CHAPTER I
INTRODUCTION

Common bean or French bean (*Phaseolus vulgaris* L.) is an important legume for human nutrition and a major protein and calorie source in the world. Several common names are given to this crop in different regions viz., rajmah, rajmash, haricot bean, kindey bean, snap bean, navy bean, field bean, dry bean, pole bean etc. in different parts of the world was domesticated in Central and South America more than 6000 years ago. Wild forms of small black seeds are found in Tropical America from where it was introduced to West Africa and later to India. Common beans were spread to Europe, Africa and Asia by Spanish and Portuguese and at present it is grown throughout the cooler tropics but not in the hot semi-arid or wet-humid regions (Chatterjee and Bhattacharyya, 1986). French bean is quite nutritious and potential source of protein carbohydrates and minerals. The mineral matter, crude fibre and ether extract are concentrated in seed while crude protein and energy are stored in the cotyledons. It contains about 17.5-28.7 per cent protein in the dry seeds and about 1.0-2.5 per cent protein in the green pods, 3.2-5.0 per cent mineral matter, 4.2 to 6.3 per cent crude fibre, 1.2-2.0 per cent crude fat and 340450 kcal energy, besides about 61.4 per cent carbohydrates, 3.8g ash, 425mg phosphorus, 13.7mg calcium, 16.7mg iron per 100g of edible parts and about 11 per cent water (Aykroyd and Doughty, 1973). French bean is grown in different parts of the world for its mature dry seeds, immature/tender green or yellow pods (snap bean) and for its leaves (in Africa and Asia) to be used as vegetable. In Northern India, dry pods of French bean fetch higher price to that of other pulse crops as its vegetable preparation is considered to be one of the most nutritious and delicious dish for the 'Sunday special'. The dry seeds can also be canned and exported. Tender pods of French bean for vegetable purpose can be harvested at about 55-60 days after sowing. French bean is traditionally a crop of temperate region. It is cultivated in hilly tract of Jammu & Kashmir, Himachal Pradesh (Kullu, Barot, Chamba and Shimla valley) and Uttar
Pradesh. While its cultivation is mainly restricted to hilly region of north India, its consumption is more in the plains of north and central India, where its demand is not fully met. It is grown in Jammu & Kashmir, Himachal Pradesh, Hills of Uttar Pradesh and in some parts of Maharashtra (Mahabaleshwar and Ratnagiri region) as a kharif crop and in some other parts of Maharashtra, Andhra Pradesh, western and eastern Ghats and north-east plains where winters are mild and frost free as a winter crop. Recently its cultivation has been extended to northern plain zone. Chandra and Ali (1986) exploited the feasibility of growing rajmah as a potential rabi crop in the plains of north India. Introduction of this non traditional crop to north eastern plains of India as a winter crop has generated lot of interest in the farming community due to its higher productivity, responsiveness to inputs and remunerative price.

India is the largest producer of pulse crops in the world with 25 per cent share in global production. The total production was estimated to be 14.76 million tones from an area of 23.63 million hectares with average productivity 625kg/ha (Anon, 2011). French bean is grown mainly in the states of Maharashtra, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Tamil Nadu (Nilgiri), Kerala (Palni hills), Karnataka (Chickmangalur) and West Bengal (Darjeeling hills) (Prasad, 2005). According to UN Food & Agriculture Organization (FAO, 2012), India is the third producer (6,20,000 MT) of this green bean after China (16,200,000 MT). In India, French bean covers an area of 2.3 million hectare with production of 1.1 million tones and productivity of 478kg ha\(^{-1}\) (Anonymous, 2005). Since it is a short duration (85-90 days) crop, it can very well fit as a component of intercropping and sequence cropping in many of the agro-climatic zones. During the last decades French bean is becoming increasingly important as a cash crop in India. It has a large export potential (Abdel-Mawgoud et al., 2005).

