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Ecological studies on Jassids in Rewa region

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Abstract
Jassid is a sucking pest occurring throughout the crop growing period on cotton in all the zones. The pest injects toxins into leaves while feeding which results in abnormal changes in leaves - marginal chlorosis and reddening. Since the pest severity is dependent on the occurrence of congenial weather conditions, we have devised weather based rules for weekly prediction of the pest severity. Based on severity prediction (based on ETL), pest management interventions and sprays can be taken up taking into account parameters such as pesticide efficacy, safety, spray interval (a gap of 7-15 days is advised between sprays), crop age and economics. analysis results performed on the 2 groups of natural living Jassids (*Nephotettix nigropictus* (Stal.) / Green leaf hopper) and the 2 groups of Jassids (*Nephotettix nigropictus* (Stal.) / Green leaf hopper) in stressful conditions showed significant changes in biochemical parameters concentration of hemolymph under the stress influence.

Keywords: ecological, Jassids, Rewa region

1. Introduction

Since the creation of life on this earth, animals and plants have been mutually interdependent in every walk of their lives. The connections were very close or distant, apparent or latent, due to their similar, constant and simultaneous requirements. This has brought into play what is popularly known as 'struggle for existence'. It is no lesser pride to say that man, by his sharp wit excelled over the rest of the creation on the earth by devising adequate means to combat all his foes. He thinks himself 'The Victorious', though complete victory is yet for to achieve.

The Super family Jassoidea comprises a large number of small or comparatively small homopterous insects, which agree in respect to the character of the hind tibiae. The latter are prismatic in shape and are armed with a row of spines on their posterior margins. The head varies in shape and may be angular or rounded, produced or shortened. The eyes are located on the lateral margins of the head, and the breadth across them is frequently the widest part of the body. The antennae are usually inserted on the face between the eyes. The thorax varies considerably, but in all the pronotum is the most pronounced region. There are two pairs of wings, the first pair being developed as tegmina and are usually coriaceous, while the second pair may be membranous. In some forms the elytra are reduced in size.

The super family is generally subdivided into four subfamilies, viz.: Bythoscopidas, Tettigoniellidae, Jassidae and Typhlocybidae, the subdivision of the first three being based on the location of the ocelli, and of the last, on the character of the venation of the elytra. In the Bythoscopidae, the ocelli are situated on the front below the border of the vertex; in the Tettigoniellidae they are on the disk of the vertex, while in the Jassidae they are to be found on the border of the vertex or between the latter and the face. In the three subfamilies mentioned, the elytral nervures fork on the disk, while in the Typhlocybidae the nervures fork at the base and run to the apex of the elytron without further dividing. Again in the last named family the ocelli may or may not be present. The various subfamilies are further subdivided into a number of genera, and frequently into tribes and divisions.

The chief object of this investigation has been to obtain definite understanding of the external and internal morphology for the group generally and to establish homologies with the other Homopterous families. Very little work has been done on the morphology of the Jassids, and as far as the writer is aware, no complete treatment of any phase of the morphology has yet been offered. Considerable work has been accomplished on the other Auchenorrhynchous families by Muir, Kershaw, Licent, Pantel, Bugnion, Sulc and others, but the only treatment of the Jassids anatomy is to be found in the general discussions of systematic works on the group. Thus the works of Signoret, Burmeister, Flor, and Melichar contain general discussions of the external anatomy, which are necessary for taxonomic purposes. The wings and their structure have been ably treated by Metcalf, and only mention will here be made of this phase.

The defining feature of hemipterans is their possession of mouthparts where the mandibles and maxillae are sheathed within a modifiedlabium to form a "beak" or "rostrum", called a proboscis, which is capable of piercing tissues (usually plant tissues) and sucking out the liquids typically sap. The forewings of Hemiptera are either entirely membranous, as in the Sternorrhyncha and Auchenorrhyncha, or partially hardened, as in most Heteroptera. The name "Hemiptera" is from the Greek-hemi; "half" and pteron; "wing", referring to the forewings of many heteropterans which are hardened near the base, but membranous at the ends. Wings modified in this manner are termedhemelytra (singular: hemelytron), by analogy with the completely hardened elytra of beetles, and occur only in the suborder Heteroptera. The forewings may be held "roofwise" over the body (typical of Sternorrhyncha and Auchenorrhyncha), or held flat on the back, with the ends overlapping (typical of Heteroptera). In all suborders, the hindwings if present at all are entirely membranous and usually shorter than the forewings.

