Study On Starvation-induced Physiological Changes in Nezara Viridula Linn., A Pest of Important Crops, in the Context of its Agricultural Significance in India and Bhutan.

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ABSTRACT

Nezara viridula Linn. (Southern green stink bug) is a well – known crop pest, particularly in tropical and subtropical regions like India and Bhutan. It is an economic pest of many cultivated plants around the world. During March – MAY months high population of green stink bug were observed in Maize and Bajra (millets) crops in Bihar and Western Uttar Pradesh, a leading state of production in India. Nezara viridula is a significant pest in Bhutan affecting various crops. It's a polyphagous insect, it feeds on many different plants. In Bhutan it's known to damage crops like Peppers, Chili, Soybeans and Millets. Bugs feeding punctures can lead to stunted growth, fruits deformities, and even crop loss. Body weights in adult southern green stink bug, Nezara viridula Linn. were greater in fresh & dry condition. Body weight significantly increased in adult females N. viridula found during summer to spring season. Female bugs were heavier than male bugs. Insect is a sap sucker and during fed condition, the digestive tract remains turgid and full of food sap in the foregut and is midgut regions while hindgut full of blackish brown waste material. The gut becomes flaccid when starved while the hind gut remains still partially filled with excretory waste changes occurred during starvation influence histologically in midgut only.

Keywords:- ***Heteroptera, Pentatomidae, Nezara viridula, Digestive tract, Bajra, Maize, Rice, Chili.***

Introduction:

The cosmopolitan green stink bug, Nezara viridula Linn., is an important pest of soybeans (Glycine max (L.). in the southern United States (Jensen & Newsom, 1972). N. viridula damages several crops in many parts of the world (Dewitt & Godfrey, 1972). N. viridula is a polyphagous insect that feeds on the seeds & fruits of many plant species, including crops of high economic importance plant i.e., Bajra, Berseem, Soybean, cotton, Indian Hemp, Corn, Rice, Chili & important wild native plants in India.

In India, it has been found on potato halms in Bangalore (J. Cameron), & near Mumbai on the leaves of Gyanridropsis pentaphyl (Distant, 1910). Insect desaps many of host plants at the time of flowering & ripe crop season. Bug feeds a piercing & sucking mechanism. In many insect lipids are an important source of energy, stored by several species which are used during starvation.

Meterials and Methods:

For the study of body weight & changes occurred in different regions of the gut during starvation, fresh alive N. viridula were collected while infesting the seeds & Foods of host plants i.e. Bajra, Berseme, Indian Hemp & others important wild plants which are found in the crop field in Bihar (Patna) & Western U.P. (Saharanpur). Crops are grown in ample number in the crop field.

Fig. 1: Nezara viridula Linn.

Fig. 2: N. viridula on Host Plants

Bajra is a staple diet in all classes of society & also animals in some parts of India, it is rich in food value (carbohydrates, fats, proteins & minerals). Grains are used in the form of flour for bread & as a whole, making malt. Plants are used as fodder & dried stems for thatched hut roofs or fuels. Productivity of the seeds is lost due to desapping of the host plants' young seeds by insects.

Nezara viridula has been collected during the feeding of host plants by jerking twigs in a polythene bag from crop fields. Insects were reared in the laboratory & collected in a globe chimney, which is covered atop with a thin muslin cloth. Laboratory-reared bugs were separated by sex at adult emergence & provided fresh food & water as and when necessary. Adult bugs are dissected in the laboratory after narcotizing by using co, gas, which is prepared in the laboratory by using a Wolf's bottle. co, gas passed over five adult bugs of both male & female to be narcotized & dissected placed in a glass vial for histo-morphological study of digestive tract. Well fed insect & without food insects has been studied histo-morphologically for 24 hours, 48 hours

up to 72 hours under starved condition are dissected & alimentary canal from the visceral cavity is incised lengthwise & fixed in alcoholic Bouin's after cutting into pieces of different parts of gut i.e. foregut, midgut I,II,III,IV & hindgut for 24 hours & then proceeded for microtomy & slides are prepared for study.

Results and Discussion:-

Nezara viridula digestive tract is a coiled tube which morphologically divided into foregut (Stomodaeum), Midgut (Mesentrom), & Hindgut (Proctodaeum). When fully stretched the gut, the length of the gut in both sexes shows a difference i.e. 5.2 cm in male & 6.4 cm in female during the fed condition. The digestive tract remains turgid & full of food sap in the foregut & midgut, while the hindgut remains full of blackish brown waste material. The gut becomes flaccid when starved, while the hindgut remains still partially field with excretory waste. The only changes in starvation influence histologically is the midgut. The epithelial cells become loosely set. The epithelium shows folds & remains in a position so that the lumen of the midgut is appreciably reduced or collapsed. The secretory cells also become shriveled. The chromatin takes deep stain & the nucleus stain fast & is oval. Sometime epithelial cells reduced or collapsed & fall in the body cavity.