French bean is an important and highly profitable vegetable crop of North Eastern Hill Region of India. Generally, it is cultivated for vegetable purpose round the year except winter months (October-January) in foothills as well as in the mid altitude in all the North Eastern States including Sikkim. However, at present its
average yield is low in farmers filed as compared to its potential yield. The increase in productivity of French bean will meet the increasing demand for green vegetables of the region. As per the requirements of good crop of French bean wide range of soil but thrives well in well drained, loamy and light alluvial soil with pH 6.0 to 7.0 are ideally suited. The main cultivated district of Assam are Dhubri, Borpeta, Darrang, some pockets of Kokrajhar and Barak Valley including Karimganj. The production in darrang district during 2012-13 was 3767.4MT with productivity 6440kg per ha from 585ha land area. In Karimganj, the total production of French bean was 3055.8 thousand tonnes from an area of 2.78 thousand hacter area (1.39ha in rabi and 1.39ha in summer) during 2010-11. French bean is as common crop of Hailakandi district of Assam that covered 1355 ha area with a production of 1693.75MT and there was an increase of cultivated area during 2012-13 against the previous year which was 1350ha and 1161 MT. (Anonymous, 2014)

About 30 species of insects have been reported damaging French bean crop (Srivastava and Butani, 1998). Among the major pests reported elsewhere for beans are the bean seed fly (Delia platura), bean flies (Ophiomyia spp.), cutworms (Agrotis spp.), aphids (Aphis craccivora and A. fabae), leafminers (Liriomyza spp.), spider mites (Tetranychus spp.), whiteflies (Bemisia tabaci) and the African bollworm (Helicoverpa armigera) (Allen et al., 1996). Thrips are the most important pest of French beans at flowering and harvesting (Nderitu et al., 2010; Nyasani et al., 2012b). Losses of more than 60% have been reported on the marketable pods as a result of thrips damage (Nderitu et al., 2009). Two spotted spider mites attack French beans at seedling to maturity levels, other pests that attack French beans at different growth stages include white flies, pod borers and leaf miners (Lohr, 2006).

Aphid is a serious pest, causing damage to most bean growing areas in the world. The aphid, Aphis craccivora Koch, is the principal pest of bean crops in this region. Indeed, this pest causes major yield losses, due to the transmission of two major viruses, French bean necrotic yellow virus (FBNYV) and Bean leaf roll virus
(BLRV) (Oufroukh, 1997) and commercial losses due to its production of large amounts of honeydew, rendering the pods unsightly and unsaleable. The wingless aphids are up to about 2.5mm long, greyish-green in colour, with a dark head and black stripes on the body. The aphid is covered with a greyish-white coloured waxy powder, which is also secreted onto the surface of host plants. The winged aphids are slightly longer than the wingless ones and have a dark coloured head and body. The veins on the wings appear brown in colour. The aphids have small siphons (looking like small antennae) at the back of their body. Siphons are a good way to recognize aphids. Colonies of these aphids are usually found on the lower surface of the leaves and tender stem. The aphids can reproduce asexually and female gives birth directly to small nymphs. That means large numbers of aphids can be produced in a very short time under favourable condition. Only in cool areas, eggs are produced after mating. The eggs over winter and young nymphs emerge when the temperature rises. All winged aphids are females. The first signs of attack are small bleached areas on the leaves of infected plants. The leaves then turn yellow and become crumpled. The aphid colonies are protected inside the crumpled leaves. The effects of infestation are worst on seedlings and young plants. They can be stunted and may die at unfavourable weather conditions. Early damage to the growing point of the plant distorts the head. Even when young plants are infected only lightly, the leaves of the plants when they are mature continue to show signs of the original attack (FAO, 2007). Infestations on larger plants may reduce yield and also spoil the plants by contaminating them with wax, cast skins and honeydew. Honeydew is the excretion of aphids. Honeydew can make the leaves sticky where several fungi species grow on the honeydew producing black marks on the leaf surfaces. Aphids tend to be much localized; they usually colonize just a few plants but can be very abundant on each plant. In addition to the direct crop damage, aphids also transmit the bean mosaic virus to beans.