2. Material and Methods

Collection of Jassids for observation in sites for the present research work has been done from paddy fields in Rampur Baghelan Satna, Mauganj Rewa, Manikwar Rewa, the local Chinmay Ashram, laxmanpur, Rewa and also near the village Anantpur about five kilometers from Rewa town. Particularly during September and October and more so on sultry humid nights these insects appear to be a nuisance under bright lamps.

3. Observation

Hemolymph is the circulating fluid or “blood” of Jassids. It moves through the open circulatory system, directly bathing the organs and tissues. Jassids hemolymph differs substantially from vertebrate blood, with the absence of erythrocytes and a high concentration of free amino acids being two of the common distinguishing features. The main component of hemolymph is water, which functions as a solvent for a variety of molecules. Water in hemolymph makes up to 20-50% of the total water in Jassids bodies, with larval stages generally having a larger relative hemolymph volume than adults. Hemolymph serves as a water storage pool for use by tissues during desiccation and as a storage depot for other types of chemicals. It also contains circulating cells called hemocytes. Hemolymph can function as a hydraulic fluid, for example, in the expansion of a newly molted Jassids wings. Hemolymph serves important roles in the immune system and in transport of hormones, nutrients, and metabolites.

The composition of inorganic ions in hemolymph varies widely among different Jassids species. The pH of the hemolymph of most Jassids is in the range of 6.4-6.8. Apterygotes contain high levels of sodium and chloride, similar to mammalian blood. In hemolymph of exopterygotes, sodium and chloride are also high but magnesium makes up a large portion of the total inorganic cations. In endopterygotes, particularly Lepidoptera, Coleoptera, and Hymenoptera, concentrations of sodium and chloride tend to be much lower and are replaced with high levels of potassium, magnesium, and organic anions. This difference has been attributed to the coevolution of these Jassids species with flowering plants and the consequent dietary importance of leaves (which contain high concentrations of magnesium and potassium). However, the concentration of inorganic ions is not a function of only the diet, because Jassids are able to regulate the ion composition of hemolymph to some degree.

Citric acid and other organic acids and organic phosphates (such as glycerol 1-phosphate and sorbitol 6-phosphate) account for much of the anion content in hemolymph from many Jassids species. The most abundant carbohydrate in hemolymph of most Jassids is the disaccharide trehalose. Transport of trehalose as an energy source for tissues is an important function of the hemolymph. Trehalose levels are hormonally regulated and can be increased through synthesis from glucose phosphate derived from glycogen stored in the fat body. Glucose may also be present in hemolymph, although generally at a lower concentration than trehalose. In some Jassids, diapause or exposure to low temperatures can stimulate synthesis of glycerol and sorbitol (from glycogen stored in fat body). The resulting high concentration of these compounds in hemolymph depresses the freezing point and protects the Jassids from damage that would occur if ice crystals were to form in hemolymph.

Hydrophobic lipoidal compounds present in hemolymph are carried by specific transport proteins. Diacylglycerol is the major transported form of lipid in most Jassids, but triacylglycerol, fatty acids, phospholipids, and cholesterol are also present. Pigments such as carotene, riboflavin, and biliverdin, which give hemolymph of many Jassids a characteristic yellow or green color, are also carried by specific proteins.

Free amino acids are present at high concentration (up to 200 mM) in hemolymph and make a major contribution to hemolymph osmo-larity. All 20 of the amino acids found in proteins exist as free amino acids in hemolymph. Although the relative concentrations of the amino acids vary in different species, glutamine and proline are typically abundant. Proline is known to serve as an energy source for flight muscles in some species. Hemolymph may also contain some amino acids that are not found in proteins, such as alanine and taurine. Tyrosine, which is metabolized for use in cuticle sclerotization, often occurs in hemolymph as a conjugate with glucose, phosphate, or alanine, which increases its solubility. The phosphate and glucose substituents are removed from tyrosine by specific enzymes when tyrosine is needed for sclerotization. Catecholamines derived from tyrosine, which are used in cuticle sclerotization and pigmentation, are also present in hemolymph as conjugated forms.

Proteins are a major component of the hemolymph plasma. Typical protein concentrations in plasma range from 10 to 100 mg/ml. In most species, the concentration of proteins in plasma increases during each instar and decreases at each molt. The fat body is responsible for the synthesis of the majority of plasma proteins, but there is also a contribution of some specific proteins from epidermis and hemocytes. Plasma from each species contains a few very abundant proteins and more than a hundred other proteins at much lower concentrations. Although the identities and functions of the major proteins are understood, many of the minor hemolymph proteins have not yet been thoroughly investigated.

