In the process of evolution of animal life on planet earth, insects came into existence long before the man and have since then mastered the diversities of nature and survived all the ravages that this planet has undergone. The unfortunate ones like dinosaurs could not withstand many such climatic changes but the tiny insects not only survived but also adapted themselves to newer environs that came into existence. Soon after the man became civilized enough to acknowledge the utility of plant life for his survival, he faced the competition from insects and entered into a never to end struggle for supremacy. However, it is untrue to believe that all the insects are borne-enemies of mankind as there are many examples of useful and beneficial insects such as honey bees and those which play an important role in the process of pollination and thereby propagation of plant life. The gradual process of man’s civilization, which in many ways changed all aspects of his life style, made the insects more vulnerable and prone to attack. The process of civilization also had its side effects as it caused disturbance in natural habitats of insects, which led them to look for alternative habitats resulting ultimately in the invasion of new ecological niches, which could provide food and shelter. In the process of this adaptation possibly many of them could have found new means for existence, which happened to be of the interests of man’s own survival. This ultimately gave them the status of pests. Now the stage has arrived when among the man’s natural enemies, insect pests from a large group by any
standard. Disproportionately small and devastatingly enormous in number, they continue to harass man by directly competing for his \textit{very food} or inflicting him with the pathogens of serious disease all over these years. Man on the other hand has been waging a continuous but unsuccessful war against the insects with newer ammunitions in the hope of success since time immemorial.

Over all these millions of years of evolution of animal life on the earth, insects by all means have far better adopted the new environmental conditions by developing diverse mechanisms to survive. Also diverse are their harmful impact on human health and economy. Insects, feed on, infect and destroy all kinds of crops and other important flora, which go unnoticed to our eyes. They also cause injury to man, animals and also spread as a vector causal organisms (pathogens) of many serious diseases such as malaria, filariasis, dengue, yellow fever, Japanese encephalitis, leishmaniasis (Kala Azar) and sleeping sickness, plague etc. Every moment that ticks by, millions of insects chew, suck, bite and bore away at our crops, livestocks, timber, gardens, homes and warehouses. They inadvertently affect the yield of crops, lower the quality and increase the cost of production.

In a broader sense insects may be categorized as beneficial, harmful and (neutral) insects, which neither harm nor benefit the man. Our main concern is towards the harmful insects only. With the fast depleting natural resources to satiate the demand of inflating population, man is hard pressed
with the need to control harmful insects well below the economic threshold. To meet these two faceted challenges, man has been fighting war against the insects by deploying mechanical, chemical, biological and traditional methods evolved over years of experience. Thus aborigines in pre-historical times definitely knew that pests in stores were a problem. In general they did little storing, and their simple methods of preservation by drying and roasting were quite effective and warded off attack by the pests. The beginning of the "Agricultural Revolution" ten to fifteen thousand years ago, brought about considerable changes. The protection of food stores was of considerable importance to those who gathered in harvests and who harvested large amounts of wild plants. The seeds and fruits of wild plants which were less easily affected by pests stimulated thought and action by man in a purposeful fight against the continuous losses of the crop and grains in store. The methods of protecting crops by inorganic materials like tannins, vinegar were thus developed some four thousand years ago. Though a lot of information was available in Asia and Europe during 400 BC to the sixteenth century regarding the medicinal properties of large number of plants, the first use of _Chrysanthemum_ powder to combat pests dates back to 1697 and that of tobacco to 1763. The oils, sulfur compounds and botanical derivatives like nicotine, pyrethrum dust, _Derris_ root powder etc. were used against insect pests from early to middle of 19th century. One of the earliest reports of the use of plant derived alkaloids such as nicotine, anabasine and the lupenine
against mosquito larvae dates back to 1933. Soon after the discovery of pyrethrum, *Quassia* extract and other plant materials were introduced to combat insects. The use of natural insecticides continued to increase constantly in spite of the constraints by wars and introduction of synthetic insecticides like DDT, which was discovered during first world war in 1939. This was followed by the discovery of other organochlorine, organophosphorus and carbamate insecticides, as well as the synthetic pyrethroids.

