ACTA SCIENTIFIC AGRICULTURE (ISSN: 2581-365X)

Volume 3 Issue 6 June 2019

Review Article

Integrated Management of Fruit Borer (*Helicoverpa armigera*) of Tomato in Nepal

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Received: March 12, 2019; **Published:** May 09, 2019

DOI: 10.31080/ASAG.2019.03.0472

Abstract

Tomato is one of the major vegetable crops of Nepal. It is one of the major sources of income for small farmers. However, it is attacked by many insects and *Helicoverpa armigera* is one of the major insect of Tomato in Nepal. Tomato growing farmers of Nepal apply exceptionally higher amount of chemical insecticide. Chemical management of *Helicoverpa* is increasing in alarming rate which is threat to human health and agro-ecosystem. On the other hand this practice has led to development of resistant pest. Thus, there are increasing concern to develop sustainable management strategies that rely less on chemical pesticides. Achieving such a magnificent goal requires in depth knowledge about biology and method of spread of pest. Management of *Helicoverpa* requires an integrated pest management method which aims in producing healthy crops and maintaining better sustainable agro-ecosystem. Integrated pest management aims to maintain pest population below economic injury level. It is an integration of appropriate measure that inhibits the development of pest population. Integrated pest management aims to grow healthy crops with least damage to agro-ecosystem. *Helicoverpa* can damage 90% of fruit and reduce yield by 30-40%. Resent research have been made in biological and cultural management of *Helicoverpa* but development of resistant variety is best option. Flubendiamide 40SC@0.21ml/ltr and Emamectinbenzoate are best chemical whereas Trichogramma @30cards/ha, Helionucleo polyhedrosis and neem based pesticide are best biological method for the pest management. LA1230 is most resistant cultivar of tomato for *Helicoverpa* management. Three times weeding, three times handpicking and indoxcarb @ 370 ml/ha is most effective for management of *Helicoverpa* larva but hand picking is best from economic point of view. Light trap and pheromone trap is another best option for monitoring of adult.

Keywords: *Helicoverpa armigera*; Integrated Management

Introduction

Tomato (*Lycopersicum esculentum*) belongs to family Solanaceae and is native to tropical America [1]. Among different vegetable crops tomato has emerged as leading vegetable of Nepal. Tomato is important source of vitamins and minerals [2]. It is used in making soups, ketchup, pickles, juices and sauces [3]. The production and marketing of tomato is getting commercial in Nepal. It is cultivated during spring and rainy season in hills whereas winter in Terai [4]. Tomato is cosmopolitan in distribution but China, India and USA are leading tomato producers. Tomato production in world is 170.8 million ton, china contributing 31% followed by India, US and Turkey [5]. In Nepal, tomato is cultivated in 17,273 hectare with 13.5 metric ton/ha productivity and 2, 32,897 metric ton production [6]. Tomato fruit borer (*Helicoverpa armigera*), polyphagous pest which feeds on more than 15 crops [7] causes great damage on tomato in Nepal [8]. *Helicoverpa* cause 90% damage to fruit which is of up to 3.48% of economic damage level. Fruit damage results into disfiguration of surface, rotting through secondary infection by bacteria [9]. There are several biotic and abiotic factors which has limited the production of tomato. Pesticide use in vegetable and fruit per year in Nepal is increasing at 10-20% [10]. Nepal consumes low quantity of pesticides as compared to other south Asian countries but commercial vegetable grower apply exceptionally higher dose of pesticides (142 gm a.i./ha) [11]. Chemical pesticide consumption in Nepal is 396 gm a.i/ha [12]. Nepalese farmers use more than 90% of total pesticide in vegetable farming [13]. Adverse effect of pesticide on human health is more common in less developed countries like Nepal [14]. Over use of chemical pesticides contaminate ground water, soil, reduce soil fertility and soil micro-organism [15]. Thus, integrated

pest management is alternative to chemical management [16]. Therefore, relevant literatures were gleaned and overviews prepared for the management of *Helicoverpa* in this crop.

Materials and Methods

Information related with management of tomato was collected from the available literature including problem identification, Significance of the pest, pest biology and IPM measures. Pertinent information was arranged systematically and findings from them are summarized, briefed in texts and table with conclusion.