Foregut is a straight tube extends from the mouth to the mesothorax & joins the midgut. Nothing any significant changes have been found during the investigation in the histology of the foregut of the fed & starved bugs except for a little change in the shape of alimentary canal due to absence of food & hence non-functioning of the gut in starved condition. Midgut is functions as an organ of storage, digestion & absorption which is about four times longer than the foregut. It is the longest coiled part & gut in the male is shorter than the female which divisible into midgut I, II, III & IV.

Midgut I is a long sac-like in appearance & stretched from mid mesothorax up to the mid of the sixth abdominal segment. During starved individual after 24, 48 & 72 hours, the epithelial cells of the first ventriculus remain tall, narrow, columnar, almost equal in size & filled with granular cytoplasm. After 72 hours of starvation, a minute change in epithelium & regenerative cells, which are conspicuous in the starved bug.

Midgut II is tubular in shape. Muscle fibers are poorly developed. Epithelial cells are present on a basement membrane. The cells are either with single or double nuclei. In the middle, the cells are binucleate and bear a brush border.

In a starved individual, the appearance of vacuoles and a gradual increase in their number may be observed in the cytoplasm of the cells, which gradually become crowded towards the striated border. Holocrine secretions and merocrine secretions occurs in cells and the zymogen granules get collected at the tips of the cells, are not discharged in the lumen as blisters, After 24 hours of starvation in midgut second are seen the circular muscles, longitudinal muscles and secretary material and apocrine secretion has been secreted by the ruptured wall. Thus, after 48 and 72 hours of starvation in mid-gut second the different ruptured cells are visible because circular and longitudinal muscles shrink and nuclei degenerate. Secretary material and semi-digested food remains in the mid-gut lumen.

The coiled part of the mud gut third is distinct. Musculature is poorly developed. The epithelium is single layered, comprising of columnar cells with central nuclei. Cells are secretory and binucleated. The tips of the cells have small vacuoles full of secretion and mixed with food under fed conditions only.

Lumen of the mid-gut is found emptied, almost irregular, round likely to be collapsed. Different progressive deteriorating conditions are seen in various hours-24, 48, and 72 hours of starvation in the midgut fourth the deterioration is seen further in progress from earlier midgut regions.

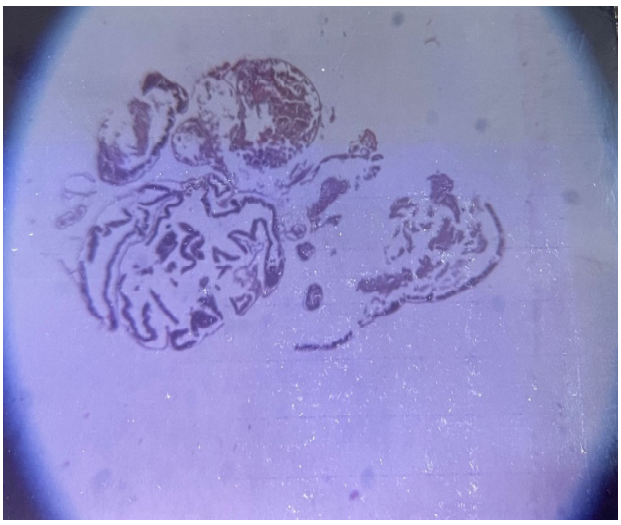

Fig.3: 72 hours salivary gland with mid gut first male.

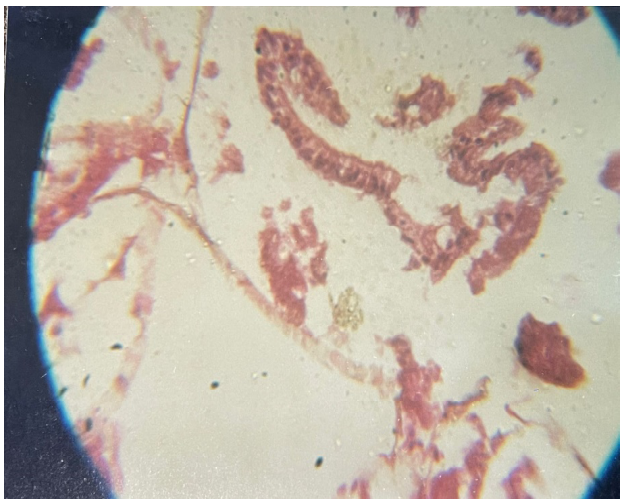

Fig. 4: 72 hours mid gut fourth male

Histological changes in hindgut feeding and after 24, 48 and 72 hours of starvation:-

The changes under starved conditions are not prominent in ileum. No significant anatomical and histological variations are seen. The hind gut appears to be transparent in starved insect. Only the hindgut have been seen lying in a collapsed state.

Acknowledgements

The author highly thankful to the Director, I.A.R-I, New Delhi, Horticulture Research Institute, Saharanpur & Zoological Survey of India for providing library facilities & to the college administration for laboratory facilities. The author is also highly thankful the farmers growing crops for allowing to catch the insects.

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