Even though synthetic insecticides have helped greatly in combating insects and nearly eradicated vector-borne and other deadly diseases from many countries, their continuous use and chemical nature created major ecological hazards. Conventional synthetic insecticides like DDT and BHC suffer from their high residual toxicity but their spectacular effects in controlling pests led to indiscriminate use both in agriculture and public health sectors without visualizing the insects capability to develop resistance to these chemicals, persistent residual effect on the environment and the imbalance imposed on the ecosystem. At this stage the scientific community felt the need to develop safer and biodegradable chemicals, which will assure more dependable and long-lasting effects and yet not be deleterious to others. Of the various avenues explored, few of them such as biological control, use of microbial pesticides, sterilization of insects by electro-magnetic radiation
and chemicals, insect attractants, repellents, antifeedent agents have been explored and introduced in integrated control of insect. Maximum success in control of insects is possible by better understanding of the natural controlling factors. Attention was also paid to understand how the plants defend themselves against the insect attack. Based on the fact that plant derived insecticides have several major advantages over synthetic insecticides, like very low mammalian toxicity and no persistence and harmful residues in the environment, influenced scientists to search for natural pest control agents from plants which were shelved for some time by the advent of synthetic insecticides. Several pressures have accelerated the search for more environmentally and toxicologically safe and more selective and efficacious pesticides.

Plant allelochemicals play an important role in host plant selection by phytophagous insects and not only guide insects in their food selection behavior, but also affect the physiology of insects once ingested. Therefore, such chemicals deter insect feeding, act as insect growth regulators, and anti-hormones or may simply kill them. Insects on the other hand also have in their possession a variety of strategies in the guise of toxic molecules along with an appropriate delivery mechanism to face varied encounters in nature. The success of these natural weapons was found to depend on the ways in which in-built mechanisms have been devised for synthesizing all sorts of molecules that are effective either on a specific target or act as general shoot
out signals. Majority of these compounds act by interfering in normal signaling mechanisms of the nerve cells, i.e. basically in the manner similar to the modern insecticide that interrupt the membrane permeability of cells. Leads of similar nature have resulted in the industrial synthesis of many compounds. The generally protected view is to discover the mode of action of natural products on pests so that synthesis is directed towards environmentally safe and effective compound that will lower down the populations of pests of agriculture and of vectors of diseases.

Plants contain a virtually untapped reservoir of pesticides that can be used directly or as a template for synthetic pesticides. Plant products are well known for their use as insecticides. Several *Chrysanthemum* species pyrethroids have been used in Asian countries for centuries. Numerous synthetic pyrethroids have been developed which are more active and have longer residual activity than the natural forms. Natural alkaloid substances have also been used commercially. This includes nicotine, derived from *Nicotiana* species and rynodine, from the tropical shrub, *Ryania speciosa*. Several plant phenolic compounds have insecticidal properties and have been correlated with host plant resistance to insects. Rotenone derived from roots of three genera *Derris*, *Lonchocarpus* and *Tephrosia* was used commercially as an insecticide in 1930s.

The number of options that must be considered in discovery and development of a natural product as a pesticides is larger than the synthetic
pesticides. Furthermore, the molecular complexity, limited environmental stability and low activity of biocides from plants compared to synthetic insecticides discouraging. However, advances in chemical and biotechnology methods are increasing the speed and ease with which man can discover and develop secondary compounds of plants as insecticides.

In view of the above, the present investigation was undertaken to survey plants and evaluate the efficacy of potential plant extracts against the insect pests. After a thorough search through the available literature, preliminary screening of several plants finally led to the selection of four plant species. The extracts of these plants species were subjected to evaluation for their effectiveness against the insect pests. All the selected plant species were easily found in and around Vallabh Vidyanagar and are not utilized by animals or insects as food and are easily accessible, as they grow wild.

