Analyzing the adoption of Bt Cotton in India

Abstract

Cotton production has been very much bountiful in the regions of india, circling the states like Gujarat, Rajasthan, Punjab,Haryana, Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Tamil Nadu. The hybrid line of Bt cotton has many advantages like of resisting jassids, aphids and pink bollworm which poses a big economic threat to the production.Bt cotton led the development of “gene revolution” in India. The HD-SS gene variety of Bt cotton enhanced profits and reduced seed and insecticides cost. Along with uplifting the food security of the nation its has also quite negative effects which are mainly making the respective soil exhaustive after the harvest, some soils are claimed to be non-preferable for the production and also creating a ill-commotion in the cattle. Bt crops releases a sort of Bt toxins which lowers the soil chemical and biological activity. The adoption rate of the Bt cotton has been majorly found in the northern states of India with the farmers and the stakeholders being having a large portion of the land. During the 2014, it was being observed in the rate of adoption of Bt cotton shown a very drastic increase and also the shape of the graph formed a Roger’s “S” Shaped curve.The farm science centres (KVKs), proved itself to be the most influencing and playing a major role in the demonstration of ipm (integrated pest management) of the Bt cotton through trainings, front line demonstration (FLD), on farm trials (OFT) and other extension activities which enhanced the overall development of Bt cotton.

Keywords- Bt cotton, pink bollworm, rainfed Bt cotton,food security,Sustainable Development Goal, cotton aphids, germplasm

Abbreviations- Bt- B*acillus thuringiensis,*SAM- micro-social accounting, GDP- gross domestic production, ipm- integrated pest management, IRM- insecticidal resistance management, HD-SS- high density- short season, EIQ- environmental impact quotient

Introduction

Most of the scientists and breeders have closely watched the case of genetically altered and modified cotton which has been produced as the Bt cotton *(Bacillus Thuringiensis)* giving a quantum effect momentum in production along with having a long-term impact in India. It not only increases the yield but also resists a list of pests, diseases and frost conditions (chilling injury) which beforehand was a major economic and social issue (Kranthi and Stone, 2020). The small landholding farmers were very much beneficial through the revolution of the crop. The impact has been measured via pesticide use efficiency and cost-effective in nature which turned out to be very astonishing as the Bt cotton reduced the use of the pesticide by 50-70 percent (Kouser and Qaim, 2011).The transgenic technology of the Bt cotton production line has resulted in the adoption in high pace irrespective of the small landholding of the grower. So, the area under the Bt cotton is determined to proliferate in the coming era of farming (Barwale *et. al*, 2004). Wide effects in the village community have been found of the modified crop and a system of SAM (micro-social accounting) being proposed and it stimulated and attracted the growers towards its adoption (Subramanian and Qaim, 2009). In a comparative analysis between the economics of Bt and non-Bt cotton production where it was being introduced by

china and its adoption was hugely admired by the masses of India. Many concerns were being put up regarding the social organizational aspect but were mitigated after being proven as environmentally friendly, it also linked with employment ratio and reduced the poverty rate (Orphal, 2005). Previously, the cotton had a hazardous relation with pink bollworm which costed in economic crisis and yield retardation but after the establishment of the Bt cotton technology the production and hamper related problems vanished with a fast rate. Now, the cotton produced is very quality- sensitive in nature along with resistance to many diseases and pests (Naranjo and Ellsworth, 2010). The acquitted venture of Bt cotton started when in some particular districts, Bt cotton may have presented some indirect effects to farmer indebtedness, leading to the suicides of the farmers, but the failure was mainly recognized as a process of plantation in a wrong environment to grow (Gruere and Sengupta, 2011). From a preliminary study conducted in India, data showed certain good statistical values in relation to the yield perspective per hectare/acre, some requirements were urged by the farmers like a better demonstration and field extension (Gandhi and Namboodiri, 2009). Biotechnology and genetically modified crops in due course had been the major subject of debate but Bt cotton in the year of 2002 led the development of the "gene revolution" (Kalamkar, 2013). In order to take a great advantage of the hybrid technology, the farmers urged to lower the seed cost, more demonstration of the crop via extensionist and wanted more Bt varieties to check the environment suitability (Gandhi and Namboodiri, 2009). A very good transition was found after the success of Bt cotton, and the evolvement of Bt brinjal (Herring, 2015).

