

Contents

I. Introduction	3
II. Non Pesticidal Management options	5
III. Methodology	11
<i>i) Pigeonpea Varietal Evaluation</i>	<i>12</i>
<i>ii) First Year of NPM program implementation (1998-99)</i>	<i>14</i>
<i>iii) Scaling UP of NPM program during 1999-2003</i>	<i>18</i>
<i>iv) Sensitization of farmers about hazards of Pesticides</i>	<i>18</i>
<i>v) Implementing the Program</i>	<i>20</i>
<i>vi) Innovative Approaches Followed</i>	<i>21</i>
IV. DIRECT IMPACT OF NPM PROGRAMME	24
V. Visible Gains of the NPM	34
VI. SUMMARY	35
VII. ACKNOWLEDGEMENTS	35

I. Introduction

The high yielding varieties introduced during green revolution responded to high nitrogen and pre disposed them to pests and diseases. Farmers out of anxiety started using pesticides indiscriminately. Even though, over all consumption of pesticides per hectare is low, but the injudicious use of pesticides resulted in harmful affects to the environment. The insect pests have developed resistance to almost all the pesticides recommended for agriculture use. The pesticides have polluted the soils, water and air, which are natural resources used for the benefit of the humanity. The pesticide residues on food grains, milk products, eggs and vegetables are causing health problems to the human beings when consumed. It has been reported that the breast milk contains DDT residues above the tolerant limits in the areas of cotton ecosystem. The pesticide usage per hectare has declined but its usage has increased from 2.4 kg/ha in 1985 to 2.7 kg/ha in 1989 on cotton crop alone. Among the pesticides, insecticides constitute about 72% of the total pesticide accounting for 48.8% of the total quantity of the pesticide followed by herbicides and fungicides. The insecticides have destroyed the useful insects like parasites, predators and beneficial organisms like honeybees, frogs, and insectivorous birds and predatory animals. The whole ecosystem is in danger due to over exploitation of the agriculture. In mid 1980s, the new concept was emerged to control pests in less harmful way in community led program called Integrated Pest Management that combines cultural, mechanical, biopesticides and chemical pesticides (Box1).

BOX 1 Integrated Pest Management – Concept and components

Indiscriminate use of chemical pesticides adversely affects soil health and contaminates the ecosystem. Some times, these pesticides even enable pests to develop resistance. Realising the dangers, an Eco-friendly integrated pest management (IPM) program was initiated in 1980s. IPM is a farmer participatory community activity rather than one imposed from outside. IPM means the use of different methods to effectively control pests to minimise the loss and optimise the returns from crops. It favours greater use of all ecofriendly practices, like natural pesticides (Biopesticides), beneficial insects, birds, and special cultivation practices. Yet, it does not rule out the use of less harmful chemical pesticides in a complementary role, in critical condition.

Components of IPM

IPM is an integrated approach for effective pest management to save crops. The different components in IPM are

- ◆ Use of cultural methods
- ◆ Use of mechanical methods
- ◆ Use of biopesticides and bio control agents
- ◆ Use of avian predators

In addition, use of chemical pesticides in a complementary role.

In Andhra Pradesh, over 400 farmers committed suicide in 1997-98 because they were unable to meet the input demands of cotton monocrop they were growing. They spent money on everything: Seeds, fertilizers, pesticides and electricity for irrigation. Consequently their debts started mounting and at one point of time, they understood that they did not know how to dismount. The only way out for them was to take their own lives by consuming pesticides. In this direction, the KRISHI VIGYANA KENDRA had attempted to minimize the external input usage especially in dealing with crop pests by following a blend of traditional effective practices and selections from modern scientific discoveries. Here, one such attempt made by the Krishi Vigyan Kendra over the years for management of dreaded pest *Helicoverpa armigera* on Pigeonpea success story is presented in detail. The pest *Helicoverpa armigera* Hubner, is posing itself an insurmountable difficulty to the dry land farmer by devastatingly infesting on pulse crops, particularly on red gram and chickpea (Box 2).

BOX 2 Old World bollworm - *Helicoverpa armigera* Challenging Pest!

