

**ADOPTION OF INTEGRATED PEST MANAGEMENT
IN CHICKPEA PRODUCTION IN KOTA
DISTRICT OF RAJASTHAN**

**जगतलकु दसदक फ्तयेसपुक मरिनु गसुल एसर उकृतु
िउकु ध खगः रक**

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Doctor of Philosophy in Agriculture

(Extension Education)



**By
MUKESH CHAND GOYAL
2006**

**Maharana Pratap University of Agriculture and Technology
Rajasthan College of Agriculture, Udaipur**

CERTIFICATE - I

Date : / / 2006

This is to certify that **Mr. Mukesh Chand Goyal** has successfully completed the preliminary examination held on 5th July 2003 as required under the regulation for the degree of **Doctor of Philosophy in Agriculture**.

(Dr. V.P. Sharma)
Professor & Head
Department of Extension Education
Rajasthan College of Agriculture
MPUAT, Udaipur (Raj.)

**Maharana Pratap University of Agriculture and Technology
Rajasthan College of Agriculture, Udaipur**

CERTIFICATE - II

Date : / /2006

This is to certify that the thesis entitled “**ADOPTION OF INTEGRATED PEST MANAGEMENT IN CHICKPEA PRODUCTION IN KOTA DISTRICT OF RAJASTHAN**” submitted for the degree of **Doctor of Philosophy in Agriculture** in the subject of **Extension Education**, embodies bonafide research work carried out by **Mr. Mukesh Chand Goyal** under my guidance and supervision and that no part of this thesis has been submitted for any other degree. The assistance and help received during the course of investigation have been fully acknowledged. The draft of this thesis was also approved by the advisory committee on 1st September, 2006.

(Dr. V.P. Sharma)
Professor & Head
Department of Extension Education
Rajasthan College of Agriculture,
MPUAT, Udaipur

(Dr. V.P. Sharma)
Major Advisor

(Dr. H.C.L. Gupta)
Dean
Rajasthan College of Agriculture,
MPUAT, Udaipur

**Maharana Pratap University of Agriculture and Technology
Rajasthan College of Agriculture, Udaipur**

CERTIFICATE - III

Date : / /2006

This is to certify that the thesis entitled “**ADOPTION OF INTEGRATED PEST MANAGEMENT IN CHICKPEA PRODUCTION IN KOTA DISTRICT OF RAJASTHAN**” submitted by **Mr. Mukesh Chand Goyal** to the Maharana Pratap University of Agriculture and Technology, Udaipur in partial fulfilment of the requirements for the degree of **Doctor of Philosophy in Agriculture** in the subject of **Extension Education** after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in the oral examination on his thesis has been found satisfactory, we therefore, recommend that the thesis be approved.

(Dr. V.P. Sharma)
Major Advisor

(Dr. Chitranjan Sharma)
Advisor

(Dr. K.A. Varghese)
Advisor

(Dr. A.K. Srivastava)
Advisor

(Dr. V.P. Sharma)
Professor & Head
Department of Extension Education

(Dr. L.K. Murdia)
DRI Nominee

(Dr. H.C.L. Gupta)
Dean
Rajasthan College of Agriculture,
Udaipur

External Examiner

Approved

(Dr. G.C. Nanawati)
Director Resident Instructions
Maharana Pratap University of Agriculture and Technology,
Udaipur

**Maharana Pratap University of Agriculture and Technology
Rajasthan College of Agriculture, Udaipur**

CERTIFICATE - IV

Date : / /2006

This is to certify that **Mr. Mukesh Chand Goyal**, student of Doctor of Philosophy in Agriculture, Department of Extension Education, Rajasthan College of Agriculture, Udaipur has made all corrections/modifications in the thesis entitled **“ADOPTION OF INTEGRATED PEST MANAGEMENT IN CHICKPEA PRODUCTION IN KOTA DISTRICT OF RAJASTHAN”**, which were suggested by the external examiner and the advisory committee in the oral examination held on The final copies of the thesis duly bound and corrected were submitted on, are enclosed herewith for approval.

(Dr. V.P. Sharma)
Major Advisor

Enclose : One original and two copies of bound thesis forwarded to the Director, Resident Instructions, Maharana Pratap University of Agriculture and Technology, Udaipur through the Dean, Rajasthan College of Agriculture, Udaipur.

(Dr. H.C.L. Gupta)
Dean
Rajasthan College of Agriculture,
MPUAT, Udaipur

(Dr. V.P. Sharma)
Professor & Head
Department of Extension Education
Rajasthan College of Agriculture,
MPUAT, Udaipur

Adoption of Integrated Pest Management in Chickpea Production in Kota District of Rajasthan

Mukesh Chand Goyal^{*}
(Research Scholar)

Dr. V.P. Sharma^{**}
(Major advisor)

ABSTRACT

Chickpea (*Cicer arietinum* L.) is one of the important *rabi* pulse and alternative crop for diversification but the productivity of Chickpea is low due to various reasons particularly incidence of diseases and insect pests causing substantial yield reduction. Farmers follow mainly the chemical pesticidal approach under plant protection system to suppress these pests which is often uneconomical and leads to pesticide resistance problem as observed in *Helicoverpa armigera* (gram pod borer). Besides, it disturbs ecological balance and leads to environmental pollution resulting in to human health hazards. A holistic approach is needed to combat these pest and other problems effectively in a sustainable manner.

Integrated Pest Management is one of such systematic approach which emphasizes not only the reduction in use of pesticides and keeping below the level of pest causing economic injury but also it facilitates the use of cultural, mechanical, botanical, biological and chemical methods of control in an integrated manner and restores ecological balance for sustainable agriculture. It, thus, imply that the farmers needs to learn the principles of IPM and acquire the knowledge and skills necessary to make self decision based on specific farm condition and discourages the indiscriminate use of pesticides.

Despite this background and vast scope of IPM along with several efforts and advances done by government towards promoting IPM technology among farming community for Chickpea production in Kota district of Rajasthan, no systematic research from agricultural extension education point of view on this aspect of plant protection has been conducted in the past. Therefore, keeping all in this mind, the present investigation entitled “Adoption of Integrated Pest Management in Chickpea Production in Kota District of Rajasthan” was carried out to assess the present status of adoption and future prospects of IPM in Chickpea production with the following specific objectives:

* Ph.D. Scholar, Department of Extension Education, Rajasthan College of Agriculture, MPUAT, Udaipur-313001.

** Prof. & Head, Department of Extension Education, Rajasthan College of Agriculture, MPUAT, Udaipur-313001.

1. To study information input and its processing behaviour of chickpea growers.
- ~~2. To find out the existing knowledge of farmers about recommended practices of Integrated Pest Management in Chickpea.~~
3. To find out extent of adoption of recommended practices of pest management by chickpea growers.
4. To study the constraints as perceived by the chickpea growers in adoption of Integrated Pest Management practices.
5. To assess the training needs of chickpea growers with regards to Integrated Pest Management.
6. To suggest suitable extension strategy for effective transfer of technology for Integrated Pest Management in chickpea.

The present study was conducted in purposively selected Kota district of Rajasthan. The proposed district consisted of five panchayat samities, among from them, three panchayat samities were selected randomly. Five villages from each selected panchayat samiti were selected through random sampling technique, among from those villages, where farmers were benefited through various IPM promotional schemes in chickpea crop. Thus 15 villages were included in the study. For selection of respondents, 15 beneficiary farmers from each identified village were selected randomly. Thus total sample size comprised of 225 respondents for the present investigation.

A research tool was specifically developed and standardized keeping in view the objectives of study. Data on that structured tool were collected personally from respondents through face to face technique of interview. To arrive at the specific inferences, various statistical measures viz., frequency, percentage, mean score, mean percent score, standard deviation, analysis of variance, critical difference, standard error of mean, coefficient of variation were used.

Major findings of the study are as follow:

1. It was found that majority of the respondents were of middle age with good educational qualifications. Most of them belonged to other backward castes and had nuclear family. Majority of them had big size of land holdings.
2. Personal localite sources of information were the most consulted sources for availing information by sampled chickpea growers followed by impersonal cosmopolite and personal cosmopolite sources.
3. Overall intensity for information processing behaviour of the chickpea growers was 69.12 per cent. Judgment based on weigh keeping with relative

advantages and informal discussion in group meeting were most widely used criteria for putting information to use.

4. Overall knowledge level of the respondent farmers was found 67.38 per cent regarding recommended practices of IPM in chickpea. They possessed maximum knowledge with respect to chemical pesticidal practices and minimum knowledge about botanical pesticidal practices.
5. Overall adoption level of the farmers was found 48.43 per cent towards the recommended practices of IPM. Maximum and minimum adoption was found towards cultural practices and botanical pesticidal practices respectively.
6. Overall intensity of severity of constraints in adopting IPM practices confronted by chickpea growers was 58.08 per cent. General constraints came to be the most severe constraints followed by the constraints related to identification of pests and their monitoring through ETL. Whereas, the least perceived constraints were related to cultural practices of IPM.
7. It was found that most needed areas of training related to IPM by chickpea growers were preparation and application of neem based botanical pesticides followed by ETL assessment, cost benefit ratio of IPM v/s non-IPM crop, conceptual frame work of IPM and pest surveillance.
8. To suggest suitable extension strategy for effective transfer of IPM technology in chickpea, it is recommended that there is a need of concerted efforts by different extension and developmental agencies involved in TOT to promote the IPM practices among the farming community and equip them with the latest knowledge of it through different extension methods with a view to motivate them for accelerating the adoption of IPM in chickpea.

Besides, the suggested strategy includes promotion of the people's participation, awareness generation through different media and extension methods, organization of training programmes, demonstration and field visits for farmers and extension functionaries, involvement of NGOs and pesticide industry, promotion of the women's involvement of local organizations, exploration of indigenous practices and; use of information technology in IPM.

1. INTRODUCTION

“Technology, unlike science, is a group activity. It is not based on an individual Intelligence, but on the interacting intelligence of many.”

-H.E. Dr. A.P.J. Abdul Kalam

India’s population is expected to be 1.3 billion by the year 2020. In global terms, India today has 16 per cent of human population, 15 per cent of farm animal population, 2 per cent of the geographical area, 1 per cent of rainfall, 0.5 per cent of forests and 0.5 per cent of grazing land. Just to meet the foodgrain requirements, our country will required to produce an additional 5-6 million tonnes of foodgrain annually.

The green revolution, one of the greatest success stories of India with its dramatic impact an food security is role model for many developing countries of the world. However, spread of intensive agriculture by the green revolution actually led to newer problems such as:

- (i) Excessive and untimely use of irrigation water.
- (ii) Replacement of rich diversity of traditional varieties with fewer high yielding varieties, and
- (iii) Inappropriate use of fertilizers and pesticides.

Thus, with the intensification of agriculture and consequent increase in genetic uniformity of crops, dense plant population, monocropping, higher fertilization and irrigation and; inappropriate cropping systems for immediate profit motives etc., insect pests and diseases have also increased. It has been estimated that approximately 18 per cent losses of total crop produce due to insect pests, diseases and weeds occur every year. At the current prices the monetary value of the total losses due to various pests (insects, diseases, nematodes and weeds) may exceed Rs.50,000 crores annually.

Such high losses due to pests have been occurring regularly inspite of the increased use of pesticides over the years. However, injudicious use of chemical pesticides have been responsible for ecological imbalance, environmental pollution,

health hazards. The development of pesticide resistance also contributed to the loss of beneficial insects and micro-organisms. Even the fertility of the soil is adversely affected due to repeated applications of soil pesticides. This has now been realized that over reliance on the pesticides has taken its toll and created numerous side effects. In addition, the aspect of pesticide residues also poses a serious threat as a non-tariff barrier to the export of agricultural commodities.

Therefore, the pests have to be managed through ecologically safe, environmentally sound and economically viable technologies. Thus, the issue of sustainability, productivity and stability have to be addressed through a system approach taking a holistic view.

The pest control started since long back, out of which some significant developments as the corner stones of Integrated Pest Management (IPM) that are as:

| Year | Event |
|-------------|--|
| 1959 | Concept of ET, EIL and IPM |
| 1981 | IPM in India |
| 1985 | National Policy on IPM |
| 1988 | Establishment of NCIPM by ICAR |
| 1992 | Agenda 21 of UNCED at Rio de Janeiro on IPM. |

Further, the use of pesticides for pest control has increased over the years. India used 54,133 tonnes of pesticides in 1999-2000 of all the pesticides, out of which insecticides have dominating share of 65 per cent (herbicides 3%, fungicides 20% and others 12%).

The strong impetus to IPM system was pesticides, particularly the insecticides that came under severe attack from the environmentalists in 1960s due to their over use in controlling crop pests had created various problems and it was realized that their continuous use resulted in unwanted side effects as under:-

- Destruction of the natural control agents (predators, parasitoids) of the pests and other beneficial creatures (bee pollinators, eels, frogs, snakes, worms, birds etc.)
- Pest resurgence and development of resistance in pests to pesticides.

- Pollution of the soil, water and air.
- Pesticide residues in agricultural products leading toxicity in animals, including human beings.
- Direct hazard to human beings due to acute or chronic poisoning and death.

In view of the above scenario, plant protection scientists and all those concerned with pest management in agriculture must be prepared to face the challenges ahead. Over dependence on pesticides for plant protection measures must be minimized. A number of pesticides have been banned and some of them have been restricted for their use in agriculture and this had been one of the highlights on IPM achievements in the country.

Towards this goal, the plant protection technology through IPM, evolved by the national agriculture research system, has to be validated, promoted and applied on a large scale in partnership with farmers, researchers, extension specialists, industry and non-governmental organizations.

What is integrated pest management (IPM)?

In 1967 a FAO (Food and Agriculture Organization of the United Nations) panel of experts defined IPM as “A pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest population at levels below those causing economic injury”.

IPM emphasizes the need for simpler and ecologically safe measure for the pest control to reduce environmental pollution and other problems caused by excessive and indiscriminate use of pesticides.

IPM aims at:

- Keeping the pest numbers below harmful (economic threshold) levels instead of their eradication.
- Protecting and conserving the environment including biodiversity.
- In making plant protection feasible, safe and economically even for the small farmers.

Advantages of IPM

- It's a more efficient and cheaper method of control.
- It does not upset the balance in nature.
- It considerably delays the development of resistance.
- It minimizes considerably the residue hazards of pesticides.

IPM : The environment friendly way

In 1962, Rachel Carson in her book *Silent Spring* aroused worldwide concern about the excessive use of pesticides which eventually led to the concept of IPM as an environmentally sound alternative to the sole use of chemicals. Agenda 21 of the United National Conference on Environment and Development (UNCED) at Rio de Janeiro in June, 1992 identified integrated pest management and control in agriculture as one of the requirements for promoting sustainable agriculture and rural development.

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 population below economically damaging levels.

The IPM concept is based on the principle that it 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. The first line of defence against pest is prevention through the use of good agronomic practices or cultural methods which are favourable for the development of pest problems. Regular monitoring of pest activity is essential for decision in IPM. Selected control measures to check pest are to be taken at Economic Threshold Level (ETL) or Action Threshold Level (ATL). IPM strives to optimize rather than maximize pest control efforts.

An integrated strategy for crop pest management includes use of resistant varieties, modifying agronomic practices to evade reduce pest incidence,

biological control and other novel approaches for pest suppression and only need based and judicious use of chemical pesticides.

In brief, the IPM is a holistic approach to manage the pest problems in a sustainable manner. This involves various interventions starting from soil tillage to the crop harvest that are responsible for pest suppression. Thus, IPM system is ecologically safe and sound, as it emphasizes judicious use of pesticides along with non-chemical methods like cultural, mechanical, botanical practices and biological control with definite focus on reduced use or no use of pesticides.

The benefits of IPM are economically viable, farmers friendly, environmentally sound and socially acceptable with the limitations of location and crop specific.

Further more, the productivity of cereals through green revolution have motivated the farmers to adopt practices of cereals based cropping systems on their productive lands. This unitary approach though provided food sufficiency and food security to the country has also lead to advance consequences. These are now being witnessed in the form of shortage of pulses due to fall in the area under their cultivation, degradation of soil health causing decline in soil productivity, depletion of ground water resources and serious problems of environmental pollution due to excessive use of chemical fertilizers and pesticides. Concerns have been voiced about the present situation at various levels, and more diversified and integrated farming systems are being advocated. His Excellency President of India in his address to the Parliament in February, 2003 made a direct reference to the important issue by stating “there is an urgent need to review the current policies, which have impeded crop diversification and led to unsustainable food subsidies, and to ensure crop neutral support to our farmers.”

Pulse, being the cheapest source of dietary proteins for human beings and valuable animal feed, were used to be an essential component of diet. However, they have now become unaffordable because of their high prices. They were an integral part of farming system in India, because of their soil reinvigorating ability. Chickpea (*Cicer arietinum* L.) popularly known as Bengal gram or gram, is the most important winter season (rabi) pulse crop of India and contribute about 32 per cent of the total annual production among pulses.

Until 1970s it was a premier crop of northern India. With the adoption of irrigated based intensive cereals cropping system, chickpea like other pulses, which did not gain technological advances, was relegated to marginal lands under rainfed cultivation with no chemical fertilizers, manures and pesticides. Productivity thus suffered and the farmers lost faith and confidence in the cultivation of chickpea. Over the time, good quality genetic material also got lost. However, chickpea has now been identified as one of the alternate rabi crops for diversification of the cereals based cropping system in India.

Though with improved cultivars and supportive technology, the attainable yield of chickpea is more than 20 q/ha., the realized yield is around 35 per cent of its potential. The major cause of wide gap between the attainable and realized yields appear to be the lack of appropriate technologies, which can help the crop to withstand the vagaries of weather, the menace of pathogens, insect pests and inadequate supply of quality varieties seeds, resistant to diseases and insect pests. The absence of minimum assured procurement price is another major disincentive for farmers. In addition to this, producer/consumer price gap in cereals is 10-15 per cent against 60-70 per cent in pulses. Strong intervention of public sector is required to narrow down the produced/consumer price gap to maximize the profit of the producer.

To over come these above mentioned barriers related to production technology in chickpea, Integrated Pest Management (IPM) is considered to be an effective alternate to chemical pesticides, technically as well as economically. Its adoption however has remained restricted to hardly two per cent of the total crop area. It is because of poor understanding of the technology – characteristics by the farmer and absence of socio-economic and institutional conditions, pre-requisite for its adoption. The wide spread adoption of IPM requires involvement of all the stakeholders, timely and adequate supply of plant protection inputs and a collective approach by the farmers. Government may consider incentives to the farmers, biopesticide industry and development of markets for the pesticide free agricultural products.

Important inputs of IPM and their availability

IPM is a knowledge-based technology. It involves integration of different methods of disease and pest management to manage an important disease or pest of a crop or to manage all the important diseases and pests of a particular crop or to manage all diseases and pests in a particular cropping system. Under IPM, use of chemical pesticides is discouraged but not totally banned. IPM modules are area specific. They take into consideration not only diseases and insect pests but also availability of inputs. Most of the modules include too many practices, which usually discourage the farmers. They are not ready to invest their entire energy in pest management alone. Therefore, it is important to develop modules involving few critical interventions.

Use of resistant varieties are most important input of any IPM module. The use of pesticides should be avoided as much as possible. However, need based and judicious use of pesticides is advocated under IPM. Where ever available use of environmentally safe pesticide should be preferred.

Bio control agents and biopesticides market in India

Biological control can be achieved either by introducing biocontrol agents directly into natural ecosystem or by adopting practices, which favour population buildup of biocontrol agents under natural condition. Combination of both the approaches is probably the best solution. In recent years, there has been a tremendous progress in this area. Various kinds of biocontrol agents are available in India.

At present, the biopesticides share approximately 2.5 per cent of total pesticides in market compared to 1 per cent in 2001. This increase is due to utilization of biopesticides mainly in vegetable crops, sugarcane and paddy. The projected share of the biopesticides by the end of 2006 is 12-15 per cent of total pesticides in market. They are now integral part of “organic farming” and IPM and are available in private market in most of the states. The estimates of some of the biopesticides available in India are given in table 1.

Table 1. Estimated biopesticides availability in India

| S.No. | Product | Availability |
|--------------|----------------|---------------------|
|--------------|----------------|---------------------|

| | | |
|----|-------------------------------|----------------|
| 1. | Azadirachtin formulations | 2000t |
| 2. | <i>Bacillus thuringiensis</i> | 500t |
| 3. | <i>Trichoderma</i> species | 500t |
| 4. | Fungal entomopathogens | 100t |
| 5. | <i>Psuedomonas</i> species | 50t |
| 6. | Nuclear polyhedrosis viruses | 0.5 million LE |
| 7. | <i>Trichogramma</i> cards | 1.5 million |
| 8. | Pheromone traps | 5 million |
| 9. | Pheromone lures | 15 million |

Source: Chickpea Production and Productivity Constraints: proceedings and recommendations of the brain storming session (21-22 Nov. 2003), NCIPM, ICAR, New Delhi, published in march 2005.

Table 2. Status of Rajasthan in country regarding chickpea

| S. No. | Component item | 2001-02 | | | | 2002-03 | | |
|--------|----------------------|---------|------|---------|------|---------|------|---------|
| | | India | Raj. | % Share | Rank | India | Raj. | % Share |
| 1. | Area (m ha) | 6.42 | 0.97 | 15.11 | II | 5.67 | 0.45 | 7.94 |
| 2. | Production (mt) | 5.47 | 0.74 | 13.53 | II | 4.13 | 0.34 | 8.23 |
| 3. | Productivity (kg/ha) | 853 | 759 | - | VII | 728 | 757 | - |

Source: Vital Agriculture Statistics, 2003-04, DOA, Rajasthan (Statistical Cell, Feb. 2006)

Table 3. Area, production and productivity status of chickpea in Kota district and in Rajasthan state

| Year | Rajasthan | | | Kota | | |
|---------|-----------|---------------------|----------------------|-----------|---------------------|----------------------|
| | Area (ha) | Production (tonnes) | Productivity (kg/ha) | Area (ha) | Production (tonnes) | Productivity (kg/ha) |
| 1990-91 | 1652668 | 1010999 | 612 | 40365 | 28576 | 708 |
| 1995-96 | 1820273 | 1090257 | 673 | 18134 | 12166 | 671 |
| 2000-01 | 672634 | 395141 | 587 | 10827 | 7467 | 690 |
| 2001-02 | 969625 | 735528 | 759 | 17195 | 16807 | 977 |
| 2002-03 | 449680 | 340620 | 757 | 7875 | 6912 | 878 |
| 2003-04 | 1117506 | 707192 | 633 | 5406 | 6638 | 1228 |

| | | | | | | |
|---------|---|---|---|------|------|------|
| 2004-05 | - | - | - | 2166 | 2332 | 1077 |
|---------|---|---|---|------|------|------|

Sources:

- (1) District wise trends of agriculture production in Rajasthan, 1990-2001. Directorate of Agriculture, Rajasthan (Statistical cell, Dec., 2001).
- (2) Vital Agriculture Statistics 2003-04, Directorate of Agriculture, Rajasthan, Jaipur (Statistical cell, Feb. 2006)
- (3) Rabi Crops-Package of Practices, Kota Zone V, Kota, 2005.

Table 4. Chickpea cropping pattern over years in Kota district

| Year | Area (ha.) | % to Gross Cropped Area |
|---------|------------|-------------------------|
| 1981-82 | 85000 | 12.41 |
| 1991-92 | 28397 | 8.96 |
| 2001-02 | 17195 | 4.18 |
| 2002-03 | 7875 | 3.03 |

Source: Socio-economic Agricultural profile of Kota district, Published by Socio-economic and Agricultural Policy Planning Research Cell, MPUAT, Udaipur, Feb. 2005.

1.1 STATEMENT OF THE PROBLEM

Trend of increasing population, demand of additional food and exhaustive use of shrinking natural resources are some of the major concerns of today's agricultural scenario in our country. The green revolution in the 1970's led the country from scarcity to the over flowing godowns of today. The promotion of intensive agriculture has led to increased pest problems. Some of the problems related to pest management have been of complex nature because of the over use of pesticides, loss of friendly insects and microorganisms and development of pesticide resistance in a number of insects, plant pathogens and weeds. At the same time, new pests problems are emerging in different parts of the country. The farming community has faced with major challenges due to increase in cost of production. Lot of information have been generated by plant production and protection scientists to combat these problems through various control measures of individual pest. However, a holistic approach considering all possible control measures blended with indigenous technical knowledge and promotion of sustainable technologies in pest management like IPM is yet to become popular with the farmers due to various reasons. The problem associated with over

reliance on pesticides and their indiscriminate use are well recognized. Also the availability of various eco-friendly IPM modules for a number of crops under different production systems is well documented. But till now, the farmers have not been able to take full advantage of IPM technologies developed by the plant protection scientists. This is basically due to three reasons:

- (i) An effective interface between institutions working on IPM doesn't exist.
- (ii) The IPM modules have been tested so far are only on small scale; and
- (iii) The efforts towards adoption of this programme by various agencies have been only in isolation.

On the other side, green revolution in cereals has made India self-sufficient in food and provided the country a sense of national security and pride. It has verily been the engine of growth and progress over the last thirty years. However, other crops, specially pulses, which used to be an integral part of the farming system and human diet for rich protein content, could not achieve equally high technological advances. As a result, their cultivation became less profitable. They were gradually relegated to more and more marginal lands causing decline in their productivity and production.

The cereal based cropping system in the irrigated tracts of northern India has started showing signs of fatigue and strain. The loss in soil productivity, lowering of ground water table and environmental pollution due to high use of chemical fertilizers and pesticides are all pointers of unsustainability of the present mode of intensive agricultural production system. This is a matter of serious concern and has to be rectified. Crop diversification, integrated farming and reintroduction of pulses in the cropping system are being strongly advocated to reverse the present trend. This is possible by making pulse production as profitable as the cereals.

Further more, pulses are the cheapest source of dietary proteins and valuable animal feed. Besides, they are also important for sustainable agriculture, due to their inherent capacity to fix large amounts of atmospheric nitrogen and thrive on the limited available moisture because of their deep root system.

Chickpea is one of the most important pulse crop in India and has been identified as one of the alternative rabi crops for diversification in cereals based cropping system for sustainable agriculture. However, the production of chickpea

has remained almost stagnant over the years. The yield reducing factors are mainly responsible for the gap between the attainable and realized yields. The major causes for low yields are attributed to lack of appropriate chickpea production technologies with sound plant protection options, inadequate supply of quality seeds to farmers and lack of assured price in the market.

Further more, pulses are attacked by pod borer and other insect pests which results in damage up to 30 per cent. By saving pulses from these insect pests, the yield can be increased from 13.1 to 18.7 million tonnes thus increasing the income by 37520 million rupees. The additional possible income from all these crops comes to 292400 million rupees annually.

In pulses, *Helicoverpa* alone has been found to cause an average loss of 14.8 per cent in chickpea and pigeon pea. The total average loss due to insect pests has been estimated to be 29.2 per cent in chickpea. The estimates of total annual monetary losses due to insect damage in agricultural crops are highly variable. The estimates made during mid eighties revealed the annual losses due to insect pests to the tune of Rs.6000 crores. However, the estimates made during mid nineties put this figure at Rs.33660 crores including Rs.29240 crores due to field pests and Rs.4420 crores during storage. Looking to this, there is an urgent need to bring down the losses due to pests by following proper pest management strategies.

Therefore, in view of the potentiality in the management of crop pests by application of IPM technology in chickpea, it is necessary to harness synergies between different research and developmental agencies, policy making bodies and the farming communities so that the emerging crop protection challenges facing the agriculture are met without failure.

In the Kota district of Rajasthan state, various efforts by different agencies have been done to accelerate the IPM strategy in chickpea for boosting up production in a sustainable manner, along with this a national sub project on “validation and promotion of IPM technology in chickpea” under NATP mission mode in the leadership guidance of NCIPM, ICAR, New Delhi has been taken up in the district.

Keeping in view of this background and considering the vast scope of IPM strategy, chickpea in diversification and as an alternative to rabi crop perspective, it was felt to conduct a research study entitled “Adoption of Integrated Pest Management in Chickpea in Kota District of Rajasthan” with the following specific objectives:

1.2 SPECIFIC OBJECTIVES OF THE STUDY

- 1.2.1 To study information input and its processing behaviour of chickpea growers.
- 1.2.2 To find out the existing knowledge of farmers about recommended practices of Integrated Pest Management in chickpea.
- 1.2.3 To find out extent of adoption of recommended practices of pest management by chickpea growers.
- 1.2.4 To study the constraints as perceived by the chickpea growers in adoption of Integrated Pest Management practices.
- 1.2.5 To assess the training needs of chickpea growers with regards to Integrated Pest Management.
- 1.2.6 To suggest suitable extension strategy for effective transfer of technology for Integrated Pest Management in chickpea.

1.3 ASSUMPTIONS

- 1.3.1 It is assumed that the conditions prevailing in the study area are conducive for the extension of integrated pest management practices in chickpea production.
- 1.3.2 It is assumed that the chickpea growers have availed different sources of information to a desirable extent.
- 1.3.3 It is assumed that the chickpea growers process the information properly once it is received.
- 1.3.4 It is assumed that chickpea growers possess a fair degree of knowledge about recommended practices of integrated pest management.

- 1.3.5 It is assumed that the chickpea growers have adopted the recommended practices of integrated pest management to a desirable extent.
- 1.3.6 It is assumed that the chickpea farmers were confronted with some type of constraints related to IPM practices.
- 1.3.7 It is assumed that chickpea growers of the study area needed training on different aspects of IPM.
- 1.3.8 It is assumed that there are prospects of integrated pest management technology in chickpea production in the study area.

1.4 HYPOTHESIS

According to George A. Lundberg, “A hypothesis is a tentative generalization, the validity of which remains to be tested.” In its most elementary stage, the hypothesis may be any hunch, guess, imagination or ideas which become the basis for action and investigation.

According to Goode and Hatt, “Proposition which can be put to test to determine its validity is called hypothesis.”

Prior to any investigation, formation of hypothesis is imperative due to following reasons:

1. Hypothesis makes the research more specific and to the point.
2. Hypothesis helps in deciding the direction in which to proceed and;
3. Hypothesis helps in drawing specific conclusions.

Keeping in view the specific objectives of the study, broad hypotheses were developed and tested. The broad hypotheses are stated in null form as under:

H₀1 : There is no difference between the panchayat samities’ farmers with respect to knowledge of integrated pest management practices in chickpea.

H₀2 : There is no difference between the panchayat samities’ farmers with respect to adoption of integrated pest management practices in chickpea.

1.5 NEED AND IMPORTANCE OF THE STUDY

We would continue to be in competition with pests that interfere with our ability to produce food and fibre or threaten our health and comfort. The need for effective pest management is obvious. It must however, be implemented by methods that are compatible with the twin goals of sustainability and environment quality. The role of research and development is seeking alternatives to the use of pesticides cannot be over emphasized. Future pest control technologies will be the refinements or modifications of tactics presently available to us i.e. biotechnology can provided opportunities for manipulating desirable properties in living organisms in such a way as to greatly increase their usefulness in biologically based pest management. It is expected, therefore, that with research the number of situations in which biologicals can provide competitive, acceptable methods of managing pest will increase. However, emphasis on biotechnology must be balanced with equal attention to the old fashioned biology and ecology so that new technologies can be utilized effectively with minimum risk. Today, even though a number of novel approaches and “hitech” methods including the use of transgenic plants are becoming available, pest control in the next decade for resource poor farmers of the country will have to depend overwhelming on making the best use of conventional methods, including conventional pesticides, as part of IPM. Cultural control methods though may not be considered emerging technologies, will continue to be very important pest management tactics as part of integrated system.

