Plight of Indian Ayurveda journals

We read with much interest about the plight of Indian research journals in a Guest Editorial in *Current Science* by Lakhotia[1]. He has precisely pointed out the schizophrenic aptitude of Indian scientists when it comes to publishing their research articles. It is highly relevant to see how we prioritize the journals to publish our work. Publishing in journals that are considered 'international' or at least non-Indian seems more attractive compared to journals with Indian or national names. It is highly relevant to analyse the impact and consequences of this practice to the whole research process. First, this deprives Indian journals from articles of high impact which may be relevant for the growth of science within the specified domain of knowledge in the country. At one end, this lessens the chances of native journals to improve against more established non-native publishing houses. At the other end, it also deprives native researchers to get easy full-text access of material which is often available free or at a nominal charge in Indian journals. A large interest in journals sounding international has also created a genre of bogus and predatory journals that lure scientists.

For journals on traditional healthcare systems, particularly Ayurveda published from India, the situation is more alarming[2]. The subject area is already suffering both qualitatively and quantitatively; and not submitting articles in the field to Indian journals, where one is expected to get maximum readership pertinent to the subject area, is really worrying. I remember, when as senior editor of an Ayurveda journal, I requested a renowned researcher, physician and scientist of modern medicine also working with Ayurveda, to submit his work to the journal. He enquired if ours was a PubMed indexed journal. We were actually not and so, I modestly replied that unless people like him start submitting their work in such journals, how can we get indexed in PubMed?

We have seen Ayurveda researchers publishing in journals where there are actually hardly any serious readers. Unless, the article has some effective keywords, there is the possibility that it will be lost in the plethora of research emerging every now and then. Eventually such works are not going to have any impact on the society for which it should have been of great importance.

A good work not reaching the hands of the ultimate readers is a great loss on many counts. Making it so premium that it can be handled only by a chosen few is also a drawback. Research is of no use unless it benefits the society at large.

1. Lakhotia, S. C., *Curr. Sci.*, 2018, **115**, 2187–2188.
2. Rastogi, S., *Ann. Ayurvedic Med.*, 2018, **7**, 75–78.

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Bt-cotton hybrids

In an article on 'hybrid *Bt*-cotton', Gutierrez[1] concludes that government agencies should encourage development of high-density short-season (HDSS) varieties as a straightforward solution to stabilize cotton production in India which, in his view, has suffered due to the many ills of cultivating *Bt*-cotton hybrids since 2002. While HDSS varieties of *Gossypium hirsutum* could provide another option to the Indian cotton farmer under subsistence farming conditions, technology stakeholders need to be watchful and factor in the hard lessons learnt from the pre- and post-*Bt* cotton eras. Some of the watch outs could be:

First, cotton bollworm management in India should not rely solely on chemical insecticides. We have learnt bitter lessons in the past. Undeniably, *Bt* traits in cotton have been key to the management of bollworm complex till pink bollworm evolved field resistance to *Bt*-cotton in Central and South India[2]. Even today, *Bt*-cotton (stacked version with two *Bt* genes) is effective in managing *Helicoverpa armigera*, the most dreaded bollworm, *Earias* spp., and *Spodoptera litura* and pink bollworm in North India. Hence any new cotton variety or hybrid to be developed should have stacked *Bt* genes in them, different from those expressed by Bollgard II®, for effective bollworm management and as a resistance management tool for extended efficacy of the variety.

Well aware of the indispensability of *Bt* technology, the Central Institute for Cotton Research (CICR), Nagpur has adopted a strategy to revive cotton varieties, but with *Bt* traits, so that suitable *Bt* varieties could be extended to rainfed and resource-poor farmlands. CICR has further announced a long-term plan to stack three *Bt* genes in a collaborative effort with several public institutions[3].

It could be argued that HDSS varieties can be managed with Integrated Pest Management (IPM), with need-based use of insecticides as an integral part. However the hard fact is that in spite of well-formulated packages[4,5] and best extension efforts, IPM has never been adopted by cotton farmers on a large scale, even in the pre-*Bt*-cotton era when insecticides on cotton constituted ~50% of the total insecticides used in agriculture and costed the cotton farmer 45% of the variable price[6]. No cotton farmer wants to return to that era when his cotton fields had to be sprayed 15–20 times with chemicals[6], followed by resistance breakout.

Secondly, the author[1] has stated that HDSS would escape the peak infestation window of pink bollworm as it is generally a late-season pest. This could be no longer true. Due to large carryover between seasons, the population levels of *Bt*-resistant pink bollworm in Central and South India are sufficiently high resulting in infestation of *Bt*-cotton during bloom initiation and peak bloom. HDSS varieties will not escape pink bollworm in this scenario. Thus HDSS is a new initiative for enhancing cotton productivity, but should be endowed with *Bt* traits for long-term sustainability. Lastly, refuge-in-bag should be the refuge delivery mechanism for extended product durability.