The most abundant proteins in larval hemolymph belong to a class known as storage proteins or hexamerins (because they are assembled from six -80kDa polypeptide subunits). The storage proteins are synthesized by the fat body and reach extremely high concentrations in the last instar. At the end of this stage, most of the storage proteins are taken back into the fat body, through interaction with specific receptors, and stored in protein granules. During metamorphosis the storage proteins are broken down into free amino acids, which are used for synthesis of other proteins required in the adult stage. In some exopterygotes, hexamerins are again synthesized by the adult, although their function at this developmental stage is unclear. The hexamerins can be classified according to their amino acid compositions. Those rich in the aromatic amino acids (phenylalanine, tyrosine, and tryptophan) are called arylphorins, whereas another group of hexamerins are known as methionine-rich storage proteins. In addition, some other proteins that function as storage proteins but are not similar in sequence to the hexamerins have been identified in lepidopterans.

Several hemolymph proteins function to transport small molecules that have low solubility in water. Jassids plasma contains two proteins that specifically bind iron; ferritin appears to sequester dietary iron, whereas transferrin acts as a shuttle to transport iron between tissues. The most abundant transport protein in hemolymph is lipophorin, which transports lipids between tissues. Like lipoproteins in mammalian plasma, lipophorin is composed of proteins that complex with lipids in such a way that the lipids are protected from contact with the surrounding water. Lipophorin docks with specific receptors on the surface of tissues to either accept or unload diacylgycerol. Lipophorin contains two polypeptide subunits, apolipophorin-I and apolipophorin-II, which are produced by proteolytic cleavage of a larger protein precursor. In insects that use lipids as a fuel for flight muscles, diacylglycerol is released from the fat body into the hemolymph under control of a peptide hormone known as adipokinetic hormone. As lipophorin accepts large amounts of diacylglycerol, its volume increases and its density decreases as it is converted from high-density lipophorin to low-density lipophorin. Low-density lipophorin contains a third type of protein subunit, apolipophorin-III, which binds to the surface to stabilize the expanding lipid-water interface.

Juvenile hormone (JH), a sesquiterpenoid lipid, has low solubility in water and is transported through hemolymph bound to a specific carrier protein. JH binding proteins of 30kDa have been well characterized from plasma of lepidopterans, whereas in other Jassids lipophorin or a specific hexamerin takes on the role of JH transport. In addition to keeping JH in solution, these proteins also protect the hormone from degradative enzymes that help to regulate JH concentration in plasma. JH binding proteins may also aid in delivery of the hormone to target tissues.

In adult female Jassids, certain proteins synthesized by the fat body and secreted into the hemolymph are delivered to the ovary, where they are taken up by developing oocytes. The most abundant of these is called vitellogenin. Once vitellogenin becomes a part of the egg yolk, it is called vitellin. Vitellogenins are typically large, phosphorylated lipoglycoproteins that are expressed specifically in adult females. Lipophorin is also taken up from hemolymph into eggs and provides additional lipids for use by the developing embryo. Vitellogenin and lipophorin are related in their amino acid sequences, indicating that they have a common ancestral gene. Vitellogenin, lipophorin, and a few other plasma proteins are taken up into oocytes by receptor-mediated endocytosis.

A group of plasma proteins functions in defense against microbial infection. Hemolymph of many insects contains lysozyme, an enzyme that degrades bacterial cell walls. In addition, low molecular weight antimicrobial peptides are synthesized in response to bacterial or fungal infection. Many of these peptides act by disrupting the integrity of bacterial cell membranes. Phenoloxidase, an enzyme present in plasma of some species and stored in hemocytes of others, is synthesized as an inactive precursor, prophenoloxidase. In response to infection or injury, prophenoloxidase is activated and catalyzes the production of quinones that polymerize to form the pigment melanin, which helps to trap and kill invading organisms. The tendency of hemolymph to darken has been known for more than 100 years, but this melanization has only recently become understood at a molecular level. Plasma contains proteins that bind to carbohydrates on the surface of microorganisms. This causes activation of a cascade of proteases that results in the proteolytic activation of prophenoloxidase. To regulate this immune response, plasma contains several types of proteins that function as protease inhibitors.

The circulating cells in hemolymph are called hemocytes. Jassids lack erythrocytes, and hemocytes cannot be directly equated with vertebrate leukocytes. Some fraction of hemocytes remains sessile and attached to the surfaces of tissues, and in some species (e.g., mosquitoes) such cells may account for a majority of the hemocytes. Several different morphological types of hemocytes can be identified in each insect species. Some commonly observed hemocyte types are illustrated in Prohemocytes are small, round cells that may be precursors from which some other cell types develop. Granular hemocytes contain conspicuous cytoplasmic granules that can be discharged as part of a defensive response to invading parasites. Plasmatocytes usually contain few granules and are characterized by their ability to change from round or spindle-shaped cells in suspension to extensively flattened, ameboid cells after attaching to a substrate. Spherule cells contain very large cytoplasmic granules, which may contain mucopolysaccharides. Oenocytoids are large cells that synthesize prophenoloxidase.