Helicoverpa armigera is a serious pest on several crops and is widely distributed in Europe, Africa, Asia, Australia and Newzeland. The pest is highly polyphagous and is known to attack more than 180 cultivated and wild plants. In India, it is primarily known as gram pod borer. According to surveys conducted on farmer's field, it is evident that annual losses caused by *H. armigera* on chickpea and Pigeonpea alone may exceed \$ 300 million per year. If the losses on cotton and other crops are added, the figures may further increase substantially. In the northern Cotton Belt till 1970s it was never a pest. From 1980s, serious outbreaks of this pest have occurred in the states of Karnataka, Andhra Pradesh and Punjab on crops such as cotton, chickpea and pigeonpea.

Studies conducted at Bangalore on the life cycle *Helicoverpa armigera* on Pigeonpea shows that the total generation period is 42- 50 days with a fecundity of 712- 1466. The incubation period is 3.4 –5.2 days, larval period 16.3- 20.5 days, pupal period 13.8 – 20.5 days and the total developmental period 38- 42.3 days. The adult moth's life span is about 7.6 days for male and 10.1 days for female. The pest can undergo a long period of diapause under unfavourable conditions of winter and summer. The pest is also having long migration status of more than 200 km. The pest has build-up resistance to commonly used pesticides methomyl, chloropyriphos, quinolphos, acephate, fenvalerate, endosulfan and moocrotophos and synthetic pyrethroids up to 20- 60 fold depending on the location (Singh¹ etal 2002).

¹ Singh, S.P., Ballal, C.R and Poorani, J 2002 Old world boll worm *Helicoverpa armigera*, associated *Heliothinane* and their natural enemies. Project Directorate of Biological Control, Bangalore, India, Technical Bulletin No. 31 iii+135pp.

II. Non Pesticidal Management options

KVK has opted to tackle the menace through Eco-friendly; salubrious and economically viable practices with much focus on local knowledge available within the ethnic groups of farming community with an ultimate goal to attain the reality of a sustainable agro-ecosystem. The practices included in farmers' pest management strategy included the following;

i. Deep summer ploughing

The practice has come a long way as a part of the cultural practice by the farming community. This tends to reduce soil born insects and those, which pass any developmental stages under the soil by -

- * Mechanically damaging the pest
- * Burying and exposing the developmental stages of the pest
- * Changing the physical conditions of the soil thereby hastening the growth or increasing the vigor of the crop

This has been used as the prophylactic measure under Non-Pesticidal Management of *Helicoverpa*. The deep summer ploughing exposes pupae in torpid stage to the natural enemies like birds/ and to the scorching sun. Thus the roles of the natural mortality factors have been enhanced to keep the population under check.

ii. Burning of farm refuge/ stubble

The farming sections know the habit of burning the stubbles left in the field since times immemorial. This is one of the effective traditional/cultural methods that would certainly keep the incidence to the lower degree. Farmers adopt burning of stubble's between 6.30 p.m. to 8.00p.m. The flames entice the nocturnal insects especially the moths that fall prey to the flames.

iii. Intercropping & Mixed cropping

Growing of two or three different crops within the same field reduces the chance of loss incurred due to the failure of a crop being lost due to some constraints. The Medak farmers are adapted to Sorghum +red gram inter cropping as a tradition of their cropping system. Farmers find the practice as viable and sustainable rather than growing pure crops. The habit of Sorghum + Red gram cropping encourages the birds to alight especially during the panicle stage of the sorghum. Thus hastens and harnesses the birds as natural enemies in the ecosystem.

Mixed cropping of different cereals, millets, pulses and oilseed crops simultaneously on the same piece of land with or without any row proportion is also a valid practice to overcome vagaries of weather abnormalities and crop failures. This practice minimizes risk in case of crop failures, acts as barrier for pests, builds soil fertility and makes the farmer self-sufficient.