Insect pest problems

- **Problem Identification:** Under field observation, Potato flea beetle (*Epitrix cucumeris*), Wire worm, Stink bugs, Thrips, Aphids (*Macrosiphum euphorbiae*), cutworms (*Agrotis*), Tomato pinworm, hornworm (*Manduca sexta*), Cabbage Looper, Tomato fruitworms and Leaf miners (*Lyriomyza*) were observed in tomato [17]. Tomato fruit borer (*Helicoverpa armigera*) is one major biotic constraint in tomato production in Nepal [18]. Different insect pests have been reported in tomato from Nepal, tomato fruit worm has been identified as the most destructive insect pest.
- **Loss assessment:** *Helicoverpa armigera* is polyphagous [19] and attacks more than 200 species [20]. *Helicoverpa* can damage 90% of tomato fruit. *Helicoverpa* damage fruit by disfiguration of surface, rotting through secondary infection [9]. Larva feeds by forming which act as source for microbial attack resulting in development of disease [21].

AVRDC acession no	Species identification	Fruit damage (%)
L34	*Lycopersicon esculentum*	19.9
L43	*Lycopersicon esculentum*	50
L124	*Lycopersicon esculentum*	31
L139	*Lycopersicon pimpinellifolium*	3.7
L181	*L. esculentum var. cerasiforme*	2
L593	*L. peruvianum*	2.7
L677	*lycopersicon pimpinellifolium*	1.3
L690	*Lycopersicon peruvianum*	3.1
L697	*L. pimpinellifolium*	4.5

Table 1: Level of fruit damage by *Helicoverpa armigera* in various Tomato species.

Source: [22]

Significance of the pest

Tomato fruit worm (*Helicoverpa armigera)* is one of the destructive pest in Asia and highly destructive in Nepal, India, Philippines, Thailand and Taiwan [22]. In Nepal recently it has been reported more frequently in rainy season [20].

INTEGRATED MANAGEMENT

Integrated pest management also known as integrated pest control is an economically justified and sustainable system that integrates all available pest control techniques in such a way that leaving least possible adverse consequences to human health, environments and crops. Since 1983, IPM is promoting in nine countries in south and south-east Asia by the United Nations Food and Agricultural Organization (FAO) [23]. In Nepal, IPM was initiated in 1997 A.D as IPM-Farmer Field School in support of Food and Agriculture Organization (FAO) [24]. The Tenth five year plan gives priority and states that IPM will be promoted so that excessive dependency on chemical pesticide gets reduced [25]. Government of Nepal has promoted intregated pest management practice [26].

- **Use of botanical materials:** The botanical materials are natural products which can be used even in their crude form. Mainly botanical materials are nontoxic to non-targeted pest and have multiple uses. Neem (*Azadirachta indica* A. Juss) and Neem based products are mainly used botanical materials by farmers for *Helicoverpa* management. Neem derivatives works as a repellent, growth disturbance, antifeedants and phagodeterrance in insects [27]. Neem product have found act as deterrents of oviposition for *H. armigera* [28]. Azadirachtin, salanin and meliantriol are chemical compounds found in seed kernel of Neem which attributes bitter principle thus they shows deterrents effects [29]. Azadirachtin is an active ingredient which is available in emulsified form in Neem based pesticide, reduces ecdysone hormone which disrupt molting process [30].
- **Cultural Practices:** Cultural manipulation is one of the elementary procedures which create hygienic condition in field that is unfavorable for pest development. Hand picking is a traditional practice for removing large size larvae and infested fruits [31]. Three times weeding, three times handpicking and indoxcarb @ 370 ml/ha is most effective for management of *Helicoverpa* larva but hand picking is best from economic point of view [32]. Deep ploughing during summer reduces number of pupa whereas fall

ploughing reduces the number of overwintering population of *Helicoverpa* [32]. Early sowing, balance dose of fertilizer application, better intercultural operation and irrigation practice reduce no of *Helicoverpa* in tomato field. Strip cropping or Inter cropping with marigold, wheat, sunflower, sesame, soybean, cowpea and mungbean reduce *Helicoverpa* infestation in tomato [33].

