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Insect pest issues and their long-term trends in vegetable crop losses: A review

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Abstract

The world population has been growing at an uncontrollable rate, and the green revolution has undoubtedly increased global food supplies. However, in addition to degrading the environment, it has resulted in increased pest losses. In the twenty-first century, the insect pest problem in agriculture has undergone a significant shift.With changes in cropping patterns, prudent pesticide use, climate change, and the introduction of input-intensive high-yielding varieties. Many pests have broadened their host range and developed pesticide resistance. Exotic pests are being introduced. In India, many pests are major biotic constraints to vegetable production. The loss caused by insect pests is estimated to be 30-40%.We discuss major insect pests of vegetable crops in this review paper. Growers must quickly identify insect problems and implement early control measures to prevent pests from becoming out of control.

Keywords: emerging insect pest, vegetable, crop loss, food.

INTRODUCTION

Insects are the most successful group of living fauna at earth. They constitutes about three fourth of the total organism present on earth (Pedigo, 2002). Insects account for 4-8 million of the world's estimated 5.57-9.8 million animal species (Mammond and May 1995). Insect pests are insects that cause damage to crop plants. Insects that cause five to ten percent crop loss are classified as minor pests, while those that cause more than ten percent crop loss are classified as major pests (Dhaliwal at el., 2010).The pest whose status has been changing from minor to major are called as emerging pests (Rathee and Dalal, 2018). They cause plant damage in a variety of ways. Insect damage can range from reduced plant vigor to plant death, resulting in significant crop losses. Insects harm plants by chewing foliage, sucking juices, laying eggs, and transmitting diseases. Insect pest losses in Indian agriculture have been estimated on a regular basis.The first attempt to estimate crop losses due to various pests on global scale was made by Cramer (1967). Subsequently, Oerke et al. (1994) made extensive study to estimate losses in principal food and cash crops. Despite widespread use of synthetic pesticides and other control measures, losses due to insect and mite pests increased in the post-green revolution era (Oerke et al.,1994) compared to the pre-green revolution era (Oerke et al.1994). In the post-green revolution era, losses due to insect and mite pests increased more than in the pre-green revolution era (Oerke et al., 1994).

LONG TERM TRENDS IN VEGETALBE CROPS DUE TO INSECT PESTS

Vegetable crops occupy an important status in the agricultural economy and form an essential component of the diet. Theses vegetables provide adequate quantities of vitamins, proteins, carbohydrates and minerals. The nutritional contents of vegetables vary considerably, though generally they contain little protein or fat, and different proportions of vitamins such as vitamin-A, vitamin-k &vitamin b-6, pro-vitamins, dietary minerals and carbohydrates. Vegetables contains a great variety of photo-chemical, some of which have been claimed to act as antioxidant, antibacterial, antifungal, antiviral and anti-carcinogenic properties. Some vegetables also contains fiber that is important for gastrointestinal.

Some of the insect pests of vegetable crops become major and are gradually attaining the major pest status in different regions of the country due to changes in the ecosystem and habitats.The pest reported from an area on a particular crop whose population has been increasing considerably over a period of time causing or likely to cause economic damage is termed as an emerging insect pest.

An already known insect pest whose incidence or geographical distribution has been increasing notably, or a newly described indigenous or invasive species is also designated as an emerging insect pest. In other words the pest insect whose status has been changing from minor to major or secondary to primary pest is termed as an emerging insect pest. The insect pests scenario in north plains of India changed due to impact of global climate change. The insect pests like *Helicoverpaarmigera* on vegetables, pulses and seed crops, *Spodopteralitura*on vegetables have become increasingly severe during last decade (Arora and Dhawan, 2013).

Insect pests attack crops in a variety of ways, with each pest targeting a different part of the plant. Few insect pests attack two or more crops at the same time. Insect pests can harm vegetables in a variety of ways. Feed on leaves, suck sap from plants by piercing the epidermis, and harm vegetables by sucking plant juices from leaves, stems, and roots, for example. Some of these insects secrete poisonous saliva, which they inject into plants (Potato leap hopper). Adult mites spin webs and lay eggs on the underside of the leaf. Chewing insects obtain their food by chewing off the outside of plant parts. Caterpillars, the larval stage of moths and butterflies, wreak havoc on the foliage and fruit of a variety of vegetables. Beetles cause more damage to seedlings and young plants than other insects.

