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Studies on pests of cotton plants and their control measures in Vindhya Region

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Abstract
Cotton is a soft, fluffy staple fiber that grows in a boll, or protective capsule, around the seeds of cotton plants of the genus *Gossypium*. The fiber is almost pure cellulose. Under natural conditions, the cotton bolls will tend to increase the dispersion of the seeds. The fiber is most often spun into yarn or thread and used to make a soft, breathable textile. The use of cotton for fabric is known to date to prehistoric times; fragments of cotton fabric dated from 5000 BC have been excavated in Mexico and the Indus Valley Civilization (modern day Pakistan and some parts of India). Although cultivated since antiquity, it was the invention of the cotton gin that so lowered the cost of production that led to its widespread use, and it is the most widely used natural fiber cloth in clothing today.

Keywords: Pests, Cotton plants, Control measures, Vindhya Region

1. Introduction

Cotton today is the most used textile fiber in the world. Its current market share is 56 percent for fibers used for apparel and home furnishings and sold in the U.S. Another contribution is attributed to nonwoven textiles and person care items. It is generally recognized that most consumers prefer cotton person care items to those containing synthetic fibers. World textiles fiber consumption in 1998 was approximately 45 million tons. Of this total cotton represented approximately 20 million tons. The earliest evidence of using cotton is from India and the date assigned to this fabric is 3000 B.C. There were also excavations of cotton fabrics of comparable age in Southern America. Cotton cultivation first spread from India to Egypt, China and the South Pacific. Even though cotton fiber had been known already in Southern America, the large – scale cotton cultivation in Northern America began in the 16th century with the arrival of colonists to southern parts of today's United States. The larges rise in cotton production is connected with the invention of the saw – tooth cotton gin by Eli Whitney in 1793. With this new technology, it was possible to produce more cotton fiber, which resulted in big changes in the spinning and weaving industry, especially in England.

Cotton is the most important source of natural fibre. India is the world's third largest cotton producer. One of the major limiting factors, which affect cotton production in India, is the incidence of pests, especially bollworms, causing more than 50 per cent yield loss (Atwal, 1976)[1]. The limited genetic variability for bollworm resistance in cotton land/wild races makes the task of developing pest-resistant lines very difficult. In the past decade insecticidal proteins of Bacillus thuringiensis (Bt), a Gram-positive soil bacterium, have been expressed in cotton and other crop species by genetic engineering with significant social, environmental and economic benefits to the farmers (Kumar, 2003)[2]. Bt-cotton expressing Cry1Ac protein of Bt was cultivated in an area of 20.0 million hectares in more than a dozen countries including India in 2005 (James, 2006)[3].

There has been a constant accumulation of the literature in taxonomic, morphological, toxicological, bionomical, ecological, biological control, genetical, physiological and cytological studies of insects. Many new species are being added every year from different corners of the world and it is seen that there is an overlap of different species showing only marginal differences between them. There are difficulties to understand the various aspects of the insects. The science of entomology of generally considered being an applied discipline, although the importance of fundamental research for solving many problem of applied nature is also realized. In India the emphasis of Entomological research has been mainly on the insect toxicology and chemical control of insect pest. However, in recent days the studies on insect morphology, physiology and cell biology upon which stress initially applied entomological studies are done. Therefore, a need is felt to supplement the morphological studies of ecological studies of certain vegetable pests and their control measures in Vindhya region.

Very little work has been done on the insect fauna of Vindhya region (M.P.). Since the Himalayan region, is extremely rich in its fauna, it has attracted many entomologists from the different places of the world. Entomologists of the countries like. England, Japan, Germany, Canada, India, U.S.A. etc. have been visiting India very often in groups for field collection of the Indian insects. The British Museum (Natural History) London sent a big term of entomologists to collect the insect from India. It has published one of the prestigious series of articles on 'Diptera India'. The Japanese entomologists, too, had made an excellent collection of butterflies moths and aquatic insects of India. The entomologists of Canada have also collected a large number of insects which are being identified and published periodically.

