CHAPTER II

Review of Literature
2.1: Review of Literature

Various scientists all over the globe worked on different aspects of grasshoppers. The small rice grasshopper *Oxya hyla hyla* is an important pest of rice distributed all over India. A few works were reported on this serious pest regarding various aspects of ecology, biology and its management.

Capinara and Horton (1989) studied on the geographic variation in effects of weather on grasshopper infestation in Colorado and reported that grasshoppers in Northern states are favoured by warm, dry summer conditions whereas in southern areas appear to require spring and summer moisture. Monitoring of rainfall in relation to the control of migrant pests was recorded by Milford and Dugdale (1990). The dominance of different regulating factors for rangeland grasshoppers was reported by Belovsky and Joern (1995). Environmental factors correlates with population build up of rice insect pests through light trap catches studied by Bhatnagar and Saxena (1999) who reported and found that yellow stem borer, Green leaf hopper and Gundhi bug
showed significant negative correlation with temperature and Leaf folder and Case worm also showed significant negative correlation with relative humidity and rainfall.

Ghani et al., (2002) worked on the occurrences and abundance of grasshopper species on rice and reported that grasshopper population was abundant in the rice field during July to October. Joern, (2000) studied the consequences of non-linear ecological interactions for grasshopper control strategies. Denholm et al., (2001) reported the Insect population dynamics from the aerable crops. Sustainable management of insect herbivores in grassland ecosystems was studied by Branson et al., (2006)

Ray and Bhattacharjee (2006) studied on the diversity and composition of insecta in rice agro- ecosystem in Barak valley of Assam (India). Grasshopper (Orthoptera: Acrididae) communities respond to fire, bison grazing and weather in North American tall grass prairie was investigated by Jonas and Joern, (2007). Singh et al., (2007) studied the population dynamics of Orthoptera (Insecta) collected from light trap and found twenty four species of Orthopterans under six families which
was correlated with temperature and relative humidity. Muralidharan et al., (2007) studied nature, extent of damage and crop losses due to some economic species of grasshoppers in north Gujarat. Jena et al., (2009) studied the influence of weather factors on pest incidence in aromatic rice during wet season of 2001-2006 and reported the maximum population during 2001 due to weather parameters. Observations on the seasonal variations in population of three species of grasshoppers (Orthoptera: Acrididae) of Kashmir Himalaya was studied by Azim et al., (2010) and found that grasshopper population were increases with increase in temperature and relative humidity. Tamkeen et al., (2011) reported on grasshopper species composition in Mirpur Division of Azad Jammu and Kashmir and documented that Oxya hyla hyla was abundant in Bhimber district among the entire three Districts in Mirpur Division. Das and Ray (2012) studied the population dynamics of Oxya hyla hyla (Orthoptera: Acrididae) on rice in Cachar District of Assam N E India and found that the maximum population of Oxya hyla hyla was recorded during Shali season in two study sites.

Iqbal and Aziz (1975) investigated the food preference of Spathosternum prasiniferum Walker (Orthoptera: Acridoidea) and
reported that the pest preferred the weeds, *E. colonum, C. dactylon, C. rotundus*. Otte and Joern (1977) studied on the feeding patterns in desert grasshoppers and the evolution of special diets of some North and South American desert grasshopper species and reported that these faunas became adapted to desert conditions independently.