Bhat (2020) conducted a study about bio-diversity of lepidopteron pests and their natural control and observed 28 species of lepidopteron pets cause damage in vegetable crops of Jammu and Kashmir.

Borkakati et al. (2019) investigated the insect pest of brinjal and observed that six insect species under the three orders and three families were observed.

Rathee and Dalal, (2018) studied many pests which can be considered as many emerging pest. Insect pests on an average are estimated to cause 15-20% yield losses in principal major food and cash crops. Pest whose status has been changing from minor to major or secondary to primary pest is termed as an emerging pest. *Bemisiatabaci* (Gennadius) on cotton, *Helicoverpaarmigera* (Hubner) on vegetables and pulses, *Spodopteralitura*(F.) on vegetables, cotton and oilseeds, *Pierisbrassicae L.* on crucifers, have become increasingly severe during last decade. Increasing incidence of aphid complex, comprising of *Sitobionavenae (F.)*, *Rhopalosiphummaidis (Fitch)* and *Schizaphisgraminum (Rondani)* is now observed on wheat, barley and oat. Mites of the Eriophyiidae and Tetranychidae family have emerged as major pests of bean, brinjal, cotton, cucurbits, okra, apple, ber, citrus and mango in Northern India.

Sharma et al. (2017) reviewed crop losses in rice, wheat, maize, sorghum, oil seed, cotton, sugarcane and vegetables. Yield losses due to major insect pest in Indian crop are as shown in figure 1. The maximum yield loss by insect pest in cucurbits followed by cabbage, brinjal, chilli, tomato, okra and potato. As many insect pests attack vegetables, it becomes clear that maximum crop loss takes place in cucurbits that is 100% loss, cabbage loss is nearly same as 99%. Loss of chilli crop is 90% which is less than the brinjal that is 93%. Loss of the tomato crop is 73% followed by okera 66% and potato is least infected by insect pest that is 27 (Figure 1).

Dhaliwal et al., (2015) studied the global losses due to insect pests have declined from 13.6% in post-green revolution era to 10.8% towards the beginning of this century. In India, the crop losses have declined from 23.3% in post-green revolution era to 15.7% at present.

Sarwar (2014), studied winter vegetables and its pests, the frequently seen pests are of order Lepidoptera, Homopetera, Hemiptera, Coleoptera, these pests cause so many changes in vegetables plants and also effect the crop production.

Rai et al. (2014) studied with changes in the cropping pattern, ecosystems and habitat, climate, and introduction of input intensive high yielding varieties/hybrids, a shift in pest status has been realized in time and space. Many pests have expanded their host horizon, developed resistance to pesticides and often there are secondary out breaks. Fruit fly causes the most damage to cucurbit cops, as shown in Table 1. Diamondback moth, one of four cabbage pests, is also a very destructive pest, causing a 29 percent crop loss. Thrips, a chilli pest, causes more damage than mites. The more serious pest of brinjal is the fruit and shoot borer [*Leucino dsornonals*], which causes a 93 percent loss. *Helicoverpa armiera* cotton ballworm also causes significant damage to tomato crops. Lea has annihilated okra. Figure 2 shows that the Fruit fly causes the most damage, followed by the Aphid, which causes the least.

Losses due to insect pests in Indian agriculture have been estimated from time to time (Pradhan, 1964; Krishnamurthy and Murty, 1983; Atwal, 1986, Jayaraj, 1993; Lal, 1996; Dhaliwal and Arora, 1996, 2002; Dhaliwal et al., 2003, 2004). In general, the losses in post-green revolution era (Dhaliwal et al., 2004) have shown an increasing trend than in the pre-green revolution era (Pradhan, 1964).

