Brief Communication

The human health benefits from GM crops

Stuart J. Smyth*

Department of Agricultural and Resource Economics, College of Agriculture and Bioresources, University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Reductions in farmer pesticide poisonings have been quantified in China, India, Pakistan and South Africa. Often, cases of pesticide poisoning are not formally reported to health centres and the results on pesticide poisoning may be underestimated due to the lack of reporting. In South Africa, farmers reduced pesticide applications from 11.2 per year to 3.8, with reported cases of pesticide poisoning declining from over 50 per year to <10 over the first 4 years of Bt cotton adoption (Bennet et al., 2003). One third of non-Bt cotton farmers in China reported cases of pesticide poisoning, compared with 9% of Bt cotton-producing farmers (Hossain et al., 2004). Assessing the health impacts in India reveals a reduction in cases of pesticide poisoning of 2.4–9 million cases per year (Kouser and Qaim, 2011). Cumulatively, since 2003, when Bt cotton was first commercialized in India, a minimum of 38 million fewer instances of pesticide poisoning have occurred, with an upper potential of 144 million. Farmers in Pakistan growing non-Bt cotton reported up to seven instances of pesticide poisoning in the growing season with 35% reporting no instances, versus Bt cotton farmers reporting up to six poisonings with 45% reporting none (Kouser and Qaim, 2013).

A medical assessment of 246 Chinese farmers, involving 35 health indicators, found that fungicides associated with the production of non-Bt cotton had linkages to damaged liver function, while the insecticides used in non-Bt cotton production may be associated with severe nerve damage (Zhang et al., 2016). The use of non-glyphosate tolerant crops was found to likely reduce renal function and decrease serum folic acid.

Changes in farmer suicide

Mental health challenges and issues affect all walks of life and economic sectors, with agriculture being no different. Access to sufficient mental health resources can be problematic within the agriculture sector due to rural areas, remote locations and lack of access to mental health support systems. Unfortunately, suicide is a concern in agriculture. India has one of the highest suicide rates in the world, and research has examined the relationship between farmer suicide and the adoption of GM cotton.

Research examining the relationship between farm suicide and Bt cotton adoption revealed a plateauing of the suicide rate following the commercialization of Bt cotton (Grüère and Sengupta, 2011). Farmer suicides were trending upward from 15 000 per year, peaking in 2004, the year after Bt cotton was first commercialized in India. By 2007, the actual suicide rate was 25% below the extrapolated suicide rate. Cumulatively, the reduced rate of suicide associated with the adoption of Bt cotton represents the prevention of a minimum of 75 000 farmer suicides.

Lowering cancer incidences

The development of insect-resistant crop varieties has begun to have a noticeable potential to improve human health through the...
reduction in cancer rates. Prior to the commercialization of Bt crops, maize in particular, insect damage to the harvested crop increased the potential for the development of harmful health effects. A study of 21 years of maize production quantified that Bt maize contained lower concentrations of mycotoxins (29%), fumonisins (31%) and thricotecens (37%) (Pellegrino et al., 2018). Mycotoxins are both toxic and carcinogenic to humans and animals and are considerably more concerning in developing economy food systems where access to food safety toxicity tests is less prevalent. Fumonisins are correlated to being the cause of higher rates of neural tube defects in high maize-based diets (Missmer et al., 2006). With food security challenges existing in many developing countries, corn containing mycotoxins are consumed as part of the household diet due to the lack of any other option.

Mental health benefits

One factor not assessed to date is the mental health improvements incurred by GM crop adopters. Stress in agriculture is like every other sector of the business economy, although in the agriculture sector, the stresses may be more related to financial debt servicing and the potential of crop failure. Both of these factors can contribute to the stress burden of farmers. With the quantified higher yields from GM crops (Klümpner and Qaim, 2014), farmers can now gain some degree of confidence that their crop will not fail due to insect pressures, be overcome with weeds and be more resilient should a drought occur.