Photo 6 NPM Demonstration farm showing crop diversity



Diversity in crops plays an important role in pest management. Traditional agriculture systems are highly diverse; this diversity helps to insure against losses due to pests. Non Pesticidal management of pests requires a multi-pronged approach –soil fertility management – use of locally adopted resistant varieties, mixed cropping, use of pest repelling plants and habitat creation to encourage natural predators.

iv. Trap cropping

Small plantings of the susceptible or preferred crop of a pest grown near the main crop act as a trap crop. Farmers adopt marigold as a trap crop for the gram pod borer reduces the pest load on pigeonpea. The flowers that have been ovi posited by the female moths of *Helicoverpa* can be picked out and destroyed.

Table 1 Growing trap crops

Crops	Pest	Trap crops
Cotton	<i>Spodoptera</i>	Castor, Sunflower
Cotton, Chickpea	<i>Helicoverpa</i>	Marigold
Pigeonpea	<i>Helicoverpa</i>	Marigold
Ground Nut	<i>Spodoptera</i>	Castor
Cotton	Spotted boll worm	Bhendi

v. Bird perches

The birds are the potent predators on the larvae of insects. The chance of gram pod borer larvae being predated by the Avian gets hastened by erecting the bird perches randomly in the field. A wooden log or a branch bifurcated at the top provided with an earthen container filled with water mixed with cooked rice attracts the birds. The farmers of Medak region adopt the broadcasting of puffed rice to attract the birds in their fields.

vi. Manual collection & destruction of larvae

Farmers to save the crop from the damage adopt the mechanical picking, collecting and killing of larvae of *Helicoverpa*. The larvae after collection will be burnt and destroyed. Alternately, Shaking of branches may be done and the larvae collected can be thrown to flames.

vii. Natural Extracts

The low cost natural extracts as chief options in taming the gram pod borer include:

- Cattle dung + urine extract
- Jaggery solution
- Neem seed kernel extract
- Tobacco Extract

(a) Cattle dung + Urine solution spray

Farmers use this spray to nourish the crop plants besides reducing the pest attack. The spray discourages the infestation and improves the crop health and flower retention of the stand by means of trace elements presented in it. For getting the desirable results, it is always advisable to spray after 3.30 p.m. Increasing the number of sprays to two or three times produce the effect desired.

Preparation

The cattle urine of 3 to 5 liters mixed with 3 to 5 kg of dung is allowed to ferment for four days in a tank covered with a lid. The slurry is allowed to pass through a diaphanous cloth to get the stock solution. Adding 200 to 250 g of quick lime neutralizes the acidity of the solution. The stock solution thus obtained is adequate to be sprayed on one acre of field after diluting it with 50 to 80 liters of water.

(b) Jaggery solution spray

Farmers record attraction of ants to the pigeonpea fields sprayed with 5 per cent Jaggery solution. The sweetness of the solution allures the ants that predate upon the eggs of *Helicoverpa* besides preying upon the initial instar stages of the larvae. Four kilograms of Jaggery dissolved in eight liters of water acts, as the stock solution, which is made to 80 liters, will be adequate for one acre of field. Farmers witnessed this besides attracting ants, also helped in improving the texture of leaf.

(c) Neem Seed Kernel Extract (NSKE)

Farmers have been used to spraying NSKE which acts as a ovi-positional deterrent. The leaves and other parts of the plant sprayed with the extract repels the larvae from feeding resulting in death due to starvation.

Preparation of Extract

Take 3 to 7 kg of Neem seed and pound it gently. The powder obtained will be taken in muslin cloth and tied to get a pouch, which is allowed to soak in 50 to 80 L of water for over night. The pouch is thoroughly squeezed for four to five times to get the extract into water. 50 to 100 g of detergent is added to the extract to get milky white NSKE.

Farmers adopt the following practices to ensure the access and efficacy of the extract:

- Collect the Neem fruits during bearing season and air-dry them under shade.
- Do not use the seeds over eight months of age. The seeds stored over and above this age lose their activity and hence not fit for NSKE preparation.
- Spray the extract after 3.30 P.M. to get effective results.

(d) Tobacco Extract

Tobacco is cultivated for use in the tobacco industry to make cigarettes, bidis and chewing tobacco. It has excellent insecticide properties and farmers use for killing of insect pests since time immemorial. However its usage must be restricted in causing harm to beneficial insects and not advocated much.

