INTRODUCTION

India's population is expected to increase to 150 millions by 2025 A.D., which will require 325 metric tonnes of food grains. Taking the current food production level into consideration, India has a compulsive need to raise food production by 5 metric tonnes per year as against 3.1 metric tonnes achieved over past 40 years. Since the land to man ratio is narrowing rapidly, there is almost no scope for horizontal expansion to meet the future demand. India triggers the transition from traditional practices to modern science based agriculture. In 21\textsuperscript{st} century, Indian agriculture is facing an arduous task to provide food security as well as nutritional security for all.

The major effect of green revolution is that our agriculture has been chemicalized. As the availability of land is decreasing day by day, application of fertilizers and pesticides are the easier options to meet the demand of food grains. The effect of prolonged and over usage of chemicals has resulted into human health hazards.

Modern agriculture is equipped with emerging technologies like biotechnology. These may help to solve the problems, which do not have solution through traditional practices. But the present day issue is whether to adopt the new input intensive technologies or to adopt traditional agricultural practices like organic farming or IPM for sustainable development.

In India damages of crops due to pests ranges from 10-30 per cent per year depending on the kinds of crop and the environment. Complete crop failure may occur in case of serious attack. Annual crop loss due to various pests in India was estimated to Rs.600 crores in 1983, which at today's price could easily exceed Rs. 2000 crores. Of this, loss from weeds is considered to be about 33 per
cent. diseases 26 per cent, insects and rodents 26 per cent and bird, nematodes etc. account for the rest (Puri, 1995).

The total amount of pesticide used in India increased from 154 metric tonnes in 1953-54 to 80,095 metric tonnes in 1993-94. Thereafter, the consumption has declined due to the ban/restriction on the use of DDT/BHC and greater emphasis on IPM approach. During 1999-2000, the total consumption of pesticides in India was 53,135 metric tonnes, i.e. 288 g/ha. Many states like, Andhra Pradesh, Tamilnadu, Karnataka, and Maharashtra, which were earlier using high amounts of pesticides, have shown declining trend in pesticide consumption.

Nearly 600 crores agro-pesticide markets are concentrated in Andhra Pradesh, Karnataka, Gujarat and Punjab (Khan, 1996). However, pest problem continues to rise. About 500 species of insects have been reported to develop resistance to one or more insecticide (Singh and Singh, 1996). The number of acute poisoning cases due to use of synthetic pesticides is estimated at 3 million with 220,000 deaths and 25 million agricultural workers having pesticide poisoning and seeking medical help globally.

In 1996, the value of pesticide used was Rs. 2,500 crores of which insecticides, fungicides, herbicides and others constituted 76,12,11 and 1 per cent, respectively. Among insecticides consumers, cotton ranked first (52 %) followed by rice (13 %), vegetables (8 %) and other crops (27 %). With respect to fungicides, orchard crops accounted for 22 per cent followed by potato (18 %), groundnut (13 %), tea (11 %), vegetables (11 %) and other crops (25 %). The region-wise consumption indicates that Andhra Pradesh topped the list (Rs. 425 crores) while, Rajasthan used Rs. 100 crores (Anonymous, 1997).
IPM as applied in agriculture, is the most ideal as it is economical, safest, ecologically sustainable and sociologically acceptable combination of physical, chemical and biological methods to limit the harmful effects of crop pests. The need for IPM, as Jayraj (1996) puts it, arises due to the heavy dependence of farmers on chemical pesticides and their indiscriminate use which has resulted in the development of resistance in pests to pesticides, resurgence of target and non-target pests, destruction of beneficial organisms like honeybees, pollinators, parasitoids and predators. In this context there has been a considerable global awareness on the toxicity problems of chemical pesticides and on the need for evolving more and more non-chemical methods of pest control in the overall concept of IPM.