- **Monitoring:** Pheromone trap is effective *Helicoverpa* monitoring tools among various monitoring techniques [34]. Moth becomes active at March-April which coincides with fruiting period of tomato. Thus, monitoring of *Helicoverpa armigera* in that period gives fruitful results [19]. Adult is nocturnal in nature so that it can be monitored through light traps [35].
- **Resistant variety:** Resistant genotypes are best for insect pest management [36] but in tomato these genotype are not widely used. Several genotype of chickpea, cotton and pigeonpea have shown high level of resistance. Earlier, in United States, *L. esculentum var. cerasiforme* (LA1310 and LA 1320) accessions and commercial cultivers (Tiny Tom) are resistant to *Helicoverpa armigera* [37].

Cultivars	Fruit damage(%)
LA 1310	5.08
LA 1320	2.02
Tiny Tom	25.61
CL 5915	8.02

Table 2: Level of fruit damage by *Helicoverpa* in different cultivar of tomato.

Source: [37]

Chemical management

Farmers depend on chemical pesticides for production of Tomato in Nepal. Use of modern agrochemicals have invaded and destroyed traditional integrated pest management systems [38]. Insecticides such as Synthetics Pyrethroids, Fenvalerate, Deltamethrin, Cypermethrin, Endosulphan, Methyl parathion, Phosphamide etc have been used in various concentrations for management of *H. armigera* [39] but endosulsulfan is most effective among them [22]. Application of endosulphon has increased 92% yield of tomato than non application. Flubediamide and Emamectin benzoate are novel insecticide for *Helicoverpa* management [40]. Experiment conducted by Regmi., *et al*. in Chitwan, Nepal concluded that Flubendiamide 40SC @ 0.21ml/ltr is most effective against Helicoverpa [41].

Biological management

The major microorganisms causing diseases in *H. armigera* are bacteria, fungi and virus [42]. They may cause diseases that kill insects, reduce their growth and development. Microbial agents are effective, less expensive and environmentally friendly. Microbial agents are best IPM practices among others, however very little work has been done in Nepal [43]. Entomopathogenic fungus have been used in management of *Helicoverpa* [44]. Several Bt formulations such as Biolep, Dipel, Lipel are most effective against *H. armigera* management [45]. More than 350 viruses cause disease to 400 arthropod species. Majority of the virus cause disease to Lipidoptera, Coleoptera and Diptera. The best known virus for management of *Helicoverpa* is Helicoverpa Nuclear Polyhedrosis Virus (HaNPV) [46]**.** *Bacillus thuringiensis* K. @ 3 g per liter of water is effective for management of *Helicoverpa* [45]. *Hyposoter exiguae* is a parasite of *H. armigera* [35]. The augmented release of *T. chilonsis* @ 30 cards/ha was found effective against *Helicoverpa* [47]. [48] recorded that, mass release of *Trichogramma pretiosum* was most effective against *H. armigera* in southern california.

Family	Predators and parasites
Trichogrammatidae	*Trichogramma pretiosum*
Ichneumonidae	*Hyposoter exiguae*
Ichneumonidae	*Campoletis chlorideae*

Table 3: Predators and parasite of *Helicoverpa armigera.*

Source: [17]

Treatment	Marketable yield (ton/ha)	Bored fruits (ton/ha)
Control	17.1	17.75
Trichogramma	31.23	2.25

Table 4: *Trichogramma* in *Helicoverpa* management**.**

source: [47]

Conclusion

Tomato producing farmers of Nepal apply exceptionally higher amount of insecticide which is gigantic threat to human health and environment. Integrated pest management aims to grow healthy crops with least damage to agro-ecosystem., therefore knowledge of IPM must be disseminated to farmers growing tomato.

Flubendiamide 40SC @0.21ml/ltr and Emamectinbenzoate are best chemical whereas Trichogramma 30 cards/ha, Helionucleo polyhedrosis and extract of neem are best biological method for the pest management. LA1230 is most resistant cultivar of tomato for *Helicoverpa*. Three times weeding, three times handpicking and indoxcarb @ 370 ml/ha is most effective for management of *Helicoverpa* larva but hand picking is best from economic point of view. Thus, hand picking is best for small and marginalized farmers of Nepal. Light trap and pheromone trap is another best option for monitoring of adult.

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Volume 3 Issue 6 June 2019