The need for IPM and its relevance to sustained agriculture and environmental quality is now well recognized. However, in most cases, even today only lip service is paid to implementation of IPM by most researchers, academicians and advisory and extension staff. The meaning of the concept of IPM is seldom specified in detail. This is certainly not enough when it comes to planning an IPM system. Implementation of IPM is only possible if criteria necessary for appropriate decision making are developed. The utilization of the concept of “economic threshold” and “economic injury level” still encounter numerous difficulties. A system management approach is essential and research effort need to be intensified to understand the interactions between crop, pests, climate and

natural enemies in order to fine tune control approach for particular problem in an agroecosystem.

The survey and surveillance programmes must be strengthened and research is needed to develop effective methodology for sampling, collection and analysis of data. Development of forecasting and forewarning systems with corresponding advisory services are prerequisites for effective implementation of IPM programmes. Here, the role of plant protection advisory services must be emphasized. Trained and specialized extension personnel are needed to undertake monitoring and scouting to provide forecasting and forewarning services and also to ensure timely action. The current IPM programmes like that of Indonesia, must attempt to link the scientific development of ecological concepts with the intensive field training of farmers in ecologically sound field management techniques.

These represent the “second generation” green revolution technologies, which are compatible with environment conservation, public health and farmer profitability. Such an approach is fundamentally different from the earlier one in that IPM must now be practiced not as a fixed package of inputs formulated at a central level and dropped on to farmers, but instead rely on making farmers experts, capable of managing the local ecology of their fields in a sustainable manner.

In order to achieve the wide spread adoption of biologically based technologies, much critically important research, education and demonstration work is still needed and unless and until the farmers, extension workers and even researchers and policy makers acquire greater confidence in the use of these approaches, the long term goal of creating a truly sustainable agriculture will continue to elude us. It is felt that the efficacy and dependability of biological or ecological approaches of IPM has yet to be adequately demonstrated to the satisfaction of farmers and others. Greater emphasis must be given to the improvement and wide scale adoption of these methods.

The initiative for development of what is now described as bio-intensive pest management programmes will have to continue to come from researchers and policy makers. As far as the farmers are concerned ideological reasons alone are unlikely to change their attitude/ideals on chemical control. Also chemical

companies are unlikely to stop the production of broad spectrum pesticides by their own initiative. Hence the central and state governments must take the lead in making chemical control less attractive by legislation, registration taxation etc. and promoting environmental friendly methods by funding research and teaching and by improving extension services.

Further more, so far as IPM on chickpea in Rajasthan is concerned, considerable development can be observed over the years but no systematic efforts have been made to find out the possible factors and their extent behind the low productivity at producer level and condition of the farmers as well as the factors associated with farmers market interaction. Further, no effort has been made to explore the possible reasons allocated to slow pace of this aspect i.e. lack of knowledge of technologies or some other factors.

Looking to these facts, present investigation was aimed to study the various variables which would be of immense help to weigh the extent to which they are in concordance with the recommendations and principles so that the deficient areas revealed therefore, can be abridged.

The present investigation was aimed at studying the information input and information processing behaviour of the chickpea growers. The out comes of these two parameters of study would be of immense help to the concerned agencies to exploit the sources and channels being commonly used for further dissemination of information relevant to IPM in chickpea to the concerned farmers in more comprehensive and successful ways. Further, knowledge regarding information processing behaviour of chickpea growers would immensely help in strengthening and modifying the popular modes so that farmers may get maximum advantage from them.

Further, the present investigation was aimed at studying the existing level of knowledge of chickpea growers about IPM practices. the out come of this aspect will be of great value to the top and grass root level functionaries to know where client system stands so far as knowledge of advocated scientific IPM practices are concerned. Thus, looking to the present level of knowledge of farmers, the future line of action could be standardized for working with the farmers and abridging their knowledge gulf.

As also part of proposal, the present study has analyzed the extent of adoption of recommended IPM practices by the chickpea growers. Therefore, the obvious evidences regarding the adoption level is expected to make the extension agents and various agencies working in the field aware about what ought to be recommended practices. Hence, the findings about adoption level of recommended IPM practices in chickpea would assist both governmental as well as private agencies working in the field for augmenting the adoption level where it would be at the very lowest level.

The present study has also a cursory look on the constraints encountered by the chickpea growers in adoption of IPM practices. Knowledge of such obstacles and bottlenecks with their magnitudes which “put shackles on” in the adoption of recommended IPM practices would be of immense help to devise a plan of action for the concerned departments, SAUs, Directorate of Extension and top ranking policy makers and administrators to ease them.

One of the objectives of the present study was to identify the areas of training needs of chickpea growers regarding IPM which are main hindrances in popularizing the concept of IPM strategy and future prospects of the IPM concept, which would be of immense help in designing future strategy for promotion of this aspect of IPM.

Lastly, the present study vividly ascertains the suitable extension strategy for effective transfer of technology for IPM in chickpea.

In brief, the outcomes of the investigation would be helpful to the Rajasthan state and else where by providing basic data regarding the status and prospects about IPM strategy in chickpea. So that, accordingly, effective policy can be framed for proper transfer of technology up to the grass root level.

1.6 LIMITATIONS OF THE STUDY

- 1.6.1 Though all possible precautions were taken to make the study more precise, objective and reliable, yet because of limited time and resources available at the disposal of the student researcher, the study was confined to only one district.

- 1.6.2 Since the study was confined to only three panchayat samities, the large area was not covered. This has been a serious handicap in generalizing the findings.
- 1.6.3 As the entire investigation is based on the expressed verbal responses of the respondents selected under study, individual biasness and prejudices on the part of respondents might have influenced the various findings of the study.

1.7 DEFINITIONS OF IMPORTANT TERMS USED

- 1.7.1 Adoption:** It is a decision to make full use of new idea as the best course of action available. The term in the present investigation refers to the use of recommended practices of integrated pest management in chickpea production either fully, partially or not at all.
- 1.7.2 Knowledge:** A clear and certain perception of something; the act, fact or state of knowing or understanding is called knowledge (Webster, 1958). Also, knowledge are those behaviour and test situations which emphasized the remembering either by recognition or recall of an idea or/and material on some phenomenon (Bloom *et al.*, 1955). In the present context, this term refers to the totality of understood information of integrated pest management practices possessed by the chickpea growers.
- 1.7.3 Constraints:** Constraints in the present investigation may be defined as the impediments, obstacles or bottlenecks which “put shackles on” in the adoption of recommended integrated pest management practices in chickpea production.
- 1.7.4 Antecedents:** All those variables presents in the situation prior to the introduction of an innovation are called antecedents e.g. individuals personal attributes.
- 1.7.5 Age:** Refers to number of years a respondent is old at the time of interview.
- 1.7.6 Education:** It is the level of literally formal education told by the respondents at the time of interview.
- 1.7.7 Caste:** Caste is a social category whose members are assigned a permanent status within a given social hierarchy and their contacts are restricted accordingly (Lundberg).

- 1.7.8 Interview:** is essentially a conversation face to face carried out by the researcher with the respondent for getting his response.
- 1.7.9 Schedule:** Refers to a set of questions which are asked and filled in by an interviewer in a face to face situation with another person.
- 1.7.10 Information input :** Implies the sources of information which an individual use to avail the information relating to a particular cause.
- 1.7.11 Information processing :** Refers to the handling and curtailing of information received according to the needs of the receiver or it is all that is done to the received information before it is put to actual use.
- 1.7.12 Pest :** Any species, strain or biotype of plant, animal or pathogenic agent, injurious to plants or plant products.
- 1.7.13 Surveillance :** An official process which collects and records data on pest occurrence or absence of survey, monitoring or other procedures.
- 1.7.14 Treatment :** An officially authorized procedure for the killing, removal or rendering infertile of pests.
- 1.7.15 Integrated Pest Management :** “A pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest population at levels below those causing economic injury.” (FAO, 1967)
- 1.7.16 Management :** Management is both an individualized activity as also a group activity both working together to achieve a set purpose.
- 1.7.17 Economic Threshold Level:** ETL defined as the pest density at which control measures should be applied to prevent an increasing pest population from reaching the Economic Injury Level (EIL).
- 1.7.18 Economic Injury Level :** EIL defined as the lowest pest population density that will cause economic damage.
- 1.7.19 Economic damage:** The amount of damage that will justify the cost of artificial control measures.

1.7.20 Training : Training refers to the process of developing or augmenting knowledge, skills and attitude in the person to be applied in the performance of his or her specific work situation.

2. REVIEW OF LITERATURE

Review of literature relevant to the objectives of the study is an indispensable part in any scientific research endeavour. The term “review” implies “a look back on” of “a retrospective survey or view of the past events, experiences etc”. It provides knowledge of the latest research findings which indeed is essential for a research worker not only to get acquaintance with the past work but also to apply previous research findings to solve day to day problems and; to plan and conduct further researches based upon the past human experience and experiment.

The main function of review of literature is to determine what work both theoretical and empirical has been done previously to get assistance in the delineation of the problem area. Besides, it provides an insight of the methods and procedures suggests operational definitions to the major concepts and provides a basis for interpretation of findings. Further, it provides the testimony that the researcher is well versed with that is already known and what is still unknown and untested so as to avoid the duplication.

Although much work on integrated pest management from extension education point of view has not been reported, therefore not much literature is available on this theme of research problem. However, in view of this, an attempt has been made to make summaries of the writings of recognized authorities and findings of the previous researches in this chapter having direct or indirect bearing on the present study.

The review of literature has been presented into the following sections:-

- 2.1 Information input behaviour of the respondents
- 2.2 Information processing behaviour of the respondents
- 2.3 Level of knowledge of the respondents
- 2.4 Level of adoption of the respondents
- 2.5 Constraints as perceived by the respondents; and
- 2.6 Training needs of the respondents.

2.1 INFORMATION INPUT BEHAVIOUR OF THE RESPONDENTS

Punjabi (1990) studied the information seeking behaviour of small farmers in relation to their age, caste, education and socio-economic status. These four variables formed the predictors of response variables i.e. information behaviour of small farmers.

Bareth and Intodia (1997-98) revealed that “Village Extension Workers” (2.58 MS) were the main source of information for small farmers. Next were “friends” (MS 2.21), “Assistant Agricultural Officers” (AAO) with 1.83 mean score and “Neighbours” (1.83 MS). But in case of marginal farmers, the order was slightly changed i.e. friends were given first priority instead of village extension workers and vice-versa. The least used sources by small farmers were “Krishi Upaj Mandi”. Similarly, among marginal farmers “cooperative society” and “films shows” were least used sources.

Punjabi *et al.* (1997-98) reported that among the personal localite sources, relatives (96.11 per cent) and neighbors (95.85 per cent) were the most utilized sources of information by the respondents. The village leaders were less approached by the respondents in getting information. Further, the agricultural supervisors and extension officers as the personal cosmopolite sources of information proved to be the most important as these were accorded first and second ranks respectively.

Veeranna and Jawali (2000) found that the sources of information utilized by the entrepreneurs were mainly their neighbours, veterinary officers and relevant literature.

Kumar and Se (2001) revealed that the most preferred mode of getting information by the respondents was interview (76.6%) followed by drama (68.8%) and folk songs (56.6%). However, the least preferred mode was straight talk.

Nath *et al.* (2001) found that most of the respondents received information by training on farm (90%) followed by the Agricultural Extension officers (86.66%), field day (80%) and result demonstrations (76.66%) under the personal cosmopolite sources. Training on station (90.99%), training on farm (83.33%) and field day (70%) were the personal cosmopolite sources perceived in order of importance by the concerned farmers.

In case of impersonal cosmopolite sources of information, majority of the opinion leaders had sought information from television (90%) followed by radio (86.66%) and newspapers (80.00%). Whereas farmers consider radio (96.66%) as the best source of information for opinion leaders. In the personal localite category both the opinion leaders as well farmers had sought information from agricultural input suppliers 93.33 and 98.33 per cent respectively followed by friends and immediate neighbours.

Singh and Mishra (2001) reported that as communication sources, neighbours were used to the greater extent followed by both relatives and friends and; leaders, village development officer, progressive farmers, veterinary officers and bank personnel. University staff was found to be least used source. Among group communication sources, demonstration was the most used source followed by meetings and field days. However, training, video and group discussions were other less used group communication sources. Among mass communication sources, radio was the most frequently used source followed by television, fair and exhibition. Newspaper, poster and film were least used sources of mass communication by respondents for availing information.

Ahmed *et al.* (2002) revealed that the daily newspaper were the main information sources through which farmers know about the date and location of extension activities.

Choudhary *et al.* (2002) concluded the utilization pattern of different formal information and mass media sources on three major aspects viz. ; extent of contact, degree of understanding and trust worthiness. They found that informal sources had more importance than the formal and mass media sources. The formal media got third place in the same context. It led to the conclusion that though the information were received by the farmers indirectly through informal sources. Yet they give more importance to formal and mass media sources.

Jones and Evans (2002) opined that farmer organizations and technologically innovative farmers were the most effective modes for delivery of technological to the fellow farmers.

Kaushik (2002) concluded that inter-system communicational linkages were not very strong in availing information. The top-bottom and bottom-up linkages

showed inconsistency, hence a need was felt for input system for frequent facilities for communication and exchange of ideas.

Lalitha *et al.* (2002) revealed that agricultural assistants were the most consulted sources of information followed by field assistant.

Ozcatalbas and Sozer (2002) found that 72.2 per cent of the farmers believe that giving information to the farmers by different means helps in increasing their input setting. They suggested that official extension services and farmers organisations should cooperative with themselves to ensure optimum usage of information input in agricultural production.

Pyasi *et al.* (2002) revealed that only 58.33 per cent of the respondents had radio and 28.33 per cent had television as source of information.

Roncoli *et al.* (2002) revealed that farmers were interested in receiving scientific information because they perceive local knowledge as less reliable. It emphasized need for scientists to integrate information dissemination projects with effects to improve farmers capacity to respond positively.

Shriram and Chauhan (2002) revealed that progressive farmers (MS 2.25), neighbours (MS 2.62) and local leaders (MS 2.55) were the major personal localite sources of information used by majority of the respondents. Among personal cosmopolite sources of information village extension worker (MS 2.92) was the most used source followed by group meeting (MS 2.75), farmer's fair (MS 2.69), demonstrations (MS 2.61), training in Directorate of Extension Education and Agriculture department (MS 2.50) and Assistant Agricultural officer (MS 2.20) were the main sources of information. Likewise, from impersonal cosmopolite sources, television (MS 2.92) and radio were prominent. There were also commercial agencies as sources of information.

Vipin Kumar and Karippai (2002) opined that farmers naturally become fully conscious about the necessity of keeping good interpersonal relationship for availing information with other farmers to reduce the cost of cultivation and thereby to achieve maximum yield.

Jat (2003) found that village lambardars were one of the most utilized sources of information to opium poppy cultivators. He further reported that progressive farmers and relatives were also contacted by the farmers most often for receiving

information on opium poppy cultivation. He further revealed that radio was most preferred channel among the opium poppy cultivators for information input. Television as a channel of information also established its credibility among the cultivators in the study area. As against the assumption exhibitions, demonstrations, film shows and trainings etc. were utilized by lesser number of cultivator for information input. The study further revealed that antisocial elements of the village were also preferred by few of the cultivators for getting information input about unfair means.

Mahindra and Kaur (2003) found that among personal sources friends and family members provided maximum awareness i.e. 50 per cent respondents had only friends and 24.17 per cent had only family members as their source of awareness. Among impersonal sources radio was most popular followed by television. Farm publication plays a very less role in the awareness of farm women regarding pesticide residues in cereals, vegetables, milk products.

Kirar *et al.* (2004) indicated that progressive farmers, neighbour farmers, friends and relatives, RAEO, Agriculture Scientist, demonstration and radio were used by majority of the farmers, though casually. However, newspaper, magazine, Gram panchayat and television were the least utilized source.

Paul (2004) concluded that personal localite sources were the widely used information sources (MPS 52.96) by the poultry farmers. Theses were followed by personal cosmopolite sources (MPS 49.96). However impersonal cosmopolite sources were the least used sources of information (MPS 23.13) by the farmers for getting poultry related information.

Sharma *et al.* (2004) observed that marginal and small farmers mostly receive information through media like Rural Agricultural Extension officers (RAEO), progressive farmers, neighbours, friends, cooperative societies, radio, T.V., relatives, salesman and dealers. Thus, both types of farmers receive agriculture information through interpersonal and localized available media but among the popular sources of information RAEO was found most credible source to get the necessary information about the recommended agriculture technology.

Sisodia and Sharma (2004) concluded that with ever changing technology of groundnut production farmers remains in contact with sources of information so as to

increase their production. Most of the farmers prefer informal sources followed by formal source, mass media and in lastly goes to other sources. Among individual source, they prefer to contact village extension worker first then likes to seek information from friends followed by neighbours and radio. But these growers used least information from folders, leaflets and demonstrations.

2.2 INFORMATION PROCESSING BEHAVIOUR OF THE RESPONDENTS

Bhardwaj (2001) highlighted the need for requisite information processing and management as a key focus for sustainable development of agricultural enterprises.

Garforth (2001) showed differences between men and women; socio-economic categories and villages in access to uses of sources of information and its processing before actually putting to use.

Malik *et al.* (2001) renewing the multifarious roles of new information technologies centre could be developed through coordinated effects of SAUs and target group i.e. farmer, youth and farm women and; other extension organizations for proper discussion (processing) of information. Nodal members like communicators, researchers and community leaders are to be identified to aid in information processing. The feasibility of promoting networking with other developmental activities should also be foreseen as another step to improve the information processing standards.

Nath *et al.* (2001) revealed that majority of the opinion leaders had judged the received information by consultation with other specialists (90%) followed by technical feasibility (83.33%) and consultation with concerned farmers (66.67%) working in the field. As per the perception of the concerned farmers, judgment based on the economic feasibility (86.66%), consultation with other farmers (83.33%) and acceptance of technology with little modifications (78.33%) depicts to the information processing behaviour of the opinion leaders.

Bhimawat (2002) reported that all the respondents had strongly expressed that the use of television followed by group discussion was very essential.

Chermak and Kraise (2002) opined that information processing is an important determinant not only in strategy choice but also in the choice to strategic over multiple rounds.

Fritz (2002) concluded that it is necessary for information flow to get proper processing procedures between the enterprises as determined by the sector's particular production condition. Different types of processing patterns are followed according to different mechanisms. Possible impacts of information processing on an enterprises internal organization and interim coordination are positive.

Hubbard (2002) reported that the main contribution of assessing the utility of information before using is to take better and informed decisions and; is in facilitating the spread of further refined information to the peer group. He suggested to create more opportunities for information judgment.

Hueth and Marcoul (2002) found that information sharing generally leads to increase in expected total welfare but may reduce expected profits. Even when expected profits increase, information sharing does not represent equilibrium behaviour. This situation can be overcome if enterprise commits to simultaneous reporting their received information and if reports are verifiable.

Huffman *et al.* (2002) reported that an increase in the respondents education lowers the probability of sharing the received information with others. Educated receivers generally do not process the information using external sources but use it according to their own comprehension.

Kadian and Kumar (2002) analysed information processing pattern of the respondents in terms of preservation of information and; the method used for evaluating the information for decision making and ultimate use. It was found that majority of the farmers preserve the information in their memory. The evaluation of received information was done by discussing with friends, relatives and progressive farmers (87.22%) as well as considering the feasibility and profitability of the innovation. Due consideration must be given to educate the farmers so that they may maintain subject matter file to preserve the useful information.

Legesse (2002) reported that differences in gender and marital status of the respondents, educational level and size of unit setup were associated with differential processing pattern of information.

Ozcatalbas and Sozer (2002) found that 27.28 per cent of the respondents were trying to get help from others for deciding the information use. 72.2 per cent of the respondents believed that sharing information with other farmers helps in maximising the output.

Vipin Kumar and Karippai (2002) operationalized processing skill as the ability of a respondent to process on information. It was measured in terms of three specific components *viz.*, translation, interpretation and extrapolation. The skill in translation is defined as the degree to which a farmer can give meaning to the message he receives from the “other farmers” in an interpersonal communication situation. Skill of extrapolation is defined as the degree to which a farmer can visualize or predict the implications of an idea received from another farmer in his own conditions and life situations.

Dhinga and Hasija (2003) opined that the information regarding technologies should be promoted using every conventional and non-conventional media and should be disseminated in such a way that it reaches the target audience timely and fits in their life style.

Fountas *et al.* (2003) revealed that about 80 per cent of the respondents liked to store the information themselves. Only a few indicated that they exchange the information regarding management practices with others.

Gueye (2003) concluded that appropriate information processing techniques are those that ensure to make efficient use of conventional as well as non-conventional sources. While introducing information discussion, socio-cultural and economic environments of target group should be taken into account.

Hudson and Hite (2003) opined that how well a technology integrates into current farming practices depends to a large extent on the degree to which the information received regarding the technology is discussed before putting to use.

Jat (2003) revealed that past success or failure of the practices was a big consideration among the growers for acceptance or rejection of innovations. The satisfaction with the level of production, monetary gains and relative advantages of the technology were also important consideration for information processing behaviour of the opium poppy cultivators.

He further found that triability, predictability, observability and communicability did not play any important role in the information processing behaviour of the opium poppy growers.

Just *et al.* (2003) revealed that the information processing behaviours are differentiated on the basis of their access to specific information sources. Even when information sources are available, the value derived depends on the analytic capacity of the decision maker for making use of specifically formulated information. It is accounted to the relationship between information format and actor's analytic capabilities.

Mahaliyanaarachhi (2003) revealed that the respondents processed the received information from their respective information sources based on the quality and quantity of information required.

Paul (2004) revealed that nearly one fourth of the farmers (24.58%) had high degree of information processing. It was followed by 21.25 per cent of them having medium and 20.83 per cent having very low level of information processing. Besides, respondents who fell in the category of low and very high level of information processing were 18.75 and 12.92 per cent respectively.

2.3 LEVEL OF KNOWLEDGE OF THE RESPONDENTS

Goyal and Verma (1992) indicated that farmer's knowledge regarding gram production technology was not of high order as about three-fourth (72.00%) of the total number of respondents had low to medium level of knowledge. Further, they pointed out that the knowledge level regarding insect pest control and disease control in gram production was low i.e. 33.00 and 15.00 per cent, respectively.

Bhairamkar *et al.* (1998) observed that more than half (53.33%) of the beneficiaries had high knowledge while 26.67 per cent of them had no knowledge about the IPM programme. On the other hand, 43.33 per cent of the non- beneficiaries had medium knowledge while 36.67 per cent of them had no knowledge about IPM programme. The knowledge scores of the beneficiaries, non- beneficiaries and total sample size were 12.46, 6.65 and 9.51 respectively. Thus, it can be said that beneficiaries had benefited substantially in increasing about plant protection technologies than that of non- beneficiaries.

Sharma *et al.* (1998) revealed that the existing knowledge of the farmers for opium production related to time and method of sowing, fertilizer application, irrigation management, weed and their control measures and plant protection measures was 45.46, 91.00, 61.94, 63.95 and 40.28 per cent respectively.

Goyal and Intodia (1999) revealed that farmers possessed only 7.77 MPS and 8.46 MPS knowledge regarding plant protection measures in wheat production in trial and non-trial areas respectively, while MPSs for seed treatment knowledge were 4.75 and 6.19 respectively in both the areas.

Kubde *et al.* (1999) revealed that 98.67 per cent of the respondents had knowledge about the practices related to plant protection measures against insect pests. While only 20.67 per cent and 17.33 per cent of the respondents had knowledge about the seed treatment and disease management respectively for soybean production.

Chapke (2000) reported that 75.91 per cent of the respondents had moderate knowledge about bio-control measures where as comparatively less percentage of respondents had low (16.05%) and high (8.04%) level of knowledge about bio-control practices.

Badodia *et al.* (2002) opined that in case of practice-wise knowledge gap of the respondents, the maximum gap was observed in seed treatment, use of *Rhizobium* culture, plant protection measures and number of irrigations regarding chickpea cultivation technology.

Bhati and Sharma (2002) concluded that on the whole majority about (62 per cent) of the farmers had medium to high knowledge level about the recommended mustard production technology. They further pointed out that majority (about 78 per cent) of big farmers were also found to have medium to high knowledge level about recommended practices of mustard cultivation while 75.23 per cent and 76.55 per cent of small and marginal farmers respectively showed low to medium knowledge level about recommended production technology.

Chaturvedi *et al.* (2002) concluded that the highest knowledge (73.60 per cent) of the total respondents about improved practices of cotton cultivation was found in the category of big farmers. A significant difference was noted in the level of knowledge possessed by IGNP and non-IGNP village respondents.

Ganesan and Seethalakshmi (2002) revealed that majority of the respondent had high knowledge (43.33%) followed by medium (30.83%) and low (25.84%) level of knowledge on IPM in rice.

Singh *et al.* (2002) revealed that 86 per cent of farmers were having low to medium level of knowledge about improved production technology of chickpea. On the whole only a small percentage of farmers comprising 14 per cent had adequate knowledge of recommended package of practices. They further highlighted that 28 per cent, 42.50 per cent 29.5 per cent of respondent had low, medium and high level of knowledge about pest management practices of chickpea production technology.

Singh and Waris (2002) revealed that farmers selected under lab to land programme were having high level of knowledge of improved practices of til crop. About 47.50 per cent, 30.00 per cent and 22.50 per cent beneficiaries were having medium, low and high level of knowledge as compared to non-beneficiaries i.e. 57.50 per cent, 35.00 per cent and 7.50 per cent of low, medium and high level of knowledge respectively.

Deshmukh *et al.* (2003) observed that the practice wise knowledge of trainees and non-trainees integrated pest management practices showed that majority of trainee (92.00 %) had knowledge about spraying of neem seed extract (5.00 %) against bollworms, where as the percentage of non-trainees having knowledge about this practice was found 70.67 per cent. More than three fourth of trainees had knowledge about grazing the field by sheep and goat after last picking, whereas more than one-fourth of non trainees (28.00%) had knowledge about the same practice. More than half of trainees (67.33%) had knowledge about spraying showed be undertaken when pest population reaches ETL, whereas a few trainees (9.33 %) had knowledge about it.

Singh *et al.* (2003) revealed that under IPM module for tomato and cabbage, regular monitoring and collected data clearly indicated that even during the peak cropping season August and September infestation due to disease and insect-pests were more in non-IPM fields than in IPM fields. Results also showed that despite the farmers are having good awareness about pests (56 %) but, none of them were aware of friendly insects in the field, which is reducing either as a result of indiscriminate use of chemical pesticides or total lack of knowledge about natural enemies. Net

profit with IPM practices was also calculated with corresponding value for non-IPM plots and this draws the attention that for a profitable agribusiness one has to adopt IPM, which is not only an ecofriendly management but also a need for sustainable rural development.

Upadhyay and Maheshwari (2003) concluded that overall mean per cent knowledge score about bio fertilizers was 49.89 indicating of possessing average knowledge of rural women.

Kumar (2004) revealed that the extent of knowledge about time of sowing of gram, nipping practice, soil and soil preparation, seed rate and recommended spacing and harvesting, threshing and storage was 83.19, 81.25, 74.69, 71.87 and 59.66 per cent respectively, while the knowledge about seed treatment practice was very low having highest knowledge gap 70.10 per cent among gram growers.

Saharan and Pundhir (2004) pointed out that the knowledge level among beneficiary farmers was 63.20 per cent regarding plant protection practices where as this level was 44.80 per cent among non-beneficiary farmers which shows significant gain in knowledge among beneficiaries

Saxena *et al.* (2004) revealed that in IPM common practices like summer ploughing and hand weeding were completely known by all categories of farmers. Whereas use of neem leaf abstract, neem oil, tobacco decoction, spray of HaNPV/Bt at early stage of infestation and light trap were not known by majority of all categories farmers. These practices need to be exposed to farmers.

Shinde *et al.* (2004) concluded that cent per cent respondents possessed knowledge about loaning period followed by 83.33 per cent of the respondents having knowledge about compulsorily participation for the farmers who borrowed the loan. Over three-fourth (76.67%) of the respondent possessed knowledge about the crops that are covered under the scheme followed by little less than three-fourth (73.33%) knowing that the various banks were the implementing agency for the National Agricultural Insurance Scheme. Thus they inferred that the farmers who participated in the scheme were quite aware about the functioning of National Agricultural Insurance Scheme.

2.4 LEVEL OF ADOPTION OF THE RESPONDENTS

Shinde *et al.* (1997) revealed that majority of the cotton growers did not adopted the mechanical and biological practices of IPM programme. Whereas overwhelming majority of the cotton growers adopted the cultural practices with the point that majority of them lack the scientific information base for doing so. In the study, Chemical control measures indicated that more than half of the cotton growers (58.33 %) followed the recommended spraying of insecticides which is as good indication of curtailing indiscriminate use of pesticides by the cotton growers. However, the other important aspects related with IPM technique such as use of plant products and sex pheromone traps for monitoring the infestation of pest on the basic economic threshold level were found to be meagre among the cotton growers.

Chaturvedi *et al.* (1999) concluded that the adoption of plant protection measures in cauliflower cultivation was 28.66 and 20.00 per cent in periphery and distant farmers respectively. While the adoption level in weed control was 62.22 and 43.33 per cent respectively.

Goyal and Intodia (1999) depicted that the extent of adoption for plant protection measures was only 0.55 MPS and 1.11 MPS in tribal and non-tribal areas respectively, whereas the extent of adoption for seed treatment was nil in tribal area and 2.22 MPS in non-tribal area regarding wheat production.

Kalaskar *et al.* (1999) revealed that technology involving low cost adopted by majority of the respondents, where as the technology involving knowledge, skill, expenses and less availability found adopted by relatively lesser proportion of the respondents.

Kubde *et al.* (1999) observed that 53.33 per cent of the respondents had fully adopted the insect pest management practices while 17.33 per cent of respondents adopted partially and 29.33 per cent of respondents did not adopted at all for soybean production. They further pointed out that only 7.33 per cent of the respondents had adopted fully the seed treatment while 92.67 per cent of the respondents did not adopted at all. In case of disease management only 16.00 per cent of respondents adopted fully while 84.00 per cent did not adopted at all.

Chapke (2000) reported that 85.40 per cent respondents had overall moderate adoption level about bio-control measures. A negligible percentage of the respondents had low and high adoption level about biocontrol measures.

Sarmah and Goswami (2001) revealed that 100 per cent adoption gap was found in seed treatment and weeding practices, while 53.97 and 84.92 per cent adoption gap was found in chemical control of insects and chemical control of diseases respectively. Whereas adoption gap in seed rate was 55.75 per cent in Sali rice cultivation practices.

Badodia *et al.* (2002) revealed that overall extent of adoption about improved chickpea cultivation technology was observed maximum in medium level category. In case of practice-wise adoption regarding chickpea cultivation technology, the maximum adoption was observed in selection and preparation of land after the harvesting of kharif paddy, application of fertilizer and sowing time and methods.

Meena *et al.* (2002) that level of adoption for onion production technology among trained respondents with specific package of practices for seed treatment, weed management and plant protection was 44.17, 45.83 and 48.33 MPS respectively which shows significant adoption gap.

Singh (2002) revealed that the extent of adoption of mung production technology related to the practices of high yielding varieties, seed rate, seed treatment, time of sowing, fertilizer application and plant protection measures was 57.85, 73.33, 32.55, 79.85, 27.69 and 47.50 per cent respectively among beneficiaries. While the extent of adoption of moth production technology in the same practices was 44.75, 69.58, 29.69, 71.33, 23.60 and 43.25 per cent respectively among beneficiaries.

