Syllabus for Ph.D. Entrance Test- 2024

Agricultural Entomology

I. Insect Morphology

Insect body wall structure, Structure and modification; mouthparts, antennae, their types and functioning; wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; legs: structure and modifications. post-embryonic development. Types of immature stages in insect orders, morphology of egg, nymph/ larva and pupa, significance of immature stages for pest management.

II. Insect Anatomy and Physiology

Physiology of integument, moulting, chemistry of cuticle, biosysthesis of chitin; growth, hormonal control, metamorphosis and diapause; pheromone secretion, transmission, perception and reception.

Physiology and mechanism of digestion, circulation, respiration, excretion, reproduction, secretion (exocrine and endocrine glands) and nerve impulse transmission in insects. Importance of insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra-cellular microorganisms and their role in physiology; artificial diets.

III. Insect Taxonomy

Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them. Collembola, Protura, Diplura. Class Insecta: Subclass Apterygota – Archaeognatha, Thysanura. Subclass: Pterygota, Division Palaeoptera – Odonata and Ephemeroptera. Division: Neoptera: Subdivision: Orthopteroid and Blattoid Orders (=Oligoneoptera: Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid Orders (=Paraneoptera): Psocoptera, Phthiraptera, Thysanoptera and Hemiptera. Distinguishing characters, general biology, habits and habitats of insect orders and economically important families contained in them (Continued). Division Neoptera –Subdivision Endopterygota, Section Neuropteroid-Coleopteroid Orders: Strepsiptera, Megaloptera, Raphidioptera, Neuroptera and Coleoptera, Section Panorpoid Orders Mecoptera, Siphonaptera, Diptera, Trichoptera, Lepidoptera, and Section Hymenopteroid Orders: Hymenoptera.

IV. Insect Ecology

Basic concepts of abundance- Model *vs* Real world. Population growth basic models– Exponential *vs* Logistic models. Discrete *vs* Continuous growth models. Concepts of

Carrying capacity, Environmental Resistance and Optimal yield. Vital Statistics-Life Tables and their application to insect biology. Survivorship curves. Population dynamics- Factors affecting abundance-Environmental factors, dispersal and migration, Seasonality in insects. Classification and mechanisms of achieving different seasonality- Diapause (Quiescence) – aestivation, hibernation. Biotic factors- Food as a limiting factor for distribution and abundance, Nutritional Ecology. Food chain- web and ecological succession. Interspecific interactions- Basic factors governing the interspecific interactions- Classification of interspecific interactions – Evolution of mimicry, colouration, concept of predator satiation; evolution of life history strategies.Community ecology- Concept of guild, Organisation of communities- Hutchinson Ratio, May's *d/w*, Relation between the two and their association with Dyar's Law and Przibram's law. Relative distribution of organisms, Concept of diversity. Assessment of diversity. Climate change and insect pest/ natural enemy population; ecological engineering.

V. Biological Control of Insect Pests and Weeds

Important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation. Infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and nematodes.

Host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa, etc., their mode of action. Biological control of weeds using insects. Defense mechanisms in insects against pathogens.

Mass production of quality bio-control agents- techniques, formulations, economics, field release/ application and evaluation. Development of insectaries, their maintenance.

Importation of natural enemies- Quarantine regulations. Semiochemicals in biological control.

VI. Toxicology of Insecticides

Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature; categorization of insecticides on the basis of toxicity; structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds/ new insecticide molecules; nanopesticides.joint action of insecticides-synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity. Insecticide metabolism; insect-pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.

VII. Concepts of Integrated Pest Management

Definition and various terminologies. Principles, classification, components, types and mechanisms of resistance. Crop protection organizations; insecticide regulatory bodies; insecticide, bio-pesticide and pheromone registration procedures; label claim of pesticides. Ecological principles, economic threshold. Insect-host plant relationships; theories and basis of host plant selection in phytophagous insects.

