Patentmatics Monthly Bulletin February 2018

Top Scientists Unanimously Condemn Union Minister's Anti-Darwin Remark, Pallava Bagla, NDTV.

All the top scientists unanimously condemned Junior Education Minister Satyapal Singh's statement questioning the evolutionary theory of Charles Darwin, dismissing it as an unscientific concept and that it should be pulled out of the school and college curriculum.

Minister of State for Human Resource Development, Satyapal Singh, the former IPS officer, who took voluntary retirement to contest the 2014 general elections, today called Darwin's theory was "scientifically wrong" and that "our ancestors haven't mentioned anywhere that they ever saw an ape turning into a man. Nobody has said or written that they ever saw an ape turning into a human being. No book we have read or the tales told to us by our grandparents had any such mention."

The three top Science Academies of India in a joint statement said that they "wish to state that there is no scientific basis for the minister's statements. Evolutionary theory, to which Darwin made seminal contributions, is well established. There is no scientific dispute about the basic facts of evolution. This is a scientific theory, and one that has made many predictions that have been repeatedly confirmed by experiments and observation. An important insight from evolutionary theory is that all life forms on this planet, including humans and the other apes have evolved from one or a few common ancestral progenitors."

Union minister Satyapal Singh called Charles Darwin's evolution theory "scientifically wrong"

More than 2000 leading scientists from all fields of science are part of the academies which includes, The Indian National Science Academy, New Delhi, The Indian Academy of Sciences, Bengaluru, and the National Academy of Sciences, Allahabad.

"It would be a retrograde step to remove the teaching of the theory of evolution from school and college curricula or to dilute this by offering non-scientific explanations or myths. The theory of evolution by natural selection as propounded by Charles Darwin and developed and extended subsequently has had a major influence on modern biology and medicine, and indeed all of modern science. It is widely supported across the world," the scientists said in the statement.

The minister, however, claimed he was also a "man of science", adding that "Darwin's theory is being challenged the world over. Darwinism is a myth."

***"If I'm making a statement I can't make it without a basis... I am a man of science; I'm not coming from Arts background... I have completed my PhD from Delhi University," Mr Singh told NDTV, reports* Pallava Bagla.**

Unfortunate though, a barrage of such anti-science poison is being injected to the minds of our ill-informed people, more so lately! The main stream S&T community must rise in protest, “not madly or badly but through incessant strivings” in the words of Jawaharlal Nehru, the Architect of Modern S&T in our country.

Main theme: Far greater T/T outputs from agriculture R&D to its entrepreneurial farmer customers, though all in private sector?

The January Bulletin had ended as below:

"In summary, with the mixed signals continuing so far, the end result for the immediate future need not be very bright for civilian and indigenous R&D, though the strategic sectors are certainly better placed".

And yet one can claim that relatively speaking the quite a few ICAR/SAUs seem to be performing more effectively than its sister institutions in the civilian sector - in terms of development of new plant varieties , effecting their transfers to entrepreneurial farmers, increase helping augment national production and thereby increasing the much required Self Reliance and Food Security.

1. Indian Express has recently published an article named "Farm Truths: Here's what makes us optimistic about Indian agriculture, There is a vested interest in projecting the country's farm sector as crisis-prone and underestimating its inherent robustness" by Rajju Shroff on January 4 in its Rural page (executive chairman and founder of the crop protection chemicals company UPL}


Indian agriculture today is structurally different and more robust compared to even the Green Revolution era.

It was Elisabeth Noelle-Neumann, a German political scientist, who framed the "spiral of silence" theory, which holds that when a wide majority starts to believe in a certain viewpoint, the remaining — howsoever well informed — tend to fall silent. It, then, allows for the predominant view to gain further ground and emerge as the norm.

The "spiral of silence" theory probably explains the general public opinion about Indian agriculture — as primitive, backward, un-enterprising, crisis-prone, and a major drag on economic growth. Strong and vocal vested interests, both within and outside the country, have so aggressively articulated this perception that it has got etched in people's minds.

The truth is just the opposite: Indian agriculture today is structurally different and more robust compared to even the Green Revolution era. Between the early-1970s and the late-nineties, India's annual farm gross domestic product (GDP) expanded from about $25 billion to over $100 billion. Not only was growth sluggish over three decades from a low base, it was also largely cereals-centric, limited to wheat and rice.