Singh and Waris (2002) revealed that the adoption level of beneficiaries related to seed rate, time of sowing, seed treatment, and plant protection measures was 75.00, 67.50, 37.25 and 45.00 per cent respectively for til production technology.

Deshmukh *et al.* (2003) observed that the practice wise adoption of trainees and non-trainee about IPM practices showed that majority of the trainees (98.67 %) had adopted the spraying of dimethoate. Where as, more than half of the non-trainees (66.66%) had adopted it. As regards spraying of neem seed extract, 97.33 per cent trainees adopted it and 64.00 per cent non-trainees adopted the same practice. Majority of the trainees (94.67%) adopted the practice of spraying of pyrethroids

whereas the percentage of non trainees adopting the same practice was found 92.00 per cent. As regards grazing by sheep and goat, 93.33 per cent trainees and 81.33 per cent non-trainees had adopted it. More than three-fourth of trainees had adopted spraying when pest population reaches ETL. Where as quite a few non-trainees (9.33%) had adopted the same.

Gupta *et al.* (2003) revealed that seed treatment as recommended was adopted by only 36.66 per cent whereas 63.33 per cent farmers did not adopted at all. As far as the level of adoption for plant protection is concerned only 4.66 per cent farmers adopted as recommended and 16 per cent adopted less than recommended and 79.33 per cent farmers did not adopted at all.

Kumar and Dangi (2003) revealed that minimum adoption was recorded in plant protection measures and seed treatment while maximum adoption was in seed rate and spacing and harvesting and storage respectively.

Manhas *et al.* (2003) concluded that the respondents were good adopters of practices related to field preparation, irrigation management, time and method of sowing. However, they were relatively poor adopters of practices related to post harvest technology, gap filling, soil treatment and insect pest management. It was found that though respondents had adopted some of the recommended practices, however, there still existed overall adoption gap of 41.75 per cent.

Maurya (2003) revealed that the type of information ideally required for the development of IPM system are farmers perception of the problems socio-economic impact of control measures, current methods of control, socio-economic constraints on use of control measures, pest ecology and yield loss, crop and economic data etc. Farmer did not adopt full recommended package of practices besides the summer ploughing, improved and resistant varieties, field sanitation and bioagent and biopesticides. The use of extension and training aids like audio visual needs to be strengthened so those farmers could be effectively educated.

Naruka and Singh (2003) concluded that the overall technological gap in soybean production technology was 57.91 per cent. In comparative study, there was significant difference in big and small, big and marginal and small and marginal farmers. The technological gap was maximum in adoption of plant protection measures while it was minimum in sowing time.

Sharma and Sharma (2003) concluded that the overall technological gap in adoption was found to be 82.4 per cent in recommended gram production technology. Majority of the farmers had high technological gap in practices like proper use of seed rate, plant protection measures, fertilizers, seed treatment and improved varieties seed. Whereas no technological gap was observed in practices as far as irrigation schedule was concerned.

Singh (2003) concluded that majority of the respondents had adopted bajra technology to a low extent. The technology which had no or low adoption were seed treatment, doses of nitrogenous and phosphatic fertilizers, time and method of their application, plant protection measures and weedicide application.

Waman *et al.* (2003) highlighted that none of the respondent farmers used any plant protection measures in bajra i.e. 100 per cent adoption gap.

Kumar (2004) observed that maximum adoption was reported in soil and soil preparation (74.34 MPS). This was followed by the practices like time of sowing, nipping, seed rate and recommended spacing, harvesting, threshing and storage and water management. The MPS of these practices were 72.87, 72.10, 68.67, 57.99 and 52.26 respectively. Where as higher adoption gap existed among the respondents about HYV of gram (72.53 MPS), seed treatment (71.52 MPS) and soil treatment (69.01 MPS)

Saharan and Pundhir (2004) pointed out that 55.00 per cent of the beneficiary farmers of KVK adopted the plant protection practices. Where as this level of adoption among non-beneficiary farmers was 37.80 per cent.

Saxena *et al.* (2004) reported that in IPM common practices like summer ploughing and hand weeding were completely adopted by all categories of farmers. Further more, in adoption of organic farming technology farmers were facing some problems especially in preparation of tobacco decoction and use of Ha NPV/Bt, which is sprayed for control of gram caterpillar at early infestation stage.

Soni and Bhimawat (2004) revealed that nearly half of the small farmers (49%) were medium adopters, while 30 and 21 per cent of them were low and high adopters of organic farming practices in maize cultivation. Lack of technical knowledge on complex practices cost involvement and insufficient time were the major reasons which compelled more number of small farmers belonging to medium level to adopt organic farming practices.

2.5 CONSTRAINTS AS PERCEIVED BY THE RESPONDENTS

Chandra *et al.* (1996) highlighted the constraints for adoption of soybean technology in order of ranking were non-availability of improved seed, lack of technical knowledge regarding package of practices small land holding, damage to the crop by cattle, not suitable for mixed cropping etc. respectively.

Shinde *et al.* (1997) noticed that about 90 per cent of the cotton growers were unaware about intercropping cowpea or maize as trap crop. One-fifth of them also faced the constraints of non availability of delinted certified cotton seed. A great majority of the cotton growers were also lacking knowledge about the use of yellow sticking pans for controlling white fly pest on cotton as mechanical practice. The other mechanical practices such as inadequacy of labour and high wage rate were found to be constraints for 90.83 per cent of cotton growers for carrying out the work hand picking larvae, destroying affected fruiting bodies, detopping of plant and removing toasted flowers manually for want of labour.

As regards the biological control of cotton pest cent per cent respondents stated that they did not get the bio agent for seed treatment, eggs of *Chrysopa*, *Trichogramma* and HNPV for spraying on cotton crop towards the control of cotton boll worms. Similarly lack of knowledge about the use of these bio-agents for effective control of pest was found to be a major constraint for almost all of them.

In case of Chemical control, exorbitant prices of insecticides appeared to be a constraint for more than 90 per cent of cotton growers, followed by the constraint of non-availability of recommended insecticides in the market to 41.67 per cent of them. As regards the use of plant product, nearly three-fourth of the cotton growers expressed that lack of knowledge about preparation and use of 5 per cent extract of neem seed kernel against cotton boll worm and the unavailability of neem seed kernels were the constraints in adoption of IPM practices.

A lack of knowledge about the use and unavailability of pheromone traps emerged as constraints to 90 per cent cotton growers.

Chandra and Babel (1998) concluded that among all the constraints, inadequate availability of improved seed, lack of knowledge about improved seed and plant protection measures of high cost of fertilizers were major constraints in adoption of improved mungbean cultivation practices.

Singh (1998) concluded that non-availability of high yielding varieties at proper time, lack of assured irrigation, high cost of inputs and lack of credit facilities were the major constraints in adoption of improved practices of moth crop.

Sharma (1999) revealed that majority of farmers of both tribal and non-tribal areas had perceived “inadequate subsidy, high cost of constructing filter tank, high maintenance cost, clogging of well as sand is entered into the well, scheme is not suitable for fine textured soil and for leveled land, problem of maintenance of filter tank, lack of training to construct filter tank, lack of technical knowledge and proper guidance, no provision of field visit, inadequate publicity of the programme, scheme deteriorate the quality of water of the well, water table did not increase after adoption of WRP and non-cooperation of the community member” as major constraints being faced by them in effective adoption of the well recharging programme.

Constraints realized by field functionaries were lack of training provision for grass root level functionaries, negative attitude of the farmers towards WRP due to fall of rain water into well, difficulty in supervising scattered wells recharging site, high cost of construction and maintenance of filter tank, inadequate subsidy, lack of transport facilities etc.

Chitnis and Kothikhane (2000) revealed that lack of sufficient training was reported by 39 per cent of extension workers. Scientists visit to the fields where new technology is being adopted, play very important role in TOT as well as removing doubts and giving correct solutions for the field problems.

They further revealed that considering the importance of field visits by the scientists, the lack of visits of the scientist to the farmers field (13%) and lack of opportunity for direct interactions with the scientists (4%) were reported as constraints for non-adoption of IPM technology by the farmers, which in turn effects the implementation of IPM programme on the fields of farmers.

Researchers further stated that low participation of farmers in the IPM programme was the social constraint as reported by 24 per cent of the extension workers. Participation of the farmer was poor in this programme due to its non credibility (20%) was another similar constraint reported by the respondents.

Non-availability of inputs is the main reason which affect proper implementation of any programme of technology. The non-availability of inputs

namely NPV/HNPV (19%) Pheromone traps (14%) and biotic agents (12%) reported by extension workers respectively which reflected in non-adoption of IPM programme and constraints faced by the respondents for implementation of the said programme.

They further reported that minimum infrastructure facilities are essential for implementation of any new programme in a effective manner. Near about one-third of the extension workers reported a genuine constraint of non-availability of IPM laboratory at taluka level which is essential for getting solution of field problems.

Top of bottom approach of administration hinder the working and implementation of any programme in rural areas. Local needs are to be considered. Participatory approach methodology should be adopted for effective implementation which is lacking in the top to bottom approach. This was reported as one of the administrative constraint by 14 per cent of the respondents. Late communication after commencement of season or after onset of monsoon is another administrative constraint reported by 12 per cent of the extension workers.

Chaturvedi *et al.* (2000-2001) indicated that unavailability of improved seed at the time of sowing and lack of operational skill in the plant protection measures were the most important constraints faced by the IGNP farmers in adoption of improved cotton cultivation technology. Where as, high cost of seed and lack of knowledge about weedicde were expressed as the most important constraints by the non-IGNP respondents.

Badodia *et al.* (2002) highlighted the constraints experienced by the chickpea growers included lack of improved implements for the preparation of land after the harvest of *kharif* paddy, high cost of improved seeds, high cost of chemicals for seed treatment, line sowing, fertilizer and non-availability of adequate irrigation. The lack of knowledge was observed in some of the practices like varieties, seed treatment and plant protection measures (weedicides, insecticides and fungicides) were the major constraints.

Meena *et al.* (2002) pointed out that the financial constraints were perceived with highest intensity by the respondents which was followed by technical constraints, input constraints, general constraints and institutional constraints respectively with more or less similar magnitude.

Nirmala *et al.* (2002) concluded that inability to remember the quantity and method of application and no reinforcements on the technology were the constraints. In case of bio-physical dimensions, inadequacy of irrigation water at the time of application and inability to plan in advance were the constraints.

Podikunju *et al.* (2002) concluded that the major constraints faced by respondents were 'material provided during training was inadequate', 'improved variety required more fertilizer for their response lack of money to purchase required requisite', 'lack of motivation and education', 'high cost of inputs' etc.

Ramakrishnan and Sharma (2002) concluded that lack of irrigation water for successful cultivation of crops, poor supervision and monitoring of kisan mandal system by higher officials and lack of advanced knowledge possessed by agricultural supervision were perceived as most important constraint by both the category of respondents in receiving agricultural technology through kisan mandal.

Sachan and Sharma (2002) revealed regarding constraints related to plant protection measures and noted that lack of knowledge about plant protection measures and unavailability of plant protection equipments were the major constraints as these constraints received first (85.66 MPS) and second (MPS 82.33) rank respectively.

'High cost of insecticides and pesticides' (MPS 77.66 and rank third) and lack of operational skills in the use of plant protection measures' (MPS 70.66 and rank fourth) were another reasons by which farmers have not been able to use the plant protection measures.

Singh and Waris (2002) highlighted that seed treatment was not adopted due to lack of knowledge, technical guidance, high cost of fungicide and non-availability of fungicides as reported by beneficiaries 42.50, 35.00, 12.50 and 7.50 per cent respectively. Whereas the reasons for non-adoption of plant protection measures were lack of knowledge, lack of technical guidance, high cost of plant protection chemicals, high cost of plant protection equipment and lack of finance as reported by beneficiaries 52.50, 30.00, 22.50, 37.50 and 25.00 per cent respectively for till production technology.

Gupta *et al.* (2003) revealed that cent per cent of the farmers expressed non-availability of inputs in time as 'very much' problem, majority of the respondents expressed high cost of inputs and lack of finance as very much a problem. Therefore,

extension efforts must be directed to make sure availability of inputs in time and at reasonable price which an ordinary farmer can manage.

Sharma and Sharma (2003) highlighted that high cost of crucial inputs like seed, fertilizer and plant protection chemicals were the serious constraints in adoption of recommended gram technology. More than 60 per cent of farmers did not adopt seed treatment, plant protection measures and recommended level of fertilizers due to lack of knowledge about quantity and proper method of their use. Inadequate capital was also one of the main constraints in adoption of recommended technology.

Zagade *et al.* (2003) observed that high cost of pesticides was the major problem of the cashew growers. The common cashew growers can not afford to purchase the costly pesticides and plant protection equipments which ultimately results in low adoption of recommended crop protection measures. Therefore, the concerned govt. agencies will have to come forward with some practical solution such as supply of important inputs through village cooperative at subsidized rates.

Kumar (2004) indicated that irregular availability of electricity, higher cost of inputs, lack of knowledge about crop insurance and timely unavailability of technical advice were some of the important constraints expressed by the gram growers in the adoption of gram cultivation practices.

Meti (2004) observed that plant protection measures were partially adopted in cotton crop due to lack of knowledge (45.00%) and high cost of chemicals (32.91%) and lack of knowledge about pest and diseases (10.00%) as expressed by small and marginal farmers.

Prjapati and Pruthi (2004) concluded that in gram/pea/pigeonpea/lentil/moong/urad the major problems are non-availability of good seeds and fertilizers. In case of mustard and linseed major problems are inadequate seeds and fertilizers availability. In case of mustard

second major problem reported in lineed rust infection.

Saharan and Pundhir (2004) pointed out that 20 per cent of the beneficiary farmers have discontinued the technologies of chickpea given under FLDs. The reasons for discontinuance revealed that non availability of variety seeds and less resistant of the varieties to insect, pest and diseases were the two serious most constraints in the adoption of the technologies followed by the reasons like less market value of produce.

2.6 TRAINING NEEDS OF THE RESPONDENTS

Nikam *et al.* (1992) concluded that paddy cultivator's training needs mainly focus on plant protection, weed control, seed treatment, drying of paddy, marketing and storage, soil testing, water management, fertilizer, improved varieties were most essential aspects.

Prasad and Mrabyuniayam (1992) found that the training needs of farmers with regards to skill have clearly highlighted the importance of various areas in HYV of paddy cultivation.

Seema *et al.* (1992) reported that identification of tikka, root-knot and leaf minor disease, plant protection and recommended varieties were found to be top in the list of training needs area as preferred and indicated by the respondents in case of groundnut cultivation.

Urade *et al.* (1992) concluded that the respondents in water shed programme needed more of practical training on soil preparation, intercropping, insect and disease control, improved varieties, seed treatment, soil treatment, use of fertilizer and irrigation.

Khan *et al.* (1993) reported highest mean score of 2.88 for training in the area of plant protection measures against pest and diseases and improved varieties. The other training needs which the farmers perceived as most essential were use of fertilizers and manures, water management, storage, harvesting and drying of paddy respectively.

Chundawat (1997) reported that farmers need training in the area of seed treatment and use of chemical for cumin crop cultivation.

Ganesan *et al.* (1997) concluded that small rice growers needed appropriate and timely training in the major area of plant protection measures, manures and fertilizer application and seed and seed sowing.

Gholva *et al.* (1997) observed that application of fertilizers, plant protection measures, pruning and inter culture operations of mulberry were the important areas in which respondents needed training.

Raut *et al.* (1997) concluded that the training need in various areas furnished in order of priority were crop protection, irrigation, harvesting, land preparation, fertilizer application and storage which clearly indicated the relative importance and weight age assigned to the respective area.

Sharma (1997) in his study found that improved varieties, application of fertilizer, plant protection measure, harvesting and storage of cumin were the important areas in which respondents needed training.

Wankhede and Dubey (1997) found that the important areas in which farmers required training were information on subsidies for agriculture development, high yielding varieties, plant protection measures, manures and fertilizers, improved package of practices of vegetable crops.

Intodia *et al.* (1998) concluded that the training area in order of preference of farmers can be arranged as use of manures and fertilizers, plant protection measures, storage and marketing, preparation of land, soil testing, crop management, seed and sowing irrigation and water management and harvesting and threshing respectively.

Sharma *et al.* (1998) concluded that the mustard growers needed the training in the area of manure and fertilizers, pest and disease control, improved varieties, credit facilities and crop rotation with inter cropping.

Anandan and Vasanth Kumar (1999) concluded in their study on groundnut growers preference for training that training may be organized in the village which will help in participation of majority of farmers. Majority of farmers preferred training once in a year and participatory type training which will help the farmers to know the recent advance in groundnut cultivation. The training if imparted before the

crop season would help the farmers to get the recommended technologies and use them in groundnut cultivation.

Singh and Singh (1999) revealed that all categories of farmers perceived training needs in high yielding varieties and fungicidal seed treatment as most needed. Training need in plant protection measures was perceived as most needed in case of small farmers. Training in weed management and storage was perceived as needed by all the categories of farmers.

Meena and Chauhan (2002) highlighted the training needs of the beneficiaries in the areas of crop rotation and soil conservation, plant protection measures, use of manures and fertilizers in order of priority respectively.

Meghwal (2002) highlighted the training needs as perceived by trained and untrained farmers and practice-wise first rank was given to the plant protection measures by both the category of farmers.

Menaria *et al.* (2002) pointed out the training areas regarding soybean production technology in which important areas were quantity and method of manures and fertilizer application, plant protection measures, method of sowing, storage practices, seed treatment and weed control measures as perceived by the farmers.

Selvi and Vimali (2002) assessed the training needs of farm women respondents on IPM in rice on priority ranks as neem based pesticides/biopesticides, beneficial insects in pest management, ETL assessment, pest resurgence, pest surveillance, environmental issues in pest management, pesticide residual effect, use of different traps in pest management, bio-control agents, insecticidal spray fluid preparation, optimum dose of nitrogen to paddy, crop rotation and insect resistant varieties respectively.

Deshmukh *et al.* (2003) revealed that trainee respondents differed significantly over the non-trainee respondents in possession of knowledge of IPM practices and its adoption by them.

This is due to training imparted to them by KVK. Secondly, it could be concluded that there was a substantial impact of the training over the existing knowledge and adoption of the trainee respondents than the non-trainee respondents.

Raju *et al.* (2003) highlighted the training needs related to plant protection aspect of betel vine farmers were not having technical skills involved in integrated pest and disease control methods, which includes identifying the pest and disease attack symptoms, preparation of spray fluid with correct concentrations, techniques of spraying and maintenance of equipments.

Bhandarkar *et al.* (2004) indicated that based on the training needs area of lower priority may not be excluded but, more emphasis may be laid on complex items (high priority area) like plant protection measures, nursery management and knowledge about H.Y.V. of paddy. Several studies have shown that these are the complex technologies which need special attention in all the training and extension programmes it may, however, be notes that the high priority areas in case of all categories of farmers are more or less same.

Kumar (2004) indicated that soil treatment with chemicals, application of insecticides, weedicides and fungicides, operation and handling of plant protection equipments, selection of seeds, knowledge regarding various insect pest and diseases were expressed as most important areas of training by all the categories of gram growers, whereas field preparation, sowing methods and appropriate time and method of harvesting and threshing were less important training needs as perceived by the respondents.

3. MATERIAL AND METHODS

This chapter of dissertation throws light on the adopted *modus-operandi* for achieving the objectives of the present investigation. Various methods and procedures employed to study the set objectives have particularly been discussed and the detail there of incorporated herein including methods and procedures followed in selection of locale and sample. Further, the construction and standardization of research tool, method employed in collection of research data including design of research as well as statistical analysis are also discussed under this chapter.

The design and conduct of the study was developed according to the central purpose and nature of the specific objectives as outlined in the first chapter. Therefore, it was necessary to accomplish the following steps before data was presented in the study:

- 3.1 Locale of research and selection of study sample
- 3.2 Construction of research tool
- 3.3 Collection of research data
- 3.4 Measurement of variables
- 3.5 Analysis of data; and
- 3.6 Statistical measures used.

3.1 LOCALE OF RESEARCH AND SELECTION OF STUDY SAMPLE

3.1.1 Selection of Locale:

The present study was conducted purposively in Kota district of Rajasthan which comes under south-eastern humid plain zone of Rajasthan. The district lies between 24°25' and 25°51' north latitude and 75°37' and 77°26' east longitude. It is bounded on the north and north-west by Sawai Madhopur, Tonk and Bundi districts, on the west by Chittorgarh district, on the south by Jhalawar and Baran district. Kota district consists of 5 tehsils and 5 blocks. In all, there are 899 villages, out of which 814 are inhabited and 85 are uninhabited. The Chambal is the principal perennial river of the district. Canals are the major source of irrigation. The literacy rate of both male and female population of the district (74.45%) is much higher to state average. Total

geographical area of the district is 5.21 lac hectares. Average annual rainfall of the district is 732 mm. The districts possess black cotton soils which has very much agricultural production potential. The crop production is more commercial in the district since 48.00 per cent of gross cropped area is under oilseeds, 16.9 per cent under spices, 26.6 per cent under cereals and 5.9 per cent is under pulses. The cropping pattern of the district is relatively diversified with cereals, pulses, oilseed, spices, fruits and vegetables.

The reasons for selection of the Kota district for undertaking present investigation are:

- (i) During last years, the efforts of the Department of Agriculture and Krishi Vigyan Kendra has been emphasized the transfer of technology regarding integrated pest management in chickpea through various programmes including front line demonstrations, trainings, exposure visits, IPM schools and other means.
- (ii) A project on “Validation and Promotion of IPM Technology” in chickpea was carried out at ARS and KVK, Kota which was the only district in the country in which this project on chickpea was there under NATP mission mode project of ICAR. The lead centre of this project was National Centre for Integrated Pest Management (NCIPM), New Delhi.
- (iii) The ideal situation of the district are at par with other districts of Hadoti region of south eastern humid plain zone, so that by studying one district, its implications can be applied for all the district of Hadoti region i.e. Kota, Bundi, Baran and Jhalawar.
- (iv) In addition to these, the district was easily accessible where the investigation work within the limited resources at the disposal of the researcher could easily be carried out.

3.1.2 Selection of Panchayat Samities:

The development block so called panchayat samiti is the basic unit for the preparation of perspective and annual action plans, implementation of various developmental programmes and for providing feed back. Administratively, Kota district is divided into five panchayat samities *viz.*, Ladpura, Digod, Itawa, Sangod

and Kherabad. For conducting the present investigation, three panchayat samities were selected randomly namely Ladpura, Digod and Sangod.

3.1.3 Selection of Villages:

The next stage in the sampling procedure was to select the villages. For this purpose, the list of villages from the selected three panchayat samities was prepared. The villages were those where farmers were benefited through various IPM promoted schemes like IPM school, IPM demonstrations and trainings on chickpea crop. For the present investigation, five villages from each panchayat samiti were selected through random sampling technique. Thus a sample of 15 villages was drawn and included in the present research work.

3.1.4 Selection of the Respondents:

A comprehensive list of the IPM beneficiary farmers of the identified villages in chickpea was prepared village wise with the help of agriculture department and krishi vigyan kendra. Out of this list, 15 beneficiary farmers from each village were selected randomly. Thus total sample size comprised of 225 respondents for the present investigation. The table 5 gives the details about the number of respondents from each selected village.

Table 5. Selection of the respondents

| S.No. | Ladpura P.S. | | Digod P.S. | | Sangod P.S. | | Total | |
|--------------|-----------------------|-------------|------------|-------------|-------------|-------------|-----------|-------------|
| | Village | Respondents | Village | Respondents | Village | Respondents | Village | Respondents |
| 1. | Deeppura | 15 | Fatehpur | 15 | Garmodi | 15 | 3 | 45 |
| 2. | Abhaypura | 15 | Haripura | 15 | Anwa | 15 | 3 | 45 |
| 3. | Rajpura | 15 | Jakhod | 15 | Khajuri | 15 | 3 | 45 |
| 4. | Jhonpadia Abhaypur | 15 | Udपुरia | 15 | Umarhedi | 15 | 3 | 45 |
| 5. | Gandiphali | 15 | Nayagaon | 15 | Kurad | 15 | 3 | 45 |
| Total | 5 | 75 | 5 | 75 | 5 | 75 | 15 | 225 |

3.2 CONSTRUCTION OF RESEARCH TOOL

Construction of relevant research tool to achieve the objectives of the research is an important step in any scientific extension research for measuring the behavioural domain. Every research tool how reliable and valid it may not be applicable in all the situations. So, for obtaining appropriate and valid research results, it becomes very necessary to design, develop and standardize the research tool specifically for the study area and the study sample. This ensures universal results true to the reality. Standardization of research tool provides a predisposition about the type of responses to be obtained and suggests a criterion for weeding out irrelevant or non responding stimuli or to modify the stimuli according to the initial responses obtained. It also helps in curtailing and hence shortening the length of research tool/schedule and; in saving the time as well energy of the researcher during data collection.

Keeping in view the sample and objectives of the study, a suitable tool was designed and used for data collection as given below.

3.2.1 Personal Interview Schedule:

The interview schedule for the present study was specially designed by the investigator for Integrated Pest Management in chickpea cultivation. The schedule was constructed after reviewing the literature and in depth discussion with the scientists engaged in IPM on chickpea at Rajasthan College of Agriculture, Udaipur, the subject matter specialists working at Krishi Vigyan Kendra and ARS, Kota, personnel of agriculture department and other relevant resource persons were also consulted for information prior to finalization of the schedule.

Efforts were further made to include all the aspects of study, it was assured that all the aspects of crucial importance are included in the schedule designed for present investigation. The fully developed interview schedule for the present investigation was divided in to seven sections.

The first section of the schedule dealt with the personal background information of respondents. The second section was related to information input behaviour of chickpea growers. The third section was related to information processing behaviour of chickpea growers. Likewise, the fourth and fifth section dealt

with knowledge and adoption of the chickpea growers regarding Integrated Pest Management respectively.

Sixth section of the schedule was meant to study the constraints as perceived by the chickpea growers in adoption of IPM. Where as seventh section dealt with the training needs of chickpea growers regarding IPM. The detailed information of these sections are as follows:-

Section-I : Background information of the respondents

This section of the schedule dealt with the general information of the respondents pertaining to age, caste, education, size of land holding, subsidiary occupation, family type, sources of irrigation, chickpea area and other crops grown in Kharif and rabi season.

Section-II : Information input behaviour of the chickpea growers

This section was developed to assess the information input behaviour of the chickpea growers. For this purpose, all possible sources and channels for availing information were collected from available literature and discussion with the personnel having relevance with communication field. These information availing sources were grouped under three major heads i.e., personal cosmopolite, personal localite and impersonal cosmopolite sources. 16 sources were included under personal cosmopolite category, 7 sources were kept under personal localite category and 7 sources were placed under the category of impersonal cosmopolite sources for availing information relevant to IPM for chickpea cultivation.

Section-III : Information processing behaviour of chickpea growers

This section of the research tool was designed to study the information processing behaviour of chickpea growers. The literature pertaining to information processing behaviour of farmers was thoroughly studied and discussed with the chickpea growers and related personnel, and all possible modes of processing were listed.

It is necessary here to mention that information processing implies what is done to the information once it is received to take decision about its application. In all, 17 possible modes of processing for the received information were included in the schedule for the present investigation to assess the degree of information processing behaviour of the chickpea growers.

Section-IV: Knowledge of the chickpea growers regarding Integrated Pest Management

This section of the schedule was developed to know the extent of knowledge of chickpea growers regarding integrated pest management technology. A knowledge test was developed by the researcher to assess the level of knowledge of respondents.

(i) Knowledge test:

Knowledge test in this study was operationalized as a standardized situation designed to elicit a sample of individual behaviour and consists of questions or tasks presented to the subject. Kerlinger has defined test as a systematic procedure in which the individual to be tested is presented with a set of constructed stimuli to which he responds, the responses enabling the test to assign testee a numeral or set of numerals from which inferences can be made about the testee's possession of whatever the test is supposed to measure. On the basis of this criteria "knowledge test" was developed for this study. Since the standardized test to measure the knowledge of respondents about IPM in chickpea was not available, therefore, it was decided to develop the knowledge test by the investigator for this study purpose. The following procedure was followed in the development of knowledge test.

(ii) Selection of knowledge items:

The statements related to knowledge about IPM practices in chickpea cultivation were listed and put under some major aspects. The items were collected from different sources like scientific literature, bulletins, zonal recommended packages of practices, reports, journals etc. these items were further discussed with the concerned experts and scientists of IPM in chickpea project at Rajasthan college of agriculture, Udaipur and krishi vigyan kendra, Kota. The efforts were made to

ensure that no any one of practices of crucial importance are left out from the list. The criteria used for selection of item were:

- (a) Response to items should promote thinking rather than mechanical and rare memorization.
- (b) They should differentiate the well informed respondents from less informed and should have certain different value.
- (c) The items included should cover all the areas of knowledge about IPM in chickpea cultivation.

Thus, in line with the suggested criteria, 135 items under 7 major aspects were selected for construction of knowledge test after they were edited by subjecting them to expert scrutiny. The items were then framed in the interrogative form, yes/no, known/unknown, open ended etc.

(iii) Scoring procedure:

The marks were allotted to each question included in the test on the basis of equal weight. The respondents were asked to answers each of these questions and those who responded correctly were awarded marks as per weightage in the knowledge test. The detailed test instruments have been appended in appendix-I.

The major practices aspects included in the knowledge test along with the number of items in each practice were:

| S.No | IPM practices | Score/Number of items |
|-------------|--------------------------------|------------------------------|
| 1. | Conceptual frame work of IPM | 9 |
| 2. | Key pest of chickpea | 15 |
| 3. | Cultural practices | 59 |
| 4. | Mechanical practices | 12 |
| 5. | Botanical pesticidal practices | 8 |
| 6. | Biological practices | 23 |
| 7. | Chemical pesticidal practices | 9 |
| | Total | 135 |

(iv) Pre-testing:

Knowledge test so developed was pre-tested with 20 farmers (other than the study sample) so as to achieve clarity of language, coverage of subject matter and to remove the double barreled questions form the test. The knowledge test was then revised in the light of modifications/ suggestions received.

(v) Reliability of the test:

According to Kerlinger, “Reliability is the accuracy or precision of measuring instrument.” Anastasi referred reliability to the consistency of the scores obtained by the same individual when re-examined with test on different locations with different sets of equivalent items or under variable examining conditions.” To know the reliability of knowledge test developed for the study, test-retest method was used. The knowledge test was administered among the 20 farmers other than the sampled respondents. Again the test was re-examined after an interval of 15 days among the same respondents. The reliability coefficient of correlation was then calculated between the scores. This value was found to be 0.93 which reflects high reliability of the test developed.

(vi) Validity of the test:

The term validity means truth or fidelity. Lindquist (1951) defined validity of the test as accuracy with which it measures that what it is intended to measure. Validity means correct measurement. Validity of the test was assessed by following jury opinion method. Five experts were given the test so developed to get their views. High degree of uniformity in their views or opinion regarded test of high validity.

Section-V: Adoption of IPM technology by the chickpea growers

(i) Adoption Scale:

This section was developed with a view to find out the extent of adoption of IPM technology by the chickpea growers. To develop adoption scale, initially the statements related to adoption of IPM technology in chickpea cultivation were listed.

In listing of these statements, care was taken to list only those aspects in which actual adoption/action in the field is possible i.e. to ensure proper recording of responses, efforts were made to include only those practices of IPM of chickpea in which adoption can practically and really be noted. These items were further discussed with concerned experts and scientists to ensure the inclusions in the list of all important adoption practices of IPM technology for chickpea cultivation. After having an indepth discussion on the practices, they were finally structured pertaining to adoption and this section was divided into six major aspects *viz.*; key insect pests of chickpea and their monitoring, cultural practices, mechanical practices, botanical pesticidal practices, biological practices and chemical pesticidal practices. In all, 62 items formed the adoption scale.