Majeed and Aziz (1981) studied the food preference of different stages of *Gastrimorgus transverses* under controlled condition of temperature and relative humidity and found that food plants belonging to the family gramineae were highly preferred. Muraliranjan and Muraliranjan, 1990 reported the role of physico-chemical factors in host selection of *Oxya nitidula* and observed that the early nymphs prefer only the weeds and the later nymphs and adults choose crop plants and the physical characteristics like presence of trichomes and the thickness of leaf lamina are also important factors in host selection. Chapman (1990) studied the food selection and biology of grasshopper. The Polyphagy in the acridomorpha and the bionomics of grasshoppers, katydids and their kin was reported by Chapman and Sword (1997). Suresh Chand & Muraliranjan, (1999) studied the evaluation of food consumption by *Oxya nitidula* (Walker) in relation to plant age of some
rice cultivars, *Oryza sativa* L. and reported that the pest species showed
preference to growth stages II and III in all cultivars. Observation on
grasshopper and vegetation complexes in Indo-Pak border area during
1994 was carried out by Sinha and Prasad (1999). Vedham and
Muralirajan (1999) investigated the effect of different host diets on the
grasshopper, *Diabolocatantops pinguis* (Walker) reported that among
the four hosts tested, *Arachis hypogaea* and *Phaseolus aureus* were
significantly better hosts for the Acridid species. Begna and Fielding
(2003) determine the damage potential of grasshoppers (Orthoptera:
Acrididae) on early growth stages of small-grains and canola under
subarctic conditions in Alaska.

Muralidharan *et al.*, (2007) studied nature, extent of damage and
crop losses due to some economic species of grasshoppers in north
Gujarat and observed that the highest damage of the crops were due to
*Hieroglyphus nigrorepletus* followed by *Aiololoppus thalassinu* among
the four grasshopper species. Distribution of grasshoppers among
different host plants and habitats in two districts of Tamil Nadu, India
was investigated by Paulraj *et al.*, (2009) and reported 21 species of
grasshopper under family Acrididae, which was 63.60% of the total
species and among different habitats. Varietal preference and diurnal activity of *O. hyla hyla* on rice agro-ecosystem was studied by Das and Ray, 2013 and found that Luit, Aizong and Guchiboroa were the most susceptible varieties during all the three cultivated seasons (Shali, Boro and Aus) and maximum diurnal activity was noticed during 9- 12 hrs in all the seasons in both the years under Cachar District of Assam.

Das and Ray, 2013 studied the diurnal activity performed by *O. hyla hyla* in the crop field at Cachar District of Assam and recorded maximum diurnal activity at 9- 12 hours during all the seasons in both the years. Bhattacharjee and Ray, 2007 studied seasonal variation of certain morphometrical parameters and diurnal activity of *Dicladispa armigera* (Olivier) (Coleoptera: Chrysomelidae) in sub- tropical rice agro-ecosystem during three seasons in Cachar district and found that the diurnal insect activity was higher at 8- 11 hours and less at 11- 13 hours.

Scriber and Slansky, (1981) studied the nutritional ecology of immature insects and found that growth and development of insect is influenced by environmental factors and quality of food. A detailed study was
carried out by Bodenstein, (1984) on physiology and post-embryonic development of insect.

Bordoloi and Hazarika, (1992) recorded the seasonal variations of body weight, lipid reserves, blood volumes and haemocyte population of *Antheraea assama*. Tropical dry and wet season polyphenism in the butterfly, *Melanitis leda* was observed by Brakefield, (1987). Marngar and Kharbuli, (2003) studied the life cycle of small rice grasshopper, *Oxya hyla* and found that the occurrence of instar period is greatly influenced by environment and they also reported the various morphometrics as well as different stages of instars and fecundity. Marngar, (2008) studied the natural stages of development in *Oxya hyla* and observed various aspects regarding life cycle of the insect.

Fecundity and fertility of a pestiferous acridid *Oxya fuscovittata* (Marschall) in relation to population structure was studied by Das *et al.*, (2001). Engelmann, (1970) in the physiology of insect reproduction described as mating is an important factor in determining the number of eggs produced. Sultana and Wagon, (2010) carried out the comparative study on the immature stages of three *Hieroglyphus species* (Acrididae:
Orthoptera) from Pakistan and reported that the measurement of various body parts were significantly different in all the three species and sex ratio was higher in case of females in all the species. The optimum temperature and photoperiod for mass production of *Oxya hyla hyla* (Serville) was determined by Das *et al.*, (2012) and concluded that 35 ± 2.0°C with a photoperiod of 12:12 was suitable for mass production of *Oxya hyla hyla*.