However, between 2000 and 2014, the country's agricultural production has surged from $101 billion to $367 billion, driven mainly by high-value segments such as horticulture, dairy, poultry and inland fisheries. No other country grows

as many food and non-food crops as India. Moreover, our small-sized family farms practice a unique kind of mixed agri-horti-livestock farming. It is, indeed, common to see agri farmers doubling up as milk producers, goat rearers, poultry keepers or even aqua-culturists.

The growth of a domestic industry that produces high-yielding seeds, fertilisers, pesticides, farm equipment and other modern inputs for our farmers, and improved roads and communication systems, have also contributed immensely to India becoming a global leader in agriculture. In 2014, India ranked second in agricultural output (after China), with an eight per cent global share. In the much-hyped services sector, India's rank was 11th with a two per cent share of the global pie. It was even worse in manufacturing, where India's global rank is 12th.

Agriculture is India's largest private sector, employing over half of its total workforce. It is this labour-intensive agricultural sector that has taken India to global glory, whereas services and manufacturing are the real laggards.

INDIA'S AGRI, SERVICES & INDUSTRY SHARE IN GLOBAL OUTPUT

SECTOR	WORLD OUTPUT	INDIA'S OUTPUT	INDIA'S SHARE (%)	INDIA'S RANK
Agriculture	4,771	367	8	2
Services	49,669	1,185	2	11
Industry	23,857	496	2	12

Output figures in $ billion; Source: UN/IMF data accessed from www.statisticstimes.com Year: 2014

GLOBAL AGRICULTURAL PRODUCTION

RANK	COUNTRY	AGRICULTURE OUTPUT($ BN)
1	China	1,005
2	India	367
3	USA	279
4	Brazil	130
5	Nigeria	122
TOTAL		1,903
WORLD TOTAL		4,771

Source: UN/IMF data for the year 2014 accessed from www.statisticstimes.com

When we assess yields or efficiency, the acceptable benchmark for India should be "total output" — the sum of everything a given land parcel produces, be it grains, fruits, vegetables, fodder, milk, eggs, fish, meat, manure, honey or timber. This is as opposed to just "crop yield", which refers to production per unit area of a single crop. High yields of the latter kind are typically achieved in the input-intensive industrial monoculture farming systems of western economies.

In India, the majority of farms fall in the marginal or small category with holding size below two hectares. Driven by the economic necessity to maximise returns, these small farms have evolved through self-engineered innovation into producing a variety of produce. Crop cultivation and livestock co-exist, ensuring year round economic activity. The aggregate agricultural output per unit area per year in India is among the highest in the world. Every unit of farmland in India produces multiple outputs, making its agriculture relatively resilient, vibrant and less vulnerable to uncertainties.

India is the world's largest producer of milk, at 146 million tonnes (mt) in 2015. Smallholder dairy farming systems supply over 90 per cent of its milk. Stovers of cereals and legumes, haulms of potato, sugarcane tops, fruits and vegetable wastes, together with own farm-grown green fodder, are what the livestock here eat. Small herds of cattle and flocks of chicken in the backyard are important household assets.

The milk and eggs from them brings home regular income, supplementing the main income from crop sales.

The Indian food production and consumption patterns, too, are very unique. The world produces more "feed grains" than "food grains", given that much of its food is meat-centric. Out of the 2,528 mt of global cereals output in 2015, the share of coarse grains was 55 per cent. In richer countries, 70 per cent or so of grain production gets fed to animals. But while the per capita annual consumption of meat in the world is 43 kg, and over 100 kg in the US, it is a mere 4 kg in India. Over here, "meatless meal" is what is more common. Therefore, food grains, vegetables, fruits and milk lead India's food production

as and consumption. The share of feed grains in our foodgrain production is less than 15 per cent.

Production of fruits and vegetables (256 mt) has now become higher than that of staple cereals such as rice and wheat (198 mt). Also, out of India's food market, estimated at $312 billion, a third ($101 billion) is accounted for by fruits and vegetables, followed by milk and eggs ($74 billion). Cereals are a poor third ($61 billion), while the share of meat is only $14 billion.

Indian agriculture, it must be emphasized, is also globally competitive. As per latest data from the World Trade Organisation for 2015, India ranked 19th in overall merchandise exports, but 9th in agricultural exports. India is probably the only country where you can get a dozen bananas or eggs for one dollar! Our share in global agricultural exports can easily reach 10 per cent from the present 2.35 per cent level, if supported by appropriate policy intervention and aggressive marketing.