(ii) Pre-testing:

So as to make adoption scale befitting to the study area and to make necessary modifications, the initially drafted adoption items were administered to 20 chickpea growers other than the respondents of study sample. This was done to ensure clarity of language and coverage of subject matter. The scale was modified in light of the responses obtained and suggestions were incorporated in it.

(iii) Reliability:

Reliability of the scale was measured by using test-retest method. The value of reliability coefficient came to be 0.89 which indicated high reliability of the adoption scale.

(iv) Validity:

Validity was assessed using jury opinion method. All the judges gave similar favourable opinion for the adoption items indicating their high validity.

The detailed adoption scale along with the two point continuum is appended in appendix-I (Section-V).

Section-VI: Constraints as perceived by the chickpea growers in adoption of IPM technology

This section of the schedule dealt with the identification of magnitude of constraints as perceived by the chickpea growers in adoption of IPM technology. Constraints were divided into two parts *viz.*, specific practice constraints and general constraints. All possible constraints were identified and listed with the help of available relevant literature, review and discussion with field level staff, progressive farmers of the area and the experts. Efforts were made to ensure that no crucial constraint is left out of the initially prepared list. The constraints were grouped into two major heads *viz.*, specific practice wise constraints (102 items) and general constraints (19 items). Further, specific practice wise constraints were divided into six different aspects *viz.*; constraints related to identification of pests and their monitoring (5 items), constraints related to cultural practices (42 items), constraints related to mechanical practices (18 items), constraints related to botanical pesticidal practices (7 items), constraints related to biological practices (23 items) and constraints related to chemical pesticidal practices (7 items).

The list so prepared was administered to 20 chickpea growers of the study area (other than the respondents of study sample) to make necessary modifications and for clarity of language. In light of the respondent's responses to the items, they were slightly modified. The responses were to be taken on three point continuum i.e. most severe, severe and less severe.

Section-VII: Training needs of chickpea growers regarding IPM

This section of the schedule dealt with the training needs of the chickpea growers regarding Integrated Pest Management practices. For this purpose, 32 possible areas of training needs related to IPM in chickpea were identified and listed with the help of available relevant literature, review and discussion with field level staff, experts and progressive farmers of the area. Efforts were made to ensure that no crucial area of training need is left out of the initially prepared list.

The list so prepared was administered to 20 chickpea growers of the study area (other than the respondents of study sample) to make necessary modifications and for

clarity of language. In light of the respondents' responses to the items, they were slightly modified. The responses were to be taken on three point continuum i.e. most needed, needed and less needed.

3.3 COLLECTION OF RESEARCH DATA

Keeping in mind the purpose of study and subjects included in the sample, the researcher selected personal interview method as the most appropriate and practical technique for collecting the required data. The final standardize interview schedule (Annexure-1) acted as a stimulus and was administered to the sampled farmers individually. Hindi and local dialect i.e. Hadoti was used to ask the queries and responses were recorded accordingly by the researcher himself on the spot in the field situations. The interview method of data collection was preferred over other methods of data collection because of several added advantages. The interview technique provides a situation where face to face opportunity to explain the purpose and significance of the study and to clarify points, remove doubts and uncertainties and; motivate respondents to answer questions carefully and truthfully is possible. Another advantage of this method is that there is cent per cent surety of obtaining information.

3.4 MEASUREMENT OF VARIABLES

This part of the chapter concerns with the measurement of various independent and dependent variables included in the study.

3.4.1 Measurement of independent variables:

Age, education, caste, land holding, family type etc. are the important personal characteristics indicating background information of the respondents and also referred as antecedent variables. The details of these variables with their respective measures are as under:

3.4.1.1 Age: The number of years completed by the respondents at the time of enquiry was considered as his age. On the basis of the reported age, the respondents were grouped into three categories as:

- (i) Young age - up to 35 years
- (ii) Middle age - between 36-50 years
- (iii) Old age - above 50 years.

3.4.1.2 Education: The respondents were grouped in five categories on the basis of educational standard attained by them.

- (i) Primary - Up to class 5th
- (ii) Middle - Up to class 8th
- (iii) Matriculate - Up to class 10th
- (iv) Higher secondary - Up to class 12th
- (V) Graduate - B.A./B.Sc./B.Sc.(Ag.)/B.Com.

3.4.1.3 Caste: Considering caste, the respondents were grouped as:

- (i) Scheduled caste
- (ii) Scheduled tribe
- (iii) Other backward cast
- (iv) General caste

3.4.1.4 Size of land holding: Total cultivated land irrespective of irrigated and unirrigated that a farmer possess was considered as size of land holding. On the basis of this, the respondents were categorized into three groups as:

- (i) Marginal holding - less than one hectare
- (ii) Small holding - between 1-2 hectare
- (ii) Big farmer - more than two hectares

3.4.1.5 Family type : Respondents were grouped into two categories depending upon the composition of the family i.e. joint and nuclear family.

3.4.2 Measurement of Dependent Variables:

Dependent variables are those which for their values depend upon the values of independent variables i.e., these are the presumed effect of the cause. Dependent variables in the present study are information input behaviour, information processing behaviour, knowledge, adoption, constraints and training needs. These were measured as:

3.4.2.1 Measurement of information input behaviour:

To assess the information input behaviour of the chickpea growers, a location specific tool containing various sources that could be used for availing information was developed (section-II). The items of the tool were supplemented by assigning marks. The quantification was done on the basis of given responses i.e., always, sometimes and never. The scores of 2, 1 and 0 were given to always, sometimes and never responses respectively. The information input behaviour index was calculated using the formula:

$$\text{IIB} = \frac{\text{Obtained score for a source}}{\text{Maximum obtainable score}} \times 100$$

Where IIB = Information Input Behaviour Index.

3.4.2.2 Measurement of information processing behaviour:

To find out information processing behaviour of the chickpea growers, a particular tool for the study area was developed (section-III). The particular modes of processing information and responses there from were supplemented by assigning numerals. On the basis of given responses quantification was done. The scores 2,1 and 0 were given to always, sometimes and never responses respectively. Then information processing index was calculated using formula:

$$\text{IPI} = \frac{\text{Obtained information processing score}}{\text{Maximum obtainable score}} \times 100$$

Where IPI = Information Processing Index

3.4.2.3 Measurement of knowledge:

To determine extent of existing knowledge of the chickpea growers regarding IPM practices, a suitable knowledge test was developed and standardized particularly for the present study. The items under each knowledge category were assigned marks. One mark was assigned for each correct reply and zero to incorrect reply or no reply. Therefore possible knowledge score one could obtain was 135.

The knowledge index for each respondent was calculated using formula:

$$\text{K.I.} = \frac{\text{K}}{\text{P}} \times 100$$

Where, K.I. = Knowledge Index

K = Knowledge score obtained

P = Maximum obtainable knowledge score

3.4.2.4 Measurement of adoption:

To measure the extent of adoption, an index was specifically prepared containing six important major practices of IPM in chickpea production. To convert responses of the respondents into numerical data, the adoption index so formulated was quantified. This quantification was done keeping in view responses i.e., adopted and not adopted and; scores of 1 and 0 were assigned to these responses respectively. The adoption index was calculated as:

$$\text{A.I.} = \frac{\text{A}_o}{\text{A}_{mo}} \times 100$$

Where, A.I. = Adoption Index

A_o = Adoption score obtained

A_{mo} = Maximum obtainable adoption score

3.4.2.5 Measurement of constraints:

To express the severity of bottle necks perceived by the chickpea growers in quantitative manner, the instrument so framed was assigned score on a three point continuum on the basis of seriousness of response. Accordingly, scores 3, 2 and 1 were given to the most severe, severe and less severe responses made to the constraint statements respectively by the respondents.

3.4.2.6 Measurement of training needs:

To express the training needs of the chickpea growers regarding integrated pest management in quantitative manner, the instrument so framed was assigned score on a three point continuum on the basis of degree of need response. Accordingly, scores 3, 2 and 1 were given to the most needed, needed and less needed responses made to the area of training statement respectively by the respondents.

3.4.2.7 Methodology criteria for suggesting extension strategy regarding IPM technology in chickpea:

Based on the findings of study, interaction with farmer respondents, departmental personnel and scientist experts during data collection and reviewing relevant literature, suitable extension strategy has been suggested for effective transfer of technology related to Integrated Pest Management in chickpea.

3.5 ANALYSIS OF DATA

The qualitative data gathered after conducting personal interviews with the respondents were converted into quantitative form. For this purpose, responses were transferred on telesheets, given scores assigned and converted into numerical form. Prior to applying statistical tests, their sum totals were made and tables were framed.

3.6 STATISTICAL MEASURES USED

Application of various statistical measures is the very first necessity to arrive at specific conclusions. The statistical measures used in the present study are:

3.6.1 Frequency and percentage:

Simple comparisons were made on the basis of frequency and percentage.

3.6.2 Mean score:

It was obtained from total score of each statement divided by total number of respondents.

3.6.3 Mean per cent score (MPS):

Mean per cent score was obtained by dividing total obtained score by maximum obtainable score and multiplied it by 100.

$$\text{MPS} = \frac{\text{Total obtained score}}{\text{Maximum obtainable score}} \times 100$$

3.6.4 Analysis of Variance (F-test):

Analysis of variance was applied to compare the knowledge and adoption regarding IPM practices of chickpea growers between different panchayat samities of the study area. It can be calculated as under:

3.6.4.1 Correction factor (C.F.)

$$\text{C.F.} = \frac{(\sum X)^2}{N} = \frac{(\text{Grand total})^2}{\text{Total number of respondents}}$$

3.6.4.2 Total sum of squares (T.S.S.)

$$\begin{aligned} \text{T.S.S.} &= \sum X_1^2 + \sum X_2^2 + \dots + \sum X_n^2 - \text{C.F.} \\ &= \sum X_n^2 - \text{C.F.} \end{aligned}$$

3.6.4.3 Sum of squares between panchayat samities:

$$\text{S.S. between P.S.} = \frac{(\sum X_1)^2}{n_1} + \frac{(\sum X_2)^2}{n_2} + \dots + \frac{(\sum X_n)^2}{n_n} - \text{C.F.}$$

3.6.4.4 Sum of squares (Error)

$$\text{Error S.S.} = \text{T.S.S.} - \text{S.S. between P.S.}$$

3.6.4.5 Degree of freedom:

Between panchayat samities = K-1

Total = N-1

$$\text{Error} = N - K$$

3.6.4.6 Mean sum of squares (MSS):

$$\text{M.S.S.} = \frac{\text{Sum of Squares (S.S.)}}{\text{Respective degree of freedom}} = \frac{\text{---}}{\text{d.f.}}$$

$$\text{3.6.4.7 F ratio} = \frac{\text{M.S.S.}}{\text{M.S.E.}}$$

Where, MSE is mean sum of squares due to error.

The level of significance at 5 and 1 per cent were used.

3.6.4.8 When the F value was significant, it was further tested with critical difference (minimum for a significant difference) to see the difference between the selected panchayat samities along with this C.V. was also calculated as:

$$\text{SEm} = \sqrt{\frac{\text{EMS}}{n}}$$

Where,

SEm = Standard error of mean

EMS = Mean sum of squares due to error

n = Number of respondents

$$\text{C.D.} = \text{SEm} \times \sqrt{2} \times t_{0.05} \text{ (Error d.f.)}$$

Where, C.D. = Critical Difference

Coefficient of variation (C.V.):

$$\text{C.V.} = \sqrt{\frac{\text{EMS}}{\bar{X}}} \times 100$$

Where, \bar{X} = General mean

4. RESULTS AND DISCUSSION

To make a research more scientific and sound, the results need to be presented statistically and interpreted logically. Keeping in view the objectives of the study, relevant information was collected from 225 respondents selected for study. This chapter aims to highlight the findings in the form of analysis of data, interpretation of results and their explications.

The results and their interpretations have been presented under the following heads:

- 4.1 Background information of the respondents
- 4.2 Information input behaviour of the chickpea growers
- 4.3 Information processing behaviour of the chickpea growers
- 4.4 Extent of knowledge of recommended integrated pest management practices possessed by the chickpea growers under study
- 4.5 Extent of adoption of IPM practices in chickpea cultivation by the respondents
- 4.6 Constraints as perceived by the chickpea growers in adoption of IPM practices; and
- 4.7 Training needs of the chickpea growers regarding IPM.

4.1 BACKGROUND INFORMATION OF THE RESPONDENTS

Though none of the specific objectives under the present study aimed at highlighting the background information of the respondents. However, for the sake of providing profile of the respondents, an attempt was made during the investigation to record the data regarding their antecedents. The personal characteristics of the respondents have been presented here as under:

4.1.1 Age of the respondents:

The data presented in table 6 depicts that 102 (45.33%) farmers belonged to the middle age group of 36-50 years. This was followed by 94 (41.78%) respondents who belonged to young age group i.e., 35 years while 29 (12.89%) respondents were of old age group i.e., above 50 years.

4.1.2 Caste of the respondents:

The data included in table 6 visualizes that just near to half (48.44%) of the total respondents belonged to the other backward caste, majority of them were Dhakads. Whereas, 24.89 per cent of them were scheduled tribe, 16.89 per cent were from general caste and only 9.78 per cent were from scheduled caste category.

4.1.3 Subsidiary occupation of the respondents:

The perusal of the table 6 reveals that 40 (17.78%) of the total respondents had business as their subsidiary occupation in addition to agriculture and 7.56 per cent were service class followed by of only 1.33 per cent respondents belonged to labour as subsidiary occupation.

4.1.4 Education of the respondents:

The data presented in table 6 depicts that 79 (35.11%) of the total respondents were educated up to matriculate standard followed by one-fourth (25.33%) of them educated up to middle standard, 19.11 per cent of the respondents were educated up to higher secondary standard and 12.89 per cent of them were graduates and post-graduates while only 7.56 per cent of the respondents were of primary standard. A further perusal of the table highlights that it is a matter of great satisfaction that none of the respondents was found as illiterate.

4.1.5 Land holding of the respondents:

It is evident from the table 6 that two-third of the respondents (69.77%) possessed big holdings i.e., more than 2 ha while 27.56 per cent respondent possessed small holdings i.e., 1-2 ha and only 2.67 per cent of the respondents possessed marginal holdings i.e., less than 1 ha. An overview of data indicates that majority of the respondents in the study area were big farmers.

4.1.6 Family type of the respondents:

Table 6 reveals that 57.33 per cent of the total respondents had nuclear family system whereas 42.67 per cent respondents were living in joint family system.

Table 6. Background information of the respondents**n = 225**

| S.No. | Personal characteristics | Frequency | Per cent |
|--------------|---------------------------------|------------------|-----------------|
| 1. | Age | | |
| | (i) Young (up to 35 years) | 94 | 41.78 |
| | (ii) Middle (36-50 years) | 102 | 45.33 |
| | (iii) Old (above 50 years) | 29 | 12.89 |
| 2. | Caste | | |
| | (i) Scheduled caste | 22 | 9.78 |
| | (ii) Scheduled tribe | 56 | 24.89 |
| | (iii) Other backward caste | 109 | 48.44 |
| | (iv) General caste | 38 | 16.89 |
| 3. | Subsidiary occupation | | |
| | (i) Labour | 3 | 1.33 |
| | (ii) Business | 40 | 17.78 |
| | (iii) Service | 17 | 7.56 |
| 4. | Education | | |
| | (i) Up to primary | 17 | 7.56 |
| | (ii) Middle | 57 | 25.33 |
| | (iii) Matriculate | 79 | 35.11 |
| | (iv) Higher secondary | 43 | 19.11 |
| | (v) Graduate and above | 29 | 12.89 |
| 5. | Land holding | | |
| | (i) Marginal holding | 6 | 2.67 |
| | (ii) Small holding | 62 | 27.56 |
| | (iii) Big holding | 157 | 69.77 |
| 6. | Family type | | |
| | (i) Nuclear | 129 | 57.33 |
| | (ii) Joint | 96 | 42.67 |

n = Sample size

4.2 INFORMATION INPUT BEHAVIOUR OF THE CHICKPEA GROWERS

In the present age of information, access to information is real wealth and it calls for frequent awareness and contacts with the information sources on part of the client system. For any occupation like farming, information is needed for many practices starting from the conceptualization of an idea to its final output. There are many sources from where the information is sought. In the simplest words, different sources and channels of information are used for availing information. The

behavioural pattern of chickpea growers for obtaining information relevant to integrated pest management has been operationalized as information input behaviour of the chickpea growers.

The success of any farm related technology lies in the great extent to which its ultimate users have access to the information regarding its existence, use and applicability. Without having a strong research base on utility of information sources it would be very difficult to make full utility of the information sources being properly exploited by the chickpea growers. Moreover, such an information is also directly required for speeding up the use of little used or poorly used potential sources as well as exploring the causes behind their poor performance from respondents' perspective.

Information regarding agriculture and allied activities is disseminated to farmers through many means which try to satisfy information needs of the people i.e., client system. The scientific information and its effective communication are considered to be the most important ingredients for the development of farm enterprises.

The dissemination of its information requires a series of interrelated and communicable line systems. This may help to diffuse as well as generate information and technical innovations. In this direction, many intermediary functionaries and several other types of media are working. Some of these sources are very effective as compared to others and have their own trustworthiness. An understanding of information input behaviour of the chickpea growers would help to locate the most utilized sources of information for developing a suitable approach to evolve an effective communication strategy.

4.2.1 Quantitative representation of information input behaviour of chickpea growers:

The information input behaviour of the chickpea growers has been studied under three major categories of information sources i.e., personal cosmopolite, personal localite and impersonal cosmopolite. The results have been presented in tables 7 to 10.

4.2.1.1 Personal cosmopolite sources:

A perusal of data incorporated in table 7 reveals that Agriculture Supervisor (MPS 85.56) was the prime source for getting information by the chickpea growers among the list of personal cosmopolite sources. Scientists of the KVK were second in the rank hierarchy with MPS 80.00 followed by result demonstration (MPS 65.11) and field day (MPS 54.67). However, corporate sector was the least used source with MPS 1.78 for getting IPM related information by the respondents.

Table 7. Information input behaviour of chickpea growing farmers with regards to personal cosmopolite sources

| n = 225 | | | |
|---------|---|-------|------|
| S.No. | Information sources | MPS | Rank |
| 1. | Agriculture Supervisor (VEW) | 85.56 | 1 |
| 2. | Officials of agriculture department | 52.67 | 5 |
| 3. | Scientists of KVK | 80.00 | 2 |
| 4. | Scientists of ARS | 38.44 | 12 |
| 5. | Training at village level | 50.22 | 7 |
| 6. | Training at institutional level | 51.11 | 6 |
| 7. | Method demonstration | 42.22 | 10 |
| 8. | Result demonstration | 65.11 | 3 |
| 9. | Field day | 54.67 | 4 |
| 10. | Exposure visit | 42.00 | 11 |
| 11. | Exhibition | 50.00 | 8 |
| 12. | Farmers fair | 49.56 | 9 |
| 13. | Corporate sector (CFCL, DCM, E-Chopal - Sales executives) | 1.78 | 16 |
| 14. | Personnel of cooperative society (IFFCO, GSS) | 18.67 | 14 |
| 15. | Personnel of Krishi Upaj Mandi | 2.89 | 15 |
| 16. | Telephonic consultancy | 19.11 | 13 |

MPS = Mean per cent score, n = Sample size

Other sources for getting information among personal cosmopolite were officials of agricultural department, training at institutional level, training at village level followed by exhibition, farmer's fair, method demonstration, exposure visit and scientists of ARS with the MPSs 52.67, 51.11, 50.22, 50.00, 49.56, 42.22, 42.00 and 38.44 respectively.

It was interesting to note that farmers were also getting information through telephonic consultancy (MPS 19.11) from different institutes including recently established Kisan Call Centre. Personnel of cooperative society (like IFFCO, KRIBHCO, GSS) and Krishi Upaj Mandi were also playing role in giving the farm related information as reported by the farmers with the MPS 18.67 and 2.89 respectively.

These findings are in agreement with those of Bareth and Intodia (1997-98), Punjabi *et al.* (1997-98) and Shriram and Chauhan (2002) who had reported that village level workers also known as agricultural supervisors were the main source of information for the farmers.

4.2.1.2 Personal localite sources:

Data presented in table 8 depict that among the group of personal localite sources, progressive farmers were the most widely used source with the MPS 95.56 followed by input dealers (MPS 84.89) and village leader (MPS 67.56). Relatives, friends and neighbours were almost in equally used information sources with MPS 50.44, 50.00 and 49.33 respectively. Krishak Club also known as Transfer Technology Club was ranked seventh and last in the rank hierarchy of personal localite sources with MPS 11.11 for availing information as reported by the sampled chickpea growers.

Table 8. Information input behaviour of chickpea growing farmers with regards to personal localite sources

| n = 225 | | | |
|----------------|--|------------|-------------|
| S.No. | Information sources | MPS | Rank |
| 1. | Progressive farmers | 95.56 | 1 |
| 2. | Neighbours | 49.33 | 6 |
| 3. | Friends | 50.00 | 5 |
| 4. | Relatives | 50.44 | 4 |
| 5. | Village leader (local leader/panchayat member) | 67.56 | 3 |
| 6. | Input dealers | 84.89 | 2 |
| 7. | Krishak club (Technology Transfer Club) | 11.11 | 7 |

MPS = Mean per cent score, n = Sample size

These findings are supported by Kirar *et al.* (2004) and Shriram and Chauhan (2002) who had reported that progressive farmers were the most frequently used source of information under personal localite sources. However, these findings are in contrast to those of Mahindra and Kaur (2003) who had revealed that friends and family members provided maximum awareness.

4.2.1.3 Impersonal cosmopolite sources:

A glance at the data contained in table 9 reveals that newspaper got the first rank among impersonal cosmopolite sources with MPS 84.22. It was followed by television (MPS 80.67), printed technical farm literature including folder, pamphlets, bulletins (MPS 69.33), agricultural magazines (MPS 68.89) and radio (MPS 65.33). Table further reveals that slogan and wall paining (MPS 13.11) and documentary (MPS 8.44) were least used impersonal cosmopolite sources of information among the chickpea growers of the study area.

Table 9. Information input behaviour of chickpea growing farmers with regards to impersonal cosmopolite sources

| n = 225 | | | |
|---------|--|-------|------|
| S.No. | Information sources | MPS | Rank |
| 1. | Radio | 65.33 | 5 |
| 2. | Television | 80.67 | 2 |
| 3. | Newspaper | 84.22 | 1 |
| 4. | Agriculture magazines | 68.89 | 4 |
| 5. | Printed technical farm literature (folder, pamphlet, bulletin) | 69.33 | 3 |
| 6. | Documentary/film show | 8.44 | 7 |
| 7. | Slogan and wall painting | 13.11 | 6 |

MPS = Mean per cent score, n = Sample size

These findings are in contrast to those of Nath *et al.* (2001), Pyasi *et al.* (2002) and; Singh and Mishra (2001) who had reported that radio and television were the most frequently used sources of information by the respondents. However, findings are supported by Paul (2004) and Ahmad *et al.* (2002) who had revealed that newspaper was the main source of information for the farmers.

4.2.2 Overall comparison of information input behaviour of the sampled chickpea growers:

In order to find out the overall degrees of information sources used by the sampled farmers, the scores offered by them were pooled for major information categories and have been presented in table 10.

Table 10. Overall comparison of information input behaviour of the selected chickpea growers

| | | | n = 225 |
|---------|------------------------------|-------|---------|
| S.No. | Information sources category | MPS | Rank |
| 1. | Personal cosmopolite | 44.00 | 3 |
| 2. | Personal localite | 58.41 | 1 |
| 3. | Impersonal cosmopolite | 55.71 | 2 |
| Overall | | 50.10 | |

MPS = Mean per cent score, n = Sample size

It can be visualized from the data incorporated in table 10 that personal localite sources were the most widely used information sources (MPS 58.41). These were followed by impersonal cosmopolite sources (MPS 55.71) and personal cosmopolite sources (MPS 44.00) and ranked second and third respectively in order of the hierarchy.

These findings are in line with those of Paul (2004) who had reported that personal localite sources were widely used information sources (MPS 52.96) by the respondents.

4.3 INFORMATION PROCESSING BEHAVIOUR OF THE CHICKPEA GROWERS

Taking decision about information received through different sources and channels is a creative activity that needs an atmosphere for proper mental as well as physical manipulation of the information. Today the research organizations particularly the agricultural research is facing a new challenge in the context of changing productivity as well as economic scenario. The rapid developments that have taken place in the recent years in the field of information technology have paved the way for revolutionary change in the education and new technologies have provided access to a vast volume of information. This has helped in processing of the information more competently thus, improving both quality and quantity of

production system. The transfer of technology of an innovative idea from the seat of its generation to the point of its utilization is widely dependent upon the efficiency of extension and client system. The last component is most important for modernization of the agricultural profession. This called for systematic study of information processing behaviour of the farmers. The information processing behaviour of the chickpea growers has been analysed in term of handling the information before putting it to use by the receivers for taking the decision thereby making its ultimate application. The findings manifesting the processing behaviour of the chickpea growers has been presented in the table 11.

Table 11. Information processing behaviour of the chickpea growers

n = 225

| S. No. | Mode of information processing | MPS | Rank |
|---------------|--|------------|-------------|
| 1. | Discussion with concerned chickpea farmers of the area | 88.67 | 5 |
| 2. | Judgment based on technical feasibility | 59.33 | 10 |
| 3. | Judgment based on economic feasibility | 91.11 | 4 |
| 4. | Judgment based on socio-cultural feasibility | 51.11 | 14 |
| 5. | Judgment based on past experience | 53.78 | 13 |
| 6. | Assessing through applicability of information by taking trial | 88.22 | 6 |
| 7. | Consultation with KVK scientists | 78.67 | 8 |
| 8. | Consultation with officials of agriculture department | 82.44 | 7 |
| 9. | Observe performance at other places | 56.44 | 11 |
| 10. | Consultation with input dealers | 77.11 | 9 |
| 11. | Judgment based on complexity | 54.00 | 12 |
| 12. | Judgment based on predictability perspective | 46.89 | 16 |
| 13. | Relative advantages | 98.00 | 1 |
| 14. | Acceptance of the information received as such | 12.89 | 17 |
| 15. | Acceptance with modifications | 50.67 | 15 |
| 16. | Informal discussion in group meeting | 94.00 | 2 |
| 17. | Acceptance of information if input received on free of cost | 91.78 | 3 |
| | Overall | 69.12 | |

MPS = Mean per cent score, n = Sample size

4.3.1 Quantitative presentation of information processing behaviour of the chickpea growers:

The data incorporated in table 11 indicate that majority of the respondents made judgment regarding the received information on the basis of weigh keeping with relative advantages (MPS 98.00) followed by informal discussion in group meeting (MPS 94.00), acceptance of information if input received on free of cost (MPS 91.78) and judgment based on economic feasibility (MPS 91.11). Also most of them were found to processing the information by discussion with concerned chickpea farmers of the area (MPS 88.67) followed by assessing the applicability of information by taking trials (MPS 88.22). Table further reveals that consultation with officials of agricultural department were also used more frequently (MPS 82.44) for processing the information followed by KVK scientists (MPS 78.67) and input dealers (MPS 77.11) which were accorded seventh, eighth and ninth ranks respectively by the respondents. However, judgment based on technically feasibility (MPS 59.33), observe performance at other places (MPS 56.44), judgment based on complexity (MPS 54.00), judgment based on past performance (MPS 53.78), judgment based on socio-cultural feasibility (MPS 51.11), acceptance with modifications (MPS 50.67) and judgment based on predictability perspective (MPS 46.89) were used in fair proportion by the respondents in processing the received information. It was also observed that acceptance of the information received as such was poorly practiced mode of processing the information and ranked at last i.e., seventeenth by the respondents.

These findings are supported by Kadian and Kumar (2002) and Bhimawat (2002) who had reported that respondents processed the information through informal group discussions. However, findings are in contrast with those of Jat (2003) who had reported that past success or failure of the practice was a big consideration for processing of information, and Nath *et al.* (2001) who had revealed that respondents had judged the received information by consultation with other specialists followed by technical feasibility and consultation with concerned farmers working in the field.

4.4 EXTENT OF KNOWLEDGE OF RECOMMENDED INTEGRATED PEST MANAGEMENT PRACTICES POSSESSED BY THE CHICKPEA GROWERS UNDER STUDY

In this part of the present investigation, knowledge level of the chickpea growers about recommended IPM practices was measured. Knowledge, a body of understood information possessed by an individual is one of the important components of adoption behaviour and plays an important role in the adoption of an innovation or any new idea. Even it has been considered by many researchers as a pre-requisite condition for adoption. To promote the adoption of emerging advances in agricultural technologies and to increase the level of adoption of IPM practices, the farmers must be imparted training on the aspects which they don't know or poorly know. As it has been reported in several studies that technologies not known or partly known by the respondents leads to the technological gap. Hence, it was felt incumbent to examine the existing level of knowledge of the chickpea growers regarding IPM practices.

As mentioned earlier in the chapter on methodology, a knowledge test developed and standardized for the present study was used to assess the knowledge of the chickpea growers. On the basis of that knowledge test, information obtained was translated in the form of data contained in various tables on different aspects of IPM practices *viz.*, conceptual framework of IPM, key insect pests of chickpea, cultural practices, mechanical practices, botanical pesticidal practices, biological practices and chemical pesticidal practices. The outcome of these measurements in terms of per cent farmers having knowledge of different practices of these major aspects has been presented in the tables 12 to 22.

4.4.1 Knowledge of the respondents regarding recommended practices of integrated pest management in chickpea:

Knowledge of the respondents was assessed under six major aspects of IPM in chickpea, of which, the results have been presented under the following heads:

4.4.1.1 Knowledge of the respondents regarding conceptual framework of IPM and key insect pests of chickpea:

The data incorporated in table 12 reveals that as far as the knowledge about conceptual framework of IPM is concerned, the chickpea growers possessed

maximum knowledge about the component methods to approach IPM (MPS 95.73) which got first rank in the hierarchy. This was followed by the knowledge of meaning and importance of IPM (MPS 86.37). However, it was quite discouraging that farmers had poor knowledge about the meaning of economic threshold level (ETL).

Table 12. Knowledge of the respondents regarding conceptual framework of IPM and key pests of chickpea

| | | | n = 225 |
|--------------|--|--------------|----------------|
| S.No. | IPM practices | MPS | Rank |
| A. | Conceptual framework of IPM | 83.95 | |
| 1. | Meaning and advantage of IPM | 86.37 | 2 |
| 2. | Component methods to approach IPM | 95.73 | 1 |
| 3. | Meaning of ETL | 17.78 | 3 |
| B. | Key pests of chickpea | 67.88 | |
| 1. | Insect pests and their identification | 71.78 | 2 |
| 2. | Diseases : identification and control measures | 55.75 | 3 |
| 3. | Weeds of chickpea | 98.67 | 1 |

MPS = Mean per cent score, n = Sample size

A further glance at the data included in table 12 visualizes that under the subhead of key pests of chickpea almost all the farmers possessed knowledge about the weeds of chickpea (MPS 98.67). This was followed by insect pests identification and infestation stage (MPS 71.78) and diseases identification and their control measures (MPS 55.75) which were ranked second and third in the hierarchy.

These findings are in line with those of Bhairamkar *et al.* (1998) who had reported that more than half of the beneficiaries had high knowledge about conceptual framework of IPM programme and key pests of rice.