With the increasing realization of the importance of sustainable agriculture, the concept of IPM for sustainable development has assumed significance. In the recent past, agricultural scientists as well as peasants have identified pest management methods, which are ecologically non-disrupting and stable. Concurrently, indigenous crop varieties with resistance to pests and disease have been developed and cultivated. Applying the principle of organic farming, several non-chemical methods have become quite popular among the farmers. Simple cultural practices like increased seed rate to compensate for pest damage, mulching, intercropping, trap cropping and crop rotations have been found to provide adequate protection from pest attack with zero additional cost and without harmful effects on the environment. The farmers who clamoured for chemical pesticides and their varieties in the sixties are currently disillusioned with these poisonous eco-unstabilizing substances, and are now on the look out for sensible and traditional methods of IPM.
1.1 IPM is:

- To keep the pest numbers below harmful level (ETL) instead of their eradication.
- To protect and conserve the environment including biodiversity.
- To make plant protection feasible, safe and economical even for the small farmers.

There is always a distorted view of IPM as pest control without chemical or biological control. In fact, IPM is based on the optimization, not maximization of chemical pesticides. The IPM approach encompasses all available control techniques to contain and combat pest infestation with the aim of lessening the pesticides load in the environment. It is simply not the juxtaposition of superimposition of two or more control techniques, but the integration of all suitable management techniques in a harmonious manner with natural regulating and limiting elements of the environment.

1.2 Integrated Pest Management

- Protects the environment from pesticidal pollution through air, water, soil and food chain system,
- Maintain ecological balance.
- Is economically viable and socially proposition.
- Minimizes the chances of the development of insect resistance to insecticide, pest resurgence and secondary pests.
- Protects beneficial insects and natural enemies from the hazardous effects of chemical pesticides.
- Enhances acceptability and value of produce for exports.
- Is well suited for rural areas.
- Biodegradable, no residues.
- Is essential for feed processing, particularly for export.

IPM is the modern concept of environmentally sound and sustainable strategy for pest control. IPM encourages the most compatible and ecologically sound combination of available pest suppression techniques, to keep pest populations below economically damaging level. The IPM concept is based on principle which is not necessary to eliminate all the pests but to suppress the pest population to a level at which these pests do not cause significant losses.

Through the use of good agronomic practices or cultural methods, which are unfavourable for the development of pest problems, regular monitoring of pest activities is essential for decisions in IPM. Selected control measures to check pests are to be taken at Economic Threshold Level (ETL) or Action Threshold Level (ATL). IPM strives to optimize rather than maximize pest control efforts.

Integrated Pest Management (IPM) is the integrated use of pest control strategies in a way that not only reduces pest population to satisfactory levels but also is sustainable and non-polluting. IPM strategies focus on an appropriate mixture of ecologically, economically and socially friendly practices such as adjustment of date of sowing, mixed cropping, crop rotation, planting of trap crops, use of improved resistant crop varieties, scouting for pests, better timings of pesticide application and the use of bio-pesticides. IPM is both knowledge and input intensive and requires group action.
1.3 Components of IPM

The following points are the important components of IPM.

1.3.1 Cultural Practices

The practices which help the crop to avoid the attack of pests are known as cultural methods of control. By such methods economic damage of crops can be prevented rather than eradicating the pest completely. These practices are mainly useful in combination with other management practices. It is common experience that a large number of insects pests get killed unconsciously when they get exposed to the adverse climatic or biological conditions through agricultural practices like ploughing, hoeing, weeding, etc. But more effective kill of the pest can be obtained following improved agricultural practices or synchronizing the existing practices with the life cycles of the pests. Theses methods cost hardly anything, because all that is required to be done is to adjust the time of ploughing, sowing, irrigation, following crop rotation, improved management of the farm and harvesting of the crop. Proper timing of the practices is the keynote of success.

