education in Asia & Pacific (CSSTEAP).

### **Technology Development**

Technology development a NRSA is mainly for impor substitution R & D and development of technology for in-house applications, entrepreneur development programme constitute an important

element. As of now, 32 technologies developed by NRSA have been transferred to industries for commercial production/sale.

### **Linkage with Academics**

NRSA upports ISRO's RESPOND project with academic institutions, where universities are provided with assistance to carry out research activities in the areas aligned to the activities of the Department of Space. NRSA is also recognized by Indian universities for carrying out research. Regular interaction is done with schools/colleges for promotion of remote sensing.

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## Conferences/Meetings/Symposia/Seminars

Date	Topic	Contact
4-5 November 2006	10th Orissa Bigyan Congress on "Planet Earth, Bhubaneswar	<b>Dr. S. N. Patra</b> ISCA Bhubaneswar Chapter, ND-4, VIP Area IRC Village Bhubaneswar 751015 Email : iscabc@rediffmail.com
13-14 November 2006	Workshop on <b>Ayurvedic Medicines and Practices,</b> Ahmedabad	<b>Dr. Rajani</b> B V Patel PERD Centre Thaltej-Gandhinagar Highway Ahmedabad 380 054 Email : perd@perdcentre.com
25-27 November 2006	International Conference on <b>Natural Hazards and Disasters : Local to Global Perspectives,</b> Anantapur	<b>Dr. Ravindra Reddy</b> Department of Geography Sri Krishnadevaraya University Anantapur, Andhra Pradesh 515003 Email : ravikadati_@yahoo.co.in
8-11 January 2007	Emerging Trends in <b>Free Radical and Antioxidant Research,</b> Lonavala	<b>Dr. S. Adhikari</b> Radiation & Photochemistry Division, Chemistry Group Bhabha Atomic Research Centre Mumbai 400 085 Email : info@sfr-india.org
6-16 February 2007	Instructional Workshop & International Conference on <b>Social Network Analysis :</b> <b>Theory, Methods &amp; Applications,</b> Kolkata	<b>Dr. Arun K. Chatterjee</b> Sociological Research Unit Indian Statistical Institute 203, B. T. Road, Kolkata - 700 108

## S & T ACROSS THE WORLD

### IDENTIFYING MICROBES

Scientists at the US Department of Energy's Brookhaven National Laboratory have developed a new method for identifying different species of microorganisms living in an unknown "microbial community."

The method has many applications ranging from assessing the microbes present in environmental samples and identifying species useful for cleaning up contamination, to identifying pathogens and distinguishing harmless bacteria from potential bioterror weapons.

The technique which is called "single point genome signature tagging" uses enzymes that recognize specific sequences in the genetic code. These enzymes chop the microbial genomes into small segments that contain identifier genes common to all microbial species, plus enough genetic information to tell the microbes apart. As growing cultures of microbes to identify species is slow and error prone, scientists have been searching for a way to identify key segments in the genetic code that are short enough to be sequenced rapidly and they hit upon this method.

([www.bnl.gov](http://www.bnl.gov), Mar 8, 2006)

### ANTI-MALARIA DRUG DEVELOPS RESISTANCE

Malaria which used to decimate entire population in the tropics, largely came to be controlled in the 1950's with the use of chloroquine till people began to develop resistance to it. It was replaced by artemisinin, which had been developed from a chinese herb and for the last few decades it has been widely in use. Studies now indicate that it might meet the same fate as chloroquine, unless its use is strictly regulated.

Scientists from the Pasteur Institute took blood samples from hundreds of patients in South-East Asia, and treated the samples containing the parasite *Plasmodium falciparum* to a variety of anti malaria drugs, including artemisinin. The results were then compared with a similar exercise carried out in respect of malaria patients in French Guiana. It was found that the patients of French Guiana, where the use of artemisinin was not regulated, had developed resistance to the drug unlike those in Cambodia and other South-eastern countries where there was no resistance to the treatment, because the use of the drug was regulated.

These findings underscore a warning by WHO on the need for extreme all round vigilance while prescribing artemisinin-based drugs and for its use to be carefully regulated.

