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Sustainable Management of the Corn Borer and Other Emerging Insect Pests of Maize

Maize (*Zea mays L.*) is a unique crop because of its high nutritional value, versatile use and relatively low cost of production. This crop is gaining increasing popularity and government attention in the country Bangladesh for its high yield, high protein content and diverse use as a livestock and poultry feed and in bakery, and, presently, is the second most important cereal crop in the country in terms of acreage and production. However, currently the domestic production of maize can meet only 35-40% of the national requirement and the rest is imported at the expense of valuable hard currency. Insect pest infestation is one of the major factors limiting maize production in the country. Although a dozen major insect pests cause severe damage to maize, the corn earworm and the fall armyworm are especially becoming serious threats for the maize crop. This necessitates the development of eco-friendly IPM based pest control measures. This KGF sponsored project addressed the issues of development and validation of IPM technologies for maize pest control, and awareness creation, information dissemination and access to information on the topic of sustainable management of maize insect pests.

Methodology

The project was implemented jointly by the Dept of Entomology, BAU, Mymensingh and Social Advanced Council (SAC), Gaibandha, an NGO. On-station research was conducted at BAU and on-farm and validation trials were in Chuadanga, Gaibandha and Mymensingh in a farmer participatory approach. Incidences of maize pest complex and prevalence of natural regulatory forces in the ecosystem were studied in the project areas (Mymensingh, Chuadanga and Gaibandha) to assess the relationship between the maize pests and their natural enemies. Studies on the baseline toxicity of insecticides were conducted including two diamide products namely, clorantraniliprole (Coragen) and flubendiamide (Belt 25WG). Experiments on the

Fig. 1. Laboratory tests on the effect of various insect pests on maize and field evaluation of IPM packages

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effectiveness of cultural, mechanical means and efficacy of bio-rational measures and chemical pesticides on the management of major maize insect pests were conducted (Fig. 1) to develop new IPM packages. Small scale farm level validation trials of different IPM technologies were conducted in farmers' fields in Mymensingh, Chuadanga and Gaibandha districts in collaboration with the Department of Agriculture Extension (DAE). Up-scaling of developed technologies in farmers' fields of Chuadanga and Gaibandha through economic analysis of all the developed was done. Several training sessions and field days were arranged for capacity building of 600 individuals including farmers and extension officials.

Results and Outputs

A questionnaire-based farmers' field survey and direct observations revealed that, among a dozen of major insect pests identified from different parts of the country, the corn borer (CB) (*Helicoverpa zea*), the cutworm (*Agrotis ipsilon*) and the Fall Armyworm (FAW) (*Spodoptera frugiperda*) were the emerging pests causing significant damage to the maize crop. Intensive cropping, human interventions, and climate change appeared to be playing a role in increasing the insect population in maize. The cutworm was a major problem in the very early maize growth stage and the other two pests caused damage throughout the growing period. Incidences of the maize pests complex and prevalence of natural enemies in the ecosystem were documented, and several predators, especially, the spider and the parasitoid Bracon were found to be common natural enemies of maize insect pests. The relative abundance of insect pests of maize in Bangladesh is presented in Fig 2. The invasive pest FAW has established itself as a major insect pest in the ecological conditions of Bangladesh.

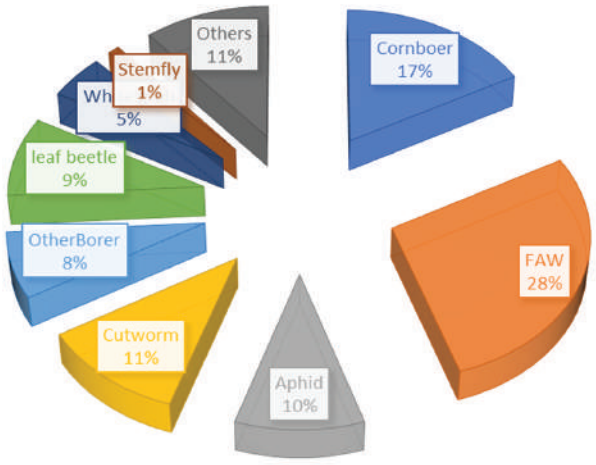

Fig. 2. Relative abundance of insect pests of maize in Bangladesh

All the 12 maize varieties tested were found to be susceptible to the major insect pests. However, the varieties, Alpha Seed and Super 42, had a comparatively low pest infestation. A single flood irrigation after 3 to 4 days of germination provided good protection of the maize seedlings from the cutworm.