According to sustainable goal 1, 8 which are no poverty and decent work economic growth the cultivation and adoption of Bt cotton has been found to be very influential towards no poverty as it has made gain to economic development so poverty would start to vanish or get eradicated and it would cause a counter-effect towards zero hunger. Decent work and economic growth being a key in all these developments attains a sustainable mark of achievement in fulfilling goal directed activity towards sustainability (SDG,United Nations, envision, 2030).

Beneficial roles of Bt cotton

The yielding attributes of the Bt cotton has marked a new benchmark in the production along with the seed costs, pesticide application. It also increased the employment, education and standard of living quality (Kiresur and Ichangi, 2011). The cultivation of long season Bt cotton and GMO (Genetically Modified Organisms) Bt hybrid cottons is very much popular in India. Pureline line High-Density Short-Season (HD-SS) rainfed varieties are in developmental phase and would be made available which strive to increase yields, reduce variability, decrease cost of seeds,insecticides and thus would enhance the profitability (Gutierrez, 2018). As a major fiber crop cotton has a great importance in the textile factories which also adds to the GDP (Gross Domestic Product) of the country. Btcotton crop uses only45 percent of the total pesticides used in Indian agriculture. In order to reduce the pesticide usage more in cotton several strategies like integrated pest management (IPM), insecticide resistance management (IRM) has been advocated (Yadav *et. al,*2018). A field survey has been done in Karnataka where it included 100 farmers. The Bt cotton technology was accepted by the farmers and the survey report concluded as mentioned by the farmers that the bt cotton gave higher yields, low pest attacks, low insecticidal sprays (Hosmath *et. al*, 2012). Studies portray that if the official adoption of Bt cotton have shown an incredible hike both in production and economy after 2005, then the

unofficial Bt cotton might have also the part of the observed increment of yields in a sequential pattern in the early stages of the era i.e, 2002 which was the official year of Bt cotton introduction in India (Gruere and Sun, 2012). Very minimal amount of variation has been shown in the agronomic performance with the adoption the hybrid technology (Suresh, 2018). As hunger and under nutrition are still the broad range problems in many countries so the technology has depicted positive effects on the upliftment of the food security of all sections of the society addressing the labors, farmers and stakeholders (Kouser and Qaim, 2013). In the state of Andhra Pradesh, family members, input sellers, and TV were the personal and cosmopolite agents along with that mass media sources which were utilized by the farmers regarding Bt cotton cultivation. It was concluded that was a reduction in the cost of cultivation due to Bt cotton cultivation. (Prathyusha *et al*, 2015).

Negative aspects of Bt cotton

In Gujarat, the total cost per hectare is higher in Bt cotton than the hybrid variety (Visawadia *et. al,* 2006). Large scale adoption of the Bt cotton had been found along with this it was observed that Bt crops releases a sort of Bt toxins which lowers the soil chemical and biological activity. Thus, giving an exhaustible symptom to the soil(Singh *et al.*, 2013). Concrete evidences were found that the Bt cotton poses a negligible threat for aphid antagonists and also states that aphids should continue to remain under controlled and natural conditions in the Bt cotton fields (Lawo *et. al,* 2009).A myth in relation to bt cotton has been bought to the mankind which courts that presumptions were being made of the production increment of cotton was due to *Bacillus thuringiensis* cotton but the fact is that genetic engineering had been at a neutral position in the production area and Bt cotton has also put the production of average cotton yields in a static and rigid position (Kuruganti, 2009).

Adoption rate of Bt cotton in India

In Northern India, the farmers having poor gradation of the soil were more keen to adopt the technology of Bt cotton and this was due to the suitability of Bt cotton for such soils which was more stable in accordance or relation to crops like rice. Thus, it was concluded that the diffusion and adoption process of Bt cotton was more likely among small farmers and in less fertile soil (Mal *et. al*, 2013).In some areas of India, it was found that the germplasm can be very much effective in the future production of the hybrid seed (Naik *et. al,*, 2005). Bt caused a hike of 24 pecent in cotton yield per acre through reduced pest damage and a positive financial procurement of 50 percent was being reported in cotton profit among smallholders(Kathage and Qaim, 2012). In a study three cotton growing states were being chosen namely Maharashtra, Andhra Pradesh and Punjab to measure the adoption and uptake pathways of Biotech cotton among farmers. The study intimidated with several outcomes where the adoption has been vastly spread in the irrigated, semi-irrigated and rainfed areas of the respective states. The adoption rate was more than 95 percent (Mayee and Choudhary, 2013).