Botanical Classification of the cotton

Order	:	Malvales
Family	:	Malvaceae
Subfamily	:	Malvoideae
Tribe	:	Gossypieae
Genus	:	Gossypium

The plant is a shrub native to tropical and subtropical regions around the world, including the Americas, Africa, and India. The greatest diversity of wild cotton species is found in Mexico, followed by Australia and Africa. Cotton was independently domesticated in the Old and New Worlds. The English name derives from the Arabic *(al) qutn* which began to be used circa 1400 AD. The Spanish word, "algodon", is likewise derived from the Arabic.

Types of cotton

There are four commercially grown species of cotton, all domesticated in antiquity:

- *Gossypium hirsutum* – upland cotton, native to Central America, Mexico, the Caribbean and southern Florida, (90% of world production).
- *Gossypium barbadense* – known as extra-long staple cotton, native to tropical South America (8% of world production).
- *Gossypium arboreum* – tree cotton, native to India and Pakistan (less than 2%).
- *Gossypium herbaceum* – Levant cotton, native to southern Africa and the Arabian Peninsula (less than 2%).

The two New World cotton species account for the vast majority of modern cotton production, but the two Old World species were widely used before the 1900s. While cotton fibers occur naturally in colors of white, brown, pink and green, fears of contaminating the genetics of white cotton have led many cotton-growing locations to ban the growing of colored cotton varieties, which remain a specialty product.

2. Materials and Methods

Vindhya region is covered by different ranges of Vindhya series. The whole area is formed by an undulated plateau, encircled by Panna range (a part of Upper Vindhyan) towards North-West and the Kymore range towards the Southern side running across South-West and North-West direction. In fact, the Vindhyan has two distrinct groups of rock deposits, viz., the upper Vindhyan System and the Lower Vindhyan System of rocks.

Successful cultivation of cotton requires a long frost-free period, plenty of sunshine, and a moderate rainfall, usually from 600 to 1200 mm (24 to 48 inches). Soils usually need to be fairly heavy, although the level of nutrients does not need to be exceptional. In general, these conditions are met within the seasonally dry tropics and subtropics in the Northern and Southern hemispheres, but a large proportion of the cotton grown today is cultivated in areas with less rainfall that obtain the water from irrigation. Production of the crop for a given year usually starts soon after harvesting the preceding autumn. Planting time in spring in the Northern hemisphere varies from the beginning of February to the beginning of June. The area of the United States known as the South Plains is the largest contiguous cotton-growing region in the world. While dryland (non-irrigated) cotton is successfully grown in this region, consistent yields are only produced with heavy reliance on irrigation water drawn from the Ogallala Aquifer. Since cotton is somewhat salt and drought tolerant, this makes it an attractive crop for arid and semiarid regions. As water resources get tighter around the world, economies that rely on its face difficulties and conflict, as well as potential environmental problems. For example, improper cropping and irrigation practices have led to desertification in areas of Uzbekistan, where cotton is a major export. In the days of the Soviet Union, the Aral Sea was tapped for agricultural irrigation, largely of cotton, and now salination is widespread.

Cotton can also be cultivated to have colors other than the yellowish off-white typical of modern commercial cotton fibers. Naturally colored cotton can come in red, green, and several shades of brown. Used to make a number of textile products. These include terrycloth for highly bath towels and robes; denim for blue jeans; cambric, popularly used in the manufacture of blue work shirts (from which we get the term "blue-collar"); and corduroy, seersucker, and cotton twill. Socks, underwear, and most T-shirts are made from cotton. Bed sheets often are made from cotton. Cotton also is used to make yarn used in crochet and knitting. Fabric also can be made from recycled or recovered cotton that otherwise would be thrown away during the spinning, weaving, or cutting process. While many fabrics are made completely of cotton, some materials blend cotton with other fibers, including rayon and synthetic fibers such as polyester. It can either be used in knitted or woven fabrics, as it can be blended with elastine to make a stretchier thread for knitted fabrics, and apparel such as stretch jeans.

In addition to the textile industry, cotton is used in fishing nets, coffee filters, tents, explosives manufacture (seenitrocellulose), cotton paper, and in bookbinding. The first Chinese paper was made of cotton fiber. Fire hoses were once made of cotton.