(PTI Science Service, Dec. 16-31, 2005)

### ARTEMIS TECHNOLOGY

Many objects today have computers or microprocessors embedded in them that cannot be modified by the consumer. For instance, in the automobile industry embedded systems operate in the car engine to improve efficiency, operate satellite navigation, air conditioning etc. A whole industry has grown around these embedded systems and now the Advanced Research and Technology for Embedded Intelligence and Systems (ARTEMIS) provides a platform which brings together the major companies in this industry.

There are believed to be more objects containing embedded systems than there are human beings on the earth and by 2020 the capability exists for such embedded systems to occupy much of our natural environment and react to our preferences automatically. To make this a reality the gulf between architecture and physics will have to be bridged speedily and while ARTEMIS is seeking



to do this from the software side, the nano-technology platform ENIAC is trying to do the same thing from the nano-architecture side.

The embedded systems industry is growing at the rate of 10% annually, and ARTEMIS which is a public-private partnership that is open for any organisation to join has ambitious plans for the future.

*(CORDIS Tech. Marketplace, March 8, 2006)*

### IMPROVED WHEAT STRAINS

Australian scientists are developing strains of wheat that contain a higher proportion of amylose, a particular form of resistant starch for incorporation into breads, cereals, and other foods to meet the deficiency caused by the excessive intake of processed and refined food by a majority of Australians.

Nowadays one of the most serious health issues in the developed world is the rise of diet-related

non-infectious diseases, such as cardiac heart disease, obesity, diabetes, and colorectal cancers. The resistant starch which contains high levels of amylose, is not digested in the small intestine and passes into the colon where it is broken down by the resident bacteria, releasing short chains of fatty acids which is believed to promote bowel health and reduce the risk of colon cancer.

The inclusion of additional fibre in breads is now a routine practice, but scientists say that the benefit of using high amylose wheat in products, such as bread, avoids the need to add supplementary fibre.

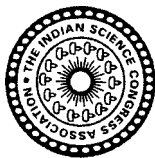
Trials on animals have shown that wheat with high amylose levels had significant health benefits, owing to the presence of short chain fatty acids in their bowels.

In this connection, gene technology has proved particularly useful in pinpointing the genetic changes in wheat that are required to create this new type of wheat.

*(National Academy of Sciences, Feb 27, 2006)*

### ANSWERS TO "DO YOU KNOW?"

- A1. In water—Four and half times faster.
- A2. In water.
- A3. No, A kiwi is about the same size as a normal hen but its eggs are eight times bigger.
- A4. Three.
- A5. The little boy.
- A6. Extra fold increase in the surface helps to dissipate massive amounts of heat produced by thinking.
- A7. Some 27 species everyday ie 9720 or 10,000 every year.
- A8. 318 miles/hour, Oklahoma, USA, 1999.



## भारतीय विज्ञान कांग्रेस संस्था

14, ड० विरेश गुहा स्ट्रीट, कोलकाता 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresb Guha Street, Kolkata-700 017, INDIA

Telegram : SCICONG : CALCUTTA  
Telephone : 2247-4530, 2281-5323  
Website : <http://sciencecongress.org>  
<http://sciencecongress.nic.in>

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E-mail : [iscacal@vsnl.net](mailto:iscacal@vsnl.net)  
[iscacal\\_2004@yahoo.com](mailto:iscacal_2004@yahoo.com)

### Terms of Membership and Privileges of Members :

Membership of the Association is open to persons with *Graduate or equivalent academic qualification* and interested in the advancement of science in India.

1. **Member** : A person willing to be enrolled as new Member has to pay an annual subscription of Rs. 200/- along with an admission fee of Rs. 50/-\* (for foreign U.S. \$70) only. The annual subscription of a Member shall become due on the 1st April of each year. Anyone who fails to pay the subscription on or before the 15th July in any year shall lose the right of voting and / or holding any office of the Association for that year. A Member failing to pay the annual subscription by the end of March of the following year shall cease to be a Member.

Members may contribute papers for presentation at the Science Congress. They will receive, free of cost, reprint of the Proceedings to Session of any one section of their interest and also the bi-monthly journal of the Association "Everyman's Science".