The baseline toxicity of commonly used insecticides was measured to assess the level of susceptibility of CB to the particular product. The toxicity ratio was higher for Chlorantraniliprole and Flubendiamide than that for the three bio-based pesticides, Spinosad, Emamectin and Lufenuron while the conventional pesticide Clhoropyriphos was documented with the lowest toxicity ratio indicating a high toxic effect against CB in the three project areas. Diamide was found to have a relatively low disruptive effect on the natural enemies of the maize insect pests.

Corn may be protected effectively from the attack of two major insect pests if insecticides are applied at or before the silking stage, the corn growth stage most preferred by CB and FAW. The mixed molecule insecticide thiamethoxam 20% + chlorantraniliprole 10% was found more effective against CB. Spinosad and Emamectin benzoate were found as very effective against CB and FAW. The biocontrol agent *Bracon hebetor* prefers aged CB and FAW larva for

parasitism. *Bracon* at variable parasitoid-host ratios indicated a clear density dependent parasitism. The bio-pesticide Bt, HNPV and emamectin benzoate proved to be ecofriendly for their low toxicity to the parasitoid compared with the frequently used Thiamethoxam 20% + Chlorantraniliprole 10% and Chlorpyriphos 50% + Cypermethrin5%. The bio-pesticide Bt @ 1.5 g/L and HNPV @ 0.3 g/L provided a mortality of 67 and 54% respectively indicating their potentiality to be used in IPM against CB. The *Spodoptera nucleopolyhedral* virus (SNPV) @ 0.3 g/L was found to be a promising bio-pesticide against FAW.

On the basis of the findings mentioned above, seven IPM packages namely, T1 = habitat management (V2) + pheromone trap + *Brancon hebetor* (V4_V6), T2 = variety + weeding (V2) + pheromone trap + Bt + metarhizium (V4_V6), T3 = clean cultivation + irrigation + emamectin benzoate + Lufenuron (V3, V6), T4 = variety + Bt + Spinosad, T5 =habitat management + irrigation + Bt, T6 =weeding + Bt + SNPV (V4_V6, R1), T7 = ASEA + ETL based application of Voliam Flexi/Virtako. All the seven IPM packages were farmer friendly. An economic analysis of the seven IPM packages for major maize pest management at three locations showed that they were more economic compared to non- IPM practices (Fig. 3). A yield increase of 13.8 to 49% occurred with IPM packages over non-IPM approaches resulting in a 14 to 59% reduction in pest management costs. The technologies were disseminated widely, with great success, across Chuadanga and Gaibandha supported by a ToT program and demonstration of IPM technologies including massive release of parasitoids and organizing field days. The IPM package T_1 with *Bracon* as a major component could be considered for recommendation as reflected from the BCR (Fig. 3). A single application of the parasitoid provided a good control with 20% yield increase.

Expected Impact

The findings of this project are expected to impact maize productivity, policy, society, economy, and the environment of the country. Damaging insect pests including the invasive FAW will be reduced contributing to increased maize production in the country. The government, DAE, NGOs, and input dealers may rethink about policies and measures to combat maize pests with a new IPM approach. The country's overall maize production will increase permitting a cut down in maize imports which is expected to improve the farmers' and the country's economic conditions. The farmers' attitude towards "mindless use of chemical pesticide spraying" will be changed and they will consider using bio-intensive packages and IPM for management of maize pests which will have a positive impact on the environment,

Recommendations

- The new IPM technology should be promoted as a national program for better and safe maize production throughout the country
- Insecticides and bio-agents should be chosen based on the preliminary toxicity ratio otherwise they would develop resistance quickly, and impede their integration
- There are many natural indigenous regulatory forces of FAW and CB along with Bracon and three pathogens; these should be explored further, and commercial technology for mass rearing of natural enemies should be developed and used
- Research needs to be continued to develop and validate more ecofriendly technologies for the notorious pests like FAW.

This Technical Bulletin has been prepared on the basis of technical information available from a completed BKGET-KGF Funded CGP Project, the details of which are given below:

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