Plasmatocytes and granular hemocytes are usually the two most abundant hemocyte types, although their proportions can vary between species and within a species at different developmental stages. These two hemocyte types participate in immune responses, including (1) phagocytosis of small organisms such as bacteria; (2) nodule formation, in which multiple hemocytes aggregate to trap microorganisms; and (3) encapsulation, in which hemocytes attach to the surface of a larger parasite and form a multilayered hemocyte capsule, in which the parasite is killed. Nodules and capsules often become mela-nized through the action of phenoloxidase. Hemocytes, especially plasmatocytes, also aggregate in a type of coagulation response, sealing wounds to prevent hemolymph loss.

The concentrations of various components of hemolymph were estimated by the following techniques. Hemolymph A (micro-cryoscopy), sodium (flame photometry), chloride (micro Volhard titration) and conductivity; as described previously (Sutcliffe, 1961a) [1]. Potassium was estimated against a series of standard potassium chloride solutions in the same manner as for sodium, accurate to ±0-5 mM./l. potassium. Bicarbonate was estimated by the addition of N sulphuric acid to a small sample of hemolymph and absorption of liberated carbon dioxide in N/20 sodium hydroxide containing phenolphthalein as indicator (Shaw, 1955)[2].

Accurate to + 5 mM./l. (as sodium bicarbonate). Hemolymph was centrifuged in ice-cold paraffin. About 20/xl. of hemolymph supernatant was immediately transferred quantitatively into a test-tube containing an ice-cold solution of 2-5 ml. de-ionized water and 1-5 ml. 25% trichloroacetic acid. After mixing thoroughly by inversion, the protein precipitate was centrifuged down. 3-0 ml. supernatant was added to 4-5 ml. de-ionized water, followed by 0-72 ml. 60% per chloric acid, 0-60 ml. of a 5% ammonium molybdate solution and 0-3 ml. amino naphthol sulphonic acid solution. Total acid-soluble phosphate was estimated by adding the perchloric acid to 3-0 ml. supernatant and hydrolysing for 24 hr. at 100° C. De-ionized water and other reagents were then added as above. Hemolymph samples were compared against a series of blanks and standard potassium dihydrogen phosphate solutions prepared in the same manner. The results on hemolymph samples were accurate to within ± 50 mg. P/l. The total concentration of free amino acids was estimated by the colorimetric method of Folin (1922) [3] as modified by Danielson (1953) [4] and adapted for use with small samples. 4-5 *y*\. Of hemolymph was transferred quantitatively into 15/il. 10% trichloroacetic acid in a small tube. The protein precipitate was centrifuged down and 15/xl. Of supernatant added to 5 ml. de-ionized water. 1 ml. aliquots of reagents were used as detailed by Danielson. Hemolymph samples were compared against blanks and standard solutions of glycine and glutamic acid prepared in the same manner, accurate to ± 5 mM./l. The method gives quantitative results for the a-amino group of most amino acids (Danielson, 1953; Frame, Russell & Wilhelmi, 1943) [4, 5] and therefore provides information on the molar concentration of free amino acids in hemolymph.

4. Discussion & Conclusion

The Jassids, their ecological studied in field as well as in laboratory during the course of this investigation from 2015-16 the experiments were laid out in the experimental field at Rewa region. In the field condition, bionomics of different Jassids pests, their ecology, developmental stages, inhabiting localities, feeding and breeding places were studied. The datas was also collected about the insecticidal effects on the pests. In the laboratory the pests were reared in glass petridishes. They were fed on green leaves of the host crops as per pest concerned. The leaves were changed daily and it was noticed that the pest stages thrived successfully during the course of their development. Various stages of the pests like eggs, caterpillar, pupa and adult were collected and their changing structures as well as characters were noted.

All the Jassids studied during the course present investigation have ability to survive in a wide range of temperature and they are able to live from the temperature 12^0C to 40^0C. They have been recorded to possess optimum ranges of activity through which temperature are favourable beyond this they become too rapid or greatly excited and if temperature becomes too extreme finally die.

Animals exposed to low temperature may die off chilling before their protoplasm actually freezes formation of ice crystals in the body of an insect usually results in death. At low temperature death may be brought about by direct mechanical injury, water loss through changes in permeability or precipitation of proteins and other irreversible chemical changes. There appears to be little chemical change or modification in the protoplasm at low temperature, the only change is that it slows down the metabolism and finally it causes death of the animal, this is probably due to increase in viscosity and ice information.

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