Toxicity and persistence of bioethanomethrin and dimethoate in the control of grasshoppers (Orthoptera) was observed by Burrage *et al.*, (1976) who found that for 8 days the dimethoate treatment was effective against the invading grasshoppers than the untreated plots. Javadi and Knutson, (1979) studied the toxicities of three insecticides to five species of grasshopper nymphs and found that permethrin produced no significant mortality to *M. bivittatus* but decamethrin produced a substantial mortality to all the grasshopper species.

(Hydrellia philippina) with granular and foliar insecticides. Barlow, (1985) experimented on the chemistry and formulation, in pesticide application along with its principles and Practice. Hinks, (1985) observed the influence of temperature on the efficacy of three pyrethroid insecticides viz- deltamethrin, fenvalerate and cyfluthrin against the grasshopper, Melanoplus sanguinipes under laboratory conditions and among these three deltamethrin found to be the most effective and cyfluthrin the least effective against the grasshopper species. Further, studies on the efficacy of folier and granular insecticides for the control of rice stem borer in Punjab was done by Dhaliwal et al., (1986). Aerial application of the pyrethroid deltamethrin for grasshopper (Orthoptera: Acrididae) control was studied by Johnson et al., (1986) and reported 65% reduction of grasshopper density after 4 days of spraying. Dubey et al., (1987) studied the efficacy of insecticides against gall midge and stem borer in rice. Ewen and Mukerji, (1987) evaluated the carbofuran bait against third- instar grasshopper (Orthoptera: Acrididae) populations in Saskatchewan and reported 70% reduction of grasshopper population after 3 days of application at 35.0 g a.i/ ha. Balanca and Visscher, (1997) studied the effects of very low doses of fipronil on grasshoppers and
non-target insects following field trials for grasshopper control and found that a 0.6 g a.i/ha spraying treatment was effective against grasshopper outbreaks with 47% mortality within two days and 91% in 10 days. Hinks and Olfert, (1992) reported the screening of cereal cultivars for resistance to early instar grasshoppers (Orthoptera: Acrididae). Comparisons of Malathion susceptibility, target sensitivity and detoxification enzyme activity in nine field populations of *Oxya chinensis* (Orthoptera: Acrididae) was studied by Wu et al., (2007). Seetha Ramu et al., (2005) evaluated some newer insecticides against sucking insect pests of rice and reported Fipronil > Thiodicarb > Chlorpyriphos > Cartap hydrochloride > spinosad as descending order of efficacy against sucking pest complex. Population dynamics and Bio-efficacy of *Raphidopalpa* (Aulacophora) *foveicollis* (Lucas) (Coleoptera: Chrysomelidae) on *Lagenaria vulgaris* Ser. in Barak Valley of Assam was studied by Nath and Ray, (2006). Kalita et al., (2008) studied the time and method of application of insecticides against early stage insect pests of rice and reported that application of Carbofuran 3G @ 30 Kg/ha, Chlorpyriphos with 0.05% at 10 DAT reduced pest population significantly. Bio-efficacy of some Conventional pesticides against *Oxya*
*hyla hyla* (Serville) on rice in Cachar District of Assam was studied by Das and Ray, (2012) and reported that Dimethoate with mortalities 77.8% and 61.2% followed by Alphamethrin and Profenophos + Cypermethrin which afforded the highest mortality of the pest species at 15 days after treatment. Ray and Devi, (2011) investigated on the management of *L. acuta* in rice agro- ecosystem of Cachar District and reported that Monocrotophos (0.2%) afforded more than 98% pest control.