4.4.1.2 Knowledge of the respondent regarding cultural practices of IPM in chickpea:

A perusal of the table 13 explicate that the selected chickpea growers had very rich knowledge about seed rate, spacing and time of sowing (MPS 81.56) followed by irrigation management, field sanitation and deep ploughing before crop sowing, high yielding varieties, seed treatment, crop rotation and fertilizer management with MPSs 81.44, 81.33, 80.17, 78.61, 76.44 and 76.22, respectively. On the other hand, they

were reported to have poor knowledge about intercropping and trap crops (MPS 41.44) followed by weed management (MPS 41.37) which were ranked lastly i.e., eighth and ninth in the hierarchy. The further detailed information of these mentioned components of cultural practices has been visualized in the table 14.

Table 13. Knowledge of the respondents regarding cultural practices of IPM in chickpea

| n = 225 | | | |
|----------------|--|------------|-------------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Field sanitation and deep ploughing before crop sowing | 81.33 | 3 |
| 2. | Crop rotation | 76.44 | 6 |
| 3. | High yielding varieties | 80.17 | 4 |
| 4. | Seed rate, spacing and time of sowing | 81.56 | 1 |
| 5. | Seed treatment | 78.61 | 5 |
| 6. | Intercropping and trap crops | 41.44 | 8 |
| 7. | Fertilizer management | 76.22 | 7 |
| 8. | Weed management | 41.37 | 9 |
| 9. | Irrigation management | 81.44 | 2 |

MPS = Mean per cent score, n = Sample size

These findings are in contrast with those of Singh *et al.* (2002) who had reported that 86 per cent of farmers were having low to medium knowledge about improved production technology particularly of cultural practices in chickpea.

4.4.1.3 Knowledge of the respondents regarding cultural practices (component wise) of IPM in chickpea:

A glance at the data included in table 14 regarding further details of cultural practices component wise visualizes that the farmers possessed excellent knowledge about field sanitation (MPS 98.67) as compared to deep ploughing (MPS 75.56) as far as the component of field sanitation and deep ploughing before crop sowing is concerned. A rich knowledge was noticed among farmers about crop rotation (MPS 76.44).

The table further reveals that under the component head of high yielding varieties, almost all the farmers had the knowledge about source of certified seed (MPS 99.56). A rich knowledge was also observed about germination test of seed (MPS 78.67) that was followed by names of high yielding varieties (MPS 72.00).

An observation of data in table 14 regarding seed rate, spacing and time of sowing reveals that excellent knowledge was possessed by the sampled farmers about time of sowing and seed rate with MPS 98.22 and 94.22 respectively. A fairly rich knowledge was noticed about crop geometry (MPS 63.11) but poor knowledge regarding advantages of sowing with seed cum fertilizer drill machine (MPS 37.33) was noticed.

As far as the knowledge about seed treatment is concerned, maximum knowledge was noticed regarding treatment procedure with biofertilizers (MPS 92.00) followed by advantages of biofertilizers (MPS 88.44), FIR sequence of seed treatment (MPS 87.56), seed treatment and its advantages (MPS 81.78) and name as well as doses of seed dressers (MPS 73.06). Further analysis of data about name and doses of seed dressers explicate that farmers were possessed rich knowledge regarding chemical fungicide, biofertilizers and biofungicide but poor knowledge about insecticides as seed dressers. These findings are in contrast with that of Kumar (2004) who had reported very low knowledge level of gram growers with regards to seed treatment.

A further glance at the data regarding intercropping and trap crops visualizes that rich knowledge was possessed by the respondents regarding intercropping (MPS 66.89), on the other hand, poor knowledge was noticed about trap crops (MPS 16.00) which is quite discouraging.

As far as the fertilizer management aspect is concerned, farmers possessed maximum knowledge about soil testing and recommended doses of fertilizers with MPS 98.22 and 92.89 respectively and minimum knowledge about time and method of fertilizer application (MPS 15.56).

A further perusal of data in table 14 makes it clear the knowledge regarding weed management that farmers possessed maximum knowledge about advantages of weed management (MPS 94.67) followed by methods of weeding (MPS 77.93). But fair knowledge was observed about time of weeding. On the other hand, it is quite discouraging that the respondent farmers had negligible (MPS 1.33) knowledge about name and doses of chemical weedicides. These findings are in line with that of Saxena *et al.* (2004) who had revealed that weeding was completely known by all farmers as it was common practice of IPM.

Table 14. Knowledge of the respondents regarding cultural practices (component wise) of IPM in chickpea

| | | | n = 225 |
|------------|---|-------|---------|
| S.No. | IPM practices | MPS | Rank |
| (1) | Field sanitation and deep ploughing before crop sowing | | |
| i. | Time and advantages of deep ploughing | 75.56 | 2 |
| ii. | Field sanitation | 98.67 | 1 |
| (2) | Crop rotation: Meaning and advantages | 76.44 | |
| (3) | High yielding varieties | | |
| i. | Name of high yielding varieties | 72.00 | 3 |
| ii. | Source of certified seed | 99.56 | 1 |
| iii. | Germination test of seed | 78.67 | 2 |
| (4) | Seed rate, spacing and time of sowing | | |
| i. | Seed rate | 94.22 | 2 |
| ii. | Crop geometry (RxR and PxP) | 63.11 | 3 |
| iii. | Advantages of sowing with seed cum fertilizer drill | 37.33 | 4 |
| iv. | Sowing time and its importance | 98.22 | 1 |
| (5) | Seed treatment | | |
| i. | Seed treatment and its advantages | 81.78 | 4 |
| ii. | Name and doses of seed dressers | 73.06 | 5 |
| | (i) Chemical fungicide | 98.67 | |
| | (ii) Biofungicide | 76.00 | |
| | (iii) Insecticides | 23.78 | |
| | (iv) Biofertilizer | 93.78 | |
| iii. | FIR sequence of seed treatment | 87.56 | 3 |
| iv. | Procedure for treatment with biofertilizers | 92.00 | 1 |
| v. | Advantages of biofertilizers | 88.44 | 2 |
| (6) | Intercropping and trap crops | | |
| i. | Intercropping | 66.89 | 1 |
| ii. | Trap cropping | 16.00 | 2 |
| (7) | Fertilizer management | | |
| i. | Soil testing and its advantages | 98.22 | 1 |
| ii. | Recommended doses of fertilizers | 92.89 | 2 |
| iii. | Time and method of application | 15.56 | 3 |
| (8) | Weed management | | |
| i. | Methods of weeding | 77.93 | 2 |
| ii. | Time of weeding | 53.33 | 3 |
| iii. | Name and doses of chemical weedicides | 1.33 | 4 |
| iv. | Advantages of weed management | 94.67 | 1 |
| (9) | Irrigation management | | |
| i. | Number of irrigations required | 100 | 1 |
| ii. | Critical stages of irrigation | 68.44 | 3 |
| iii. | Method of irrigation | 88.89 | 2 |

MPS = Mean per cent score, n = Sample size

A further glance at the data presented in table 14 reveals regarding knowledge of irrigation management and highlights that cent per cent farmers had knowledge about number of irrigations required for chickpea cultivation, and good knowledge was also observed about method of irrigation and critical stages of irrigation with MPS 88.89 and 68.44 respectively.

4.4.1.4 Knowledge of the respondents regarding mechanical practices of IPM in chickpea:

The data incorporated in table 15 vividly explicate that majority of the selected beneficiary farmers had knowledge about light traps (MPS 88.89) and ranked first followed by knowledge about removal and destruction of infected plant parts and eggs larval masses (MPS 82.67) and knowledge of pheromone traps (MPS 78.54) which were ranked second and third respectively in the hierarchy. Further details of indepth analysis of these aspects has been presented in the table 16.

Table 15. Knowledge of the respondents regarding mechanical practices of IPM in chickpea

| | | | n = 225 |
|--------------|---|------------|----------------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Light traps | 88.89 | 1 |
| 2. | Pheromone traps | 78.54 | 3 |
| 3. | Hand picking and destruction of infected plant parts and eggs larval masses | 82.67 | 2 |

MPS = Mean per cent score, n = Sample size

4.4.1.5 Knowledge of the respondents regarding mechanical practices (component wise) of IPM in chickpea:

It can be made vivid from data contained in table 16 that under the aspect of light traps almost all the respondents had knowledge about advantages of light traps (MPS 98.67) followed by crop stage for installation of light trap (MPS 85.33) and procedure for installation of light traps (MPS 82.67).

Further indepth analysis of data in table 16 regarding pheromone traps revealed that nearly all the respondents (MPS 94.67) had knowledge of crop stage for installation of pheromone traps followed by meaning and advantages of pheromone trap (MPS 93.78) and installation procedure of pheromone trap (MPS 93.33). They

were also found well acquainted with action system for attraction of insect pests (MPS 87.56) and number of pheromone traps required per unit area (MPS 71.11). However, it is a matter of serious concern that very poor knowledge was found (MPS 15.56) with regards to duration of lure replacement from installed pheromone traps.

As far as the knowledge about hand picking removal and destruction of egg and larval masses and its advantages is concerned it is evident from the table 16 that farmers possessed rich knowledge i.e., MPS 82.67.

Table 16. Knowledge of the respondents regarding mechanical practices (component wise) of IPM in chickpea

| | | | n = 225 |
|------------|---|-------|---------|
| S.No. | IPM practices | MPS | Rank |
| (1) | Light traps | | |
| i. | Installation stage | 85.33 | 2 |
| ii. | Installation procedure | 82.67 | 3 |
| iii. | Advantages of light traps | 98.67 | 1 |
| (2) | Pheromone traps | | |
| i. | Meaning and advantages | 93.78 | 2 |
| ii. | Crop stage for installation | 94.67 | 1 |
| iii. | Installation procedure | 93.33 | 3 |
| iv. | Number of traps required per unit area | 71.11 | 5 |
| v. | Insect pests attraction and action system | 87.56 | 4 |
| vi. | Lure replacement duration | 15.56 | 6 |
| (3) | Hand picking and destruction of infected plant parts and eggs larval masses and its advantages | 82.67 | |

MPS = Mean per cent score, n = Sample size

4.4.1.6 Knowledge of the respondents regarding botanical pesticidal practices of IPM in chickpea:

A perusal of data presented in table 17 reveals that majority of the farmers had knowledge about NSKE as a botanical pesticide (MPS 74.44). Besides, they had fairly good knowledge about crop stage for NSKE spray (MPS 59.11) and precautions to be taken for spraying NSKE (MPS 55.56) which were ranked second and third in the hierarchy. However, poor knowledge was reported by the respondents with regards to

controlling actions of NSKE (MPS 34.67). Table further reveals that extremely poor or negligible knowledge was observed regarding concentration of NSKE (MPS 0.89) and ranked last in the hierarchy of botanical pesticides.

Table 17. Knowledge of the respondents regarding botanical pesticidal practices of IPM in chickpea

| | | | n = 225 |
|-------|------------------------------------|-------|---------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Name of botanical pesticide : NSKE | 74.44 | 1 |
| 2. | Concentration of NSKE | 0.89 | 5 |
| 3. | Crop stage for NSKE spray | 59.11 | 2 |
| 4. | NSKE controlling actions | 34.67 | 4 |
| 5. | Precautions for spraying NSKE | 55.56 | 3 |

MPS = Mean per cent score, n = Sample size

These findings are in contrast to that of Deshmukh *et al.* (2003) who observed that majority of the trainees (92.00%) had knowledge about spraying of neem seed extract against bollworms under IPM.

4.4.1.7 Knowledge of the respondents regarding biological practices of IPM in chickpea:

As it is evident from the data incorporated in table 18 that the respondents were well apprised of 'T' shaped perches for providing roosting sites to different bird fauna which has been placed at the first rank in the hierarchy with MPS 78.22 by them. They possessed good knowledge pertaining to trichoderma powder as a biopesticide particularly biofungicide (MPS 60.27). On the other hand, poor knowledge was reported by the farmers with regards to HaNPV biopesticide and *B.t.* biopesticide with the MPS 42.73 and 29.33, respectively.

Table 18. Knowledge of the respondents regarding biological practices of IPM in chickpea

| | | | n = 225 |
|-------|---------------------------------|-------|---------|
| S.No. | IPM practices | MPS | Rank |
| 1. | T shaped perches | 78.22 | 1 |
| 2. | HaNPV biopesticide | 42.73 | 3 |
| 3. | <i>B.t.</i> biopesticide | 29.33 | 4 |
| 4. | Trichoderma powder biopesticide | 60.27 | 2 |

MPS = Mean per cent score, n = Sample size

These findings are almost in agreement with those of Chapke (2000) who had reported that majority of the respondents had moderate knowledge about biocontrol measures.

4.4.1.8 Knowledge of the respondents regarding biological practices (component wise) of IPM in chickpea:

It can be specified from data contained in table 19 regarding further details of component wise of biological practices that cent per cent respondents were acquainted with the beneficial bird species. Almost all the farmers also possessed the knowledge of the mechanism i.e., 'T' shaped perches used for providing roosting sites to different bird fauna (MPS 99.11). Besides, excellent knowledge was reported by the respondents with regards to height for erecting 'T' perches (MPS 88.00) and stage of the crop at which perches to be erected (MPS 85.33). Farmers were also well acquainted with stage of the crop for removal of 'T' perches and the reasons behind it with MPS 73.33. Along with this, it was also noticed that respondents possessed poor knowledge (MPS 28.44) regarding the number of 'T' perches required per unit area.

As far as the HaNPV biopesticide is concerned table 19 further reveals that farmers possessed excellent knowledge about meaning of HaNPV (MPS 84.00) followed by the time of application or crop stage for using HaNPV (MPS 76.00). Farmers were also having fair knowledge about precautions while spraying HaNPV (MPS 63.11). On the other side, poor to very poor knowledge was reported by the respondents with regards to the name of insect pests controlled through HaNPV, optimum doses for application, symptoms of visualizing its effect and time of second spray for HaNPV with MPS 33.33, 16.00, 14.22 and 10.98, respectively.

The table 19 further visualizes about *B.t.* biopesticide that poor knowledge was possessed by the respondent farmers with regards to meaning, doses for application and precautions while spraying *B.t.* with the MPS 41.33, 34.67 and 32.00 respectively and very poor knowledge about time for application of *B.t.* (MPS 9.33) was observed among the sampled farmers.

A further ransack of table 19 brings to light that majority of the farmers had knowledge about trichoderma doses for seed treatment as a biofungicide (MPS 74.67) followed by its meaning and advantages (MPS 72.67). However, they possessed only 40.67 per cent knowledge about the uses of trichoderma powder as a biopesticide.

Further indepth analysis of trichoderma uses highlights that farmers were well acquainted by seed treatment with trichoderma (MPS 80.00) but negligible acquaintance (MPS 1.33) was reported by the respondents with regards to trichoderma uses for soil application.

Table 19. Knowledge of the respondents regarding biological practices (component wise) of IPM in chickpea

| | | | n = 225 |
|--------------|---|------------|----------------|
| S.No. | IPM practices | MPS | Rank |
| (1) | 'T' shaped perches | | |
| i. | Beneficial bird species | 100 | 1 |
| ii. | Name of mechanism | 99.11 | 2 |
| iii. | Required number of 'T' shaped perches per unit area | 28.44 | 6 |
| iv. | Height of 'T' perches | 88.00 | 3 |
| v. | Crop stage for 'T' perches installation | 85.33 | 4 |
| vi. | Crop stage for removal of 'T' perches and reasons for removal | 73.33 | 5 |
| (2) | HaNPV biopesticide | | |
| i. | Meaning of HaNPV | 84.00 | 1 |
| ii. | Crop stage for using HaNPV/time of application | 76.00 | 2 |
| iii. | Time of second spray of HaNPV | 10.98 | 7 |
| iv. | Recommended doses of HaNPV | 16.00 | 5 |
| v. | Name of insect pest controlled through HaNPV | 33.33 | 4 |
| vi. | Visible symptoms of its effect on the crop | 14.22 | 6 |
| vii. | Precautions while spraying HaNPV | 63.11 | 3 |
| (3) | <i>B.t.</i> biopesticide | | |
| i. | Meaning | 41.33 | 1 |
| ii. | Time of application | 9.33 | 4 |
| iii. | Recommended doses | 34.67 | 2 |
| iv. | Precautions while spraying <i>B.t.</i> | 32.00 | 3 |
| (4) | Trichoderma powder biopesticide | | |
| i. | Meaning and advantages | 72.67 | 2 |
| ii. | Trichoderma uses: | 40.67 | 3 |
| | (i) Soil application | 1.33 | |
| | (ii) Seed treatment | 80.00 | |
| iii. | Doses for seed treatment | 74.67 | 1 |

MPS = Mean per cent score, n = Sample size

4.4.1.9 Knowledge of the respondents regarding chemical pesticidal practices of IPM in chickpea:

The data incorporated in table 20 vividly explicate that cent per cent farmer respondents were known with the precautions in using chemicals. Besides, almost all the farmers were well acquainted with the name and doses of chemicals to be used in chickpea as plant protection measures (MPS 96.00). Along with this, they had excellent knowledge regarding chemicals use as last alternative in IPM (MPS 90.67) and disadvantages of using higher doses of chemicals (MPS 86.67). But extremely poor knowledge (MPS 3.11) was noticed regarding quantity of water for preparation of insecticidal solution needed for spraying per unit area which is a quite discouraging and serious concern.

Table 20. Knowledge of the respondents regarding chemical pesticidal practices of IPM in chickpea

| n = 225 | | | |
|----------------|---|------------|-------------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Knowledge about chemical pesticide as last alternative | 90.67 | 3 |
| 2. | Name and doses of chemicals | 96.00 | 2 |
| 3. | Required quantity of water for preparation of insecticidal solution | 3.11 | 5 |
| 4. | Disadvantages of higher doses of chemicals | 86.67 | 4 |
| 5. | Precautions in using chemical pesticides | 100 | 1 |

MPS = Mean per cent score, n = Sample size

4.4.1.10 Overall knowledge of the respondents regarding various IPM practices in chickpea:

To get an overview of the overall knowledge regarding various major practices of IPM possessed by the respondents, the overall scores for each major head was summed up and results have been presented in table 21.

A perusal of data incorporated in table 21 reveals that among the major practices, respondents had excellent knowledge of chemical practices (MPS 84.94) followed by mechanical practices (MPS 81.81), conceptual framework of IPM and key pests of chickpea (MPS 73.91) and cultural practices (MPS 66.79) which were placed at 1st, 2nd, 3rd and 4th by them respectively. However, they possessed fair

knowledge regarding biological practices (MPS 55.01) but poor level of knowledge (MPS 46.28) was possessed by the chickpea growers regarding botanical pesticidal practices which is in fact very crucial practice for success of IPM in chickpea production.

Table further highlights that overall knowledge of the respondents regarding IPM practices in chickpea was found 67.38 per cent which can be considered as good level of knowledge.

This may be due to the fact that they had better education standard and they might have participated actively in the various promotional programmes related to IPM.

Table 21. Overall knowledge of the respondents regarding IPM practices in chickpea

| n = 225 | | | |
|----------------|---|------------|-------------|
| S.No. | Major IPM practices | MPS | Rank |
| 1. | Conceptual framework of IPM and key pests of chickpea | 73.91 | 3 |
| 2. | Cultural practices | 66.79 | 4 |
| 3. | Mechanical practices | 81.81 | 2 |
| 4. | Botanical pesticidal practices | 46.28 | 6 |
| 5. | Biological practices | 55.01 | 5 |
| 6. | Chemical pesticidal practices | 84.94 | 1 |
| Overall | | 67.38 | |

MPS = Mean per cent score, n = Sample size

These findings are in line with those of Saharan and Pundhir (2004) and Jat (2003) who reported that knowledge level of beneficiary farmers was 63.20 per cent and 63.07 per cent with regards to plant protection practices and overall knowledge of the farmers respectively. Further, these study are in confirmation with those of Ganesan and Seethalakshmi (2002) who revealed that majority of the respondents had high knowledge followed by medium and low level of knowledge on IPM in rice.

Further, in order to find out the significance of difference between the farmers of panchayat samities with respect to the knowledge possessed by them, analysis of variance was applied. For this purpose, the following null hypothesis was tested and results of which are presented in table 22.

H₀₁ : There is no difference between the panchayat samities' farmers with respect to knowledge of integrated pest management practices in chickpea.

Table 22. Significance of difference in the knowledge of farmers of different panchayat samities

| S. No. | Source of variation | d.f. | S.S. | M.S. | 'F' value |
|--------|------------------------------------|------|----------|----------|-----------|
| 1. | Between panchayat samities farmers | 2 | 1739.12 | 869.56 | 5.1790** |
| 2. | Error | 222 | 37273.52 | 167.8987 | |
| | Total | 224 | 39012.64 | | |

** Significant at 1 per cent level of significance

| | |
|------------|--------|
| SEm± | 0.8638 |
| CD at 5% | 2.3943 |
| C.V.% | 14.25 |
| Grand mean | 90.96 |

The calculated value of 'F' (5.1790) is greater than its tabulated value at 1 per cent level of significance, this calls for rejection of H₀₁ and leads to conclusion that there was significant difference between the panchayat samities farmers with respect to knowledge of IPM practices in chickpea.

4.5 EXTENT OF ADOPTION OF IPM PRACTICES IN CHICKPEA BY THE RESPONDENTS

Effective transfer of farm innovations and their practical application to the field situation is key to the economic development of India where the majority of population depends on agriculture and allied activities. Several programmes which are helping farmers in adoption of new technologies are in implementation throughout the country but their exploitation by the farming community has not taken place to the level considered best.

In fact, adoption, a mental process is a decision to make full use of an innovation to the best course of action available. Today, extension services in India have a large number of professional extension workers. But still there exists a wide

gulf between technology available at the research system and its ultimate adoption by the client system. In this section, an attempt has been made to know the extent of adoption of recommended IPM practices in chickpea by the respondent farmers of the study area. Adoption level of the farmers has been measured under six major aspects viz., key insect pests of chickpea and their monitoring, cultural practices, mechanical practices, botanical pesticidal practices, biological practices and chemical practices. The outcome has been presented in the subsequent tables 23 to 33.

4.5.1 Adoption of various recommended practices of IPM in chickpea by the respondents:

As earlier discussed, the adoption of various advocated practices of IPM has been assessed under six major heads. The results have been presented in these heads in the subsequent tables.

4.5.1.1 Extent of adoption regarding key insect pests of chickpea and their monitoring by the respondents:

Data presented in table 23 explicate that cent per cent of the respondents assured the identification of insect pests before using control measures. But at the time, it is quite dissatisfying that they had very poorly follow up of economic threshold level (ETL) concept before insecticidal spray (MPS 10.22) which is indeed an important practice to be followed for IPM.

Table 23. Extent of adoption by the respondents regarding identification and monitoring of key insect pests of chickpea

| | | | n = 225 |
|--------------|--|------------|----------------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Identification of insect pests before using control measures | 100 | 1 |
| 2. | Follow up of ETL concept before insecticidal spray | 10.22 | 2 |

MPS = Mean per cent score, n = Sample size

4.5.1.2 Extent of adoption of cultural practices of IPM in chickpea by the respondents:

Table 24 vividly depicts that majority of the respondents adopted recommended irrigation management practices (MPS 88.89) followed by field

sanitation and deep ploughing before crop sowing (MPS 81.33). Majority of them were also found to be adopted the practices for fertilizer management (MPS 70.14) followed by high yielding varieties (MPS 68.89) and seed treatment (MPS 63.04) which were ranked third, fourth and fifth respectively.

Further perusal of table 24 reveals that they had optimally adopted the recommended seed rate, spacing and sowing time (MPS 54.00) but low adoption level was observed in crop rotation (MPS 42.22) and weed management (MPS 41.06). On the other side, negligible adoption was found (MPS 2.67) for the cultural practices of intercropping and trap crops. Further indepth analysis of these component practices under major head of cultural practices has been discussed in the table 25.

Table 24. Extent of adoption of cultural practices of IPM in chickpea by the respondents

| n = 225 | | | |
|---------|--|-------|------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Field sanitation and deep ploughing before crop sowing | 81.33 | 2 |
| 2. | Crop rotation | 42.22 | 7 |
| 3. | High yielding varieties | 68.89 | 4 |
| 4. | Seed rate, spacing and time of sowing | 54.00 | 6 |
| 5. | Seed treatment | 63.04 | 5 |
| 6. | Intercropping and trap crops | 2.67 | 9 |
| 7. | Fertilizer management | 70.14 | 3 |
| 8. | Weed management | 41.06 | 8 |
| 9. | Irrigation management | 88.89 | 1 |

MPS = Mean per cent score, n = Sample size

These findings are in concordance with the findings of Kalaskar *et al.* (1999) and Shinde *et al.* (1997) who had reported that overwhelming majority of respondents had adopted the cultural practices.

4.5.1.3 Extent of adoption of cultural practices (component wise) of IPM in chickpea by the respondents:

A glance at the data contained in table 25 makes it vivid that almost all the respondents had adopted the practice of field sanitation i.e., to an extent of 97.33 per cent and deep ploughing before crop sowing was also adopted to an extent of 65.33 per cent. At the same time, the adoption of crop rotation was found to be 42.22 per cent.

Table 25. Extent of adoption of cultural practices (component wise) of IPM in chickpea by the respondents

| | | | n = 225 |
|--------------|---|------------|----------------|
| S.No. | IPM practices | MPS | Rank |
| (1) | Field sanitation and deep ploughing before crop sowing | | |
| i. | Field sanitation | 97.33 | 1 |
| ii. | Deep ploughing before crop sowing | 65.33 | 2 |
| (2) | Crop rotation: Follow up of crop rotation | 42.22 | |
| (3) | High yielding varieties | | |
| i. | Use of high yielding varieties | 89.78 | 1 |
| ii. | Use of certified seeds from authentic source | 84.44 | 2 |
| iii. | Seed germination test before sowing | 32.44 | 3 |
| (4) | Seed rate, spacing and time of sowing | | |
| i. | Recommended seed rate | 87.56 | 2 |
| ii. | Recommended spacing | 33.33 | 3 |
| iii. | Use of seed cum fertilizer drill for proper sowing | 0.00 | 4 |
| iv. | Timely sowing of seed | 95.11 | 1 |
| (5) | Seed treatment | | |
| i. | Seed treatment with chemical fungicides | 88.44 | 1 |
| ii. | Seed treatment with trichoderma biofungicide | 57.78 | 5 |
| iii. | Seed treatment with insecticide | 8.44 | 6 |
| iv. | Seed treatment with biofertilizers | 77.33 | 2 |
| v. | Proper method of seed treatment with biofertilizers | 76.44 | 3 |
| vi. | Follow up of FIR formula for seed treatment | 69.78 | 4 |
| (6) | Intercropping and trap crops | | |
| i. | Use of intercropping | 5.33 | 1 |
| ii. | Use of trap crops | 0.00 | 2 |
| (7) | Fertilizer management | | |
| i. | Soil testing | 70.67 | 4 |
| ii. | Use of soil testing report | 52.44 | 5 |
| iii. | Recommended doses of nitrogenous fertilizers | 97.33 | 2.5 |
| iv. | Recommended dose of phosphatic fertilizers | 97.33 | 2.5 |
| v. | Method of fertilizer application | 4.89 | 6 |
| vi. | Appropriate source/kind of fertilizers | 98.22 | 1 |
| (8) | Weed management | | |
| i. | Weeding at optimum time | 100 | 1.5 |
| ii. | Use of manual weeding | 100 | 1.5 |
| iii. | Use of mechanical method of weeding | 4.44 | 3 |
| iv. | Use of chemical method of weeding | 0.88 | 4 |
| (9) | Irrigation management | | |
| i. | Irrigation at critical stage | 93.33 | 1 |
| ii. | Appropriate method of irrigation | 84.44 | 2 |

MPS = Mean per cent score, n = Sample size

It can be observed from the table 25 regarding high yielding varieties, that majority of the respondents used high yielding varieties (MPS 89.78) followed by use of certified seed from authentic source (MPS 84.44). But only 32.44 per cent adoption was reported by the respondents for testing the seed germination.

The table further visualizes the aspect of seed rate, spacing and time of sowing and highlights that high level of adoption was seen towards timely sowing of seed (MPS 95.11) followed by recommended seed rate (MPS 87.56). At the same time, low level of adoption was found towards recommended spacing (MPS 33.33) whereas it was discouraging that none of the farmer had adopted the use of seed cum fertilizer drill machine.

As far as the extent of adoption of seed treatment is concern, the table reveals that a higher degree of adoption was observed for seed treatment with chemical fungicide (MPS 88.44) followed by seed treatment with biofertilizers (MPS 77.33), proper method of seed treatment with biofertilizers (MPS 76.44) and follow up of FIR formula for seed treatment (MPS 69.78). Seed treatment with trichoderma biofungicide was adopted to an extent of 57.78 per cent whereas, very low adoption was found in seed treatment with insecticide (MPS 8.44).

Table further highlights that very few respondents were found to be adopted intercropping (MPS 5.33) whereas none of the farmer had adopted trap crops.

As it is evident from data incorporated in table 25 that almost all the chickpea growers had adopted appropriate sources of fertilizer (MPS 98.22) followed by recommended doses of nitrogenous and phosphatic fertilizers with MPS 97.33 each. Table further visualizes that 70.67 per cent adoption level was for soil testing but 52.44 per cent adoption was found in using the soil testing report, this was due to the fact that the farmers did not get timely of the soil analysis report. Table further reveals that very low adoption (MPS 4.89) was found towards method of fertilizer application under the aspect of fertilizer management.

As far as the weed management is concerned, it is interesting that cent per cent of farmers used to weeding at optimum time with the method of manual weeding. Whereas, only a few of the respondents (MPS 4.44) used the mechanical method of weeding while negligible (MPS 0.88) adoption was found in using the chemical method of weeding.

Further, it can be observed from table 25 that majority of the respondents (MPS 93.33) irrigated the chickpea fields at critical stage of the crop followed by appropriate method of irrigation (MPS 84.44).

4.5.1.4 Extent of adoption of mechanical practices of IPM in chickpea by the respondents:

Data incorporated in table 26 reveals that optimally 50.04 per cent adoption was found for pheromone traps whereas lower adoption (MPS 27.33) was found for light traps and very low adoption was found towards hand picking, removal and destruction of infected plant parts and insect pest's eggs and larval masses (MPS 10.44). Further details of these aspects has been given in table 27.

Table 26. Extent of adoption of mechanical practices of IPM in chickpea by the respondents

| | | | n = 225 |
|--------------|--|------------|----------------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Light traps | 27.33 | 2 |
| 2. | Pheromone traps | 50.44 | 1 |
| 3. | Hand picking, removal and destruction of infected plant parts and insect pest's eggs and larval masses | 10.44 | 3 |

MPS = Mean per cent score, n = Sample size

These findings are in line with those of Kalaskar *et al.* (1999) who had reported as regards to mechanical practices particularly hand picking and destruction of larvae, clipping affected terminal shoot etc. was adopted by the respondents almost in negligible. However, these findings in contrast to the same that low adoption was found in adopting pheromone traps.

4.5.1.5 Extent of adoption of mechanical practices (component wise) of IPM in chickpea by the respondents:

Further indepth analysis of mechanical practices revealed in table 27 which depicts that farmers used light traps to an extent of only 27.55 per cent followed by 27.11 per cent adoption towards proper installation of light trap.

As far as the adoption of pheromone trap is concerned, majority of the farmers installed pheromone traps at appropriate crop stage (MPS 79.11) followed by properly

installation of pheromone trap (MPS 74.22) and used the pheromone traps in recommended number (MPS 70.22). On the other hand, low adoption was found towards proper and regular monitoring of pheromone traps in field to know EIL (MPS 14.22) followed by replacement of lure in required time (MPS 12.44).

