



Original Article

Decrease in Disease Resistance in High Yielding Varieties and the Impact of Pink Bollworm on Cotton Cultivation in Dhule District, Maharashtra

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Abstract

Agricultural biodiversity plays a critical role in sustaining crop productivity and maintaining ecological balance. Traditional indigenous crop varieties have historically shown greater resilience to pests and diseases due to their broader genetic base and adaptation to local environmental conditions. However, the widespread adoption of high yielding varieties (HYVs) in modern agriculture has resulted in increased vulnerability to pests and diseases. Climate change has further intensified this problem by altering ecological relationships among crops, pests, weeds, and pathogens. This study examines the decline in disease resistance in high yielding crop varieties and analyzes the impact of the Pink Bollworm infestation on cotton cultivation in Dhule district, Maharashtra, during the agricultural year 2017–2018. The study focuses on tahsil-wise distribution of affected areas and farmers and evaluates the socio-economic consequences of pest infestation. Results indicate that nearly 90 percent of cotton cultivation areas and farmers in the district were affected by Pink Bollworm, with Shindkheda tahsil reporting complete infestation. The study highlights the need for improved pest management strategies, climate-resilient farming practices, and sustainable agricultural policies to protect farmers from future losses.

Keywords: Agricultural biodiversity, High yielding varieties (HYVs), Indigenous crop varieties, Disease resistance, Genetic diversity, Agricultural sustainability

Introduction

Agriculture has always been closely linked with natural ecosystems. Traditional agricultural systems relied heavily on indigenous crop varieties that were well adapted to local climatic and environmental conditions. Crops such as Jowar, Bajra, Wheat, Rice, Pulses, Cotton, and various fruit crops have coexisted with regional ecosystems for centuries. These indigenous varieties possess a broad genetic base that allows them to tolerate diseases, pests, and climatic variability. However, the introduction of high yielding varieties during the Green Revolution significantly changed agricultural practices in India. While these varieties helped increase food production and ensured food security, they also created new ecological challenges. High yielding varieties often possess a narrow genetic base, making them more vulnerable to pests and diseases. Unlike indigenous varieties, they require continuous improvement and careful management to maintain productivity. In recent decades, climate change has further complicated agricultural sustainability. Changes in rainfall patterns, rising temperatures, and increased climate variability have affected crop growth and pest populations. These changes have resulted in the emergence and spread of new pests and diseases that threaten agricultural production.

One such example is the outbreak of Pink Bollworm in cotton cultivation in Maharashtra. Cotton is an important cash crop in the state and contributes significantly to farmers' income. However, during the agricultural years 2016–17 and 2017–18, cotton crops in several districts of Maharashtra experienced severe infestation by Pink Bollworm. Dhule district, located in the northwestern part of the state, was among the regions most affected. This research paper examines the decline in disease resistance in high yielding crop varieties and investigates the impact of Pink Bollworm infestation on cotton cultivation in Dhule district during the year 2017–2018.

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Objectives of the Study

The main objectives of this study are:

- To examine the relationship between crop genetic diversity and disease resistance.
- To analyze the role of climate change in influencing pest outbreaks in agricultural ecosystems.
- To study the impact of Pink Bollworm infestation on cotton cultivation in Dhule district.
- To analyze tahsil-wise distribution of affected areas and farmers.
- To suggest measures for improving pest management and sustainable agricultural practices.

Study Area

Dhule district is located in the northwestern region of Maharashtra state in India. The district lies between the Tapi River basin and the Satpura mountain ranges. Agriculture is the primary occupation of the population, and cotton is one of the most important commercial crops grown in the region.

The district consists of four major administrative subdivisions (tahsils):

Dhule, Sakri, Shindkheda, Shirpur

Cotton cultivation in the district is carried out under two main agricultural systems:

Jirayat (Rainfed agriculture), Bagayat (Irrigated agriculture), Rainfed cotton cultivation occupies a larger share of agricultural land compared to irrigated cotton cultivation.

Methodology

The present study is based on secondary data collected from agricultural department reports, government records, and district-level agricultural statistics.