Effectiveness of neem products against rice leaf folder, in rice field was evaluated by Baitha *et al.*, (1993) and reported that while comparing carbofuran and monocrotophos with various neem based formulations that proved to be the superior against control. Ambethgar, (1996) also studied the effectiveness of neem (*Azadirachtin indica* A. Juss) products and insecticides against rice leaf folder, *Cnaphalocrosis medinalis* Guenee and reported neem cake + NSKE was the next best treatment followed by quinalphos. New eco-friendly pesticides for integrated pest management were used by Roy and Dureja, (1998). Tripathi and Tripathi, (2000) studied the role of bio-pesticides in environmental safety and concluded that environment can be protected by reducing the use of toxic chemical pesticides and replacing them by botanical and microbial

Arshad and Hafiz, (1983) studied the Microbial trials of a pathogenic fungus, *Beauveria bassiana* (Bals.) Vull. against the adults of *Aeolesthes sarta* Solsky. Trial of *Beauveria bassiana* (Bals.) Vuill. a pathogenic fungus against larvae of *Piesmopoda obliquisciella* (Hmps) (Pyralidae, Lepidoptera) a leaf sticher of *Cassia fistula* was reported by Khawaja et al., (1984). Meade and Byrne, (1991) reported the use of *Verticillium lecanii* against subimaginal instars of *Bemisia tabaci*. Laboratory
experiments were conducted by Bajwa and Zimmerman, (1994) on microbial control of *Pityogenes chalcographus*.

Efficacy study of *Beauveria bassiana* as biocontrol agent against hadda beetle *Epilachna dodecasrigma* was done by Gul and Hamid, (1997) under laboratory conditions. A field trial on the cotton leaf roller, *Sylepta derogate* with *Beauveria bassiana* was studied by Ramesh *et al.*, (1999). Rosa *et al* reported the effect of *Beauveria bassiana* and *Metarhizium anisopliae* upon the coffee berry borer under field conditions. CAMB bio-pesticides to control pests of rice was used by Shahid *et al.*, (2003). A study was made by Perry *et al.*, (2005) with *Metarhizium anisopliae* isolates for the control of cattle ticks.

Thompson *et al.*, (2006) studied the impact of moisture and UV degradation on *Beauveria bassiana* Vuillemin conidial viability in turfgrass. Effect of climatic factors on bio- efficacy of bio-pesticides in insect pest management was reported by Abbazadeh *et al.*, (2011). Bio-pesticides: The next line of defense for resistance management was studied by Manker, (2012).
Bowers et al., (1976) discovered the insect’s antijuvenile hormones in plants. Anti-gonadotropic hormones from the goatweed, Ageratum conyzoides was studied by Fagoonee and Umrit, (1981). Evaluation of plant extracts for biological activity against mosquitoes was studied by Sujatha et al., (1988) and reported that the juvenile hormone activity of Acorus calamus, Madhuca longifolia and Ageratum conyzoides were found to be produce significant inhibition in adult emergence at the concentration of 5 and 10 mg/ l. Jacobsen, (1989) mentioned and analyzed the past, present and future potentials of Botanical pesticides. Bhathal et al., (1994) studied the Insecticidal activity of Ageratum conyzoides Linn. against Lipaphis erysimi and reported that among ether and chloroform extract nymphs were inflicted high immediate mortality with ether extract while adults were abnormal with chloroform extract of Ageratum conyzoides.