Table 27 further reveals that only 16.00 per cent adoption was found towards removal and destruction of the infected plant parts in chickpea crop whereas only a few respondents (MPS 4.89) adopted the practice of hand picking and destruction of pest's eggs and larval masses.

Table 27. Extent of adoption of mechanical practices (component wise) of IPM in chickpea by the respondents

| | | | n = 225 |
|--------------|---|------------|----------------|
| S.No. | IPM practices | MPS | Rank |
| (1) | Light traps | | |
| i. | Use of light traps in chickpea crop | 27.55 | 1 |
| ii. | Proper installation of light trap | 27.11 | 2 |
| (2) | Pheromone traps | | |
| i. | Installation of pheromone traps at appropriate crop stage | 79.11 | 1 |
| ii. | Proper method of pheromone trap installation | 74.22 | 2 |
| iii. | Use of recommended number of pheromone traps | 70.22 | 3 |
| iv. | Proper and regular monitoring of pheromone traps in fields to know EIL | 14.22 | 4 |
| v. | Replacement of lure (septa) in required time | 12.44 | 5 |
| (3) | Hand picking, removal and destruction of infected plant parts and insect pest's eggs and larval masses | | |
| i. | Hand picking and destruction of pest's eggs and larvae | 4.89 | 2 |
| ii. | Removal and destruction of the infected plant parts from chickpea crop | 16.00 | 1 |

MPS = Mean per cent score, n = Sample size

4.5.1.6 Extent of adoption of botanical pesticidal practices of IPM in chickpea by the respondents:

A perusal of data presented in table 28 reveals that farmers used neem based botanical pesticides at appropriate crop stage to an extent of 29.33 per cent only followed by spraying of NSKE in recommended dose (MPS 28.44) and spraying neem based solution in evening hours was adopted to an extent of only 24.00 by the respondents. Thus the table visualizes lower adoption of botanical pesticides.

Table 28. Extent of adoption of botanical pesticidal practices of IPM in chickpea by the respondents

| n = 225 | | | |
|---------|--|-------|------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Use of neem based solution at appropriate crop stage and ETL | 29.33 | 1 |
| 2. | Spraying of NSKE in recommended doses | 28.44 | 2 |
| 3. | Spraying neem based solution in evening hours | 24.00 | 3 |

MPS = Mean per cent score, n = Sample size

These findings are in contrast with those of Kalaskar *et al.* (1999) who revealed that majority of the respondents adopted the spraying of neem seed extract. However, the findings are supported by Shinde *et al.* (1997) who had reported that use of plant product which is an important aspect of IPM was found to be meagre among the cotton growers.

4.5.1.7 Extent of adoption of biological practices of IPM in chickpea by the respondents:

A perusal of data in table 29 makes it vivid that 66.67 per cent adoption level was found towards 'T' shaped perches and ranked first in the hierarchy of biological practices. Whereas, lower adoption was found towards trichoderma biofungicide as a biopesticide (MPS 29.78) followed by HaNPV biopesticide (MPS 25.68). Table further reveals that negligible adoption level (MPS 2.67) was found toward *B.t.* biopesticide. In short, it can be concluded that biological practices were adopted in lower level. The further details of these components of biological aspects has been given in table 30.

Table 29. Extent of adoption of biological practices of IPM in chickpea by the respondents

| n = 225 | | | |
|----------------|---------------------------------|------------|-------------|
| S.No. | IPM practices | MPS | Rank |
| 1. | 'T' shaped perches | 66.67 | 1 |
| 2. | HaNPV biopesticide | 25.68 | 3 |
| 3. | <i>B.t.</i> biopesticide | 2.67 | 4 |
| 4. | Trichoderma powder biopesticide | 29.78 | 2 |

MPS = Mean per cent score, n = Sample size

These findings are in line with those of Chapke (2000) who had reported that overall moderate adoption level was found about biocontrol measures. However, the findings are not in agreement with those of Kalaskar *et al.* (1999) who revealed that very low adoption was found in biological practices.

4.5.1.8 Extent of adoption of biological practices (component wise) of IPM in chickpea by the respondents:

Data incorporated in table 30 makes further indepth analysis of biological practices and reveals that majority of the respondents used 'T' shaped perches mechanism for providing roosting sites to different bird fauna (MPS 83.11) followed by erection of these 'T' shaped perches at appropriate crop stage (MPS 77.78) and removal of 'T' perches at grain ripening stage (MPS 64.00) but lower adoption was found towards using the appropriate number of 'T' perches (MPS 41.78).

As far as the HaNPV biopesticide is concerned, the lower adoption was found towards spray of HaNPV at appropriate crop stage (MPS 42.22) followed by recommended dose of HaNPV (MPS 40.00) and spraying of HaNPV at evening time (MPS 34.67). Whereas, very low adoption was found in observing the symptoms of HaNPV on larval population of *Helicoverpa armigera* (MPS 10.67) and negligible adoption (MPS 0.89) was found towards second spray of HaNPV at 15-20 days after first spray.

Table 30 further highlights that negligible adoption was found towards all the aspects related to *B.t.* biopesticide.

Table further visualizes that fairly good i.e., 58.22 per cent adoption was found towards the use of trichoderma biofungicide for seed treatment whereas negligible (MPS 1.33) adoption was found towards the use of trichoderma as soil application.

Table 30. Extent of adoption of biological practices (component wise) of IPM in chickpea by the respondents

| | | | n = 225 |
|--------------|---|------------|----------------|
| S.No. | IPM practices | MPS | Rank |
| (1) | 'T' shaped perches | | |
| i. | Use of 'T' perches for providing roosting sites to different bird fauna in chickpea field | 83.11 | 1 |
| ii. | Use of appropriate number of 'T' perches | 41.78 | 4 |
| iii. | Erection of 'T' perches at appropriate crop stage | 77.78 | 2 |
| iv. | Removal of 'T' perches at grain ripening stage | 64.00 | 3 |
| (2) | HaNPV biopesticide | | |
| i. | Spray of HaNPV at appropriate crop stage | 42.22 | 1 |
| ii. | Use of recommended doses of HaNPV | 40.22 | 2 |
| iii. | Spraying of HaNPV at evening time | 34.67 | 3 |
| iv. | Observation of symptoms of HaNPV on larval population of <i>Helicoverpa armigera</i> | 10.67 | 4 |
| v. | Second spray of HaNPV at 15-20 days after first spray | 0.89 | 5 |
| (3) | B.t. biopesticide | | |
| i. | Spraying of <i>B.t.</i> at appropriate crop stage | 2.67 | 2 |
| ii. | Application of <i>B.t.</i> in recommended dose | 3.11 | 1 |
| iii. | Spraying of <i>B.t.</i> at evening time | 2.22 | 3 |
| (4) | Trichoderma powder : biopesticide | | |
| i. | Use of trichoderma for soil application | 1.33 | 2 |
| ii. | Use of trichoderma for seed treatment | 58.22 | 1 |

MPS = Mean per cent score, n = Sample size

4.5.1.9 Extent of adoption of chemical practices of IPM in chickpea by the respondents:

Data incorporated in table 31 reveals that all the respondent farmers were using recommended doses of chemical pesticides for spraying purpose and ranked first in the hierarchy. Further, majority of farmers was applying chemical pesticides at appropriate crop stage (MPS 83.11). Whereas, lower adoption was found towards the

application of chemical pesticides only after when all other control measures have adopted and insect pest population possess ETL (MPS 31.11). However, very few respondents were found applying of required quantity of water for preparation of insecticidal solution needed per unit area (MPS 3.11). In all, fair adoption level was found towards chemical practices.

Table 31. Extent of adoption of chemical pesticidal practices of IPM in chickpea by the respondents

| | | | n = 225 |
|-------|--|-------|---------|
| S.No. | IPM practices | MPS | Rank |
| 1. | Application of chemical pesticides at appropriate crop stage | 83.11 | 2 |
| 2. | Spraying of chemical pesticides in recommended doses | 100 | 1 |
| 3. | Application of required quantity of water for preparation of insecticidal solution per unit area | 3.11 | 4 |
| 4. | Application of chemical pesticides only after when all other control measures have adopted and insect pests population possess ETL | 31.11 | 3 |

MPS = Mean per cent score, n = Sample size

These findings are in agreement with those of Shinde *et al.* (1997) and Kalaskar *et al.* (1999) who had revealed that majority of the respondents had followed and adopted the recommended spraying of insecticides.

4.5.1.10 Overall adoption of IPM practices in chickpea by the respondents:

To sum up the scores of all the major aspects of adoption, the scores for the practices selected under each major aspect were added and have been presented in table 32.

The data presented in table 32 reveals that among the various practices selected for studying their adoption, maximum adoption was found for the cultural practices (MPS 60.37) and ranked first in the hierarchy of the IPM practices. It was followed by adoption regarding key pests of chickpea and their monitoring (MPS 55.11) and chemical pesticidal practices (MPS 54.33) and ranked second and third respectively. However, below average adoption was found for mechanical practices

(MPS 35.65) followed by biological practices (MPS 33.05) and botanical pesticidal practices (MPS 27.26) which got fourth, fifth and sixth ranks respectively.

The table further highlights that overall adoption level of the respondents regarding IPM practices in chickpea production was found 48.43 per cent which can be considered as fair level of adoption.

Table 32. Overall adoption of IPM practices in chickpea by the respondents
n = 225

| S.No. | Major IPM practices | MPS | Rank |
|-------|---|-------|------|
| 1. | Identification of key insect pests of chickpea and their monitoring | 55.11 | 2 |
| 2. | Cultural practices | 60.37 | 1 |
| 3. | Mechanical practices | 35.65 | 4 |
| 4. | Botanical pesticidal practices | 27.26 | 6 |
| 5. | Biological practices | 33.05 | 5 |
| 6. | Chemical pesticidal practices | 54.33 | 3 |
| | Overall | 48.43 | |

MPS = Mean per cent score, n = Sample size

These findings are in concordance with Shinde *et al.* (1997) who had revealed that majority of the cotton growers did not adopt the mechanical, botanical and biological practices of IPM programme whereas, overwhelming majority of the cotton growers adopted cultural practices and chemical practices of IPM.

Further, in order to find out the significance of difference between the farmers of panchayat samities with respect to the adoption possessed by them, analysis of variance was applied. For this purpose, the following null hypothesis was tested and results of which are presented in table 33.

H₀₂ : There is no difference between the panchayat samities' farmers with respect to adoption of IPM practices in chickpea.

Table 33. Significance of difference in the adoption of farmers of different panchayat samities

| S. No. | Source of variation | d.f. | S.S. | M.S. | 'F' value |
|--------|------------------------------------|------|------------|----------|-----------|
| 1. | Between panchayat samities farmers | 2 | 1193.1289 | 596.5645 | 11.9639** |
| 2. | Error | 222 | 11069.6533 | 49.8633 | |
| | Total | 224 | 12262.7822 | | |

** Significant at 1 per cent level of significance

| | |
|------------|--------|
| SEm± | 0.4707 |
| CD at 5% | 1.3047 |
| C.V.% | 23.51 |
| Grand mean | 30.03 |

The calculated value of 'F' (11.9639) is greater than its tabulated value at 1 per cent level of significance, this calls for rejection of H_0 and leads to conclusion that there was significant difference between the panchayat samities farmers with respect to adoption of IPM practices in chickpea.

4.6 CONSTRAINTS AS PERCEIVED BY THE CHICKPEA GROWERS IN ADOPTION OF IPM PRACTICES

There is no dearth of proven and improved technologies now-a-days and a number of sophisticated technologies have been introduced to boost up the IPM technology. Despite intensive efforts made by different agencies, still there is a wide disparity between the available technologies and technologies being used in farming sector. The most significantly contributing causes of this disparity are the constraints perceived by the farmers which affect the effective dissemination and utilization of IPM technologies.

The constraints which hamper the adoption of recommended IPM practices by the chickpea growers of the study area were critically analysed in this section. In the present context, the term constraint means all those barriers or barricades, both material and non-material which came in the way of chickpea growers while adopting the IPM practices. It is needless to mention that the pace of adoption can be augmented by overcoming the perceived constraints. So it was felt incumbent to find out the constraints as perceived by the respondents in adoption of IPM practices in chickpea cultivation. The constraints with their degree of effect have been presented

under seven heads namely constraints related to identification of pests and their monitoring through ETL, constraints related to cultural practices, constraints related to mechanical practices, constraints related to botanical pesticidal practices, constraints related to biological practices, constraints related to chemical practices and general constraints. The results are presented in the subsequent tables 34 to 44. Further, all the constraints were categorized into two i.e., specific IPM practices wise constraints and general constraints. Tables from 34 to 42 visualizes specific IPM technology constraints and table 43 highlights the general constraints perceived by the respondents in adoption of IPM practices.

4.6.1 Degree of constraints perceived by the respondents:

Various constraints with their respective intensities have been presented under the following heads:

4.6.1.1 Constraints perceived by the respondents regarding identification of pests and their monitoring through ETL:

As it is evident from the data incorporated in table 34 that lack of technical guidance regarding ETL assessment was the most severe constraint encountered by majority of the respondents (MPS 95.56). Besides, lack of knowledge about pests life cycle and their infestation stages (MPS 89.93) and improper monitoring of fields for pest surveillance (MPS 65.04) were the other serious constraints faced by chickpea growers which were assigned second and third rank in the hierarchy respectively. Lack of skill was another serious constraint hampering to an extent of 54.67 per cent followed by ignorance (MPS 42.22) due to laziness or other factors.

Table 34. Constraints perceived by the chickpea growers regarding identification of pests and their monitoring through ETL

| n = 225 | | | |
|----------------|---|------------|-------------|
| S.No. | Constraint | MPS | Rank |
| 1. | Lack of knowledge about pests life cycle and their infestation stages | 89.93 | 2 |
| 2. | Lack of technical guidance regarding ETL assessment | 95.56 | 1 |
| 3. | Lack of skill | 54.67 | 4 |
| 4. | Improper monitoring of fields for pest surveillance | 65.04 | 3 |
| 5. | Ignorance | 42.22 | 5 |

MPS = Mean per cent score, n = Sample size

These findings are in line with those of Kalaskar *et al.* (1999) who had revealed that the technology involving more technical knowledge and skill was found to be adopted in lesser proportion of the respondents.

4.6.1.2 Constraints perceived by the chickpea growers regarding cultural practices of IPM:

Data incorporated in table 35 divulge the summary of the constraints related to various practices under cultural method of IPM which shows that majority of the respondents were confronted with constraints related to seed rate, spacing and time of sowing (MPS 71.38) followed by intercropping and trap cropping (MPS 70.12), crop rotation (MPS 65.88) and fertilizer management (MPS 60.89) which were ranked first, second, third and fourth respectively in the hierarchy. The other constraints in descending order of their magnitude were related to high yielding varieties (MPS 51.73), field sanitation and deep ploughing (MPS 50.11), irrigation management (MPS 48.59), seed treatment (MPS 47.48) and weed management (MPS 44.89). Further indepth analysis of the constraints component wise has been given in table 36.

Table 35. Constraints perceived by chickpea growers regarding cultural practices of IPM

| | | | n = 225 |
|--------------|--|------------|----------------|
| S.No. | Component constraints | MPS | Rank |
| 1. | Field sanitation and deep ploughing before crop sowing | 50.11 | 6 |
| 2. | Crop rotation | 65.88 | 3 |
| 3. | High yielding varieties | 51.73 | 5 |
| 4. | Seed rate, spacing and time of sowing | 71.38 | 1 |
| 5. | Seed treatment | 47.48 | 8 |
| 6. | Intercropping and trap crops | 70.12 | 2 |
| 7. | Fertilizer management | 60.89 | 4 |
| 8. | Weed management | 44.89 | 9 |
| 9. | Irrigation management | 48.59 | 7 |

MPS = Mean per cent score, n = Sample size

4.6.1.3 Constraints perceived by the respondents in adoption of cultural practices (component wise) of IPM in chickpea:

Data presented in table 36 shows that majority of the respondents were confronted with the problem of non-availability of suitable implements for deep ploughing (MPS 73.33) followed by costly operation of deep ploughing due to dependency on hire basis tractor (MPS 53.04). The minimum felt constraints were laziness (MPS 38.67) and lack of knowledge (MPS 35.41) under the component of field sanitation and deep ploughing before crop sowing.

As far as the constraints related to crop rotation are concerned, the severe constraints confronted was follow up of crop rotation depends on the irrigation water availability (MPS 88.44) followed by preference towards lead crop of the area (MPS 73.19). Whereas, lack of knowledge was less severe (MPS 36.00) constraint in adopting crop rotation as reported by the respondents.

Further examination of data in table 36 reveals that under the aspect of high yielding varieties, maximum confronted constraints were high cost of seed (MPS 65.33) followed by the respondents view that high yielding varieties seeds are not bold in size which fetches low prices from the market (MPS 53.48) and lack of money (MPS 50.96). The minimum felt constraints were lack of knowledge (MPS 44.59) and unavailability of seed at local level (MPS 44.30).

The table 36 further highlights the constraints related to seed rate, spacing and time of sowing that most severe constraints were non-availability of seed cum fertilizer drill machine (MPS 98.22), high initial cost for purchasing seed cum fertilizer drill (MPS 94.96), laziness in adjustment of available seed drill (MPS 86.37) related to seed rate and spacing. The severe constraints related to time of sowing were that oftenly chickpea was sown only after soybean or other kharif crop resulting into delayed sowing (MPS 80.89) and optimum time of sowing depends on the availability of canal water for irrigation (MPS 74.22). The other less severe related constraints were lack of knowledge and skill in doing germination test of owned seed (MPS 56.44), lack of knowledge about seed rate and spacing (MPS 44.89) and lack of confidence in recommended seed rate and spacing (MPS 35.11).

As far as the constraints related to seed treatment are concerned, it is clear from the table 36 that two major constraints felt by respondents and they were as seed

treatment with biofertilizer is labour intensive and time consuming (MPS 64.00) therefore, farmers ignored it. Another major constraint was lack of technical guidance (MPS 57.93). Besides, other minor felt constraints were lack of operational skills in treating seeds (MPS 48.59), lack of knowledge (MPS 44.74), supply of spurious seed dressers resulted into lack of confidence in seed treatment (MPS 41.78), non-availability of seed dressers at local level (MPS 40.44) and high cost of seed dresser pesticides (MPS 39.26).

Further perusal of table 36 reveals the constraints related to intercropping and trap crops that major problem confronted by farmers was additional and cumbersome work due to difference in sowing and maturity period from sole crop which create problems in harvesting in mechanization era (MPS 90.22) followed by lack of interest (MPS 64.00) and lack of knowledge (MPS 56.15).

Further observation of the table visualizes the constraints related to fertilizer management that majority of the respondents faced the problem of non-availability of seed cum fertilizer drill (MPS 91.11) followed by lack of technical guidance about method of application (MPS 68.15). Less severe felt constraints were lack of knowledge about need of only starter dose in chickpea being pulse crop (MPS 58.22), lacking use of soil test and its reports for balance fertilizer management (MPS 44.44) and lack of credit facilities on marginal rate of interest (MPS 42.52).

Further examination of data in table 36 reveals the constraints related to weed management that except one major problem of high cost of weedicides increases cost of production (MPS 65.63) other constraints were minor which includes lack of technical guidance, lack of operational skills in chemical weedicides, labour problems at the time of weeding and non-availability of weedicides at local level with MPS 43.85, 41.63, 38.22 and 35.11 respectively.

Table 36 further visualizes that no any serious constraint was confronted by the respondents related to irrigation management. However, to some extent the problem of lack of assured irrigation facilities (MPS 52.59) pointed out followed by non-availability of irrigation water at critical crop stage resulting into no irrigation management (MPS 44.59) by the farmers.

Table 36. Constraints (component wise) perceived by respondents in adoption of cultural practices of IPM in chickpea

| | | n = 225 | |
|--------------|---|----------------|-------------|
| S.No. | Component constraints | MPS | Rank |
| (1) | Field sanitation and deep ploughing before crop sowing | | |
| i. | Non-availability of suitable implements | 73.33 | 1 |
| ii. | Lack of knowledge | 35.41 | 4 |
| iii. | Laziness | 38.67 | 3 |
| iv. | Costly due to dependency on hire basis tractor | 53.04 | 2 |
| (2) | Crop rotation | | |
| i. | Lack of knowledge | 36.00 | 3 |
| ii. | Preference towards lead crop of the area because no other alternative as profitable | 73.19 | 2 |
| iii. | Follow up of crop rotation depends on the irrigation water availability | 88.44 | 1 |
| (3) | High yielding varieties | | |
| i. | Lack of knowledge | 44.59 | 4 |
| ii. | Unavailability of seed at local level | 44.30 | 5 |
| iii. | High cost of seed | 65.33 | 1 |
| iv. | Lack of money | 50.96 | 3 |
| v. | HYV seeds are not bold seeded which fetches low prices in the market | 53.48 | 2 |
| (4) | Seed rate, spacing and time of sowing | | |
| i. | Lack of knowledge about recommended seed rate and spacing | 44.89 | 7 |
| ii. | Lack of confidence in recommended seed rate and spacing | 35.11 | 8 |
| iii. | Lack of knowledge and skill in doing germination test of owned seed | 56.44 | 6 |
| iv. | Non-availability of seed cum fertilizer drill | 98.22 | 1 |
| v. | Laziness in adjustment of available seed drill | 86.37 | 3 |
| vi. | High initial cost in purchasing seed cum fertilizer drill | 94.96 | 2 |
| vii. | Oftenly chickpea is used to sow only after soybean or other kharif crop resulting into delayed sowing | 80.89 | 4 |
| viii. | Optimum time of sowing depends on the availability of canal water for irrigation | 74.22 | 5 |
| (5) | Seed treatment | | |
| i. | Lack of knowledge | 44.74 | 4 |
| ii. | Lack of technical guidance | 57.93 | 2 |
| iii. | Lack of operational skills in treating seeds | 48.59 | 3 |
| iv. | Locally non-availability of pesticides and biofertilizers used for seed treatment | 40.44 | 6 |
| v. | High cost of seed dresser pesticides | 39.26 | 7 |
| vi. | Supply of spurious seed dressers resulting into lack of confidence in seed treatment | 41.78 | 5 |
| vii. | Seed treatment with biofertilizers is labour intensive and time consuming | 64.00 | 1 |

| S.No. | Component constraints | MPS | Rank |
|------------|---|-------|------|
| (6) | Intercropping and trap cropping | | |
| i. | Lack of knowledge | 56.15 | 3 |
| ii. | Lack of interest | 64.00 | 2 |
| iii. | Additional and cumbersome work due to difference in sowing and maturity period from sole crop which creates problems in harvesting in mechanization era | 90.22 | 1 |
| (7) | Fertilizer management: | | |
| i. | Lack of knowledge about need of only starter dose in chickpea being a pulse crop | 58.22 | 3 |
| ii. | Lack of technical guidance about method of application | 68.15 | 2 |
| iii. | Lacking soil testing and use of its reports for balance fertilizer management | 44.44 | 4 |
| iv. | Lack of credit facilities on marginal rate of interest | 42.52 | 5 |
| v. | Non-availability of seed cum fertilizer drill | 91.11 | 1 |
| (8) | Weed management | | |
| i. | Lack of technical guidance | 43.85 | 2 |
| ii. | Lack of operational skills in chemical weedicides | 41.63 | 3 |
| iii. | Non-availability of weedicides at local level | 35.11 | 5 |
| iv. | High cost of weedicides increases cost of production | 65.63 | 1 |
| v. | Labour problem at the time of weeding | 38.22 | 4 |
| (9) | Irrigation management | | |
| i. | Lack of assured irrigation facilities | 52.59 | 1 |
| ii. | Non-availability of irrigation water at critical crop stage resulting into no irrigation management | 44.59 | 2 |

MPS = Mean per cent score, n = Sample size

These findings are in contradiction with those of Shinde *et al.* (1997) who had revealed major constraints regarding cultural practices that deep ploughing makes the soil more loose, lack of knowledge about intercropping and trap cropping, non-availability of quality seed. However, the findings are supported by those of Badodia *et al.* (2002) who highlighted the constraints experiences by the chickpea growers included lack of improved implements for land preparation, high cost of improved seeds etc.

4.6.1.4 Constraints perceived by the respondents in adoption of mechanical practices of IPM in chickpea:

A perusal of table 37 makes it clear that almost equally extent problems were faced by the farmers in all the components of mechanical practices i.e., hand picking, removal and destruction of infected plant parts and pest's eggs and larval masses (MPS 69.39) followed by light traps (MPS 64.12) and pheromone traps (MPS 60.97)

and ranked first, second and third respectively in order of hierarchy. Further indepth analysis of these component practices related to constraints has been given in the subsequent table 38.

Table 37. Constraints perceived by respondents in adoption of mechanical practices of IPM in chickpea

| | | | n = 225 |
|--------------|---|------------|----------------|
| S.No. | Component constraints | MPS | Rank |
| 1. | Light traps | 64.12 | 2 |
| 2. | Pheromone traps | 60.97 | 3 |
| 3. | Hand picking and destruction of infected plant parts and pest's eggs, larval masses | 69.39 | 1 |

MPS = Mean per cent score, n = Sample size

4.6.1.5 Constraints perceived by the respondents in adoption of mechanical practices (component wise) of IPM in chickpea:

An overview of the table 38 depicts that most severe constraints confronted by respondents related to adoption of light traps were additional botheration work (MPS 95.85), non-availability of electricity at fields (MPS 89.33) and high cost (MPS 68.44). Whereas, less severe constraints were poor quality, lack of operational skills and lack of knowledge with the MPS 54.51, 39.70 and 36.88 respectively.

Further perusal of table 38 makes it clear that severe problems in adoption of pheromone traps as perceived by the respondents were lack of technical guidance in monitoring for economic injury level (MPS 85.04) followed by non-availability of pheromone traps and lures in local market (MPS 78.67), time consuming and labour intensive work (MPS 65.04) and that farmers feels botheration work as he is interested in spraying insecticides which shows visible effects rather than pheromone traps (MPS 63.70). Other less severe constraints were high cost (MPS 53.93), lack of skill about its application (MPS 43.41) and lack of knowledge about its use (MPS 37.04).

As far as the constraints related to hand picking, removal and destruction of infected plant parts and pest's eggs and larval masses are concerned, respondents felt severe constraints and that were in descending order as cumbersome work (MPS 92.00) followed by non proper monitoring of fields (MPS 69.19), collection of larvae is labour intensive, time consuming and increase cost of production (MPS 66.81),

difficulty in finding out the eggs of pod borer (MPS 60.30) and lack of knowledge in identification of pest's eggs (MPS 58.67).

Table 38. Constraints (component wise) perceived by respondents in adoption of mechanical practices of IPM in chickpea

| | | | n = 225 |
|--------------|---|------------|----------------|
| S.No. | Constraints | MPS | Rank |
| (1) | Light traps | | |
| i. | Lack of knowledge | 36.88 | 6 |
| ii. | High cost | 68.44 | 3 |
| iii. | Poor quality | 54.51 | 4 |
| iv. | Lack of operational skills | 39.70 | 5 |
| v. | Non-availability of electricity at fields | 89.33 | 2 |
| vi. | Additional botheration work | 95.85 | 1 |
| (2) | Pheromone traps | | |
| i. | Lack of knowledge about its use | 37.04 | 7 |
| ii. | Lack of technical guidance in monitoring for economic injury level | 85.04 | 1 |
| iii. | Lack of skill about its application | 43.41 | 6 |
| iv. | Non-availability of pheromone traps and lures of pod borer in local market | 78.67 | 2 |
| v. | Cost is high | 53.93 | 5 |
| vi. | Time consuming and labour intensive work | 65.04 | 3 |
| vii. | Farmer feels botheration work as he is interested in spraying insecticides which shows quick visible effects rather than pheromone trap | 63.70 | 4 |
| (3) | Hand picking removal and destruction of infected plant parts and pest's eggs and larval masses | | |
| i. | Collection of larvae is labour intensive and time consuming job and increases cost of production | 66.81 | 3 |
| ii. | Lack of knowledge in identification of pest's eggs | 58.67 | 5 |
| iii. | Difficulty in finding out the eggs of pod borer | 60.30 | 4 |
| iv. | Not proper monitoring of fields | 69.19 | 2 |
| v. | Cumbersome work | 92.00 | 1 |

MPS = Mean per cent score, n = Sample size

These findings are supported by Chitnis and Kothikhane (2000) who revealed that non-availability of inputs like pheromone traps reflected non-adoption of IPM programme. The findings are also supported by Shinde *et al.* (1997) who had reported that high wage rate and inadequacy of labour i.e., labour intensive were found to be constraints for cotton growers for carrying out the work of hand picking of larvae, destroying affected plant parts for want of labour, further they reported that lack of

knowledge about the use (i.e., technical guidance) and unavailability of pheromone traps and lack of knowledge about working out of economic injury level in using pheromone traps emerged as constraints to cotton growers

4.6.1.6 Constraints perceived by the respondents in adoption of botanical pesticidal practices of IPM in chickpea:

The data incorporated in table 39 explicitly explicate that lack of knowledge and skill in preparing neem seed kernel extract (NSKE) solution at home level (MPS 96.89) was the prime constraint perceived by the farmers. Other severe constraints were lack of technical guidance (MPS 66.07) followed by lack of confidence in its effectiveness and feels that chemical insecticidal spray is beneficial rather than NSKE considering the cost of NSKE (MPS 61.93), high cost (MPS 58.07) and lack of knowledge (MPS 53.77). Besides, less severe constraints were non-availability of NSKE at local level (MPS 45.33) and poor quality of NSKE available in the market (MPS 40.74).

Table 39. Constraints perceived by respondents in adoption of botanical pesticidal practices of IPM in chickpea

| n = 225 | | | |
|----------------|--|------------|-------------|
| S.No. | Constraints | MPS | Rank |
| 1. | Lack of knowledge | 53.77 | 5 |
| 2. | Lack of technical guidance | 66.07 | 2 |
| 3. | High cost | 58.07 | 4 |
| 4. | Non-availability of NSKE at local level | 45.33 | 6 |
| 5. | Lack of knowledge and skill in preparing NSKE solution at home level | 96.89 | 1 |
| 6. | Poor quality of NSKE available in the market | 40.74 | 7 |
| 7. | Lack of confidence in its effectiveness and feels that chemical insecticidal spray is beneficial rather than NSKE considering the cost of NSKE | 61.93 | 3 |

MPS = Mean per cent score, n = Sample size

These findings are in agreement with those of Shinde *et al.* (1997) who had reported that as regards the use of plant product, nearly three fourth of the cotton growers expressed the lack of knowledge and guidance about preparation and use of neem seed kernel extract.

4.6.1.7 Constraints perceived by the respondents in adoption of biological practices of IPM in chickpea:

A glance at the data incorporated in table 40 reveals that constraints related to *B.t.* biopesticide were ranked first in the hierarchy of biological practices (MPS 58.43) followed by the constraints related to ‘T’ shaped perches (MPS 53.66), constraints related to HaNPV biopesticide (MPS 52.72) and constraints related to trichoderma biofungicide (MPS 46.89) which were ranked second, third and fourth respectively. Further indepth analysis of the constraints related to these components of biological practices has been highlighted in subsequent table 41.

Table 40. Constraints perceived by respondents in adoption of biological practices of IPM in chickpea

| n = 225 | | | |
|---------|---------------------------------|-------|------|
| S.No. | Component constraint | MPS | Rank |
| 1. | ‘T’ shaped perches | 53.66 | 2 |
| 2. | HaNPV biopesticide | 52.72 | 3 |
| 3. | <i>B.t.</i> biopesticide | 58.43 | 1 |
| 4. | Trichoderma powder biopesticide | 46.89 | 4 |

MPS = Mean per cent score, n = Sample size

Similar findings were reported by Shinde *et al.* (1997) and Chitnis and Kothikhane (2000) who had reported that major constraints related to biological control were lack of detailed technical knowledge about the use of bioagents, and their availability felt by the respondent farmers.