2. **Sessional Member** : Sessional members are those who join the Association for the Session only. They may contribute papers for presentation at the Science Congress and receive, free of cost, reprints of the Proceedings of the session of any one section of their interest. A Sessional Member has to pay a subscription of Rs. 250/- (for foreign U.S. \$60) only.
3. **Student Member** : A person studying at the undergraduate / post graduate level may be enrolled as a Student Member, provided his / her application is duly certified by the Principal / Head of the Institution / Department. He / She may contribute papers for presentation at the Science Congress, provided such papers are communicated through members of the Association. The subscription for student Membership is Rs. 100/- (for foreign U.S. \$50 only).
4. **Life Member** : A Member may compound all future annual subscriptions by paying a single sum of Rs. 2000/- (for foreign U.S. \$ 500) only. Any person who has been continuously a member for 10 years or more, shall be allowed a reduction in the compounding fee of Rs. 50/- for every year of such membership, provided that the compounding fee shall not be less than Rs. 1,200/- (for foreign U.S. \$ 12.50 and U.S \$ 300 respectively). A Life Member shall have all the privileges of a member during his/her lifetime.

\*Admission fee of Rs. 50/- is needed only for becoming a new annual member and not for sessional member / life member / Institutional member / student member / donor.

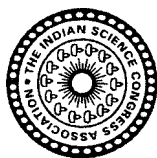
5. **Institutional Member** : An Institution paying a subscription of Rs. 5,000/- (for foreign U.S. \$ 2,500) only, can become an Institutional Member of the Association. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy of the Association's journal "Everyman's Science".
6. **Donor** : Any person paying a lump sum of Rs. 10,000/- (for foreign U.S. \$5000) only, can become a Donor of the Association. An **INDIVIDUAL DONOR** shall have all the rights and privileges of a member during his/her lifetime. An Institution paying a lump of Rs. 50,000/- (for foreign U.S. \$25,000) only, can become **INSTITUTIONAL DONOR** of the Association, which shall have the right to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional / Individual Donor shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress as also the Association's journal "Everyman's Science".

- 
- A) **Presentation of Papers** : A copy of complete paper accompanied by an abstract in triplicate not exceeding one hundred words and not containing any diagram or formula, must reach the Sectional President General Secretary (Hqrs) Latest by *September 15*, each year.
- B) Members of all categories are entitled to railway Concession of return ticket by the same route with such conditions as may be laid down by the Railway Board for travel to attend the Science Congress Session provided that their travelling expenses are not borne, even partly, by the Government (Central or State), Statutory Authority or an University or a City Corporation.
- C) Members of all categories are entitled to reading facilities between 10.00 a.m. to 5.30 p.m. on all weekdays (except Saturdays & Sundays) in the library of the Association.
- D) Members of all categories may use Guest House facilities, Lecture Hall hiring at the rates fixed by the Association from time to time.

Note : All Money Orders, Bank Drafts etc. should be drawn in favour of "*Treasurer, The Indian Science Congress Association*". Members are requested to mention their Card No. while making any correspondence to ISCA office.

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\* (A Foreign Member means one who is normally resident outside India.)



## भारतीय विज्ञान कांग्रेस संस्था

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[iscacal\\_2004@yahoo.com](mailto:iscacal_2004@yahoo.com)

<http://sciencecongress.nic.in>

### APPLICATION FORM FOR MEMBERSHIP

To

The General Secretary

The Indian Science Congress Association

14, Dr. Biresh Guha Street,

Kolkata-700 017

Stamp  
Size  
Photograph

Dear Sir,

I like to be enrolled as a Member / Life Member / Donor / Sessional Member / Student Member / of The Indian Science Congress Association.

I am sending herewith an amount of Rs. .... in payment of my subscription by Bank Draft / Money Order / Cash for Membership / Life Membership Subscription / from the year 1st April 200 ..... to 31st March 200 .....

I am interested in the following section (Please tick any one).

#### SECTIONS

- |                                                                                                           |                                                                                             |
|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 1. Agriculture and Forestry Sciences                                                                      | 8. Information and Communication Science & Technology (including Computer Sciences)         |
| 2. Animal, Veterinary and Fishery Sciences                                                                | 9. Materials Science.                                                                       |
| 3. Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences) | 10. Mathematical Sciences (including Statistics)                                            |
| 4. Chemical Sciences                                                                                      | 11. Medical Sciences (including Physiology)                                                 |
| 5. Earth System Sciences                                                                                  | 12. New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology) |
| 6. Engineering Sciences                                                                                   | 13. Physical Sciences                                                                       |
| 7. Environmental Sciences                                                                                 | 14. Plant Sciences                                                                          |

(Please type or fillup in Block Letters)

Name (in block letters) :