3. Results and Discussion

Our knowledge of control measures, insecticides and their developments has improved considerably during the last few decades. For the last many years the synthetic pyrethroids were applied for the control of vegetable pests. In the present decade new chemicals came into existence, as modern insecticides which are comparatively more effective in the field of control measure on one hand and less toxic to the consumers on other hand.

4. Cotton pests of the Vindhya region

4.1 Cotton Leaf Roller

Common name	: Ban ki surhi, Patti mor surhi
Zoological name	: *Sylepta derogata* Fabr.

Systematic position

Order	:	Lepidoptera
Family	:	Pyralidae
Genus	:	*Sylepta*
Species	:	*derogata*

Host plants: Cotton, bhindi, sunnhemp, hollyhock and other plants of Malvaceae family.

Diagnosis: The adult moth is whitish in colour with faint yellow tinge, the wings with many fine dark lines forming an

irregular pattern. It measures 12 mm long with wing expanse of 25 mm. Labial and maxillary palps are fused together to form a snout.

The pest over winters over as a full grown pinkish caterpillar among the fallen leaves. These larvae pupate in the second week of February, from which moths appear in March. The pest is active from March to October-November. There are 5-6 generations in a year but in Bengal only 3 generations are found. The total life cycle is completed in 25 to 54 days depending upon environmental conditions.

Life cycle: There are four developmental stages viz. egg-larva-pupa and adult in its life cycle which are described as below:

Egg: The female moth lays eggs singly on the underside of the leaf along the thicker veins during evening hours or at night. The eggs are flat oval and white in colour which turn to brown at the time of hatching. Single female lays about 250 to 300 eggs in her life span. The hatching time varies from 2-9 days while pre-oviposition period is 2-3 days.

Larva: The young larva feeds on the lower side of the leaf and spin threads over and around itself as a protection. Later, it turns the edge of the leaf over in a fold and binds it down with silken thread, living safely within this fold. The full grown larva is green in colour with dark brown head and bears a brown coloured notch in the prothorax. At the time of pupation it becomes pinkish. It moults four times and become full grown in 15 to 35 days.

Pupa: The pupation takes place either in rolled leaves or on the ground among fallen leaves. Before changing in to pupa, the larva shrinks and become pinkish in colour. The pupa s reddish brown in colour and measures 12 mm. Pupal period lasts in about 12 days.

Nature of damage: The damage is done by the caterpillar. The newly hatched larva feeds on the lower surface of the leaves mainly epidermis but when it grows older rolls up the leaves in to a funnel shape and feeds from the margin. The larva remains hiden beneath the rolled leaves. Initially they are found more in number on single leaf (more than 30) but later only one is found on a leaf. Sometimes it appears in epidemic form and in such case 3,000 larvae have been found in 100 sq feet (Nagpal, 1948)[4]. Practically, the whole leaf is caten up or big holes are made with the result it drops to the ground. The crop sown on the onset of monsoon and provided with nitrogenous fertilizers are subjected to much more attack of the insect. As a result of leaf damage, the photosynthesis, respiration and transpiration activities are badly affected due to which growth of the plant is affected and ultimately bears lesser bolls. The Americal cotton is more preferred than the Desi cotton.

Distribution: Besides India, it is found in Pakistan, Burma, Ceylon, China, Japan, Jawa, Egypt, Africa and Australia etc. In India it is distributed in all the cotton growing areas, specially Gujarat, Andhra Pradesh, Bengal, Maharashtra, Pubjab and Uttar Pradesh.

Control measures of the pest

1. The field should be ploughed deeply before sowing so that hibernating larvae may be destroyed.
2. Regular hand picking of rolled leaves minimise the attack of pest.
3. Balance nitrogen should be given and if possible resistant varieties viz. 10 F should be preferred.
4. The crop may be dusted with any one of the following insecticides to control the pest:
   (a) Carbaryl 10% dust @ 20 kg/ha
   (b) Fenitrotlrion 5% dust @ 20 kg.'ha
5. Effective control can also be achieved by spraying the crop with any one of the following insecticides:
   (a) Carbaryl 50 wp-3.00 kg/ha,
   (b) Endosulfan 35 Ec-2.50 lit/ha,
   (c) Formothion 25 Ec @ 1.00 llit/ha

4.2 Spotted Boll Worm

Common name : Chitkabri surhi
Zoological name : (i) *Earias vitella (fabia),* Stoll.
(ii)*Earias insulana,* Boisd

Systematic position

Order : Lepidoptera
Family : Cymbidae
Genus : *Earias*
Species : *vitella*

Host plants: Cotton, bhindi, sunnhemp, hollyhock and other Malvaceous plants.