Mites have a worldwide distribution and cause serious damage to agricultural crops, ornamental plants and stored products. Particularly two spotted spider mite has been reported to attack about 1200 species of plant (Zhang, 2003), of
which more than 150 are economically important. The two spotted spider mite (TSSM), *Tetranychus urticae* Koch (Acari: Tetranychidae) is considered a major pests of bean crop. TSSM feeds by puncturing cells with its stylets and draining the contents, thereby producing a characteristics yellow specking on the leaf surface. TSSM is economically important pests in many ornamentals and vegetables grown in greenhouses and fields all over the world (CAB International, 2007). The small size of the pest, their cryptic life form, fast reproduction, and ability to easily build up resistance to chemicals make them difficult to control with pesticides. Spider mite may cause 10-15% loss in vegetables (Ghoshal, 2013).

Spider mites inhabit the lower surface of leaves and cause damage by making large numbers of tiny punctures in the leaf and sucking out the sap. Attacked leaves often have a silvery, “peppered” appearance, particularly along the veins. The adults, about 0.5-1mm long and just visible to the naked eye are protected by the fine webs which they spin on the leaf surface. The adults are orange-red to yellow-brown in colour. They move slowly and cannot fly. Red spider mites damage beans by puncturing cells of the leaves, mainly on the lower surface. They extract plant juices and chlorophyll, interrupting the normal production of photosynthetic. An early sign of infestation is stippled areas on foliage. This can result in stunted growth of the plant, deformation of leaves and shoots, chlorosis, browning, etc. This eventually results in reduced production. Bean pods are attacked only when mite populations are very high (Skorupska, 2004).

Many insecticides have been recommended for the control of French bean insect and mite pests but these are known to cause mortality of natural enemies, residues problem, hazards to man and animal besides polluting the environment. On several occasions, insecticidal application have accentuated the insect population and quite often resulted in outbreak. Reliance on synthetic chemicals to control pests has also given rise to a number of problems such as destruction of beneficial non-target organisms (parasitoids and predators) thereby affecting the food chain and impacting on biological diversity. Although chemical control has been effective for control of
insect pests of French bean (Nderitu et al., 2008), various problems have arisen that include consumers’ demand for produce that is not free from pesticide residues, resistance development, environment issues and safety of workers as well as animals (Nderitu et al., 2007; Nyasani et al., 2012a). The injudicious use of synthetic pesticides can lead to secondary outbreaks of pests that are normally under natural control resulting in their rapid proliferation. There have also been cases of pests becoming tolerant to insecticides, resulting in the use of double and triple application rates. In addition, due to other problems such as health hazards, undesirable side effects and environmental pollution caused by the continuous use of synthetic chemical pesticides (Nas, 2004), there is renewed interest in the application of botanical pesticides for crop protection. Talukder (2006) has listed 43 plant species as insect repellents, 21 plants as insect feeding deterrents, 47 plants as insect toxicants, 37 plants as grain protectants, 27 plants as insect reproduction inhibitors, and 7 plants as insect growth and development inhibitors. Eighteen species showed insecticidal potential and anti-ovipositional properties against Sitophilus oryzae (Devi and Devi, 2011). Botanical pesticides are biodegradable (Delvin and Zettel, 1999) and their use in crop protection is a practical sustainable alternative. It maintains biological diversity of predators (Grange and Ahmed, 1988), and reduces environmental contamination and human health hazards.

Therefore, considering the above all, the present experiment was conducted with the following objectives:

**Objectives:**

1. Incidence of the insect and mite pests of french bean

2. Development and Validation of different IPM modules against the major pests

3. Evaluation of certain organic pesticides against aphid and mite attacking French bean crop.