The efficacy of plant extracts has been determined against four insects pests viz., *Anopheles stephensi* Liston, the vector of malaria in urban areas, *Aedes aegypti* L., the dengue fever mosquito, *Culex quinquefasciatus* Say, the major nuisance causing mosquito responsible for the transmission of filariasis and *Tribolium castaneum* Herbst, the red flour beetle. A brief description of the test insects used in present study is given below.
MOSQUITOES

Anopheles stephensi Liston 1901 (DIPTERA: CULICIDAE)

In India, 58 species of anopheles are found, of which 6 are primary vectors of malaria. Anopheles stephensi is normally an urban mosquito occasionally also found in rural area. It is a highly efficient malaria-carrier and is responsible, wholly or partly, for malaria in urban areas in India. It is an important rural malaria vector in western Pakistan, Bhehrin, Iran and Iraq. Recent genetic studies have revealed three races i.e. Anopheles stephensi (found in urban areas), Arj stephensi mysorensis (found in rural areas) and Arj stephensi intermediate. Adult mosquitoes rest in houses, cattle sheds and outdoor shelters. Arj stephensi feeds predominantly on cattle in rural area and human hosts in urban area. Its role as a vector in rural area is doubtful owing to its feeding habit.

An. stephensi is of major concern in the urban areas where it breeds in intradomestic water storage containers such as overhead tanks, mud pots, under ground tanks, cisterns, barrels etc. It also breeds in fountains, ornamental tanks, wells etc. In rural areas it breeds in pools, stream beds, springs, and seepages, marsh, collection of rain water and wells. The larva does not always require aquatic vegetation for its food.
Aedes aegypti LINNAEUS (DIPTERA: CULICIDAE)

It is an important mosquito species, which is responsible for transmission of dengue hemorrhagic fever (DHF) in tropical and subtropical countries including India. It is also responsible for spread of yellow fever virus but it is restricted to some West African countries. The mosquito is predominately encountered in urban areas where water storage practices in houses are common. With the pipe water supply and subsequent water storage practices adopted in rural areas as well, this mosquito has established/adopted itself to this new environment.

It seldom breeds in any natural water collection, but prefers small artificial collections. The larvae are found in intradomestic water storage containers and at times shares its breeding habitat with urban malaria vector An. stephensi. It also breeds in air coolers, tyres, discarded empty tins, broken bottles, coconut shells, flower pots, flower vases, roof gutters, fire buckets, empty battery boxes, industrial water lying in the open and waterlogged localities during rains or any such place or thing which retain water particularly during monsoon season. The eggs are deposited singly, not only on the surface of the water but also along the side of the containers above the water level and they adhere closely thereto. The eggs can withstand desiccation up to 3 years and therefore can be stored in dry
condition. Since *Ae. aegypti* is a highly domesticated mosquito, its breeding place are never far from the abode of man. It is characteristically a day-bitter, taking blood between daylight and dusk but when no blood is available in the day, it will bite at night. *Aedes aegypti* is an easy to colonize mosquito requiring simple laboratory conditions and because of its medical importance it is also a good test insect.

*Culex quinquefasciatus* SAY (DIPTERA: CULICIDAE)

*Cx. quinquefasciatus* is commonly known as southern house mosquito and is a major vector of bancroftian filariasis (Elephantiasis etc.) in man in tropical and subtropical regions. It chooses water contaminated with sewage, e.g., cess pools, septic tanks and other derelicts water collection. The egg raft is boat shaped and may contain above 200 eggs. It floats with its narrow end pointed upwards and the broad ends, which corresponds to the head of the larva, lies on the surface of water. The period from the egg to the adult stage takes from 8 to 10 days. The mosquito is capable of dispersing over a wide area, even to a distance of 5 kilometers from the breeding area. It is a major cause of nuisance in house of urban areas lacking basic civic of amenities such as underground drainage system. In Gujarat, it is responsible for the transmission of filariasis in many parts of Gujarat and Saurashtra.
Stored Grain Pest

*Tribolium castaneum* HERBST

(COLEOPTERAN: TENEBRIONIDAE)

It is commonly known as red flour beetle. The flour beetle causes inestimable damage to stored grains, rice wheat products, dried fruits and many such dry commodities of everyday use to man. The larvae and adult feed on a wide range of durable commodities and are important secondary pests of cereals. Other commodities that can be infested by them include groundnuts, nuts, spices, coffee, cocoa and occasionally, peas and beans.

The females copulate many times and lay their eggs in commodities throughout their adult lives. Female lays on an average 2.5-11 eggs each day at temperatures from 25 to 32.5°C. Under optimum conditions, larvae emerge from eggs and moult 7-8 times to reach to the pupal stage. Adult can live for about 6 months.