Diagnosis

(1) ***Earias vitella*:** The moth measures 12mm long and 21 across the wings, the fore wings have a broad green band extending from the base to apex and hind wings are white in colour. The body is pinkish white in colour having tuft of hairs behind the thorax.

(2) ***Earias insulana*:** It measures about the same as above, but for wings are completely green. The species is more prevalent in dry regions. The pest remains active through-out the year, but population is low during December to March. It begins to multiply in April-May and reaches its maximum during July to September. The life cycle is completed in 31-55 days and 7-8 generations are found in a year. The males die after copulation while females survive 10 to 20 days depending upon the season.

Life history: There are four developmental stages namely egg-larva-pupa and adult in its life history which are described as follows:

Egg: The female moth lays eggs generally singly, scattered over fresh squares etc. The eggs are spherical, bluish green in colour with parallel longitudinal ridges which projects upward and give it crowned appearance. The female lays 200-500 eggs in her life time only at night. An individual egg is 1 mm in diameter. The hatching period of eggs varies from 3-4 days in summer and 8-9 days in winter.

Larva: The newly hatched larva is brownish white with a dark head and prothoracic shield. It measures 1.2 to 1.3 mm in length. The caterpillar remains about 24 hours outside the shoots or bolls and after that it enters in to the shoot or boll. Larva moults 3 or 4 times become full grown measuring 22-

25 mm long. The caterpillar of *E. vitella* is brownish with a median longitudinal streak while of *E. insulana* has dull greenish body with a number of black marks and oval, orange dots on the prothorax. The caterpillar becomes full grown in 10-12 days during summer and 15-20 days during winter.

Pupa: The full grown caterpillar comes out of the bolls and pupates either on the plant or on the ground among fallen leaves or 5-25 cm deep in soil. The pupa is enclosed in tough silken cocoon of dirty white or light brown colour. It measures 12 mm in length and 4-5 mm in breadth. Pupal period lasts for 5-15 days during summer and rainy season and 18-31 days during winter.

Nature of damage: The larva is the destructive stage of the pest which in the begining (when plantsare small 20-30 cm. high) bores the top portion of the growing shoot which withers and drops. As a result of which plant growth is adversely affected. Lefroy (1909)[5] stated that this pest is more serious than locusts. When the flower buds and bolls appear the larvae start feeding on them. The caterpillars bore in to bolls close the hole with their excreta and feed inside. The attacked bolls are generally shed those left on the plants open prematurely with the result poor quality of fibre is produced and market value is reduced, Several holes plugged with excreta can be seen on the bolls and a single larva may destroy many bolls in its life time. The damage caused by the pest is estimated to the tune of 20-40%.

Distribution: It is found is Spain, Syria, Palestine, Egypt, India, Burma, Madagascar and Australia. In India it is commonly occur in M.P., Maharashtra, Mysore, Madras, Gujarat, U.P., Delhi and Punjab etc.

Control measures of the pest

1. Destruction of plants which harbour the pest.
2. After harvesting of crops the field should be ploughed to destroy the hiden caterpillars.
3. Collection and destruction of infested shoots and bolls etc.
4. The crop may be sprayed with any one of the following insecticides to minimise the attack of pest:
   (a) Thiometon 25 Ec @ 1.25 lit./ha.
   (b) Endosulfan 35 Ec. @ 2.5 lit./ha.
   (c) Fenetrothion 50 Ec. @ 3.00 lit./ha.
   (d) Phosphomidan 85% @ 500 Ec. lit./ha.
   (e) Carbaryl 50 wp @ 2, 5 kg./ha.

The crop should be sprayed twice first at the time of hatching of the eggs (peak hatching period) and second after 15 days of previous spraying. The quantity of water may be required 700-750 lits/ha. If the insecticides are to be applied on bindhi crop endosulfan or D D V P should be preferred.

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