Data Sources

District agricultural department records

Government reports on pest infestation

Statistical data related to cotton cultivation

Published literature on pest outbreaks and agricultural ecology

Data Analysis

The collected data were analyzed using descriptive statistical methods. Tahsil-wise comparisons were made to understand the extent of Pink Bollworm infestation in terms of:

Percentage of affected cultivated area

Number of affected farmers

Distribution of rainfed and irrigated cotton cultivation

Tables were prepared to present the findings clearly.

Decrease in Disease Resistance in High Yielding Varieties

Traditional indigenous crop varieties have long been recognized for their resilience to environmental stress and diseases. Their adaptability is primarily due to their broad

genetic base and long-term evolution within local ecosystems.

In contrast, high yielding varieties introduced through modern agricultural practices are often genetically uniform. While these varieties provide higher productivity under controlled conditions, their narrow genetic base makes them more susceptible to pests and diseases.

The major differences between indigenous varieties and high yielding varieties include:

Characteristic, Indigenous Varieties, High Yielding Varieties

Genetic diversity: High, Low

Disease resistance: Strong, Weak

Adaptation to local environment: High, Moderate

Input requirement: Low, High

Due to their limited genetic diversity, high yielding varieties often require frequent pesticide application and continuous breeding improvements. When new pests or disease strains emerge, these varieties may become vulnerable, leading to large-scale crop losses.

Climate Change and Agricultural Ecosystems

Climate change is one of the most significant challenges affecting agriculture today. Changes in temperature, rainfall patterns, and humidity influence the distribution and behavior of weeds, pests, and pathogens. Over the last forty years, agricultural regions across India have experienced noticeable climate variability. These changes have affected crop productivity in several ways: Increased pest populations, Emergence of new disease strains, Changes in pest breeding cycles, Reduced crop resilience

The altered ecological balance has allowed pests to spread into new areas and attack crops more aggressively. Cotton cultivation in Maharashtra has been particularly affected by these changes.

Pink Bollworm Infestation in Cotton Crops

Pink Bollworm is one of the most destructive pests affecting cotton crops. The insect attacks cotton bolls by penetrating the lint and feeding on seeds inside the boll.

The damage caused by Pink Bollworm is severe because:

Cotton is used for both fibre and seed oil.

The pest destroys both components simultaneously.

The pest attacks plants during early growth stages.

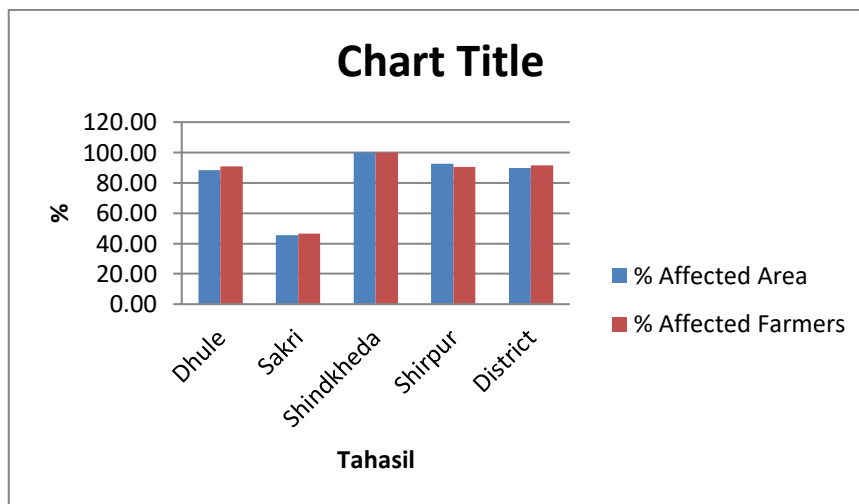
If not controlled in time, the infestation can destroy the entire crop.

During the agricultural years 2016–17 and 2017–18, the Pink Bollworm outbreak severely affected cotton-growing regions in central and eastern Maharashtra. In Dhule district, the infestation became widespread due to favorable climatic conditions. In 2017, the district experienced a long dry spell during the rainy season. There was no rainfall for nearly twenty-five days. These conditions helped the pest population grow rapidly and spread across cotton fields.

Despite the implementation of pest control measures, the infestation continued to increase and caused major yield losses.