Overall losses increased from 7.2 percent in the early 1960s to 23.3 percent in the early 2000s, according to table 2 and figure 3. Cotton experienced the greatest increase in crop loss (18.0 to 50.0%), followed by sorghum and millets (3.5 to 30%), maze (5.0 to 25.0%), and oil seed (5.0 to 25.00%).

CONCLUSION

Insect pest infestation is discovered to be a major factor in crop quality and quantity reduction. Many insects' status is changing as biotic and abiotic factors change. Crop losses due to insect pests increased after the green revolution compared to the pre-green revolution era. Crop losses are widely assumed to be increasing due to increased cultivation intensity, extensive use of agrochemicals, and other factors.

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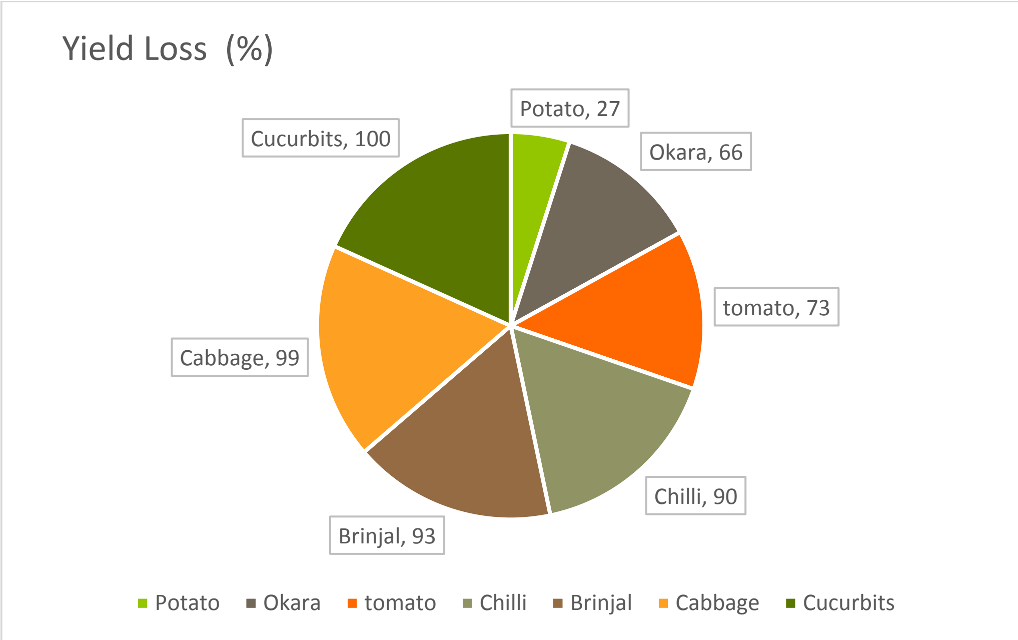