1. Gutierrez, A. P., *Curr. Sci.*, 2018, **115**(12), 2206–2210.
2. Kranthi, K. R., In *Cotton Statistics and News* (ed. Amar Singh), Cotton Association of India, Mumbai, 2015, vol. 35, pp. 1–6.
3. http://economictimes.indiatimes.com/news/economy/agriculture/monsanto-faces-challenge-from-cicrs-bt-cotton-varieties/articleshow/51099198.cms; http://indianexpress.com/article/india/india-others/desi-bt-cotton-will-indian-farmers-finally-see-an-alternative-to-monsantos-bollard/
4. Mohan, S. *et al.*, In *Integrated Pest Management for Cotton*, Director, National Centre for Integrated Pest Management, ICAR Campus, New Delhi, 2014, p. 84.
5. Vennila, S., Ajanta, B., Vikas, K. and Chattopadhyay, C., In *Success Stories of Integrated Pest Management in India*, ICAR-National Research Centre for Integrated Pest Management, New Delhi, 2016, p. 78.
6. Kranthi, K. R., In *Bt Cotton Questions and Answers*, Indian Society for Cotton Improvement, Mumbai, 2012, p. 72.

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Response:

It is important to have an open discussion about the unique hybrid *Bt* cotton (new world *Gossypium hirsutum*) adopted in India, but it is also essential to have a clear understanding of the ecology, phenology and dynamics of cotton and cotton pests that underpin the problem. We must distinguish between target key pests (e.g. pink bollworm, *Pectinophora gossypiella*) and secondary pests (e.g. American bollworm (*Helicoverpa armigera*), sap-sucking insects such as whitefly, mealybugs and others) that arise under insecticide disruption and are often more damaging than the initial target key pest. We must also know whether and when insecticides and the *Bt* technology are truly needed – to understand why some growers can produce organic cotton in India. Prior to the 1970s, when extensive insecticide use began, bollworm and whitefly were minor pests in Indian cotton, and what is obvious is that *Bt* hybrid technology was introduced to solve an insecticide-induced bollworm problem. Given this, India is not faced with a false binary choice between unrestrained use of insecticides as done during pre-2002 and currently or further *Bt*(s) technology adoption. Both of these options are based on linear thinking and are akin to a technological dog chasing its own tail. A systems model of cotton and of pests enabled sorting out many of the details in North American cotton, and this bit of technology might be useful in India[1,2].

The extensive use of insecticides in India began pre-2002 with the introduction of long-season non-*Bt*-hybrid cotton that induced secondary pest outbreaks of bollworm. With *Bt*-cotton adoption to control bollworms, there was an initial decline in insecticide use from 2002, but it increased after 2007 and by 2012 was at pre-2002 levels; however, it now targeted *Bt*-resistant bollworms and new secondary pests not controlled by *Bt* toxins (e.g. whitefly, mealybugs and other sucking insects). Secondary pest problems are caused by insecticide ecological disruption as has occurred worldwide[3] and hence it is not unique to India. It was the root cause of the disaster in cotton in the Great Central Valley of California during the 1960–70s, when massive outbreaks of secondary pests (native bollworms, defoliators, mites) were induced by insecticide misuse[4,5]. However, once the ecological basis of the problem was understood in cotton in the area, the crop could be grown largely insecticide-free and without *Bt* technologies, and secondary pests returned to their natural low levels.

In India, the costs of hand-pollinated long-season *Bt* cotton hybrid varieties are very high and result in suboptimal low plant densities (~2.5 plants m^{-2}) that contribute to low stagnant yields which are further influenced by weather. These unique hybrid cottons are used as a value-capture mechanism that does not appear to benefit resource-poor farmers with increased yield[6]. In industrial cotton in other parts of the world, open-pollinated fully fertile *Bt*-cotton varieties are used successfully because yields are vastly higher, *Bt* seed costs are lower, *Bt* varieties are effective in controlling key lepidopterous pests such as pink bollworm, resistance to *Bt* toxins is avoided using non-*Bt* refuges, most farmers have learned that they must minimize insecticide use to avoid secondary pest outbreaks, and intellectual property rights (IPR) against seed-saving and replanting are controlled by legal means. In China, fully fertile *Bt* hybrid cotton has been developed by crossing fully fertile *Bt*-cotton and non-*Bt*-cotton to create F1 hybrids that are hemizygous for the *Bt* trait[7]. Self-pollination of these fully fertile F1 hybrids produces F2 hybrid seeds for planting that are 25% *Bt* homozygotes and 50% *Bt* hemizygotes, and 25% non-*Bt* homozygotes. In the field, the 75% *Bt* portion of the F2 cotton plants controls pink bollworm and bollworm, while the non-*Bt* fraction acts as a refuge for preserving susceptibility in the pests to *Bt* toxin serving to delay or eliminate the development of resistance. This is a form of the refuge-in-the bag approach. These F2 cotton hybrids are fully fertile and hence would not be useful as a value-capture mechanism in India, where farmers would simply save seeds and replant them the following season, resulting in an erosion of commercial IPRs. I suppose mixing non-*Bt* seeds with current Indian hybrids could provide a refuge, but this begs the question of the high price of seeds and the lack of yield benefit from the current Indian hybrids. What should be obvious is that neither unrestrained use of insecticides nor the current *Bt* hybrids technology with the addition of any number of *Bt* traits provides the answer for resource-poor farmers in India. This conundrum is why Indian Government incentives are required to develop appropriate varieties and integrated pest management (IPM) strategies. The current vicious dystopic cycle needs to be broken, and the adoption and modification of open-pollinated rainfed high density short season (HDSS) cotton technology would a big step in that direction. As an important aside, incorporation of *Bt* and other genetically modified (GM) technologies in indigenous 'desi' cottons (*G. arboreum* and *G. herbaceum*) and food crops must be avoided to prevent contamination of seed stocks.