India's mixed crop-livestock farming is a model of sustainable agriculture for the whole world. Highlighting this unique, low cost and diverse farming system globally will help position India as an agriculturally vibrant economy and a leader in her own right. The poor recognition given to India's outstanding achievement in agriculture is largely courtesy the "spiral of silence" and not based on empirical grounds. I shall end with this quote from a World Bank report: "India has brought about a landmark agricultural revolution that has transformed the nation from chronic dependence on grain imports into a global agricultural powerhouse that is now a net exporter of food".

2. Schroff has aptly highlighted the "uniqueness" of Indian agriculture in its manifold varieties. Undoubtedly the "Green Revolution" was the pace setter of the total process too. It is in this sense that the roles of the ICAR institutions, celebrated State Agricultural Universities and the pioneering farmer-entrepreneurs must be described in golden letters. In other words, as Shroff had aptly highlighted this scenario as follows:

"Agriculture is India's largest private sector, employing over half of its total workforce. It is this labor-intensive agricultural sector that has taken India to global glory, whereas services and manufacturing are the real laggards".

3. Obviously the next stage in Indian agriculture development must be through another S&T revolution as applied to it. Undoubtedly the GM technology also can and should play that thrust role in many sectors as was the Green Revolution earlier. It would be of great interest to the S&T community in this context to get an idea as to how this was invented by Monsanto in the 1970-90 periods literally from scratch. A summary note prepared by me a few years ago is reproduced below:

"The history of Monsanto and the Development of Agricultural Biotechnology can be very briefly summarized as following (Ref: its pamphlet "Fields of Promise").

Beginning of biotechnology in 1953 with the discovery of the structure of DNA by Francis Crick and James Watson at Cambridge University, in 1973 Stanley Cohen of Stanford University and Herbert Boyer of University of California at San Francisco first transferred genetic material from one organism to another. These advances in understanding the molecular basis of genetics transformed biology from a descriptive science into an applied science of immense potential.

By 1967, there was genuine worry on the commercial prospects of the large chemicals-based Monsanto in remaining as a purely chemical company producing pesticides, insecticides and fungicides. Thanks to its dedicated industrial R&D, there was a respite again through the blockbuster product Lasso herbicide of 1969. "Chemistry

was still the king" in the Agricultural Division and which again brought out successfully the new Plant Growth Regulators (PGRs).

The Monsanto senior biochemist Ernst Jaworski was however convinced that 'you couldn't solve all problems with chemicals'. Intrigued by research papers that described 'the ability to regenerate whole plants from single cells', he believed in the theory that 'you could remove a cell's walls using enzymes and then fuse cells from two different species in the same genus – like potato and tomato – to form a new species, in this case called *pomato*'!

Convinced that the company needed "a window on the science of cells", the corporate vice president of Technology Monte Throdahl in 1972 negotiated Monsanto's first research collaboration with a major university, known later as the Harvard Agreement which ran for 12 years costing Monsanto several million dollars. This "caused a paradigm shift to biology within Monsanto". Its General Manager Eddie Bauer believed that fundamental studies were needed to understand 'how plants resist disease and insects'. And thus began formulating 'a plan for the development of plants that would be genetically protected from disease', a heretic idea indeed then!

Jack Hanley, the new president and chief executive from 1972, began surveying leading scientists in MIT, Pennsylvania State University and Washington University in St Louis looking for an answer for "What does the future look like for technology?" Then the decision to go for venture capital. Monsanto had a very small holding in Genetech when it was created in 1976; the company itself was co-founded by Herbet Boyer whose transfer of genetic material from one cell to another was a technological breakthrough. It did not work, nor

its efforts with on Biogen or Genex. Hence the final decision "We couldn't rely on venture capital. We had to create our own biotechnology expertise". And this was the beginning for serious efforts in the field with Howard Schneidermann, the then dean of School of Biological Sciences at the University of California at Irvine, also a distinguished specialist in insect physiology and member of the National Academy of Sciences, as the new senior vice president R&D of Monsanto. His philosophy was "There was a wonderful pleasure in understanding the rules of nature and, having understood them, making those rules work for me….The key is truly enjoying the successes of your colleagues. If you have even a micro liter of envy in your blood stream, don't be a department chairman". And he truly inspired his colleagues to their highest levels of scientific achievement! He got transferred Jaworski from the Ag division to work such as "to make us a world class molecular biology company". They started looking for four scientists : "someone who was an expert in microbial genetics; someone skilled in molecular biology; someone who knew something about getting DNA into plants; and someone who understood plant-cell and tissue culture". So were recruited microbial scientist Stephen G Rogers from Indiana University School of Medicine, David Tiemeir from University of California at Irvine who was the first to do gene-cloning at Irvine, Robb Fraley of University of California at San Francisco himself being a pioneer in the field of DNA transfer into plants, and the last being Robert Horsch of University of Sakatchewan as a specialist in plant-cell and tissue culture. The stage was set by 1981 "for one of the wildest, most expensive, but most promising rides in Monsanto's history". Schneidermann joined

Monsanto as its "chief scientist", working with the motto "Good science is the key to commercial leadership of Monsanto".