Tahsil-wise Pink Bollworm Affected Area

sr.no.	Tahsil	Area under cotton cultivation (ha)	cotton cultivated farmers	More than 33% bollworm affected area			More than 33% affected farmers	% of affected farmers
				Jirayat(Ha)	Bagayat(Ha)	Total Area (Ha)		
1	Dhule	86560.2	76054	76421.12	0	76421.12	69164	90.94
		%		88.29	0	88.29		
2	Sakri	24164.61	24241	3446.87	7503.96	10950.83	11266	46.47498
		%		14.26	31.05	45.32		
3	Shindkheda	97569.73	79878	90697.21	6870.52	97567.73	79878	100
		%		92.96	7.04	100		
4	Shirpur	60530	51946	27896.07	28212.84	56108.91	46946	90.37
		%		46.09	46.61	92.7		
	District	268824.54	232119	198461.27	42587.32	241048.59	212254	91.44189
		%		73.83	15.84	89.67		



The data shows that a large proportion of cotton farmers and cultivated land were affected by the pest infestation.

Analysis of Pink Bollworm Impact

The analysis indicates that the Pink Bollworm infestation had a severe impact on cotton cultivation across Dhule district.

Shindkheda Tahsil

Shindkheda reported the most severe infestation. The entire cotton cultivation area and all cotton farmers in the tahsil were affected by the pest.

Dhule Tahsil

Dhule tahsil recorded more than 88 percent affected area and about 91 percent affected farmers. This indicates a widespread infestation across the region.

Shirpur Tahsil

Shirpur also experienced severe damage, with more than 92 percent of cultivated area affected.

Sakri Tahsil

Sakri reported comparatively lower infestation levels. However, nearly half of the cultivated area and farmers were still affected.

Rainfed and Irrigated Cotton Cultivation

Another important observation from the study is the distribution of cotton cultivation under rainfed and irrigated conditions.

More than 70 percent of cotton cultivation in Dhule district is rainfed (Jirayat).

Less than 20 percent of cotton cultivation is irrigated (Bagayat).

During 2017–2018:

73.83 percent of rainfed cotton area was affected by Pink Bollworm

15.84 percent of irrigated cotton area was affected

Rainfed crops were more vulnerable because they depended heavily on natural rainfall patterns.

Socio-Economic Impact on Farmers

The widespread infestation caused severe economic losses for cotton farmers.

Major consequences included:

Reduced crop yields

Loss of farmer income

Increased debt due to crop failure

Higher expenditure on pesticides

Financial instability in rural households

To provide relief, the Government of Maharashtra introduced compensation measures.

Government Support Measures

The Maharashtra government provided financial assistance to farmers affected by Pink Bollworm infestation.

The compensation rates were:

Rs. 13,500 per hectare for irrigated cotton cultivation

Rs. 6,800 per hectare for rainfed cotton cultivation

Additionally, the government introduced preventive measures for future crop seasons. One important decision was to restrict the sale of cotton seeds during May.

Agricultural experts recommended that cotton sowing should begin in June instead of May. This adjustment helps reduce pest infestation by disrupting the life cycle of Pink Bollworm.

Suggestions for Sustainable Pest Management

To reduce future pest outbreaks and improve agricultural sustainability, several measures are recommended:

Promotion of indigenous crop varieties with higher disease resistance.

Adoption of integrated pest management techniques.

Improved crop rotation practices.

Timely sowing based on scientific recommendations.

Use of pest-resistant cotton varieties.

Strengthening agricultural extension services to educate farmers.

Increased research on climate-resilient crops.

Conclusion

The study highlights the growing vulnerability of modern agricultural systems due to reduced genetic diversity and changing climatic conditions. High yielding crop varieties, while productive, often lack strong disease resistance and require careful management.

The Pink Bollworm outbreak in Dhule district during 2017–2018 caused extensive damage to cotton cultivation. Nearly 90 percent of the cultivated area and farmers were affected, resulting in significant economic losses.

The findings emphasize the need for sustainable agricultural practices that combine productivity with ecological resilience. Strengthening pest management strategies, promoting genetic diversity in crops, and adapting agricultural practices to climate change will be essential for protecting farmers and ensuring long-term agricultural sustainability.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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