General Introduction

India is the second largest producer of vegetables after China which about 75 million tons (Dhandapani, et al., 2003). India’s cultivable area measures 190 million ha, while USA has 177, Russia has 126, China 124, West Europe as a whole 77 million ha (Bajaj and Srinivas, 2001). The existing area under vegetable cultivation in India is around 4.5 million ha (Dhandapani, et al., 2003). In Assam more than 70 per cent people are involved in agriculture (Deka et al., 2006). Majority of Indians are vegetarian, with a per capita consumption 135 g per day as against the recommended 300 g per day. It is still very less than recommended diet level (Dhandapani, et al., 2003). In near future, there is a need of around 5-6 million tons of food to feed our 1.3 billion Indian population expected by the year 2020 (Paroda, 1999). Indian vegetable export is very low because of increased domestic requirement and other limitations in crop production. The major limiting factor, include the extensive crop devastations due to increased pest menace (Dhandapani, et al., 2003). In many cases, there is 100 per cent yield losses due to insects (Shivalingswami, et al., 2002). The extent of crop losses in vegetables varies with the plant type, location, damage potential of the pest involved and cropping season. Vegetables are more prone to insect pests and diseases mainly due to their tenderness and softness as compared to other crops and virtual absence of resistance characters because of intensive hybrid cultivation. The insect pests inflict crop losses to the tune of 40 per cent in vegetable production (Srinivasan, 1993). If we consider Indian agricultural
vegetable production (Srinivasan, 1993). If we consider Indian agricultural scenario, there is an estimated loss of Rs. 5000 crore every year due to pests and insects (Dikshit and Alapat, 1997).

Cucurbits under the family Cucurbitaceae are widely cultivated in India (Anand, 1981; Butani and Jotwani, 1983; Kumar and Nigam, 1991) and abroad (Brown, 2003; Rahaman and Prodhan, 2007). Crops of this family are an important group among vegetables, which includes Pumpkin, *Curcubita maxima* (Naudin.) Filov.; Ash gourd, *Benincasa hispida* (Thunb.) Cogn.; Bitter gourd, *Momordica charantia* (L.); Ridge gourd, *Luffa acutangula* (Roxb); Cucumber, *Cucumis sativus* (L.) etc. popularly called as gourds. They are amenable for cultivation round the year. In Assam cucurbitaceous crops enjoy a unique status among vegetables. Many insect pests infest the crops and affect the appearance of the marketable yield.

Among insect pest Leaf beetles or Chrysomelidae are one of the important family mainly infests the cucurbitaceous crops. Being phytophagous, the group includes many established and agricultural pests. Some cases leaf beetles are a direct indicator of diversity of ambient flora. In some cases seasonal changes in leaf beetle fauna are indicator of forthcoming weather changes (Kalaichelavan, 2000).

Vegetable growers by and large depend on chemical pesticides to counter the problem of insect pests. It accounts for 13-14 per cent of total pesticides consumption, as against 2.6 per cent of cropped area. Indiscriminate use of pesticides has led to severe ecological consequences like destruction of natural enemy fauna, effect on non target organisms, residues in consumable
products including packed pure and mineral water and ultimately resistance to the pesticides, to which we solely rely (Dhandapani, et al., 2003).

Red pumpkin beetle *Raphidopalpa (Aulacophora) foveicollis* (Lucas) (Coleoptera: Chrysomelidae) causes heavy damage during early phase of plant growth in Greece, South Europe, Algeria, Egypt, Cyprus, Aden, Persia, India, Ceylon, Nepal and Burma (Dhillon and Sharma, 1989). Pumpkin beetles are usually found in aggregations within the crop on both young and old leaves. The adults lay their eggs into the soil amongst the roots of the plants where, once hatched, the creamy white larvae will feed until they pupate and emerge as adults (Brown, 2003).

The adult beetle is red, oblong and approximately 6-8 mm long and lays its eggs at the base of the host stem. A single female can lay 150 to 300 eggs (Srivastava and Butani, 1998). Adult pumpkin beetles feed on the leaves of cucurbits, chewing large holes and often leaving only the veins of the leaves. Young seedlings are particularly susceptible to damage as small numbers of beetles can cause total defoliation and death. Mature plants can sustain a larger amount of damage before yields start to decline. The adult beetles feed voraciously on the leaf lamina making regular and irregular holes and also attack cotyledons and flowers (Butani and Jotwani, 1984; Ray, 2000; Nath and Ray, 2006a). They eat seedlings, young and tender leaves and flowers. They normally occur in large numbers. The grubs are yellowish white and when in the soil cause injury to the roots (Maniruzzaman, 1981). Larval damage to the roots is usually minimal and the plants are rarely affected (Brown, 2003).
Biological pest management (BIPM) is the recent trend in Indian farming and attracting the farmers for higher income to their produce. This has resulted due to increased awareness among the end users and concerns about the deteriorating ecological situations among the eco-campaigners. However, it must be borne in our minds that there is no feasible one hundred per cent alternatives to chemical pesticides and they are must when situations are demanding. In the light of integrated pest management the biointensive pest management practices for major vegetable crops evolved by scientific approaches are discussed. Toxicity of leaf extract of *Ageratum conyzoides* L. by Pande *et al.* (1987) and microbial treatments like *B. bassiana* 2 x10^6 cfu/g (Annonymous, 2001) proved to be effective against pumpkin beetle. According to the information of Entomology Section at Berrimah Agricultural Research Centre related to the control of cucurbitaceous pests which depends on bees for pollination, it is recommended that insecticide use be kept to a minimum during the flowering period.