4. Even this brief history highlights the type of R&D and S&T infrastructure a forward looking company like Monsanto could hopefully look for in its country, the United States – forward looking industrial sector, advanced R&D universities, matching 'knowledge transfer' mechanisms and so on! Alas, such an advanced S&T infrastructure is still only in rather nascent form, save a few very bright centers here and there! In other words, expanding such an advanced S&T infrastructure in molecular biology (GM oriented) itself is big task for the GOI without which development of appropriate GM products in a variety of plant varieties will remain a pipe dream!

5. Last but not the least ICAR has reported recently that annually India is incurring an annual loss of agricultural products worth $11 billion due to inadequacy of effective pesticides and weedicides! Details are as given below:

India loses farm produce worth $11b to weeds very year: ICAR, Business Line, January 16, 2018.

TV JAYAN

Economic losses due to weeds in 10 major crops

	in $ million
Rice	4,420
Wheat	3,376
Soybean	1,559
Maize	739
Groundnut	283
Sorghum	276
Greengram	161
Mustard	72
Sesame	50
Pearlmillet	17

Losses suffered by rice, wheat top list

NEW DELHI, JANUARY 15:

India loses agricultural produce worth over $11 billion — more than the Centre's budgetary allocation for agriculture for 2017-18 — annually to weeds, according to a study by researchers associated with the Indian Council for Agricultural Research (ICAR).

At $4.42 billion, the actual economic losses due to weeds were found to be highest in rice, followed by wheat ($3.376 billion) and soybean ($1.56 billion). However, the average yield loss is the lowest in rice – 14 per cent in transplanted rice and 21 per cent in direct-seeded condition.

Production factor

The overall loss went up because of high rice production in India, said the study, which appeared online in the

journal *Crop Protection,* on Friday. The greatest average loss, on the other hand, was reported from groundnut cultivation, followed by maize and soybean. A groundnut farmer on an average lost 36 per cent of his crop to weeds, resulting in an estimated loss of $347 per hectare. The average losses in maize and soybean farming were $136/ha and $117/ha, respectively. The average yield loss in wheat was $116 per ha. The researchers, from the Jabalpur-based Directorate of Weed Research (DWR), estimated the economic losses using data generated by an all India co-ordinated research project on weed management, which carried out 1,580 on-farm research trials on 10 major crops at different locations in 18 States over a decade. "We arrived at these numbers by statistically analysing the data from this project in which 23 ICAR institutes were participating," said RP Dubey, an agronomist with DWR and a co-author of the study. To calculate the actual yield loss, the scientists multiplied the difference in yield in weed-free situations and crop yield reported by farmers with minimum support price in respective States.

Loss could be higher

"If more crops and locations are included, the losses may be much greater than what is currently estimated," said Dubey said. The greater losses due to weeds could be good news for the herbicide industry. "We feel that proper weed management could bring down these losses substantially," said PK Singh, officiating director of DWR and another author of the study. According to Singh, judicious use of herbicides can cost farmers just one-third of what they spend on manual weeding".

Studies some years ago showed that globally, weeds are responsible for decreasing production of the eight

most important food and cash crops by 13.6 per cent, leading to an economic loss of $100 billion! No wonder that some established MNCs describes how they spend as much as $30 billion on R&D complimentary to public sector amount of over 40 billion, knowing well that new products take as much as 10-12 years to get a new more environment friendly product, almost akin to a new drug!

6. If promoting indigenously large scale GM R&D is a challenging task, so is the indigenous production of state-of-art pesticides and weedicides since they are also regulated by the 2005 Indian (Amended) Patents Act, exactly like the clauses regulating the drugs and about which Patentmatics had written in great detail in its earlier Bulletins. Most annoyingly, however, very few have championed the cause of the crucial pesticide/weedicide problem for our agriculture sector from any public platform either through their ignorance or through conscious neglect of the farming sector as always!

