and plant damage, whereas the result was intermediary with those larvae fed with a single *Bt* protein (cry1Ac as in Bollgard)[5]. In India, observations on *H. armigera* that fed on *Bt*-proteins also revealed 'the older larvae may not die, but they suffer a set back in their overall growth and development. Such sick larvae feed much less'[3,4]. Considering these, the concerns expressed by Muralimohan and Srinivasa[1] that RISM may result in increased plant damage due to migrant larvae and also that it may lead to development of resistance, though valid, do not appear to be serious from a practical perspective. Nevertheless, it would be worthwhile conducting systematic studies to address all perceived implications before coming to any conclusions. It is true that such mortality, however small, would result in some reduced number of susceptible moths from the intended refuge[1] (the same is also true if general insecticides are sprayed for some reason), but it is also true that all larvae will not be affected and, therefore, some would develop into susceptible moths on the non-*Bt* plants.

Throughout their article, Muralimohan and Srinivasa[1] have assumed that the proportion of non-*Bt* seeds in RISM or 'mixed bag' will be 20%. Earlier studies elsewhere have shown that stacking of *Bt* genes, with different binding sites in the insect midgut, imparts greater insect control efficacy and also that it minimizes the probability of development of cross-resistance. Therefore, in such cases, the size of refuge can be considerably smaller[15–17]. In fact, the size of the refuge in RIB for stacked *Bt* genes in corn has been reduced to 5% (non-*Bt*) in the United States Environment Protection Agency (USEPA) registered *Bt*-corn products in USA[11], and the same recommendation has been more recently adopted in Canada[12]. Bollgard II, the two-gene *Bt*-cotton which was approved in India in 2006 and is currently predominantly cultivated (> 75%), also provides two *Bt* proteins with independent sites of action, and hence the effective refuge size would certainly be far less than 20%, perhaps around 5%.

Muralimohan and Srinivasa[1] have also expressed that 'mixed bag' (or RISM) could go against the India Seed Act, because this Act does not allow mixing of two genotypes. In reality, the India Seed Act stipulates that in hybrid cotton seed crop, 90% of plant population should be genetically homogenous and in the remaining 10% heterogeneity, out-crossed plants can constitute a maximum 1.5% and the plant population due to selfing of female lines can constitute the balance (subject of total genetic impurity of 10%)[18].

Insect resistance development is a natural phenomenon and is a genuine concern. Since implementation of structured refuge has not been satisfactory in India, RISM appears to be a practicable and viable option to ensure IRM. Considering the benefits delivered by *Bt*-cotton to over 6 million farmers and to the Indian textile economy which generates employment for several million people and large revenue, it might be prudent to adopt RISM so that this valuable technology is preserved as long as possible. It does not prevent anyone from evolving more suitable refuge management strategies or developing new products for bollworm management.

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Funds promote scientific output

Research funds are important resources for basic research, which affect scientific and social development[1] as well as the career of scientists[2]. While scientific output of basic research is measured by scientific articles, the case of scientific articles supported by research funds has also been studied[3–6]. Since August 2008, the *Web of Science* (*WoS*) has started recording funding information of publications, which provides reference data for funding analysis.

Using the *Science Citation Index* database in *WoS*, we counted 2,060,838 scientific articles and 1,165,276 funded articles in 2009–2010. Total articles and funded articles of the top 20 countries/territories (according to published articles) in the world are shown in Figure 1.

For total articles, the top 20 countries/territories accounted for 86.2% of those