1.3.2 Biological Control

Biological Control refers to the use of natural enemies (Parasitoids, Predators, Pathogens) for the management of insect pests. Control by natural enemies can be greatly strengthened by use of a large number of cultural practices like intercropping, trap cropping, strip harvesting, etc. Modification of the crop environment by manipulation of irrigation or fertilizer application, row spacing, seed rate and tillage operations, etc., may also lead to enhanced biological control.
1.3.3 Mechanical Methods

The reduction or suppression of insect populations by means of manual devices is covered under mechanical control methods, viz. Hand Picking, Exclusion by Screens and Barriers, Hand beating, Shaking, Seiving and Winnowing, Trapping & Suction Devices, Clipping, Pruning and Crushing, etc.

1.3.4 Chemical Control

Pesticides will continue to play an important role in IPM programmes. But they should be used only when other methods of insect-pest management such as the use of resistant varieties, Cultural Methods Comprising use of agronomic practices like crop rotation, field sanitation, etc. fail and no other alternative methods are available. These substances should be used only as recommended against a specific crop pest. Physiologically selective insecticides are presently available only for a limited number of insect-pests and field situations. However, even broad spectrum insecticides may be used in an ecologically selective manner. Systematic insecticides applied as granules, seed-dressing, root zone application, stem injection and leaf-axil application avoid damage to natural enemies moving on the plant surface.

Rice is practically grown in all parts of the country. Wet and humid conditions associated with rice fields provide a natural habitat to a number of friendly insects as well as crop pests. It is generally felt that in most situations, it is possible to raise a healthy rice crop without the use of pesticides provided appropriate cultural practices are adopted. Crop losses due to insect-pests in India are about 18 per cent. Conservation of existing natural enemies are the major tools for IPM in rice (Pawar, 1986).
Gram is an important pulse crop and is grown in diverse soils and agroclimatic conditions. In recent years, a new spectrum of pests has been found to lower the productivity of crop. Of these, pod borer (*Helicoverpa armigera* Hub.) and fungi (*Fusarium oxysporum* f.sp. *vaccinii*) cause severe wilt problem.

Mustard is an important oilseed crop and rank second in area and production in India. The attack of insect-pests cause moderate to heavy losses in the yield. Mustard aphid, alone has been reported to cause yield losses varying from 35-73 per cent in oilseed *Brassica* (Kumar, 1991). The colossal yield losses warrant the development of strategies for effective management of important pests of these valuable crops. Though in the past, use of resistant varieties have been stressed, however, in the absence of any highly resistant variety of mustard, the farmers are forced to depend upon the chemical control only, which has resulted in the build up of insect’s resistance to various commonly used insecticides, besides increasing the harmful residue beyond permissible limits. Hence, there is a need for integration of available techniques for effective management of important pests of mustard.

The galaxy of issues raised by the above discussion can be categorized into following questions.

- What is the level of awareness and knowledge of the farmers on IPM technologies for major crop?
- What is the adoption level and gaps in relation to IPM practices?
- What is the attitude towards IPM technologies?
- What are the constraints affecting the adoption of IPM technologies by the farmers?
To answer aforesaid queries of this study, the following specific objectives are framed.

1. To study the awareness and knowledge level of the farmers as regards to IPM technologies for major crops.
2. To study the adoption level of IPM technologies in the cultivation of major crops.
3. To delineate the technological adoption gaps in relation to IPM practices of major crops.
4. To measure the attitude of farmers towards IPM technologies.
5. To identify various constraints affecting the adoption of IPM technologies.
6. To suggest an extension strategy for the adoption of IPM technologies.

1.4 Limitation of the study:

An effort was made to make this study as much objective and systematic as possible. The findings of the study were based on the expressed opinion of the respondents. Hence, the objectives would be limited only to the extent of information received from the respondents.

The data were collected from 200 respondents belonging to ten selected villages of Kanpur Dehat district. The projection of findings of the present study should not be generalized beyond the purview of the area of this research. Nevertheless, wherever similar conditions exist, the advantages of the findings can be taken. Some scales were available which were used with high precision. However, many other scales which were not available, self-designed, direct questions were asked. Hence, precision may slightly differ in different variables.

The study was restricted to Kanpur Dehat only because of limitation of time.