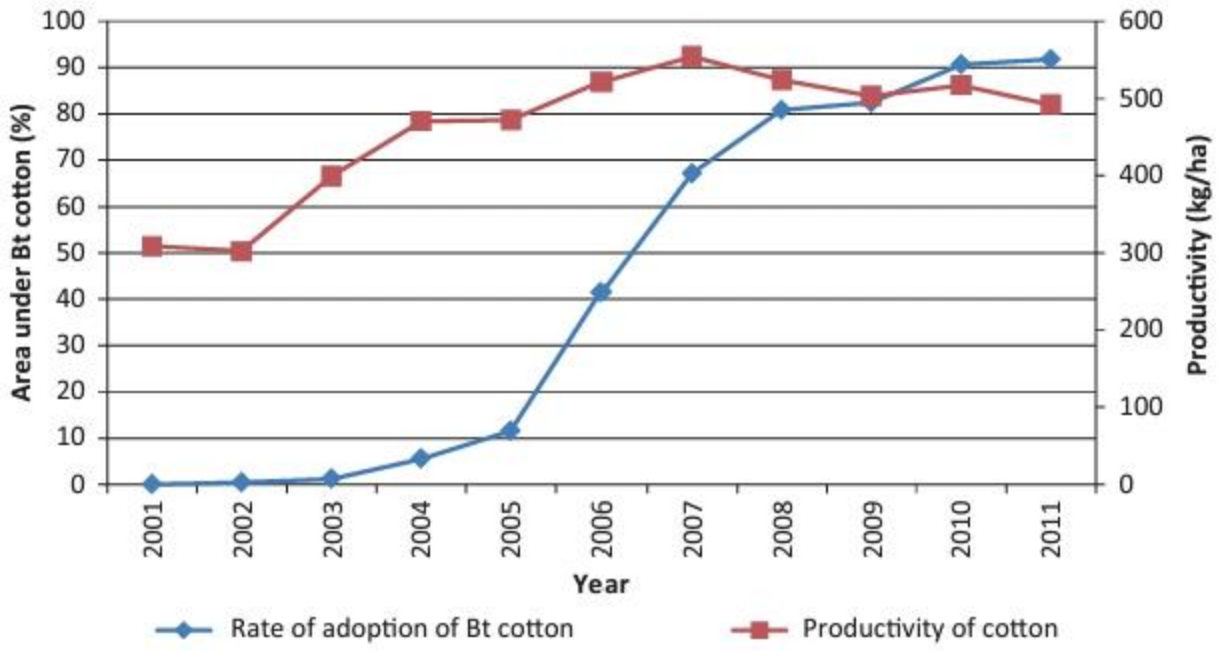

Fig. I. Peshin *et al*. (2014)

The figure shows the rate of adoption of cotton in India. The rate of adoption has formed a typical Roger's "S" Shaped adoption curve. The productivity of cotton has increased drastically by 63 percentage since the introduction of Bt cotton in the year 2002 (Peshin *et al.* 2014).

Conclusion

Policy makers, instructors, media personnel and public analysts have portrayed bt cotton which is a genetically modified crop as a pro-poor success for developing countries (Glover, 2010). Bt cotton has performed well in generating a good stability towards the use of pesticide in the crops and this study on the crop is being proven both theoretically and practically (Qiao *et al.*,2017). In a meta- analysis, both keeping in account regarding the bt cotton and non-Bt cotton farms and also the farmers switching from non-Bt cotton to Bt cotton. The study here explains that the reason regarding the virtual universal adoption of the Bt cotton and also concludes that in the battle of numbers, those of the farmers who were missing (Herring and Rao, 2012). A study surveyed through environmental impact quotient (EIQ). It concluded that high quality Bt seeds have more environmental efficiency than low quality bt seeds (Veettil, 2017).The new technological advancement of the bt cotton was a big gain to the rural sector and bought a drastic positive initiation towards the employment generation (Krishna, 2012). The farm science centres (KVKs), proved itself to be the most influencing in the demonstration of IPM (integrated pest management) of the Bt cotton through training, front line demonstration (FLD), on farm trials (OFT) and other extension activities (Gorfad *et al*., 2017).

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