SURNAME

FIRST NAME

MIDDLE NAME

Academic Qualifications :  
(Evidence to be submitted)

Designation :

Address for Communication :  
(including State, City/Town and Pin code)

Phone No. & e-mail

Permanent Address :

Yours faithfully

Date :

Signature

- 
- *As per resolution of Executive Committee in its meeting held on October 10, 2004 application for membership of ISCA in 'Care of' of some other person is generally discouraged. However, if in the application form "care of" address is given then there should be also signature of the person in whose name "care of" is given.*
  - *Admission fee of Rs. 50/- is needed only for becoming a new annual member and not for sessional member / life member / Institutional member / student member / donor.*

IF A RAILWAY CONCESSION CERTIFICATE IS REQUIRED BY THE MEMBER  
THIS LETTER MUST BE SENT TO THE GENERAL SECRETARY  
(HEAD-QUARTERS) OF THE ASSOCIATION. THIS IS IN ACCORDANCE WITH  
PROCEDURE AS LAID DOWN BY THE RAILWAY BOARD

From : (Name in full

(in block letters) .....

Address .....

.....

Dated .....

To

The General Secretary (Headquarters),  
The Indian Science Congress Association,  
14, Dr. Biresh Guha Street, Kolkata – 700 017.

Dear Sir,

As I propose to attend the 94th Session of the Indian Science Congress to be held at Annamalai University, Annammalainagar, from January 3 to 7, 2007, I would request you to issue a certificate to me so that I can avail myself of the railway concession of return ticket on payment of such fare as may be decided by the Railway Board for my journey from ..... to Chennai.

\*(i) I am a servant of the Central/State Government/Local Body or a Statutory Authority.

\*(ii) I am not a servant of the Central/State Government/Local Body or a Statutory

Authority.

\*(iii) My travelling expenses will not be borne by the Central/State Government/Local Body or a Statutory Authority.

I also certify that my total earning/emoluments do not exceed Rs. 5,000/- per month.

ISCA Membership No. ....

Signature .....

---

\*The item not applicable must be struck out by the applicant, or else the concession certificate cannot be issued.

*N. B.* Government servant etc., whose travelling expenses are borne by the Central/State Government or a Local Body like a City Corporation or Municipality or a Statutory Authority like a University, etc. either wholly or even partly, are not entitled to the Railway concession, and it is one's own responsibility not to claim this concession.

Consequently, no concession certificate can be issued to a person if he/she strikes out item (iii) above i.e. if his/her travelling expenses are borne, wholly or partly, by Central or State Government, a University or any other Statutory Authority or a Local Body.

In brief, for a person claiming entitlement to the concession, item (iii) and either item (i) or item (ii) must be applicable besides the clause relating to the income ceiling.

# THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata-700 017

INSTRUCTION TO AUTHORS FOR PAPER PRESENTATION AT THE 94TH INDIAN SCIENCE CONGRESS TO BE HELD AT ANNAMALAI DURING JANUARY 3 TO 7, 2007.

## A. PAPER PRESENTATION (ORAL/POSTER)

1. All papers to be submitted for presentation at the 94th Science Congress must be sent to the **Concerned Sectional Presidents**. Each paper must be accompanied by *three copies* of abstracts (within 100 words, without any sketches, tables, etc.) and a copy of the full paper. The name of the Section where the paper is to be presented should be indicated. The model format for abstract is given below. The addresses of Sectional Presidents are given in the website : <http://www.sciencecongress.nic.in>
2. Each author is entitled to submit only two papers.
3. All authors must be **members** of ISCA. Corresponding author must give a declaration that authors/co-authors are members of ISCA.
4. Papers should reach on or before **September 15, 2006**. The abstracts of these papers if approved will be printed in Part II of the Proceedings of the 94<sup>th</sup> Indian Science Congress. Papers (along with abstracts) received after **September 15, 2006** will not be considered.
5. Contributed papers would be presented primarily by way of posters. Authors of the accepted papers will be advised by the concerned Sectional Presidents about preparation of posters. Size of each poster should be **1 meter × 1 meter** and should be neatly prepared which can be read from a distance of 3 feet.
6. To encourage scientists, the Indian Science Congress Association has introduced a number of prizes for **Best Poster** presentation in January, 1999. A maximum of **Two** prizes of Rs. 5000/- in cash along with a certificate will be awarded to the best presentations in each Section during the valedictory function of the 94th Indian Science Congress.