Preparation:

Take 250-g tobacco waste and boil it in 4 liters of water for half an hour. Cool it and filter through muslin cloth. Add 30-g soap and mix well. Dilute 1part extract with 4 parts of water and use as spray. Adding a little lime powder increases the efficacy of the extract.

(e) Chilly + Garlic Extract

Chilly and garlic are available in every household and the farmers found excellent pest control properties with both the extracts when sprayed on crops. It acts, as ovi-position deterrent and female moths won't like to lay eggs on treated surface. Further if any early stages of larvae were present, they get killed due to pungent properties of extract.

Preparation:

Take 3 -4 kg of green chillies and 400-700 grams of garlic cloves. Grind them separately. Dissolve the green chillies paste in 8-10 liters of water and garlic paste in 150- 200-ml kerosene and filter them separately by means of thin muslin cloth. Mix both the extract and also add 50g soap to the filtrate. Dilute 1 part of the extract with 4 parts of water to spray.

viii. Mechanical collection:

Farmers in Zaheerabad region practice hand picking and shaking branches to dislodge if the pest reaches severity. With the advent of pesticides, these methods were rarely practiced. Shaking method is found to be most effective for pest control when pesticides do not control pest. In these methods, 3 or 4 family members enter in to the field and shake the branches to dislodge the pest.

In addition to above farmer's practices, the Krishi Vigyan Kendra has introduced Pheromone traps as a pest monitoring mechanism and HNPV spray to manage the pest.

ix. Pheromone Traps (for Monitoring and mass trapping Insect Pests)

Sex Pheromone lures:

Adult female insects that are ready for mating emit species-specific chemical odors to attract the males. The methods of utilizing these chemicals produced by insects for their procreation, as tools for their destruction were developed and are popularly known as Pheromone traps. Pheromones synthesized in the laboratory are formulated and supplied in the form of lures, to be used along with suitable traps to deceive, attract and trap male insects.

Monitoring:

Installation of pheromone traps with suitable lures @ 2-3 per acre can provide information on pest incidence and intensity in crop fields. Based on the number of males caught, the timing and frequency of control measures can be determined.

Mass trapping:

Sex pheromone traps can also be used as devices for reducing the population of target pests. The majority of females present in cropped fields remain unmated and lay infertile eggs as a result of mass trapping of males.

x. H-NPV virus :

In the fields, natural mortality of *Helicoverpa* can be seen due to infestation of disease causing virus particles. Such larvae can be collected and may be utilized again for checking *Helicoverpa* populations. The virus is specific to *Helicoverpa* larvae causing heavy mortality but has no deleterious effect on non-target insects, animals or crops; it is therefore safe for natural enemies and the environment.

Method of preparation:

- ◆ Larvae died due to infection of NPV are seen in the field.
- ◆ Collect 400 NPV affected *Helicoverpa* larvae from field.
- ◆ Grind the collected larvae.
- ◆ Filter the solution obtained using a thin cloth
- ◆ Dilute the NPV solution to 100 liters and add 100g of robin blue to protect from UV light in the field.
- ◆ Spray this solution during evening hours
- ◆ Insects controlled *Helicoverpa*, *Spodoptera*.
- ◆ Virus of one insect species does not kill the other species

- ◆ Virus infected dead larvae are observed hanging head upside down from top branches 2-5 days after spraying the solution in the case of *Helicoverpa* and split body in case of Spodoptera.
- ◆ With in 10 days all the larvae in the field are infected with NPV.

Application of NPV:

NPV is sensitive to ultra violet rays of sun. Options for improving the effectiveness of the NPV include spraying late in the day after peak sunshine. Additionally adding UV absorbents such as 1ml of robin blue to a liter of spray solution has been reported as improving the effectiveness of NPV. For Pigeonpea HNPV should be used at 500 LE per ha and chickpea 250 LE per ha.

xi. Usage of organic manures

In addition to above NPM options, wide usage of organic manures such as tank silt, farm yard manure, green leaf manuring (with *Glyricidia*, *Pongamia*, *Cassia tora*), green manuring (with sunhemp, *Daincha*, different legumes), processed manures (like vermicompost, neem cake, pongamia cake), penning (sheep and goat stalling overnight in the field) etc are encouraged to make "soil fertile and healthy". A fertile and healthy soil acts as first defense mechanism against pest and diseases.