Figure1: Vegetable Yield Crop Losses by Insect Pest

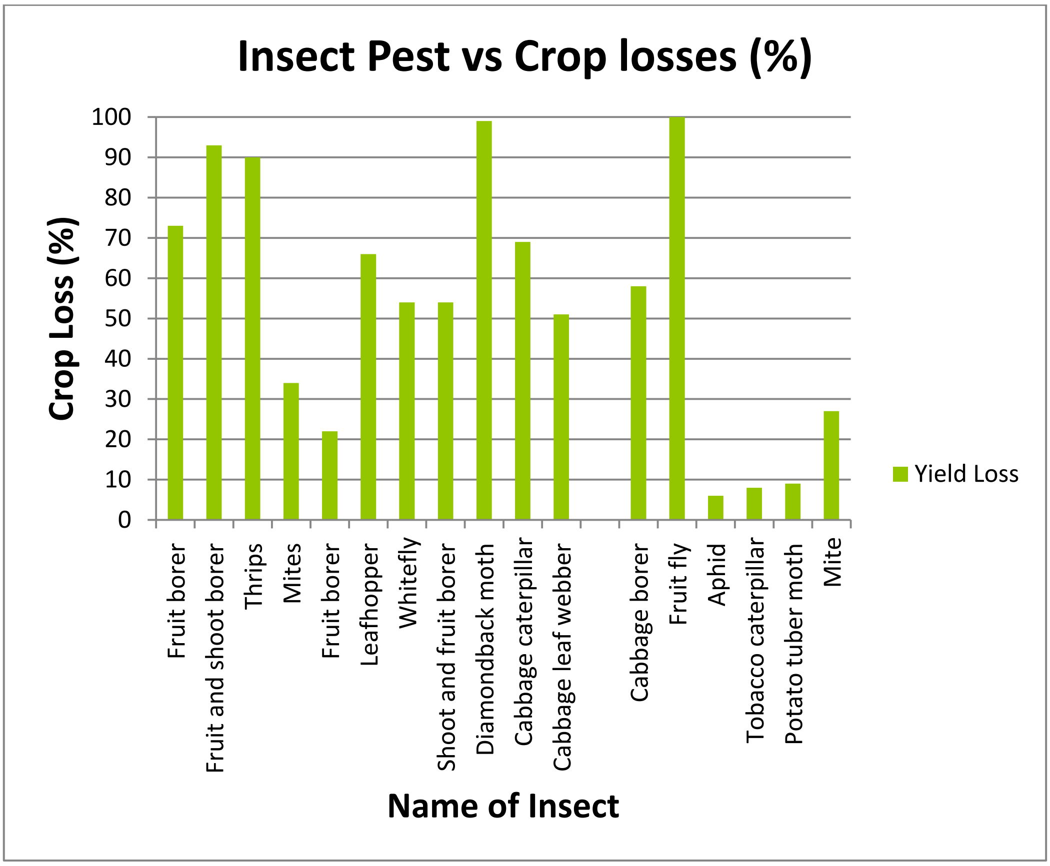

Figure 2. Insect Pest vs Crop losses (%) Source: Modified Rai at el. (2014).

