

***Bt*-cotton: the ‘five-percent issue’ may add misery to the mixed bag**

The subject of the ‘mixed bag’, which proposes non-*Bt*-cotton seeds be mixed with *Bt*-cotton seeds in the same bag, has raised an interesting debate in this journal¹⁻³. It was flagged by Hanur¹, who recommended that the mixed bag should be allowed in India. He made this proposal pointing out that the extent of adoption of structured refuge in this country was unsatisfactory. Later, Muralimohan and Srinivasa² conveyed their reservations against the recommendation. They argued that the mixed bag might encourage pest resistance, create problems during pest management, generate annoyance among farmers, etc. Recently, Manjunath³ attempted to counter the opinions expressed by Muralimohan and Srinivasa². Supporting Hanur¹, Manjunath mentioned that the ‘enforcement approach’ will ensure refuge in India. However, while upholding worries expressed by Muralimohan and Srinivasa² about the insensibility of having the mixed bag with 20% non-*Bt* seeds, Manjunath³ suggested that the proportion may be reduced to about 5%. Here we convey that this suggestion³ also fails to provide convincing reasons for adopting the mixed bag in India.

We continue the current custom to contrast India with USA¹⁻³, while recognizing reasons for India to reject the mixed bag. There are no *Bt*-cotton ‘hybrids’ planted in USA; only *Bt*-cotton ‘varieties’ are planted there. And, as varieties ensure 100% trait purity, i.e. all *Bt*-cotton seeds in a bag will essentially contain *Bt* gene/s, it might become necessary to introduce non-*Bt* plants for the sake of the refuge strategy in USA. However, in India, nearly all *Bt*-cotton is hybrid, which means it is difficult to ensure 100% trait purity among seeds in a bag. Therefore, India has allowed a window of up to 10% trait impurity in a bag of hybrid cotton seeds, indicating that up to 10% of the seeds in a bag may not have *Bt* gene/s in them. Considering Manjunath’s³ suggestion that about 5% non-*Bt* population would serve as an effective refuge, it appears that the existing policy of allowing up to 10% non-*Bt* seeds in each bag exceeds the requirement. Although some seeds passing through the 10% window may perform differently, their role in supporting insect

refuges is indisputable. There may not be any need for deliberately adding another 5%, which, in addition to being unnecessary, would pull down purity limits within a bag to 85%. Therefore, instead of calling for a change in the India Seed Act, we suggest that the available 10% window for trait purity be effectively utilized to introduce non-*Bt* seeds of the same hybrid. When every bag of *Bt* cotton seeds in India is a mixed bag containing up to 10% non-*Bt* seeds, it appears odd to be debating about introducing mixed bag with about 5% non-*Bt* seeds.

Manjunath’s³ ‘five-percent’ proposal appears to arise from the *Bt*-corn affairs in USA and Canada, where, it has been commercialized in the form of a mixed bag with each containing 5–10% non-*Bt* seeds. Interestingly, the non-*Bt* corn seeds are made to wear a different colour from their *Bt* counterparts. Differential colouration allows farmers and regulators to know the proportions of both seed types. Keeping this in view we hypothesize the following situation for India. As mentioned by Manjunath³, the two types of cotton seeds in the mixed bag may be made ‘indistinguishable’ in India. But, this might cause uncertainty among farmers about the extent of mixing in each bag, which could have negative socio-political consequences; viewpoints of ‘enforcement’ and ‘lack of transparency’ may ultimately lead to rejection of the mixed bag by the farmers. From the perspective of regulation, it would be complicated to frame an effective policy for strict implementation of the mixed bag containing about 5% similar-looking non-*Bt* seeds of the same hybrid. This is because there can be up to 10% legally allowed unintentional introduction of non-*Bt* seeds in each bag. To resolve this issue, the intentionally mixed seeds may have to be made ‘distinguishable’, as has been done in USA for *Bt*-corn. But, because of the gross reluctance among Indian farmers to plant non-*Bt* seeds¹⁻³, they would probably get rid of them from the mixed bag. All in all, there appears to be no reason to promote the mixed bag strategy to ensure refuge in India.

If India agrees on reducing the area under refuge from the current 20% to about 5%, efforts may be made to

include the 5% non-*Bt* seeds within the stipulated window of trait purity. Interestingly, while debating on lowering the proportion of refuge, it appears fair to do away with refuge as a ‘purposeful strategy’; retaining the minimal limits of trait purity at 90% per bag of hybrid *Bt*-cotton seeds would automatically take care of the refuge population. However, our suggestion is not against enhancing crop diversity, for example, cultivating pigeonpea with *Bt* cotton as an alternate strategy to generate pest refuges.

Manjunath³ has proposed to reduce the area under refuge for Bollgard II, stating that the probability of insects developing resistance decreases with increase in the number of *Bt* genes in the plant. It comes as a surprise that this proposal is being made in India 5 years after the commercial introduction of Bollgard II. Nonetheless, India might consider the proposal for reduction in refuge on strong scientific grounds. Adoption by USA, or theoretical explanations, should not be ‘sufficient’ for India to decide. There must be convincing empirical evidence arising from India showing at least similar ratios of resistant to susceptible moths in high- and low-refuge situations for all bollworm species enlisted by Manjunath³ – *Helicoverpa armigera*, *Pectinophora gossypiella*, *Earias insulana* and *Earias vitella*; data on parameters like crop yield would be irrelevant from the context of insect resistance management.

1. Hanur, V. S., *Curr. Sci.*, 2011, **101**, 470–471.
2. Muralimohan, K. and Srinivasa, Y. B., *Curr. Sci.*, 2011, **101**, 1122–1123.
3. Manjunath, T. M., *Curr. Sci.*, 2012, **102**, 541–542.

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