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Industrial Production of Bacillus Thuringiensis Based Bio-Insecticide: Which Way Forward?

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Editorial

Considering long term negative effect of chemical insecticides on the environment and human health, globally biological pest management has been promoted. *Bacillus thuringiensis* (Bt) is mostly explored and commercially successful microbial insecticide. According to a report, it constitutes almost 2% of insecticide market [1]. There are at least 32 companies involved in Bt based bio-insecticide business [2]. Microbiologically, Bt is gram-positive, facultative anaerobic bacterium most common habitats of which are soil, water or plant surfaces [3]. It can produce almost nine distinct types of toxins, among them δ-endotoxin, which is toxic to a range of insects, is mostly studied for insecticidal application [3]. This type of toxin is also known as Cry protein or Cry toxin and belongs to a family of toxin called pore forming toxins. They can kill the larvae of different insect groups usually by forming pore in mid-gut cell membrane followed by cell-lysis [1]. There are at least 500 known cry gene sequences which are broadly divided into 67 groups named as Cry1 to Cry67 [1]. Expression of the genes encoding Cry toxin are controlled by certain RNA polymerase which is produced during sporulation. Cry toxin production, therefore, coincides with spore formation [2], and hence, achieving high spore count is one of the major targets of Bt fermentation.

Although considerable success has been made, high process is a challenge for industrial production of Bt based bio-insecticide [4]. In this context, waste material such as wastewater sludge has been evaluated for potential application of low cost feedstock. In Figure 1, a pilot scale fermentation unit has been shown which is presently being used for *Bacillus thuringiensis* fermentation using waste material based feedstock. Since, Bt based bio-insecticides are already available in the market, this type of approach will be helpful for further reduction of process cost.

Apart from high process cost, development of transgenic Bt crops carrying toxin producing gene is seen as a challenge for Bt based bio-insecticide industry. These crops have the ability to express toxin protein and thereby the need of an insecticide is minimized. For example, transgenic crops such as tomato, potato, cotton, and rice having the ability to express BT toxin are widely available [2].

However, in addition to regular crops, forest areas are also affected by insects resulting in decline in wood productivity. Therefore, instead of developing transgenic plant, topical Bt spray remains to be the convenient method for this type of use. Application of aircraft to spry Bt based bio-insecticide over continuous forest area of Quebec (Canada) is a notable attempt of its large scale application [5]. Additionally, spraying gives an option to blend more than one type of Bt toxin, and the amount of such toxin can be varied according to the requirement. Thus, industrial production of Bt based biodegradable and safe insecticide has its unique importance in a competitive market.

Figure 1: A portion of the pilot scale fermentation unit presently being used for *Bacillus thuringiensis* based bio-insecticide production at INRS-ETE, Canada.

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