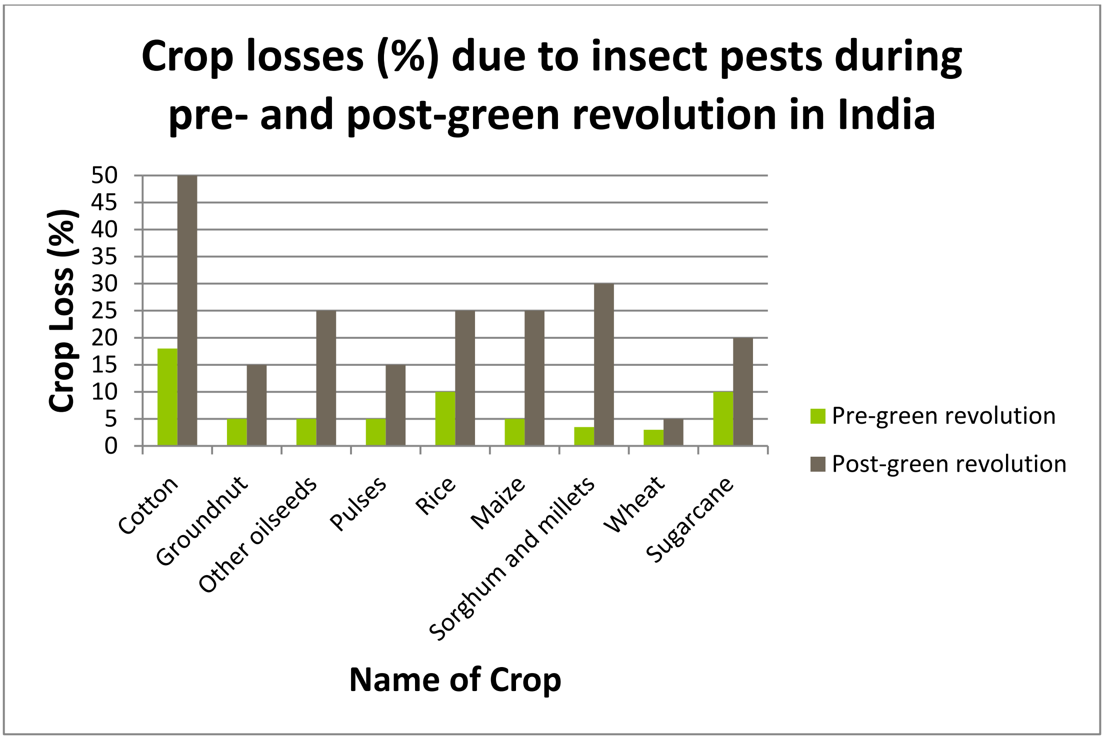

Figure 3. Crop losses (%) due to insect pests during pre- and post-green revolution in India

Table 1. Insect Pest vs Crop losses (%)

Pest	Yield loss (%)
Helicoverpa armigera	24–73
Leucinodes orbonalis	11–93
Scirtothrips dorsalis	12–90
Polyphagotarsonemus latus Banks	34
Helicoverpa armigera	22
Amrasca biguttula	54–66
Bemisia tabaci	54
Earias vittella	23–54
Plutella xylostella	17–99
Pieris brassicae	69
Crocidolomia binotalis Zeller	28–51
Hellula undalis	30–58
Bactrocera cucurbitae	20–100
Myzus persicae Sulzer	3–6
Spodoptera litura	4–8
Phthorimaea operculella Zeller	6–9
Polyphagotarsonemus latus	4–27

Source: Modified Rai at el. (2014).

Table 2. Crop losses (%) due to insect pests during pre- and post-green revolution in India

Crop	Pre-green revolution (early 1960s) (1)	Post-green Changes revolution 2000s) (2)	Changes in loss (2-1)
Cotton	18.0	50.0	+ 32.0
Groundnut	5.0	15.0	+ 10.0
Other oilseeds	5.0	25.0	+ 20.0
Pulses	5.0	15.0	+ 10.0
Rice	10.0	25.0	+ 15.0
Maize	5.0	25.0	+ 20.0
Sorghum and millets	3.5	30.0	+ 26.5
Wheat	3.0	5.0	+ 2.0
Sugarcane	10.0	20.0	+ 10.0
Average	7.2	23.3	+ 16.1

Source: Dhaliwal et al. (2007)

Table 3. Changing pest scenario in vegetable crops in India

Insect Pest	Major host	Presently infesting	Reference
Serpentine leaf miner, Liriomyzatrifolii (Burgress)	Tomato	Brinjal, Cow pea, French bean, Squash, Leafy vegetables, Cucurbits	Srinivasan et al. 1995
Spiraling whitefly	Guava, Citrus, Tapioca	Bhendi, Capsicum,	Puri et al. 2000
Aleurodicusdispersus Russell		Brinjal, Tomato	Mani, 2010
Mealy bug, Phenacoccus	Cotton	Brinjal, Tomato, Chilli,	Chaudhary, 2006;
solenopsis Tinsley		Okra, Cucumber, Pumpkin	Halder et al. 2013
Hadda beetle, Henosepilachnvigintioctopunctata Fab.	Brinjal	Bitter gourd, Cow pea	Rajapaske et al. 2005
Fruit borer, Helicoverpaarmigera (Hubner)	Gram, Cotton, Tomato, Cabbage	Peas, Chilli, Brinjal, Okra	Puri et al. 2000
Gall midge, Asphondylia, capparisRubsaman	Brinjal	Chilli, Capsicum	David, 2006; Nagaraju, 2000
Cabbage butterfly, Pieris brassicae Linn.	Cabbage, Cauliflower Mustard	KnolKhol, Radish	Puri et al. 2000
Stem fly, Ophiomyiaphaseol (Tryon)	Beans	Okra	Patil&Jamadgni, 2008
Red spider mite, Tetranychusurticae Koch.	Okra, Brinjal	Cucumber, Cowpea, Indian bean	Mahto&Yadav., 2009
Plume moth, Sphenarchescaffer Zeller	Field bean	Bottle gourd	Halder et al. 2014
Leafhopper, Empoascamotti Singh-Pruthi		Bitter gourd	Puri et al. 2000