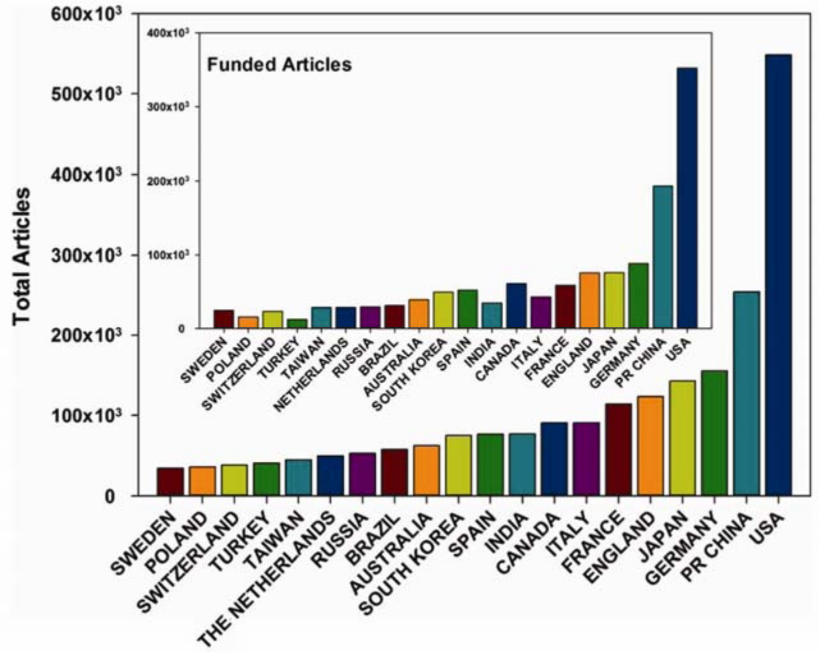

Figure 1. Total articles and funded articles of the top 20 countries/territories.

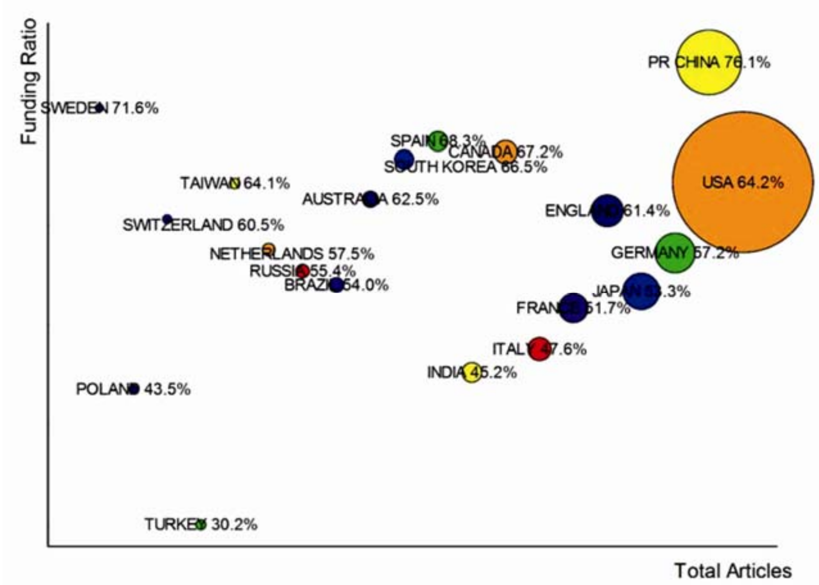

Figure 2. Funding ratios of the top 20 countries/territories.

published in the world, with altogether 1,777,023 scientific articles, where the cooperative papers were not double-counted. Whereas USA accounted for 26.6% in the world with 548,853 articles, China represented 12.3% and is growing rapidly.

For funded articles, the top 20 countries/territories accounted for 88.8% in the world, in which the top three, i.e. USA, China and Germany represented 34.1%, 18.7% and 8.6% respectively. The top three institutions are the Chinese Academy of Sciences, the Russian Academy of Sciences and the National Center for Scientific Research (France), and the top three universities are Harvard University, University of Tokyo and University of Michigan.

We now introduce the funding ratio (FR) as:

$$FR = \frac{FA}{TA} \times 100\%,$$

where FA is the total scientific articles funded by at least one research fund and TA is the total articles in a country/territory. The indicator characterizes the universality of financial support for basic research.

During 2009–2010, the funding ratio in the world reached 56.5% on an average, with 53.0% in 2009 and 59.9% in 2010. The funding ratios of the 20 top countries/territories are shown in Figure 2.

Figure 2 is a bubble chat, where the bubble size characterizes total articles of a country/territory in 2009–2010. China, Sweden and Spain were ranked as the top three measured by FR, whereas Turkey and Poland ranked the lowest. Meanwhile, there were nine countries/territories whose funding ratios were lower than the world average. Some G7 countries, such as USA, Germany, Japan, France and Italy had lower funding ratios, whereas some up-and-coming countries/territories, like China, Spain, South Korea and Australia had higher funding ratios, which shows that these emerging countries/territories are strengthening investment in basic research. Especially, China is marching ahead, though it has a low per capita GDP.

Thus, funded articles reach more than half of total articles in the world, so that research funds are promoting scientific output. It is seen that some up-and-coming countries/territories (including Canada) show higher funding ratios, while the G7 group (also including Canada) has the absolute advantage in total articles. Thus greater care is needed in the funding policy for promoting scientific output, particularly in basic sciences.

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