To give an example, there haven reports that MNCs are going all out to push new-gen pesticides into our agriculture. The new generation pesticides being marketed by multinationals in India have three broad characteristics, captured in DuPont's highly successful Rynaxypyr insect control molecule sold as 'Coragen' suspension concentrate and 'Ferterra' granular formulation. The first is that, being based on completely new chemistry and novel modes of action, they require low levels of spraying, for example, sugarcane farmers need to use just 150 ml of Coragen formulation that is diluted in 400 litres of water for every acre. For paddy,

soyabean, tomato, arhar or chilli, the requirement is even lower at 60 ml/acre.

Compared this with old generation pesticides such as chlorpyrifos, monocrotophos or endosulfan, where farmers typically had to spray anywhere from 250 ml to one litre, leaving behind higher traces of residues in the soil and up the food chain. Reduced spraying, in turn, is the product of new research. Anthranilic diamides – the class of insecticide molecules to which Rynaxypyr or Bayer's Flubendiamide ('Fame') belong – basically work on the 'ryanodine receptors' in insect pests that regulate the release of stored calcium critical for their muscle function. By binding to these receptors, the diamide compounds cause uncontrolled release and depletion of calcium, leading to muscle paralysis and ultimately the death of the insects. They are mostly patented.

DuPont's patent for Rynaxypyr was filed in August 2002, which confers it protection for at least another nine years. This is unlike an earlier molecule, Indoxacarb, which DuPont had launched in India in 2000 under the 'Avaunt' brand. "Patent protection is a huge incentive for us to bring the latest products from our research pipeline. The next major insecticide we are planning to launch is Cyazypyr, which would be for kharif 2014," said Ram K. Mudholkar, Business Director (South Asia) of DuPont's Crop Protection division". Cyazypyr (or cyantraniliprole, as the molecule is called) is again from the same anthranilic diamide class of chemicals and, of course, fully patent-protected. And so on.

That connects to the final characteristic. Since the new generation pesticides enjoy patent protection, it endows extra pricing power to the companies selling them.

7. In essence, akin to the absence of any rigorous New Drugs R&D in both the public and private sectors in our country, so is the case with New Plant Protection Chemicals too. With even the Compulsory Licensing powers getting badly weakened as in the Patents (Amended) Patents Act 2005, both these "livelihood" Sectors are left to the monopoly interests of large MNCs like Monsanto, Baeyer, Syngenta etc on the agrichemicals front and Pfizer, Novartis, etc on the drugs sector! When will the 21st century India awake to such a challenging scenario?

8. Compared to our dim scenario, China is striving to cope up with the issue through a different strategy to give her "a quick and assisted take-off". The Swiss giant has just been taken over by China National Chemical Corporation for over $43 billion in cash. In such an environment of consolidation involving 'Western' ag-science giants — driven by the global commodity downturn impacting demand — a Swiss MNC becoming a 100 per cent subsidiary of a Chinese state-owned enterprise naturally surprised many. For the Chinese authorities, the investment in Syngenta is also of great strategic value, given "their high anxiety about food security". For a country with 22 per cent of the world's population and only 7 per cent of its arable land, it is no wonder that "every time they produce a new five-year plan, you'll find food security is right on their radar".

9. Last but not the least, according to Economic Survey 2017 – 2018, losses to farmers' income could be as high as 20-25% in un-irrigated areas! More of this will be given in the March Bulletin.

10. In summary, thanks to the foresight of our earlier political leaders (the first reorganization and

modernization as GB Pant Agriculture University had taken place during the regime of Prime Minister Jawaharlal Nehru himself) to adopt the Land Grant model of the US for our SAUs, there was truly a metamorphosis to more farmer-oriented programs including adequate emphases for T/T too. This model was implemented for ICAR laboratories as well. Over the years a number of ICAR units and SAUs emerged as pioneers in their respective fields. Most obviously the celebrated Green Revolution had given the process adequate thrust too. In other words, none in knowledgeable circles can deny this role of ICAR/SAUs in our attainment of meaningful level of Food Security on a sustaining mode.

So far so good, agriculture is facing very many new challenges as well. The rapid spread of molecular biology techniques will certainly be far very demanding and challenging, so also development and implementation of new strategies for pests control including new products with lesser environmental problems and their matching at times very complex agronomic practices (Cf. "Addressing the Pink Bollworm challenge in White Gold", GD Mayee, Indian Express Jan 25, 2018). It is perhaps high time that GOI undertakes a detailed review by an expert committee (like the Abid Hussein Committee for CSIR in mid-1980s?) the whole gamut of ICAR organization and its structure, its policies and programs, personal policies and so on to make the same more effective to meet the new S&T challenges and additional requirements of food grains and horticultural and other valuable agro-based products without, however, increasing the total area under cultivation.

(To be continued)

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