Box 3 *Helicoverpa armigera* life cycle Vs Effective NPM options to follow up

The usual IPM package contains a limited use of pesticides in the event of pest reaching beyond Economic Threshold Levels. But, there are some botanical pesticides that are effectively replaceable with chemical pesticides. The chemical pesticides used in IPM package are eliminated this package and hence it is termed as Non Pesticide Management (NPM). The sets of options to be followed in different stages of the pest are given below;

- ❖ Egg stage: NSKE 5%, Trap crops, Release of Predators and Parasitoids
- ❖ Larval Stage: NSKE 5%, Tobacco decoction and Chilly garlic extract, H-NPV spray, Shaking, Bird Perches, Collection and Destruction of grownup larvae.
- ❖ Pupal Period: Deep Summer Ploughing, Destruction of plant debris,
- ❖ Adult: Light traps, Pheromone traps.

Krishi Vigyan Kendra also standardized the time of practicing various NPM practices that are given in table 9.

Table 2 Non Pesticidal Management Options – follow-up dates

S. No	Option	Approximate date of practicing in the field
1	Deep Summer Ploughing	2nd week of April - 2nd week of May
2	Sowing, Neem cake application, biodiversity maintenance	2nd Week of June – 1st week of July
3	Castor and Marigold planting as trap crops.	1st Week of July – 3rd Week of August
4	Installation of Pheromone traps and Bird perches	3rd Week of September - 1st Week of October
5	Cow dung + Urine sprays (when eggs were traced in the field)	1st Week of September – 2nd Week of October
6	Jaggery solution spray (early larval stages)	Last week of August – End of September.
7	Neem oil spray	3rd Week of October – 1st Week of November
8	Chilly + Garlic extract	2nd Fortnight October – 1st Fortnight November
9	Shaking of branches for dislodging the larvae	Last Fortnight of September – End of November
10	Manual Collection and Destruction of larvae	3rd & 4th weeks of December.

III. Methodology

The Deccan Development Society has been operating in 78 villages in 4 mandals of Medak district of AP and have been implementing programs like organizing farmers into sanghams (Women), socioeconomic development, functional literacy etc. Initially, Krishi Vigyan Kendra has demonstrated NPM practices during 1998-99 cropping season with about 10 farmers in Bidaekanna village of Jharasangham mandal situated about 15 km away from Zaheerabad. KVK has given much emphasis for women farmers, as they are the key decision-makers in the NPM program right from selection of seed to harvesting. The progress of the NPM activity chronologically is shown in a flow chart (Fig1).

PRA on Matrix Ranking of Problems

A Group Discussions was conducted on problems associated with pigeonpea cultivation and was analyzed through matrix ranking. The intensity and distribution of the problem was scored on a 10-point scale and the combined score to arrive the major problem.

Table 3 Matrix ranking of problems associated with Pigeonpea cultivation

Problem	Intensity	Distribution	Preference
Poor resource base	5	4	9 III
Timely land preparation	4	4	8 IV
Manuring and Fertilizers	8	6	14 II
Unfavorable weather conditions	6	2	8 IV
Flower drop	3	1	4 VI
Incidence of diseases like Wilt	2	1	3 V II
Heavy incidence Pests like gram pod borer	10	8	18 I
High cost of plant protection	6	2	8 IV
No Profitability of farming	3	2	5 V

Various problems listed by participants of PRA include the poor resource base of the soils, lack of animals or tractors to take up summer ploughing, in sufficient farmyard manure for fertilization of crops, unfavorable weather conditions, low returns and high cost of cultivation which relate to general problems associated with cultivation of crops. The specific problems for pigeonpea include flower drop due to moisture stress, wilt incidence and *Helicoverpa* damage, high cost of plant protection, which needed some intervention. The top most problem was due to damage by Gram pod borer and necessitated the KRISHI VIGYANA KENDRA to take up its control by following a set of practices that are with in their resource base.

i) Pigeonpea Varietal Evaluation

Another PRA was conducted with the farmers with the objective of finding solutions to pest tolerance ability of different cultivated Pigeonpea varieties (Local land races and research station developed).