4.6.1.8 Constraints perceived by the respondents in adoption of biological practices (component wise) of IPM in chickpea:

A perusal of table 41 makes it clear about the constraints related to ‘T’ shaped perches mechanism of biological practices as perceived by the sample farmers that felt severe constraints were labour intensive work (MPS 66.96) followed by ignorance (MPS 63.26) and needed additional cost for managing ‘T’ perches (MPS 61.48). Whereas, less severe constraints were lack of knowledge and time consuming process with the MPS 40.44 and 36.15 respectively.

Table 41. Constraints (component wise) perceived by respondents in adoption of biological practices of IPM in chickpea

| | | n = 225 | |
|--------------|--|----------------|-------------|
| S.No. | Component constraints | MPS | Rank |
| (1) | 'T' shaped perches | | |
| i. | Lack of knowledge | 40.44 | 4 |
| ii. | Labour intensive work | 66.96 | 1 |
| iii. | Time consuming process | 36.15 | 5 |
| iv. | Ignorance | 63.26 | 2 |
| v. | Needed additional cost for managing 'T' perches | 61.48 | 3 |
| (2) | HaNPV : biopesticide | | |
| i. | Lack of knowledge | 53.04 | 3 |
| ii. | Lack of technical guidance | 65.48 | 2 |
| iii. | Lack of skill | 42.96 | 7 |
| iv. | Non-availability of HaNPV in local market | 52.89 | 4 |
| v. | Initial cost is high because it requires two sprays | 66.96 | 1 |
| vi. | Lack of confidence about its effectiveness | 40.89 | 8 |
| vii. | It is target specific biopesticide which does not kill other insect pests associated with chickpea, requires additional cost | 51.85 | 5 |
| viii. | It is highly effective up to third instar of larvae | 47.70 | 6 |
| (3) | B.t. : biopesticide | | |
| i. | Lack of knowledge | 70.96 | 2 |
| ii. | Lack of technical guidance | 76.88 | 1 |
| iii. | Lack of skill about its application | 46.67 | 4 |
| iv. | Non-availability in local market | 55.56 | 3 |
| v. | High cost | 42.07 | 5 |
| (4) | Trichoderma powder : biopesticide | | |
| i. | Lack of knowledge | 57.48 | 1 |
| ii. | Non-availability at local market | 51.26 | 2 |
| iii. | Lack of skill in application | 39.56 | 5 |
| iv. | High cost | 40.59 | 4 |
| v. | Ignorance due to laziness | 42.81 | 3 |

MPS = Mean per cent score, n = Sample size

Further perusal of the table 41 visualizes the constraints related to HaNPV biopesticide and reveals that severe constraints perceived were initial high cost because it requires two sprays (MPS 66.96) followed by lack of technical guidance

(MPS 65.48), lack of knowledge (MPS 53.04), non-availability of HaNPV in local market (MPS 52.89) and as HaNPV is target specific biopesticide which does not kill other insect pests associated with chickpea which requires additional cost (MPS 51.85). Besides, less severe constraints were that HaNPV is highly effective up to third instar of larvae and less effective in old ones (MPS 47.70) followed by lack of skill (MPS 42.96) and lack of confidence about its effectiveness (MPS 40.89).

As far as the constraints related to *B.t.* biopesticide are concerned, it is clear from the table 41 that most severe constraints as felt by the respondents were lack of technical guidance (MPS 76.88) followed by lack of knowledge (MPS 70.96) and severe constraints was non-availability in local market (MPS 55.56) whereas, less severe constraints were lack of skill about its application (MPS 46.67) and high cost (MPS 42.07).

Further glance of data in table 41 highlights the constraints related to trichoderma biopesticide and reveals that severe intensity constraints were lack of knowledge (MPS 57.48) and unavailability at local market (MPS 51.26) whereas less severe intensity constraints were ignorance due to laziness (MPS 42.81) followed by high cost (MPS 40.59) and lack of skills in application (MPS 39.56).

4.6.1.9 Constraints perceived by the respondents in adoption of chemical pesticidal practices of IPM in chickpea:

An overview of the table 42 depicts most severe intensity constraints related to chemical practices as felt by the respondents were that they spray only at the time of high infestation later stage resulting into minimum positive results (MPS 90.22) which got first rank in the hierarchy followed by use of inadequate quantity of water for spray (MPS 83.41) and lack of proper knowledge about insect pests damaging stages (MPS 76.00). Besides, severe intensity constraints were lack of knowledge about ETL for using chemical pesticides (MPS 69.63) and lack of technical guidance for proper selection of chemical pesticide and its doses resulting into heavily dependency on the input dealers (MPS 68.00) which were ranked fourth and fifth respectively. Among the less severe intensity constraints related to chemical practices were exorbitant prices of chemical pesticides (MPS 34.67) and poor quality of chemical pesticides available in the local market (MPS 34.07).

Table 42. Constraints perceived by respondents in adoption of chemical pesticidal practices of IPM in chickpea

| | | | n = 225 |
|-------|---|-------|---------|
| S.No. | Constraints | MPS | Rank |
| 1. | Lack of knowledge about ETL for using chemical pesticides | 69.63 | 4 |
| 2. | Lack of technical guidance for proper selection of chemical pesticides and its doses resulting into heavily dependency on input dealers | 68.00 | 5 |
| 3. | lack of proper knowledge about insect pest's damaging stages | 76.00 | 3 |
| 4. | Inadequate quantity of water for spray | 83.41 | 2 |
| 5. | Spray only at the time of high infestation later stage resulting into minimum positive results | 90.22 | 1 |
| 6. | Poor quality of chemical pesticides available in the local market | 34.07 | 7 |
| 7. | Exorbitant prices of chemical pesticides | 34.67 | 6 |

MPS = Mean per cent score, n = Sample size

The findings are in contradiction with those of Shinde *et al.* (1997) who had reported that in case of chemical control, exorbitant prices of insecticides appeared to be a constraint for more than 90 per cent of cotton growers.

4.6.1.10 General constraints perceived by the respondents in adoption of IPM in chickpea cultivation:

The data incorporated in table 43 explicitly explicate that chemical control is seen as a progressive approach by the farmers because of their attitude is to gain immediate and quick results, therefore they do not find IPM approach acceptable (MPS 99.11) was the prime and most severe constraint in the growth and adoption of IPM technology as perceived by the farmers. Besides, inadequate awareness and publicity about objectives and importance of IPM was also a most severe constraint (MPS 93.33) and ranked second in the hierarchy.

Table further highlights the most severe intensity constraints were lack of regular training and education facility for acquiring proper skills and conceptual framework clarity about IPM (MPS 92.00) and with equal intensity of this constraint also was lack of proper implementation of IPM at field level i.e., MPS 92.00 followed by jumbling by the input dealers in selection of pesticides due to farmers dependency on them (MPS 90.37) which was ranked fifth in the hierarchy of general constraints.

A further deep glance at the data presented in the same table divulges that 89.78 per cent farmers felt about IPM is a complex and cumbersome technology because application of IPM has too many ifs' and buts. Besides, improper and less number of demonstrations on IPM resulting into loose confidence of farmers was also a most severe intensity constraint (MPS 87.56). Less area under chickpea thus not botheration about IPM was also considered a most severe intensity by the farmers (MPS 86.52) which got eighth rank in the hierarchy. Along with this, that chickpea cultivation is influenced by availability of water for irrigation was also a important constraint considering the direct effect on adoption of IPM (MPS 85.78).

A further perusal of the data incorporated in the same table reveals that lack of separate marketing facilities for IPM produce to get remunerative price also inhibiting the adoption of IPM as perceived by the majority of the farmers (MPS 85.04) followed by the perception of constraint as costly and lack of subsidy incentives from government side on marketable IPM control measures (MPS 78.37). Besides, majority of the respondents confronted the constraints were lack of opportunities for direct interaction with the experts (MPS 77.33) followed by lack of awareness about hazardous and residual effects of chemical pesticides (MPS 72.44) and negligence including underestimation of IPM technology (MPS 70.07) which were ranked 12th, 13th and 14th, respectively.

Further examination of data in table 43 visualizes severe intensity constraints and they were lack of special motivation and recognition of farmers for boosting IPM who are adopting IPM (MPS 66.22) followed by non-availability of literature kit about IPM (MPS 63.41), lack of risk bearing capacity and change proneness (MPS 62.37) and lack of community approach to grow chickpea resulting into decreasing area (MPS 58.52) which requires more ward and watches.

The table highlights that it was a great matter of satisfaction and encouragement and ray of hope for promoting IPM that the constraint related to lack of credibility and trustworthiness of the IPM programme was considered as least severe constraint (MPS 41.77) and ranked last (i.e., 19th) in the hierarchy by the respondents.

Table 43. General constraints perceived by respondents in adoption of IPM in chickpea

| n = 225 | | | |
|----------------|--|------------|-------------|
| S.No. | Constraints | MPS | Rank |
| 1. | Lack of regular training and education facility for acquiring proper skills and conceptual framework clarity about IPM | 92.00 | 3.5 |
| 2. | Lack of opportunities for direct interaction with the experts | 77.33 | 12 |
| 3. | Lack of credibility and trustworthiness of the IPM programme | 41.77 | 19 |
| 4. | Improper and less number of demonstrations on IPM resulting into loose confidence of farmers | 87.56 | 7 |
| 5. | Non-availability of literature kit about IPM | 63.41 | 16 |
| 6. | Lack of risk bearing capacity and change proneness | 62.37 | 17 |
| 7. | Lack of separate marketing facilities for IPM produce to get remunerative price | 85.04 | 10 |
| 8. | Costly and lack of subsidy incentives from government on marketable IPM control measures | 78.37 | 11 |
| 9. | Lack of awareness about hazardous and residual effects of chemical pesticides | 72.44 | 13 |
| 10. | Lack of special motivation and recognition of farmers who are adopting IPM | 66.22 | 15 |
| 11. | Lack of community approach to grow chickpea resulting into decreasing area | 58.52 | 18 |
| 12. | IPM is a complex and cumbersome technology because application of IPM has too many ifs' and buts | 89.78 | 6 |
| 13. | Chickpea cultivation is influenced by availability of water for irrigation | 85.78 | 9 |
| 14. | Inadequate awareness and publicity about objectives and importance of IPM | 93.33 | 2 |
| 15. | Lack of proper implementation of IPM at field level | 92.00 | 3.5 |
| 16. | Jumbling by the input dealers in selection of pesticides due to farmers dependency on input dealers | 90.37 | 5 |
| 17. | Negligence and underestimation of IPM technology | 70.07 | 14 |
| 18. | Less area under chickpea resulting into less interest about IPM | 86.52 | 8 |
| 19. | Chemical control has seen as a progressive approach by farmers because of their attitude is to gain immediate and quick results, therefore do not find IPM approach acceptable | 99.11 | 1 |

MPS = Mean per cent score, n = Sample size

The findings are supported by Chitnis and Kothikhane (2000) who had revealed that lack of sufficient training, lack of visits of the scientists, to the farmers field and lack of opportunity for direct interaction with the scientists were reported as constraints for non-adoption of IPM technology by the farmers which inturn effects the implementation of IPM programme on the fields of farmers. The reasons behind

this depicts that scientists visit to the fields where new technology is being adopted, play very important role in transfer of technology as well as removing doubts and giving correct solutions for the field problems.

4.6.1.11 Overall constraints perceived by the respondents in adoption of IPM practices in chickpea:

To get an overall picture of intensity of severity of various major constraints, the constraint scores under each major group were pooled and have been presented in table 44.

Table 44. Overall constraints perceived by respondents in adoption of IPM practices in chickpea

| n = 225 | | | |
|---------|---|-------|------|
| S.No. | Constraints aspect | MPS | Rank |
| 1. | Constraints related to identification of pests and their monitoring through ETL | 69.48 | 2 |
| 2. | Constraints related to cultural practices | 46.40 | 7 |
| 3. | Constraints related to mechanical practices | 64.36 | 4 |
| 4. | Constraints related to botanical pesticidal practices | 60.40 | 5 |
| 5. | Constraints related to biological practices | 52.63 | 6 |
| 6. | Constraints related to chemical pesticidal practices | 66.55 | 3 |
| 7. | General constraints | 78.53 | 1 |
| Overall | | 58.08 | |

MPS = Mean per cent score, n = Sample size

A perusal of data incorporated in table 44 reveals that general constraints were the most severe bottlenecks in the development and promotion of IPM technology in the study area with the intensity of 78.53 per cent and ranked first in the hierarchy of constraints. The next constraint that was hampering farmers in adoption of IPM was constraints related to identification of pests and their monitoring through ETL (MPS 69.48). Besides, constraints related to chemical pesticidal practices, constraints related to mechanical practices and constraints related to botanical pesticidal practices were other constraints perceived by the respondents in the descending order of their magnitude with MPS 66.55, 64.36 and 60.40 and ranked third, fourth and fifth respectively.

A further glance of table 44 vividly explicates that constraints related to biological practices were also found to put obstructions before the farmers to a severe extent of 52.63 per cent and ranked sixth in the hierarchy. However, the less severe felt constraints were related to the cultural practices with MPS 46.40 and ranked at last i.e., seventh in the hierarchy of constraints.

Table further highlights that overall intensity of constraints of IPM practices was found 58.08 per cent among chickpea growers.

4.7 TRAINING NEEDS OF THE CHICKPEA GROWERS REGARDING INTEGRATED PEST MANAGEMENT

Training in modern agricultural technology is a basic prerequisite for equipping them with latest technical knowledge so as to have rapid and sustained agricultural development. Several researchers have reported that training had significant impact on trainee farmers in terms of increase in knowledge and adoption of crop production technologies.

In modern days of agriculture, there is a tremendous advancement in knowledge related to IPM technology and this needs to be transmitted to the farmers. Training plays a pivotal role in transferring latest technical know-how to the farmers.

As we know that training is vital and essential to enhance motivation, create confidence and inoculate efficiency in an individual. Thus training prepares an individual to earn the living through acquisition of specific skills of a profession, an occupation or a vocation. While imparting training, the attitude of the trainees not only get sharpened but also moulded to suit the ever changing needs of environment, the society and the technology.

So as to make the training need based, it is essential to find out their needs in respect of specific areas in which they needed training, considering the above aim in mind, present research study highlights the specific objective to assess the training needs of chickpea growers regarding IPM.

Therefore, in this section, an attempt has been made to assess the training needs of the farmers regarding IPM. The training needs has been assessed through 32 major areas of trainings related to IPM, of which the outcome has been presented in the subsequent table 45.

4.7.1 Training needs of the respondent chickpea growers regarding integrated pest management:

A perusal of the data incorporated in table 45 highlights the training needs of the chickpea growers regarding different aspects of IPM that the cent per cent of the respondent farmers wanted to take training in preparation and application of neem based pesticides and reported this area of training as most needed, this may be due to the fact that neem is available with them and they can reduce the cost of production by learning the method of preparing neem based pesticides at home level. Besides, the most needed areas of training were ETL assessment (96.89%) followed by cost benefit ratio of IPM v/s non-IPM crop (90.67%), conceptual framework of IPM (87.56%) and pest surveillance (84.44%). Table further depicts other most needed training areas as *B.t* biopesticide and its application, identification of insect pests and diseases, HaNPV biopesticide and its application, nature of damage by pests, seed treatment, monitoring of adult population of pod borer through pheromone traps and environmental issues of pest management with per cent training need intensity of 80.00, 73.78, 69.33, 58.22, 56.44, 49.33 and 46.67 respectively as reported by the respondents.

A further glance of the data incorporated in the table 45 visualizes the optimally needed areas of training as perceived by the farmers with regards to high yielding varieties, crop geometry i.e., spacing of row to row and plant to plant, soil treatment, trap crops, crop rotation, 'T' shaped perches, balanced use of fertilizers and identification of parasites and predators with per cent training need intensity of 85.78, 81.78, 78.67, 78.67, 72.00, 68.89, 64.44 and 61.33 respectively.

Further observation of the table 45 makes it clear about that the respondent farmers needed less training and those areas were sowing time followed by operation and handling of plant protection equipments, application of chemical pesticides, preparation of pesticidal spray solution, first aid treatment while using chemical pesticides, precautions while using pesticides, field sanitation and deep ploughing, weed management, irrigation management, seed rate, intercropping and light traps with per cent training need intensity of 94.67, 86.67, 83.56, 82.22, 81.78, 77.78, 77.33, 75.56, 71.11, 70.67, 63.11 and 56.89 respectively.

Further indepth analysis of the table 45 depicts that few of the training areas needed by the respondents were those in which they keep already knowledge to the

extent of satisfaction level though they required trainings, the reasons behind may be due to the fact of thinking that regular training and education facility for acquiring proper skill is needed that makes conceptual clarity about different IPM practices and helps in better adoption.

The findings are supported by Selvi and Vimali (2002) who assessed the training needs of farm women respondents on IPM in rice on priority ranks as neem based pesticides/biopesticides, beneficial insects in pest management, ETL assessment, pest resurgence, pest surveillance, environmental issues in pest management, pesticide residual effect, use of different traps in pest management and biocontrol agents. Further, the findings also in line with those of Raju *et al.* (2003) who highlighted the training needs related to plant protection aspects and revealed that farmers needed training in the areas which involves technical skills in integrated pest and disease control methods which includes identifying the pest and disease attack symptoms, preparation of spray fluid with correct concentrations etc.

Table 45. Training needs of the chickpea growers regarding IPM practices**n=225**

| S. No. | Area of training need | Most needed | | Needed | | Less needed | | Mean score | Rank |
|--------|--|-------------|-------|--------|-------|-------------|-------|------------|------|
| | | f | % | f | % | f | % | | |
| 1. | Conceptual framework of IPM | 197 | 87.56 | 28 | 12.44 | 0 | 0.00 | 2.88 | 4 |
| 2. | Field sanitation and deep ploughing | 0 | 0.00 | 51 | 22.67 | 174 | 77.33 | 1.23 | 27.5 |
| 3. | Soil treatment | 13 | 5.78 | 177 | 78.67 | 35 | 15.56 | 1.90 | 17 |
| 4. | High yielding varietal seeds | 32 | 14.22 | 193 | 85.78 | 0 | 0.00 | 2.14 | 14 |
| 5. | Seed rate | 0 | 0.00 | 66 | 29.33 | 159 | 70.67 | 1.29 | 23.5 |
| 6. | Crop geometry | 39 | 17.33 | 184 | 81.78 | 2 | 0.89 | 2.16 | 13 |
| 7. | Sowing time | 0 | 0.00 | 12 | 5.33 | 213 | 94.67 | 1.05 | 32 |
| 8. | Seed treatment | 127 | 56.44 | 95 | 42.22 | 3 | 1.33 | 2.55 | 10 |
| 9. | Crop rotation | 18 | 8.00 | 162 | 72.00 | 45 | 20.00 | 1.88 | 18 |
| 10. | Intercropping | 0 | 0.00 | 83 | 36.89 | 142 | 63.11 | 1.37 | 22 |
| 11. | Trap crops | 6 | 2.67 | 177 | 78.67 | 42 | 18.67 | 1.84 | 19 |
| 12. | Balance use of fertilizers | 6 | 2.67 | 145 | 64.44 | 74 | 32.89 | 1.70 | 20 |
| 13. | Weed management | 0 | 0.00 | 55 | 24.44 | 170 | 75.56 | 1.24 | 25.5 |
| 14. | Irrigation management | 0 | 0.00 | 65 | 28.89 | 160 | 71.11 | 1.29 | 23.5 |
| 15. | Identification of insect pests and diseases | 166 | 73.78 | 52 | 23.11 | 7 | 3.11 | 2.71 | 7 |
| 16. | Nature of damage by pests | 131 | 58.22 | 91 | 40.44 | 3 | 1.33 | 2.57 | 9 |
| 17. | ETL assessment | 218 | 96.89 | 7 | 3.11 | 0 | 0.00 | 2.97 | 2 |
| 18. | Pest surveillance | 190 | 84.44 | 35 | 15.56 | 0 | 0.00 | 2.84 | 5 |
| 19. | Preparation of pesticidal spray solution | 12 | 5.33 | 28 | 12.44 | 185 | 82.22 | 1.23 | 27.5 |
| 20. | Operation and handing of plant protection equipments | 3 | 1.33 | 27 | 12.00 | 195 | 86.67 | 1.15 | 31 |

| S. No. | Area of training need | Most needed | | Needed | | Less needed | | Mean score | Rank |
|--------|---|-------------|-------|--------|-------|-------------|-------|------------|------|
| | | f | % | f | % | f | % | | |
| 21. | Monitoring of adult population of pod borer through pheromone traps | 111 | 49.33 | 109 | 48.44 | 5 | 2.22 | 2.47 | 11 |
| 22. | Light traps and their installation | 3 | 1.33 | 94 | 41.78 | 128 | 56.89 | 1.44 | 21 |
| 23. | Preparation and application of botanical pesticides i.e. NSKE | 225 | 100 | 0 | 0.00 | 0 | 0.00 | 3.00 | 1 |
| 24. | 'T' shaped perches | 42 | 18.67 | 155 | 68.89 | 28 | 12.44 | 2.06 | 15 |
| 25. | HaNPV biopesticide and its application | 156 | 69.33 | 69 | 30.67 | 0 | 0.00 | 2.69 | 8 |
| 26. | <i>B.t.</i> biopesticide and its application | 180 | 80.00 | 45 | 20.00 | 0 | 0.00 | 2.80 | 6 |
| 27. | Identification of parasites and predators | 39 | 17.33 | 138 | 61.33 | 48 | 21.33 | 1.96 | 16 |
| 28. | Application of chemical pesticides | 3 | 1.33 | 34 | 15.11 | 188 | 83.56 | 1.18 | 30 |
| 29. | Precautions while using pesticides | 3 | 1.33 | 47 | 20.89 | 175 | 77.78 | 1.24 | 25.5 |
| 30. | First aid treatment while using chemical pesticides | 2 | 0.89 | 39 | 17.33 | 184 | 81.78 | 1.19 | 29 |
| 31. | Environmental issues of pest management | 105 | 46.67 | 101 | 44.89 | 19 | 8.44 | 2.38 | 12 |
| 32. | C:B ratio of IPM v/s non-IPM crop | 204 | 90.67 | 18 | 8.00 | 3 | 1.33 | 2.89 | 3 |

f = Frequency, % = Per cent

5. SUMMARY AND CONCLUSION

The inferences of the study so brought out pertaining to the specific objectives have been presented in the form of summary and conclusion in this chapter. Besides findings, suggested suitable extension strategy for effective transfer of technology for IPM in chickpea has been given in this chapter also.

5.1 INTRODUCTION

The world at large has become appreciably conscious of the indiscriminate use of chemicals in agriculture and the environmental concern is widening today. Goals of agricultural production are now focused as harmonious alliance of environmental sustainability with human health. The concept of Integrated Pest Management (IPM) is a mandatory precursor in achieving our goals of increasing production targets in harmony with the ideals of sustainable agriculture.

Further more, the trend of increasing population, demand of additional food and over use of shrinking natural resources are some of the major concerns of today's agricultural scenario in our country. The green revolution led the country from scarcity to the over flowing godowns of today. The promotion of intensive agriculture has led to increased pest problems. Some of the problems related to pest management have been of complex nature because of the over use of pesticides, loss of friendly insects and micro organisms and development of pesticide resistance in a number of insects, plant pathogens and weeds. At the same time, now pest problems are emerging in different parts of the country. The farming community has faced with major challenges due to increase in cost of production. Lot of information have been generated by plant production and protection scientists to combat these problems through various control measures of individual pest. However, a holistic approach considering all possible control measures blended with indigenous technical knowledge and promotion of sustainable technologies in pest management like Integrated Pest Management (IPM) is yet to become popular with the farmers due to various reasons.

Furthermore, pulses are the cheapest source of dietary proteins for human beings and valuable animal feed. Besides, they are also important for sustainable agriculture, due to their inherent capacity to fix large amount of atmospheric nitrogen and thrive on the limited available moisture because of their deep root system.

Chickpea is one of the most important pulse crop in India and has been identified as one of the alternative *rabi* crops for diversification in cereals based cropping system for sustainable agriculture. However, the production of chickpea has remained almost stagnant over the years. The yield reducing factors are mainly responsible for the gap between the attainable and yields. The major causes for low yields are attributed to lack of appropriate chickpea production technologies with sound plant protection options and others.

Gram pod borer *Helicoverpa armigera* along has been found to cause of huge losses resulting into declining the area for production of chickpea. Looking to this, there is an urgent need to bring down the losses due to pests by following proper pest management strategies.

Therefore, in view of the potentiality in the management of crop pests by application of IPM technologies in chickpea, it is necessary to harness synergies between different research and development agencies, policy making bodies and the farming communities so that the emerging crop protection challenges facing the agriculture are met without failure.

In the Kota district of Rajasthan state, various efforts by different agencies including NCIPM, ICAR have been done to accelerate and promote the IPM strategy in chickpea for boosting up production in a sustainable manner.

Keeping in view of this background and vast scope of IPM strategy of chickpea in diversification and one of the alternative to rabi crops perspectives, it was felt to conduct a research study entitled “Adoption of Integrated Pest Management in Chickpea Production in Kota District of Rajasthan” with the following specific objectives.

5.2 SPECIFIC OBJECTIVES OF THE STUDY

- 5.2.1 To study information input and its processing behaviour of chickpea growers.
- 5.2.2 To find out the existing knowledge of farmers about recommended practices of Integrated Pest Management in chickpea.
- 5.2.3 To find out extent of adoption of recommended practices of pest management by chickpea growers.
- 5.2.4 To study the constraints as perceived by the chickpea growers in adoption of Integrated Pest Management practices.
- 5.2.5 To assess the training needs of chickpea growers with regards to Integrated Pest Management.
- 5.2.6 To suggest suitable extension strategy for effective transfer of technology for Integrated Pest Management in chickpea.

By studying above mentioned variables, it would be of immense help to weigh the extent to which they are in concordance with the recommendations and principles so that deficient areas revealed therefore, can be abridged by framing effective policy on IPM strategy for proper transfer of technology up to the grass root level.

5.3 METHDOLOGY

The present study was conducted in Kota district of Rajasthan which falls under south-eastern humid plain zone of Rajasthan. The district was selected purposively because of intensive efforts for transferring the technology regarding IPM in chickpea done by the department of agriculture, Krishi Vigyan Kendra and NCIPM, ICAR, thereafter three panchayat samities were selected randomly thus Ladpura, Digod and Sangod panchayat samities were selected for investigation purpose. Five villages each from every identified panchyat samiti were included in the study. The selection of villages was done through random sampling technique among from those villages where farmers were benefited through various IPM promoted schemes in chickpea crop. Thus 15 villages were included in the study. For selection of respondents, 15 beneficiary farmers from each identified village were selected randomly. Thus total sample size comprised of 225 respondents for the present investigation.

5.4 CONSTRUCTION OF INSTRUMENT

Keeping in mind the purpose of the study, a comprehensive interview schedule was developed covering all the aspects of defined objectives of the study. The interview schedule was developed by researcher after thorough scanning of the relevant literature and in consultation with the IPM experts, field extension functionaries and other relevant resource persons including farmers of the study area. The schedule so developed was standardized by following proper standardization techniques and then quantified. Its validity and reliability were comprehensively judged for measuring the parameters accurately under study. In light of the initial responses, necessary modifications were made. The finally framed schedule consisted of seven sections as mentioned below:

- Section-I:** This section of the schedule dealt with background information of the respondents.
- Section-II:** This section of schedule was developed to assess the information input behaviour of the chickpea growers.
- Section-III:** This section of schedule was utilized for assessing the information processing behaviour of the chickpea growers.
- Section-IV:** This section of schedule dealt to assess the existing knowledge of the chickpea growers regarding recommended practices of IPM.
- Section-V:** This section of the schedule was used for measuring extent of adoption of recommended IPM technology by the chickpea growers.
- Section-VI:** This section of schedule was designed to identify major constraints as perceived by the chickpea growers in adoption of IPM technology.
- Section-VII:** This section of schedule was dealt with the assessment of training needs of chickpea growers regarding IPM.

5.5 DATA COLLECTION AND STATISTICAL ANALYSIS

Data for the study were collected from the selected farmers by employing personal interview technique by the investigator himself. The data so collected were classified, tabulated and analysed in the light of the specific objectives and

appropriate statistical tests were used to arrive at specific conclusions. The statistical measures used were frequency, percentage, mean score, mean per cent score, standard deviation, analysis of variance, critical difference, standard error of mean, coefficient of variation.

5.6 MAJOR FINDINGS

The main findings emanated out of the study are as follows:

5.6.1 Background information of the respondents:

- 5.6.1.1 Findings reveal that nearly half of the respondents were of middle age followed by young and old age (Table 6).
- 5.6.1.2 Majority of the farmers belonged to other backward caste followed by scheduled tribe, general caste and scheduled caste.
- 5.6.1.3 About 18 per cent of the total respondents had business as their subsidiary occupation in addition to agriculture followed by service of about 8 per cent of the respondents.
- 5.6.1.4 Nearly one-third of the farmers were matriculate standard of education followed by middle and higher secondary standard. However, none of the respondents was found as illiterate.
- 5.6.1.5 Two-third of the farmers owned big land holdings followed by small holdings farmers.
- 5.6.1.6 More than half of the respondents had nuclear families.

5.6.2 Information input behaviour of the chickpea growers:

- 5.6.2.1 It has been found that agriculture supervisor and scientist of KVK were the prime source for availing information by majority of the farmers among the category of personal cosmopolite sources (table 7).
- 5.6.2.2 Progressive farmers and input dealers were the major personal localite sources used by most of the chickpea growers (table 8).
- 5.6.2.3 Newspaper and television were the main impersonal cosmopolite sources being exploited by the farmers for availing relevant information (table 9).

5.6.2.4 On overall basis, personal localite sources of information were preferred by majority of farmers which were followed by impersonal cosmopolite and personal cosmopolite sources (Table 10).

5.6.3 Information processing behaviour of the chickpea growers:

5.6.3.1 It was found that prime modes for processing information were judgement based on weigh keeping with relative advantages and informal discussion in group meetings (table 11).

5.6.3.2 Least followed mode was acceptance of the information received as such with respect to their information processing pattern.

5.6.3.3 On overall basis, the intensity for processing the received information by the farmers was 69.12 per cent that reflects their information processing behaviour.

5.6.4 Extent of knowledge of farmers regarding recommended practices of IPM in chickpea:

5.6.4.1 Findings reveal that the respondents possessed high level of knowledge about conceptual frame work of IPM and key pests of chickpea. Among these two sub aspects, maximum knowledge was found about conceptual frame work of IPM as compare to key pests of chickpea (Table 12).

5.6.4.2 The respondents possessed maximum knowledge with regards to seed rate, spacing and time of sowing followed by irrigation management and field sanitation and deep ploughing among various aspects of cultural practices of IPM in chickpea. Maximum knowledge gap was found in intercropping and trap crops and weed management (Table13).

5.6.4.3 Although, majority of the chickpea growers possessed the knowledge about mechanical practices of IPM. But, among these, maximum knowledge was found with respect to light traps (Table 15).