## MODEL FORMAT FOR ABSTRACT

NAME OF THE SECTION

TITLE OF THE PAPER

AUTHOR'S NAME (S)

&

AFFILIATION

KEY WORDS :

ABSTRACT

For details please contact :

General Secretary (Headquarters), The Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700 017. Phone : 033-2247 4530, Fax No. ; 0091-2240 2551, E-mail : [iscacal@vsnl.net](mailto:iscacal@vsnl.net) / [iscacal\\_2004@yahoo.com](mailto:iscacal_2004@yahoo.com) Website : <http://sciencecongress.nic.in>

## **PLANET EARTH**

**94<sup>th</sup> Indian Science Congress, 3<sup>rd</sup> to 7<sup>th</sup> January 2007**

**Annamalai University, Chidambaram, Tamil Nadu**

The Earth, our home planet, is unique. It has provided an environment for the evolution of life and natural resources for its sustenance. A planet similar to the Earth in the Universe has not been found. Human beings have been exploring the Earth's evolution since the time immemorial to understand the processes responsible for the generation of her resources, particularly hydrocarbons, minerals, etc. The everincreasing demand of energy, mineral resources and safe drinking water for the burgeoning population is of great concern due to finiteness of natural resources. The forecast of Indian Monsoon systems is still a big challenge. The issue of climate change associated with global warming leading to serious consequences such as rainfall variability, sea-level changes, glacial melting, frequency of cyclones and hurricanes, etc. needs to be addressed. In the recent past, the earth has been battered with frequent natural and man-made disasters like earthquakes, tsunami, floods, cyclones, droughts, landslides and environmental pollution, which threaten the very existence of our lives. The advances in Earth System Science, like multiparametric imaging, full waveform investigations and climate forecasting using coupled ocean-atmosphere general circulation model to name a few have made positive impact for the betterment of society. However, more integrative investigations of the planet earth are needed to improve the quality of life with least adverse impact on the environment to achieve our goal of developing and sustaining a knowledge society. The 94<sup>th</sup> Indian Science Congress devotes itself to the theme "Planet Earth" to address vital issues closely related to our natural habitat.

### **THRUST AREAS**

● Energy Security ● Mineral Resources ● Water Resources ● Ocean Resources ● Earth-Ocean-Atmosphere Interactions, Climate Change and Monsoon Forecast ● Natural Hazards ● Anthropogenic Hazards, Waste Management and Environmental Issues ● Education ● Synergy of Science & Industry ● Space Applications for Planet Earth ● Nano-Technology ● Bio-Technology ● Agriculture ● Biodiversity, Bioresources, Erosion of Genetic Pool ● Mysteries of Planet Earth ● Medical Sciences.

### **HOST UNIVERSITY**

Annamalai University spread over a sprawling campus of 405 ha, is located in Chidambaram town about 75 km south of Pondicherry. It was founded in 1929 by a visionary and Philanthropist the Hon'ble Dr. Rajah Sir Annamalai Chettiar of Chettinad. The university grown into a premier, unitary and residential university during the past 76 years and accomplished the academic excellence through teaching, research and extension under the dynamic leadership of Dr. M.A.M. Ramaswamy, Pro-Chancellor and the excellent stewardship of Dr. L.B. Venkatarangan, Vice-Chancellor. Presently the university has nine faculties which include Arts, Science, Indian Languages, Engineering and Technology, Education, Fine Arts, Agriculture, Medicine and Dentistry located under one roof. The university is actively engaged in both On-campus and Off-campus teaching programmes including diploma, post-graduate diploma, and job oriented certificate courses. The university is offering 360 different programmes through Off-campus mode which is assisted by 76 study centers spread over the country.

### **LOCAL SECRETARIES, ISC 2007**

#### **Prof. T. Balasubramanian**

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# **PLANET EARTH**

**THRUST AREAS**

**HOST UNIVERSITY**

**LOCAL SECRETARIES, ISC 2007**

178	179	180	181	182	183	184
185	186	187	188	189	190	191
192	193	194	195	196	197	198
199	200	201	202	203	204	205
206	207	208				

178	179	180	181	182	183	184
185	186	187	188	189	190	191
192	193	194	195	196	197	198
199	200	201	202	203	204	205
206	207	208				