Efficacy study of certain plant extracts against Myzus persicae Sulz. (Homoptera: Aphididae) on cabbage in Manipur was reported by Singh et al., (1995). Murray et al., (1995) investigated the effects of Citrus limonoid on Colorado potato beetle (Coleoptera: Chrysomelidae) in relation to its colonization and oviposition. Suryakala et al., (1995) and
Suryakala and Thakur (1997) studied the Ovicidal activity of plant extracts on *Spodoptera litura* and *Dysdercus koenigi* as well as other natural products as insect growth regulators. Sharma, (1996) reported the Insectistatic role of plant allelochemics in pest management and alleopathy in pest management for sustainable agriculture. Saxena, (1998) elucidated the critical issues in insect pest management with special reference to botanical pest control. The influence of some plant extracts on the feeding activity of small rice grasshopper, *Oxya hyla hyla* was studied by Marngar and Kharbuli, (2001) and found that among all the four plant extract tested, methanolic extract of *Ageratum conyzoides* at 50, 100 and 200 mg/ml concentrations were most effective at agro-climatic conditions of Shillong. Marngar and Kharbuli (2001) studied on the feeding activities of *O. hyla hyla* with four indigenous plant materials reported *A. conyzoides* showed better performance over other three plant methanolic extracts. Marngar et al., (2003) studied the bio-activity and moulting of nymphal stages on *O. hyla hyla* and reported that moulting was totally inhibited and reduce the normal life duration of *O. hyla hyla*. Tripathy et al., (2004) studied the efficacy of new botanicals
against seed beetle (*Caryedon serratus* Oliv.) (Bruchidae: Coleoptera) infesting stored groundnut under Bhubaneswar agro-climatic conditions.

Suryakala *et al.*, (2007) studied the insect growth regulatory activity of some botanical pesticides and their role in pest management and reported that the high percentage of insect growth regulating activity was shown by flower extracts of *Mimusops* sp. and *Premna* sp., fruit extract of *Solanum* sp., seed extract of *Myristica* sp. and *Mellitus* sp., root extracts of *Cocculus* sp. and *Lippia* sp.

Rao *et al.*, (2007) stated the role of bio-pesticides in crop protection: Present status and future prospects. Evaluation of insecticidal properties of some botanical products against adult surface grasshopper, *Chrotogonus trachypterus* Blanch was studied by Poonia and Bhati, (2009) who recorded the ranking of plant powder in terms of decreasing order of mortality at each of four concentration as *Azadirachta* LP > *Calotropis* LP > *Datura* LP > *Argemone* LP > *Tephrosia* LP > *Ocimum* LP. It was also observed that all the plant extracts at the 4 concentrations showed a significant mortality of the grasshopper species. Marngar, (2007) studied on the bioactivity of some plant extracts against the
behavioural activities of rice grasshopper, *Oxya hyla* and found that methanolic extract of all the five tested plants showed inhibition of activity by the rice grasshopper.

Gliessman, (1981) studied the ecological basis for the application of traditional agricultural technology in the management of tropical agro-ecosystems. Towards a grassroots approach to rural development in the Third World was reported by Altieri, (1984).

Traditional practices in pest management: some examples from north-east India was documented by Sinha et al., (2004) where they mentioned many indigenous traditional practices followed by the North Eastern farmers. Kiruba et al., (2006) studied the traditional pest management practices in Kanyakumari district, Southern peninsular India and reported that the farmers use lime, fly ash and some plant species as well as different types of traps against the insect pest.

Farmer participatory learning on integrated crop management of lowland rice in Mali was carried out by Nwilene et al., (2006). Karthikeyan et al., (2006) studied the indigenous storage practices in pulse. Use of certain bio-products for insect-pest control was reported by Chaman Lal and Verma, (2006). Deka et al., (2006) studied the traditional pest management practices of Assam and documented the use of Melastoma malabathricum leaves in the paddy field for the control of Scirpophaga incertulus. Pest management beliefs and practices of Manipuri rice farmers in Barak valley, Assam was studied by Bhattacharjee and Ray, (2010) and documented that 86.36% farmers in Rajwari study site did not use insecticides. They also reported that for
the management of different storage, farmers practiced some indigenous methods besides chemical pesticides.

Nath and Ray, (2012) documented the traditional management of red pumpkin beetle, *Raphidopalpa foveicollis* Lucas in Cachar district, Assam and reported that the total response in using traditional methods against *R. foveicollis* was found to be the maximum (77.50%) with cow dung and fly ash followed by red chilly powder (50%). The minimum (25%) used material was kala maati (black soil) powder.