Host resistance is an important addition to an insect control programme as well as a necessary tool where insecticides are too costly or unavailable. Breeding for resistance to this insect involves field selection based on a leaf injury index. Low temperatures (January or February is the sowing time) may prevent random movement of the beetle which lead into heterogeneous recurrence of the insect over the experimental area (Dhillon and Sharma, 1989). Presently the farmers are totally depended on the use of insecticides to control this pest. The indiscriminate use of pesticides has not only complicated in the field of management, it has also created several adverse effects such as pest resistance, outbreak of secondary pests (Hagen and
Franz, 1973), health hazards (Bhaduri et al., 1989) and environmental pollution (Kavadia et al., 1984; Desmarchelier, 1985; Devi et al., 1986; Fishwick, 1988). So always we are looking alternative and environment-friendly methods of pest control. It is apparent that this insect causes serious damage to several cucurbitaceous crops and even sometimes causes death resulting considerable economic loss in this region. Keeping the above statement in view the present study programme has been undertaken.
a) Objectives

- To study the population dynamics of *Raphidopalpa foveicollis* during three crop seasons on major cucurbitaceous crops in Cachar district.
- To study the host preference by the adult beetles.
- To investigate the nature and extent of damage caused by adults and larvae.
- To study the diurnal activity of the species during three seasons.
- To study the morphometry and life history of the insect.
- To find out the most effective method for the management of *R. foveicollis* which will be ecologically safer.
b) Study sites

Location and boundary

The North Eastern region of India, a part of Eastern Himalaya, is a recognized biodiversity hotspot (Myers et. al. 2000) of the world. Our present investigated area belongs to Cachar District of Barak Valley which is situated in the state of Assam in the same region. Barak Valley derives its name from River Barak that along with its tributaries. Cachar district situated at Barak valley, one of the major divisions of the state Assam with other two districts namely Hailakandi and Karimganj. This valley is having a geographical area of 6922 sq km and situated between longitude 92° 15' and 93° 15' East and latitude 24° 8' and 25° 8' with an altitude of 36 m msl. Though it contains about 9 per cent of total area of the state but it hold 11.24 per cent of the total state population as per 2001 census. The valley is characterized by undulating topography, wide plain lands and low lying waterlogged area. The total area occupied by Cachar district is 3786 sq km. the valley is bounded by the North Cachar Hill District of Assam and Jaintia Hill District of Assam in the North, the state of Mizoram and Manipur in the South and East, and by the state of Tripura and the Sylhet District of Bangladesh in the West. The valley is girdled by the Barail range of Hills in the East and the Hills of Mizoram in the south, which extends as Arakan Yoma in Myanmar.
**Geology**

The geology of Barak Valley mostly comprises tertiary formation. The total rocks found within the valley are the sandstones of the Barail series, which are concentrated in a small area. Otherwise, rocks of Surma, Tipam and Dihing series along with older alluvium are predominant. While the Surma and Tipam series mostly comprise sandstones, sandy and clay shale and ferruginous clay. The Dihing series is largely made up of pebble beds of the tertiaries contain a large number of malvine fossils, but the greater portion of the tertiary is almost barren.

**Topography**

The topography comprises of agricultural lands, floodplains tea gardens and numerous small hillocks strewn in between them. Chatla in Cachar and Shonbeel in Karimganj districts are the two major floodplain wetlands of Barak Valley.

**Climate**

The climatic condition of the valley is sub-tropical warm and humid. Most of the precipitation occurred here during May to September, which mainly controlled by Southwest monsoon season. The average rainfall of this valley is more than 2500 mm, most of which is received during May to September. Longer spell of rainfall in North-eastern India compared to other part of the country usually operates by Southwest monsoon.

**Human communities and culture**


Human communities of this area mainly consist of multi ethnic groups of Bengali, Hindi, Manipuri, Dimasa, Naga, Praia, Karbi, Mar, Kuki, Khasi, Reang. One of the major ethnic groups in the Barak Valley flood plains, especially Chatla and Shonbeel are the Kaivartas, a cultivator-fisher community. In addition to these the landscape is inhabited by a plethora of Hindu and Muslim communities who also earn their revenue from agriculture and fishery.

Agriculture plays a great role in preserving our culture and traditional wisdom treasured in the various ethnic groups. Traditional wisdom can teach us many things that can be used to give a boost to the development process at any point of time. Once an ethnic group and its culture are lost, it is lost forever.

**Forest of Barak Valley**

According to State of Forest Report 2003, the Barak Valley region of Assam having a total forest area of 3833 km$^2$ which is about 54.39 per cent of the total geographical area (6922 km$^2$) of the region as against 35.48 per cent for the state as whole. Among the three districts of Barak Valley, Cachar district represents the highest percentage with 58.80 followed by the Hailakandi district with 58.33 per cent and the Karimganj district with 46.05 per cent of the geographical area of their respective district (State of Forest Report 2003). According to Champion and Seth (1968) the forest vegetation of Barak Valley comes under Cachar tropical evergreen forest (1/1B/C3) and Cachar semi evergreen forest (2/2B/C2).
Fig. 1. Map showing the study sites.