5.6.4.4 As far as the knowledge level regarding botanical pesticide is concerned, it was found below average (Table 17).

- 5.6.4.5 Respondents possessed maximum knowledge about 'T' shaped perches followed by trichoderma biofungicide under biological practices of IPM in chickpea. Whereas towards HaNPV and *B.t.* biopesticides, farmers possessed low level of knowledge.
- 5.6.4.6 Majority of the sampled farmers possessed the knowledge of chemical practices under IPM in chickpea except the required quantity of water for preparation of insecticidal solution under which negligible knowledge was found (Table 20).
- 5.6.4.7 Out of six major practices of IPM in chickpea, highest knowledge was found in chemical pesticidal practices followed by mechanical practices. Besides, lowest knowledge level was found in botanical pesticidal practices (Table 21).
- 5.6.4.8 On overall basis, average knowledge level of chickpea growers in sampled area was found 67.38 per cent which indicates the active participation of beneficiary farmers in various IPM promotional programmes (Table 21).
- 5.6.4.9 Significant difference was found between the panchayat samities' farmers with respect to knowledge of IPM practices in chickpea (Table 22).

5.6.5 Extent of adoption of recommended IPM practices by the chickpea growers:

- 5.6.5.1 Findings reveal that cent per cent adoption was found towards assuring the identification of insect pests before using control measures but very low adoption was observed towards follow up of economic threshold level concept before insecticidal spray (Table 23).
- 5.6.5.2 Under the cultural practices of IPM in chickpea, maximum adoption was found with regards to irrigation management followed by field sanitation and deep ploughing. At the same time, negligible adoption was observed towards inter cropping and trap crops (Table 24).
- 5.6.5.3 About 50 per cent adoption level was found among the chickpea growers with regards to pheromone traps with minimum adoption towards removal and destruction of infected plant parts and hand picking of insect pests larval masses under the mechanical practices of IPM (Table 26).

- 5.6.5.4 Adoption level regarding botanical pesticidal practices of IPM was found very low among sampled chickpea growers (Table 28).
- 5.6.5.5 The extent of adoption regarding biological practices of IPM was also found low. Besides, nearly 70 per cent adoption level was observed towards 'T' shaped perches, however negligible adoption was towards B.t. biopesticide (Table 29).
- 5.6.5.6 Majority of the respondents adopted the chemical pesticides in recommended doses at appropriate crop stage but negligible adoption was found towards application of required quantity of water for preparation of insecticidal solution per unit area (Table 31).
- 5.6.5.7 Out of six major practices of IPM in chickpea, maximum adoption level was found towards cultural practices and minimum adoption was observed towards botanical pesticidal practices (Table 32).
- 5.6.5.8 On overall basis, 48.43 per cent adoption, level was found towards the IPM practices in chickpea which shows 51.57 per cent adoption gap among the sample farmers (Table 32).
- 5.6.5.9 Significant difference was found between panchayat samities' farmers with respect to adoption of IPM practices in chickpea (Table 33).

5.6.6 Constraints perceived by the farmers in adoption of IPM practices in chickpea:

- 5.6.6.1 The major constraints perceived by chickpea growers regarding identification of pests and their monitoring through ETL were lack of technical guidance regarding ETL assessment and lack of knowledge about pest's life cycle alongwith improper monitoring of fields (Table 34).
- 5.6.6.2 Among the cultural practices of IPM in chickpea, maximum constraints were faced towards seed rate, spacing and time of sowing followed by inter cropping and trap cropping. Besides, minimum constraints were faced towards the practices of weed management by the respondents (Table 35).
- 5.6.6.3 Further in depth analysis of constraints related to cultural practices shows that major constraints were non availability of seed cum fertilizer drill machine, and its high initial cost, lack of technical guidance about method of

fertilizer application, high cost of weedicides, lack of interest in inter cropping and trap cropping, high cost of seed, and seed treatment with biofertilizers is labour intensive and time consuming perceived by the respondents (Table 36).

- 5.6.6.4 The constraints related to mechanical practices almost in equal intensity in all three aspects were perceived by the chickpea growers. However, in all, additional botheration and cumbersome work, non-availability of electricity at fields, lack of technical guidance in monitoring for economic injury level, non-availability of pheromone traps and its lures, improper monitoring of fields, labour intensive and time consuming practices were felt as major constraints related to mechanical practices (Table 37, 38).
- 5.6.6.5 Lack of knowledge and skill in preparing NSKE solution at home level followed by lack of technical guidance were main constraints perceived by farmers in adoption of botanical practices of IPM in chickpea (Table 39).
- 5.6.6.6 Under biological practices, maximum constraints were faced by respondents towards B.t. biopesticide followed by 'T' shaped perches, HaNPV biopesticide and trichoderma biofungicide respectively. In all, major constraint in adopting biological practices faced by respondents were lack of technical guidance and knowledge, initial high cost, labour intensive and ignorance due to laziness (Table 40, 41).
- 5.6.6.7 Majority of the respondents faced the constraints in adopting chemical practices were spray of pesticide in later stage of infestation, along with inadequate quantity of water for spray (Table 42).
- 5.6.6.8 Among general constraints as perceived by chickpea growers in adoption of IPM practices, most severe constraint was that chemical control has seen as a progressive approach by farmers because of their attitude is to gain immediate and quick results, therefore they do not find IPM approach acceptable. Besides, inadequate awareness and publicity about objectives and importance of IPM followed by lack of proper implementation of IPM at field level and; lack of regular training and education facility for acquiring proper skills were also severe constraints perceived by the sampled respondents (Table 43).

- 5.6.6.9 Out of seven major constraint aspects of IPM, maximum intensity of severity was found towards general constraints followed by constraints related to identification of pests and their monitoring through ETL. However, minimum intensity of severity was found towards the constraints related to cultural practices (Table 44).
- 5.6.6.10 On overall basis, the intensity of severity of constrains in adopting IPM practices by chickpea growers was 58.08 per cent (table 44).

5.6.7 Training needs of chickpea growers regarding integrated pest management :

- 5.6.7.1 It has been found that most needed areas of training related to IPM in chickpea were preparation and application of neem based botanical pesticides followed by ETL assessment, cost benefit ratio of IPM v/s non-IPM crop, conceptual frame work of IPM, pest surveillance, B.t. biopesticide and its application, identification of insect pests and diseases, HaNPV biopesticide and its application, nature of damage by pests, seed treatment, monitoring of adult population of pod borer through pheromone traps and; environmental issues of pest management as reported by the respondents (Table 45).
- 5.6.7.2 Besides, optimally needed areas of training in IPM by the chickpea growers were high yielding varieties, crop geometry, soil treatment, trap crops, crop rotation, 'T' shaped perches, balance use of fertilizers and; identification of parasites and predators.
- 5.6.7.3 Less needed areas of training in IPM by the chickpea growers were sowing time, operation and handling of plant protection equipments, application of chemical pesticides, preparation of pesticidal spray solution, first aid treatment, precautions while using pesticides, field sanitation and deep ploughing, weed management, irrigation management, seed rate, intercropping and light traps.

5.7 SUGGESTED EXTENSION STRATEGY FOR EFFECTIVE TOT REGARDING IPM TECHNOLOGY IN CHICKPEA

Based on the findings of study, interaction with farmers, departmental personnel and scientist experts during data collection and reviewing relevant

literature, following suitable extension strategy is suggested for effective transfer of technology related to Integrated Pest Management in Chickpea, which will promote higher adoption of recommended IPM practices among chickpea growing farmers with similar conditions:

- 5.7.1 Frequent fresher course modules for progressive farmers and input dealers should be developed and trainings based on those modules should be conducted for them. This assumes great importance for transfer of technology and extension of IPM technology in the study area because these sources have emerged as prime personal localite sources being used to a great extent by chickpea farmers and thus they need to be properly strengthened thereby making full use of “principle of local leadership”.
- 5.7.2 Proper coverage of the IPM practices and related technology should be given through local print media on weekly basis or twice a week as majority of the chickpea growers used the newspaper as prime source of information among impersonal cosmopolite sources. Scientists of the State Agriculture University should contribute the articles and write ups for the periodic columns.
- 5.7.3 Special programmes/documentaries on various technological aspects of IPM should be prepared and; telecasted and broadcasted through television and radio. Scientists of State Agriculture University and experts of IPM from department of agriculture should be invited by the concerned units of Doordarhan and Prasar Bharti to have live discussions on IPM practices.
- 5.7.4 Opportunities be extended to the extension workers to attend special skill trainings related to IPM programme, so that they can build up confidence while guiding the farmers in respect of identification of pests, ETL level, biological, botanical and mechanical methods of controlling pests.
- 5.7.5 Chickpea growers should be encouraged to assess the usefulness of the IPM related information received by taking demonstration trials to check the practical applicability based on the principle of “seeing is believing” and “learning by doing”.
- 5.7.6 Proper attention should be given towards the aspect of neem based botanical pesticides, biological practices, mechanical practices and proper

identification along with monitoring of pests of chickpea while devising training programmes by KVK and DOA for chickpea growers and should provide trainings to train them for acquiring proper knowledge and skills of IPM technological concepts. Emphasis should be given particularly those practices involving least cost, skill and adequate availability of inputs in local setting to promote IPM.

- 5.7.7 In order to sustain momentum in IPM implementation there is a need to create greater awareness among the general public and policy makers. This could be achieved through getting up a “National IPM Day”, Farmers rallies, special T.V. programmes and other farmer centred activities. The rural school children could be included in the programme will further carry the impact of IPM to parents.
- 5.7.8 A Farmer led extension of Integrated Pest Management will help to overcome the problem of non-judicious use of pesticides. An effective implementation can only be achieved through the active and direct participation of farmers. Besides, the farmer field school educates farmers in understanding the agro-ecosystem and helps farmers to become experts in their fields. Therefore, government should thus support education of farmers via season long farmer field school model effectively followed by strong follow up action mechanism.
- 5.7.9 Bold and proactive approach by government is needed to ensure reduced dependence on chemical pesticides. This could be achieved through providing “green box” subsidy on IPM related marketable inputs including bio-control agents more than chemicals to promote IPM technology and should ensure of these IPM inputs’ availability at their local level. Besides, at least 50 per cent of the state plant protection budget to be earmarked for eco-friendly IPM inputs.
- 5.7.10 Minimum qualification of pesticide dealers should be B.Sc (Ag.). Since the farmers prefers to accept the advice provided by the input dealer, the education of dealers is bond to help the adoption of proper strategies related to IPM. Only agricultural graduates should be allowed to obtain “sale

licenses” (as in case of pharmacists/chemists shop licenses) which will also help in self employment generation to agricultural graduates.

- 5.7.11 Visit of the new farmers in general and all interested farmers in particular should be organized and conducted to the successful units of progressive farmers or the scientifically managed farms in the district, state or outside the state to create awareness and confidence in IPM practices which will help them to change the attitude for accepting IPM technology at the place of only chemical pesticidal approach.
- 5.7.12 **Farmers should be trained in preparation of neem based solutions like NKE at home level to adopt vigorously of botanical pesticidal practices which will reduce the cost of cultivation because of easy availability of neem at farmer's fields**
- 5.7.13 Demonstrations on various demonstrable aspects of IPM should be conducted and farmers should be encouraged to participate actively in them to build up confidence and motivation towards IPM. These demonstrations should be conducted at farmer's field as well as KVK instructional farm.
- 5.7.14 In order to promote IPM technology among farming community, farmers-scientists-extension workers interface should be organized by the concerning institutes to get the feed back regarding acceptability of the technology and problems faced by them in its adoption. Besides visits of scientists to the locations where IPM programme is being implemented on large area, may be organized frequently at proper crop stage so as to analyse the field situation correctly and to suggest proper methodology to overcome field problems.
- 5.7.15 For development of community participation to approach IPM local bodies like Panchayats, cooperative societies, schools etc. should be encouraged to shoulder this responsibility. Best IPM village should be given recognition to encourage use of bio agents at, district/state level and farmers should also be given some incentives/awards who are adopting IPM for promotion of IPM technology.
- 5.7.16 **Printed literature material on IPM practices and its conceptual framework should be prepared in simple and preferably in local dialect along with**

success stories of the farmers to circulate them for their eye and ready reference and when needed.

- 5.7.17 Improved implements particularly seeds cum fertilizer drill machine should be provided to the farmers on subsidized rates to promote its adoption, because majority of the farmers confronted this problem during investigation.
- 5.7.18 It is necessary to establish at least one plant protection clinic particularly bio-clinic at each Panchayat Samiti level to prescribe solutions to local problems. This can be done through establishment of agri-clinics and agri-business centres by unemployed agriculture graduates. Thus, it will also help in rural self employment.
- 5.7.19 The pest management services should be established at the village level and government should encourage setting up of more centres of IPM. This can be achieved through establishment of Technology Transfer Clubs (TTC) and Self Help Groups (SHG) whose members will work as 'para extension workers' for dissemination of IPM practices. They may be trained as and when needed.
- 5.7.20 Awareness among farming community should be created related to telephonic consultancy through recently established Kisan Call Centre for availing farm information and IPM information.
- 5.7.21 In globalization and privatization era, encouragement provision For private sector involvement in technology transfer of IPM should be there to develop new Public-Private-Partnership (PPP).
- 5.7.22 Concept of bio-village/IPM village should be promoted by the government under village adoption programme.
- 5.7.23 The pesticides should be sell against only prescriptions from plant protection officials/scientists/industry staff as in case of medicines.
- 5.7.24 In demonstration plots and minikits only bio-control agents should be supplied to farmers instead of chemical pesticides.

- 5.7.25 There is a need to develop transgenic Bt gene- chickpea on the pattern of Bt-cotton to over come the problem of *Helicoverpa armigera* which is a major pest of chickpea. Immediate research is required on this aspect.
- 5.7.26 Since producer/consumer price gap in cereals in 10-15 per cent against 60-70 per cent in pulses particularly Chickpea. Strong intervention of public sector is required to narrow down this gap by providing the profit to the producers.
- 5.7.27 Provision of diagnostic team to visit village to village on regular basis to identify the spread or outbreak of major diseases and insect pests and suggestions for control there of, should also be part and partial during crop season.
- 5.7.28 With the available improved cultivars and production technology, the potential yield of Chickpea is more than 20 q/ha, but the realized yield is only about 35 per cent of the potential. This warrants multifacet research in a mission mode. The government should urgently launch an integrated “Technology mission on Chickpea” to overcome the present scientific, technological and institutional constraints, which dissuade the farmers from cultivating Chickpea.
- 5.7.29 Application of Information Technology (IT) in IPM has already taken place all over the world and it will continue to make tremendous influence on future IPM strategies. In fact, it may not be possible in future to neglect the IT component in any IPM programme. However in India, IT has made limited progress particularly in IPM as well as agriculture due to infrastructural and other problems. But the situation is changing fast towards good. Therefore, IT tools which are useful in adoption of IPM are data base, decision support system, expert systems. Geographic Information Systems and Internet should also be included while planning and implementing the IPM programme.
- 5.7.30 For promoting the women’s involvement, it is the right time to educate women about the IPM practices and its advantages for managing pest problems. If they were adequately trained in the use of IPM practices, certainly past problem could be minimized to a great extent. Another area in

which women can play a significant role is the production of bio-agents and NSKE. Since women are considered to be good conservator of the natural resources, they could be involved in management aspects of neem plantation programme. Therefore, there is need to intervene these issues in the existing policies/programmes for IPM promotion. If needs arise, women should be educated in special farmer field schools organized exclusively for women.

- 5.7.31 Since certain anomalies and uncertainties do exist in the areas of input supply, quality and marketing, therefore, major focus should be directed towards addressing them and; proper linkage should be established between production, input supply and marketing network to implement IPM programme successfully in a systematic manner.
- 5.7.32 Insurance scheme for farmers' motivation who are adopting IPM technology in pulses particularly Chickpea should be introduced on pilot basis in the study area to create confidence about this among the farming community.
- 5.7.33 A proper and separate marketing network and facilities should be established by the government to provide remunerative price of farm produce harvested through adopting IPM practices.
- 5.7.34 Findings concluded that farmers were mediocre in possession of knowledge about bio-control practices and its adoption by them. It could therefore be recommended that there is a need of concerted efforts by different extension agencies involved in transfer of technology to promote the bio control practices among the farmers and equip them with the latest knowledge about the bio control practices through various extension methods.

In conclusion, to suggest suitable extension strategy for effective transfer of IPM technology in chickpea, it is recommended that there is a need of concerted efforts by different extension and developmental agencies involved in transfer of technology to promote IPM practices among the farming community and equip them with latest knowledge of it through different extension methods with a view of motivate them for accelerating the adoption of IPM in Chickpea.

Besides, the suggested strategy includes promotion of the peoples participation, awareness generation through different media and extension methods, organization of training programmes, demonstration, campaign and

field visit for farmers as well as for extension functionaries, involvement of NGOs including pesticide industry for public-private-partnership, promotion of women's involvement, involvement of local organizations, exploration of indigenous practices and; use of information technology to promote Integrated Pest Management.

5.8 RECOMMENDATIONS

Based on the findings of the study, it is recommended that

- 5.8.1 Frequent fresher course modules for progressive farmers and input dealers should be developed and trainings based on those modules should be conducted for them. This assumes great importance for transfer of technology and extension of IPM technology in the study area because these sources have emerged as prime personal localite sources being used to a great extent by chickpea farmers and thus they need to be properly strengthened thereby making full use of “principle of local leadership”.
- 5.8.2 Proper coverage of the IPM practices and related technology should be given through local print media on weekly basis or twice a week as majority of the chickpea growers used the newspaper as prime source of information among impersonal cosmopolite sources. Scientists of the State Agriculture University should contribute the articles and write ups for the periodic columns.
- 5.8.3 Special programmes/documentaries on various technological aspects of IPM should be prepared and; telecasted and broadcasted through television and radio. Scientists of State Agriculture University and experts of IPM from department of agriculture should be invited by the concerned units of Doordarhan and Prasar Bharti to have live discussions on IPM practices.
- 5.8.4 Opportunities be extended to the extension workers to attend special skill trainings related to IPM programme, so that they can build up confidence while guiding the farmers in respect of identification of pests, ETL level, biological, botanical and mechanical methods of controlling pests.
- 5.8.5 Chickpea growers should be encouraged to assess the usefulness of the IPM related information received by taking demonstration trials to check the

practical applicability based on the principle of “seeing is believing” and “learning by doing”.

- 5.8.6 Proper attention should be given towards the aspect of neem based botanical pesticides, biological practices, mechanical practices and proper identification along with monitoring of pests of chickpea while devising training programmes by KVK and DOA for chickpea growers and should provide trainings to train them for acquiring proper knowledge and skills of IPM technological concepts. Emphasis should be given particularly those practices involving least cost, skill and adequate availability of inputs in local setting to promote IPM.
- 5.8.7 Visit of the new farmers in general and all interested farmers in particular should be organized and conducted to the successful units of progressive farmers or the scientifically managed farms in the district, state or outside the state to create awareness and confidence in IPM practices which will help them to change the attitude for accepting IPM technology at the place of only chemical pesticidal approach.
- 5.8.8 Since certain anomalies and uncertainties do exist in the areas of input supply, quality and marketing, therefore, major focus should be directed towards addressing them and; proper linkage should be established between production, input supply and marketing network to implement IPM programme successfully in a systematic manner.
- 5.8.9 In order to promote IPM technology among farming community, farmers-scientists-extension workers interface should be organized by the concerning institutes to get the feed back regarding acceptability of the technology and problems faced by them in its adoption. Besides visits of scientists to the locations where IPM programme is being implemented on large area, may be organized frequently at proper crop stage so as to analyse the field situation correctly and to suggest proper methodology to overcome field problems.
- 5.8.10 Minimum qualification of pesticide dealers should be B.Sc (Ag.). Since the farmers prefers to accept the advice provided by the input dealer, the education of dealers is bond to help the adoption of proper strategies related

to IPM. Only agricultural graduates should be allowed to obtain “sale licenses” (as in case of pharmacists/chemists shop licenses) which will also help in self employment generation to agricultural graduates.

- 5.8.11 Farmers should be trained in preparation of neem based solutions like NSKE at home level to adopt vigorously of botanical pesticidal practices which will reduce the cost of cultivation because of easy availability of neem at farmer’s fields.

In conclusion, to suggest suitable extension strategy for effective transfer of IPM technology in chickpea, it is recommended that there is a need of concerted efforts by different extension and developmental agencies involved in transfer of technology to promote IPM practices among the farming community and equip them with latest knowledge of it through different extension methods with a view of motivate them for accelerating the adoption of IPM in Chickpea.

5.9 IMPLICATIONS OF THE STUDY

- 5.9.1 Findings of the study will provide immense help to the administrators, policy makers and researchers to assess the present status of IPM practices in chickpea.
- 5.9.2 It will provide immense help to state department of agriculture and several other concerned developmental agencies for further refinement of the technology in the light of results.
- 5.9.3 It will be of immense benefit for various government departments, NGOs and other line organizations and agencies working for transfer of technological know-how relevant to IPM for planning their future course of action.
- 5.9.4 The study will be helpful to extension agencies in bridging the gulf between technology available and technology adopted related to IPM by the chickpea growers in the district.

5.10 SUGGESTIONS FOR FUTURE RESEARCH

- 5.10.1 As the present study was limited to the particular area of one district. So similar studies should be conducted in other areas of Rajasthan to highlight the overall picture of the present status of IPM in chickpea in the state.
- 5.10.2 Benchmark surveys should be conducted to identify potential area for IPM in the state.
- 5.10.3 Studies regarding other related parameters, like attitude, relationship between personal, socio-economic, communicational and psychological traits, case studies which have not been covered under the present study should be conducted.
- 5.10.4 Comparative study should be taken up by involving non-beneficiary and other categories of farmers of the district related to IPM practices.
- 5.10.5 Similar type of studies on other major kharif and rabi crops particularly pulses should be conducted in the district as well as other areas of Rajasthan state to highlight the overall picture of the present status of IPM in other crops also.

Fig.3 : Overall comparison of information input behaviour of the selected chickpea growers

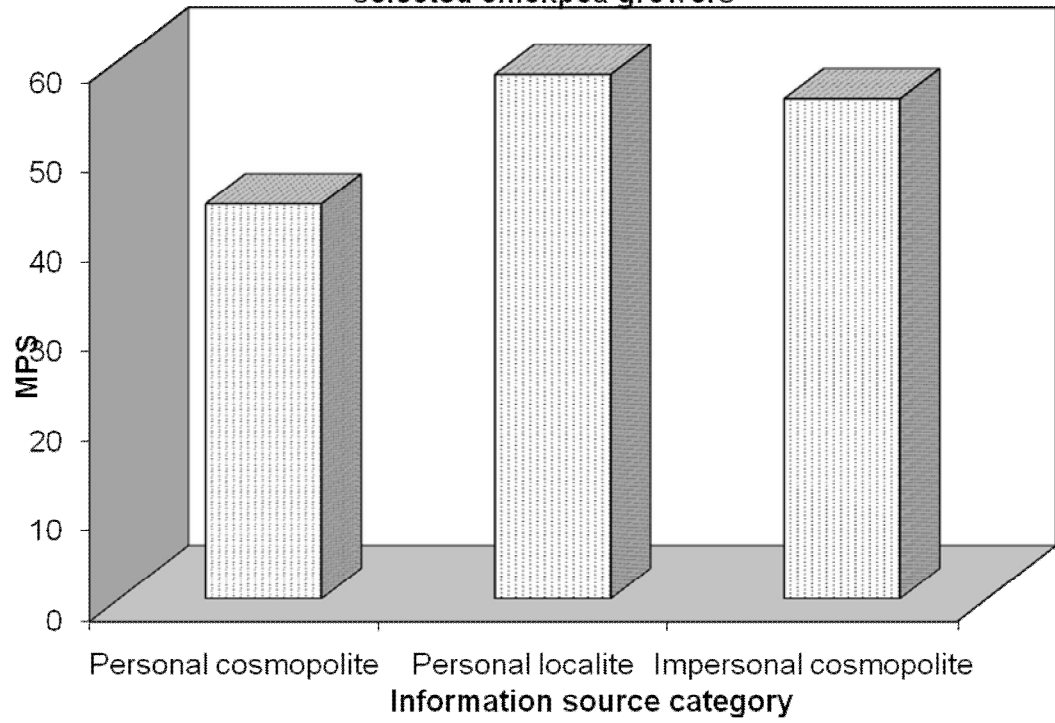


Fig.4 : Overall knowledge of the respondents regarding IPM practices in chickpea

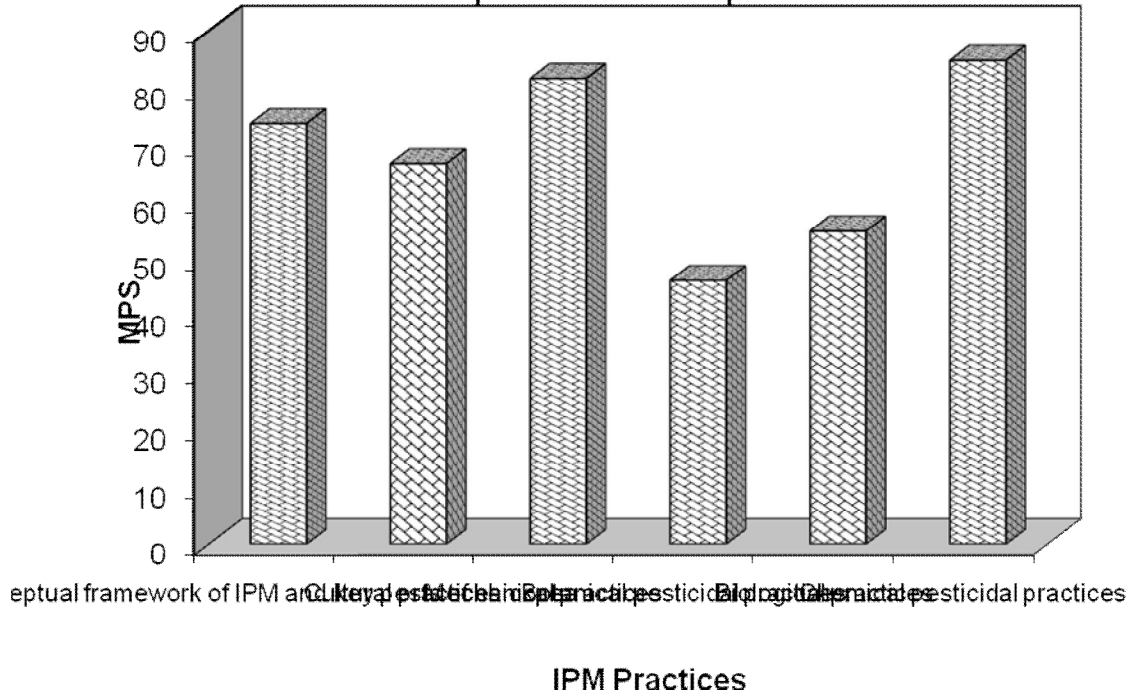


Fig.5 : Overall adoption of IPM practices in chickpea by the respondents

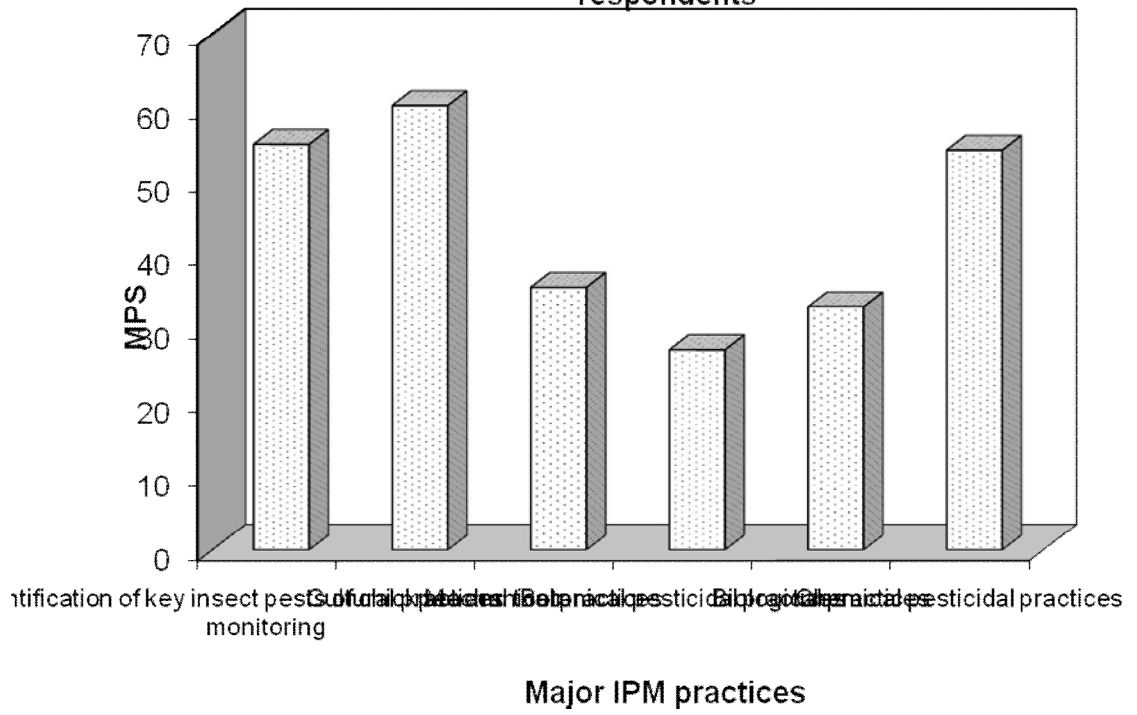
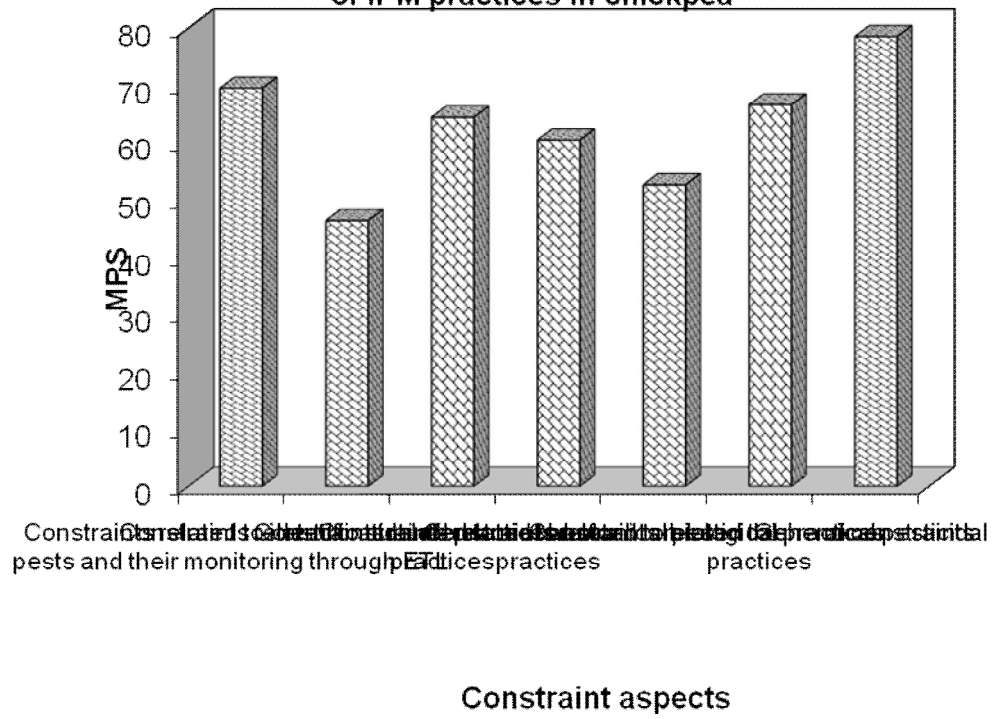


Fig.6 : Overall constraints perceived by respondents in adoption of IPM practices in chickpea



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