Legislative, quarantine regulations, cultural, physical and mechanical methods; semiochemicals, biotechnological and bio-rational approaches in IPM. Pest survey and surveillance, forecasting and various related aspects; pest risk analysis; pesticide risk analysis; cost-benefit ratios and partial budgeting; successful IPM programmes. ITKs, ecological engineering. Agro-ecosystems; sampling, population estimation; crop loss assessment, different types of losses, Computation of EIL and ETL; crop modeling; designing and implementing IPM system. Screening techniques for insect resistance in crop plants.

VIII. Pests of Crops and stored grains and their management

Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests of different field crops and vectors. Insect pests of different crops and their management of –

cereals and millets; pulses, tobacco, oilseeds; fibre crops, sugarcane; Fruit Crops- important tropical, sub-tropical and temperate fruits. Vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, French beans, brinjal, okra, all gourds, drumstick, leafy vegetables, etc. Plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa, etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, beetlevine, etc. Ornamental, medicinal and aromatic plants;

Storage entomology- post-harvest losses; factors responsible for losses; type of losses and their effect on grain quality, stored grain deterioration process and consequences; seed vault; insects, mites, rodents, birds and microorganisms associated with stored grain; storage structures; storage insects and mites, their systematic position, identification, distribution, host range, biology, nature and extent of damage, field and cross infestations and natural enemies; important rodent pests and their control; bird pests and their management.

IX. Host Plant Resistance

Principles, classification, components, types and mechanisms of resistance.

Insect-host plant relationships; theories and basis of host plant selection in phytophagous insects. Chemical ecology, tritrophic relations, volatiles and secondary plant substances; basis of resistance. Induced resistance and its types. Factors affecting plant resistance; biotypes and measures to combat them. Screening techniques for breeding of insect resistant crop plants. Biotechnology in plant resistance to insects.

X. Principles of Acarology

Important families of Acari including diagnostic characteristics. Estimation of populations; sampling and extraction methods for soil arthropods. Seasonality, nature of damage, host

range of mite pests of different crops; mite pests in polyhouses, stored products and honeybees. Management of mites. Culturing of phytophagous, parasitic and predatory mites. Mode of action of acaricides, resistance of mites and ticks to acaricides, its management.

XI. Apiculture and Sericulture

History and development of apiculture; classification of bees; distribution of genus *Apis* and races; honey bee morphology and anatomy; biology, ecology, adaptations; behaviour; bee pheromones; honey bee communication. Commercial beekeeping; bee hives; apicultural equipment; Seasonal bee husbandry, nutrition and artificial diets; Absconding, swarming, drifting – causes and management. Queen bee- mass rearing and management. Bee mite and insect pests, their biology, ecology, nature and symptoms of damage, management tactics; Predatory birds and their management; Pesticide poisoning to honey bees and management. Honey – composition, properties, crystallization, post-harvest handling and processing; Non-*Apis* pollinators, their augmentation and conservation; Bee pollinators in crop productivity.

Sericulture- importance, different organizations in sericulture; silkworm types, distribution, area and silk production. Mulberry species, ecological requirements, cultivation methods, intercropping; pest and diseases and their management. Food plants of eri, Tasar and Muga silkworm. Silkworm origin – classification based on voltinism, moultinism, distribution and genetic nature – pure races –multivoltine and bivoltine races –cross breeds – bivoltine hybrids –races and hybrids of mulberry, eri, tasar and muga silkworm- Morphology and biology of silkworm, structure and function of silk glands. Rearing house and rearing of silkworms; egg incubation methods, Chawki rearing, late age worms rearing; mountages, cocoon harvesting and marketing; pests and diseases of silkworms and their management. Post cocoon technology, stifling, cocoon cooking, reeling, re-reeling, bleaching, degumming, dyeing, printing and weaving.

XII. Plant Nematology

Characteristics of Phylum Nematoda and its relationship with other related phyla, history and growth of Nematology; nematode habitats and diversity- plant, animal and human parasites; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry. Morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology. Parasitism types; nature of damage and general symptomatology; interaction of plant-parasitic nematodes with other organisms. Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes. Principles and practices of nematode management; Emerging nematode problems, its importance in international trade and quarantine.