Nutritional benefits

Genetically modified crops have made significant contributions to address the United Nations Sustainable Development Goals, in particular goals 1 (reducing poverty) and 2 (reducing hunger). While increased yields have contributed to higher household incomes, which reduce poverty, the increased yields have also enhanced household food security. Biofortified GM crops have been adopted, increasing micronutrient availability (Hefferon, 2014). Nutritionally enhanced foods improve an individual’s nutrient intake, preventing and/or treating leading causes of death such as cancer, diabetes, cardiovascular disease and hypertension. Improving the nutritional content of daily food consumption certainly has day-to-day effects, but of significant importance are the long-term effects that extend for decades over the course of an individual’s lifetime.

In many instances, improving macronutrients (proteins, carbohydrates, lipids, fibre) and micronutrients (vitamins, minerals, functional metabolites) has significant childhood health improvements, such as reducing blindness due to the lack of vitamin availability. Improved food nutrient content, especially the increase in mineral availability, contributes to improved immunity systems and reduces stunting. In many developing countries, plant-based nutrient intake accounts for one hundred per cent of an individual’s nutrient diet, further highlighting the importance of nutritionally enhanced crop-derived foods. As the later in life benefits from improved childhood nutrition are better understood, the full value of nutritionally enhanced GM crops and foods may not be realized for several decades.

Concluding remarks

While millions of farmers growing Bt cotton are experiencing reduced incidences of pesticide poisoning, all of the estimated 17 million farmers growing GM crops globally have reduced chemical exposures. Certainly, the reduced rates of pesticide poisoning, possibly in excess of 100 million cases, are a vital statistic of the benefits of GM crops, but perhaps the most significant is the contribution to improved mental health from farmers, especially those in India. Suicide is a devastating part of agriculture, to which no country is immune and the observed plateauing and now reduction in Indian farmer suicide rates is a benefit that simply cannot be surpassed. By allowing cotton farmers to be more profitable, Bt cotton has allowed tens of thousands of Indian cotton farmers to have more options and opportunities to continue farming. The true benefit of GM crops can be measured through the thousands of family members who no longer have to deal with the anguish and grief suicide causes.

Ongoing mental health improvements from the reduced stress of the potential for crop failure and the damaging effects this has on profitability and food security, while significantly difficult to measure, will continue to be one of the exceptional, but silent, benefits from GM crop production.

Conflict of Interest

I declare no conflict of interest.

References

Bennet, R., Buthelezi, T.J., Ismael, Y. and Morse, S. (2003) Bt cotton, pesticides labour and health: a case study of smallholder farmers in the Makhathini Flats Republic of South Africa. Outlook Ag. 32, 123–128.
Gruere, G. and Sengupta, D. (2011) Bt Cotton and farmer suicides in India: an evidence-based assessment. J. Dev. Studies, 47, 316–337.
Hefferon, K.L. (2014) Nutritionally enhanced food crops; progress and perspectives. Int. J. Mol. Sci. 15, 3895–3914.
Hossain, F., Pray, C., Lu, Y., Huang, J., Fan, C. and Hu, R. (2004) Genetically modified cotton and farmers’ health in China. Int. J. Occ. Env. Health, 10, 296–303.
Klümpner, W. and Qaim, M. (2014) A meta-analysis of the impacts of genetically modified crops. Plos One. 9, e111629.
Kouser, S. and Qaim, M. (2011) Impact of Bt cotton on pesticide poisoning in smallholder agriculture: a panel data analysis. Ecol. Econ. 70, 2105–2113.
Kouser, S. and Qaim, M. (2013) Valuing financial, health, and environmental benefits of Bt cotton in Pakistan. Agric. Econ. 44, 323–335.
Missmer, S.A., Suarez, L., Felkner, M., Wang, E., Merrill, A.H. Jr, Rothman, K.J. and Hendricks, K.A. (2006) Exposure to fumonisins and the occurrence of neural tube defects along the Texas-Mexico border. Env. Health Persp. 114, 237–241.
Pellegrino, E., Bedini, S., Nuti, M. and Ercoli, L. (2018) Impact of genetically engineered maize on agronomic, environmental and toxicological traits: a meta-analysis of 21 years of field data. Sci. Reports, 8, 1–12.
Zhang, C., Hu, R., Huang, J., Huang, X., Shi, G., Li, Y., Yin, Y. et al. (2016) Health effects of agricultural pesticide use in China: implications for the development of GM crops. Sci. Reports, 6, 1–8.