Participants: Mixed group of Men and women farmers of Raipally, Metalkunta, Khasimpur, Ippapally, Gangwar villages

Different Pigeonpea Varieties Evaluated:

- ◆ Tella Togari: White seeded variety of Pigeonpea, Land race
- ◆ Nalla Togari: Black seeded variety of Pigeonpea, Land race
- ◆ Yerra Togari: Red variety of local origin /ecotype

- ◆ Doddu togari: Large bold grain type of local origin/ Ecotype
- ◆ Nadipi togari: Medium duration of Local origin
- ◆ ICPL 87119: Asha Variety developed by ICRISAT recommended for the region for Helicoverpa, Wilt and SMD (Sterility Mosaic Disease).

Parameters Evolved for study:

- ◆ *Helicoverpa* tolerance
- ◆ Wilt tolerance
- ◆ Yield
- ◆ Market acceptability
- ◆ Cooking Value
- ◆ Taste

Results:

All the farmers were asked about the different varieties in cultivated Pigeonpea and reasons for still sowing in farms in advent of many improved Varieties developed by State Agriculture University and ICRISAT. Different varieties were scored on 10-point scale for the above criteria. The highest score was ascertained to *Nalla Togari* with high degree of tolerance for *Helicoverpa* and Wilt problems. Interestingly, except *Burkha togari*, all the varieties scored higher than the improved variety ICPL 87119. The draw back was with cooking which consumes more time. In rural areas, cooking is open process and no one use of pressure cooker. More time for cooking is reported and stated it is the major set back with the variety. Further, they felt that it is of long duration and needs intense care of *Helicoverpa* than the local varieties and land races. Many of the farmers have expressed disappearance of *Burkha togari* which once sown even in small areas was due to very low yield and easy susceptible to *Helicoverpa* and wilt. Further expressed it is having some medicinal properties and are recommended for pregnant and lactating mothers.

Table 4 Scoring² and Matrix Ranking of different Pigeonpea varieties

Pigeonpea varieties	Parameters						
	Helicoverpa tolerance	Wilt tolerance	Yield	Market acceptability	Cooking value	Taste	Total Score
Tella togari	4	8	6	6	6	10	48 II
Nalla togari	10	10	8	6	8	8	50 I
Yerra togari	6	6	8	10	10	8	48 II
Burkha togari	6	6	4	6	8	8	42 IV
Doddu togari	8	8	8	8	8	8	48 II
Nadipi togari	8	8	8	8	8	8	48 II
ICPL 87119 (Asha)	6	8	10	8	6	6	44 III

² A score of 10 would indicate that all the producers considered the variety good and reducing number indicates comparatively less preference of participants of the PRA

Based on the farmers knowledge choice was given to farmers to plant the variety they like most rather than introduction of improved ones. Majority of the farmers preferred *Nallatogari* along with other local varieties.

ii) First Year of NPM program implementation (1998-99)

The KVK first implemented the NPM program in Bidaekanna village of Jharasangam mandal with 10 small farmers during 1998-99. The Bidaekanna village hosts predominantly red soil types with few acres of black soils having diverse cropping patterns. During the year 1997-98, there was heavy incidence of *Helicoverpa armigera* on Pigeonpea and other crops. Mostly large and medium farmers of Bidaekanna sprayed 300 liters. (Approx.) of pesticides like Monocrotophos, Endosulphon, Dunet etc spending nearly Rs. 57,000 – 80,000/- to control *Helicoverpa*. Though pesticide consumption on the whole is very less in the village, it caused residual problems in food, vomiting, and diarrhea and stomach pain to people exposed to pesticide sprays directly or indirectly.

The following cropping systems are prevailing in Red and Black soils in different seasons, which gives us an idea of among of diversity in agricultural crops.

Figure 1 Flow chart showing series of interventions during 1998-99 to 2003-04 under NPM program of Pigeonpea.

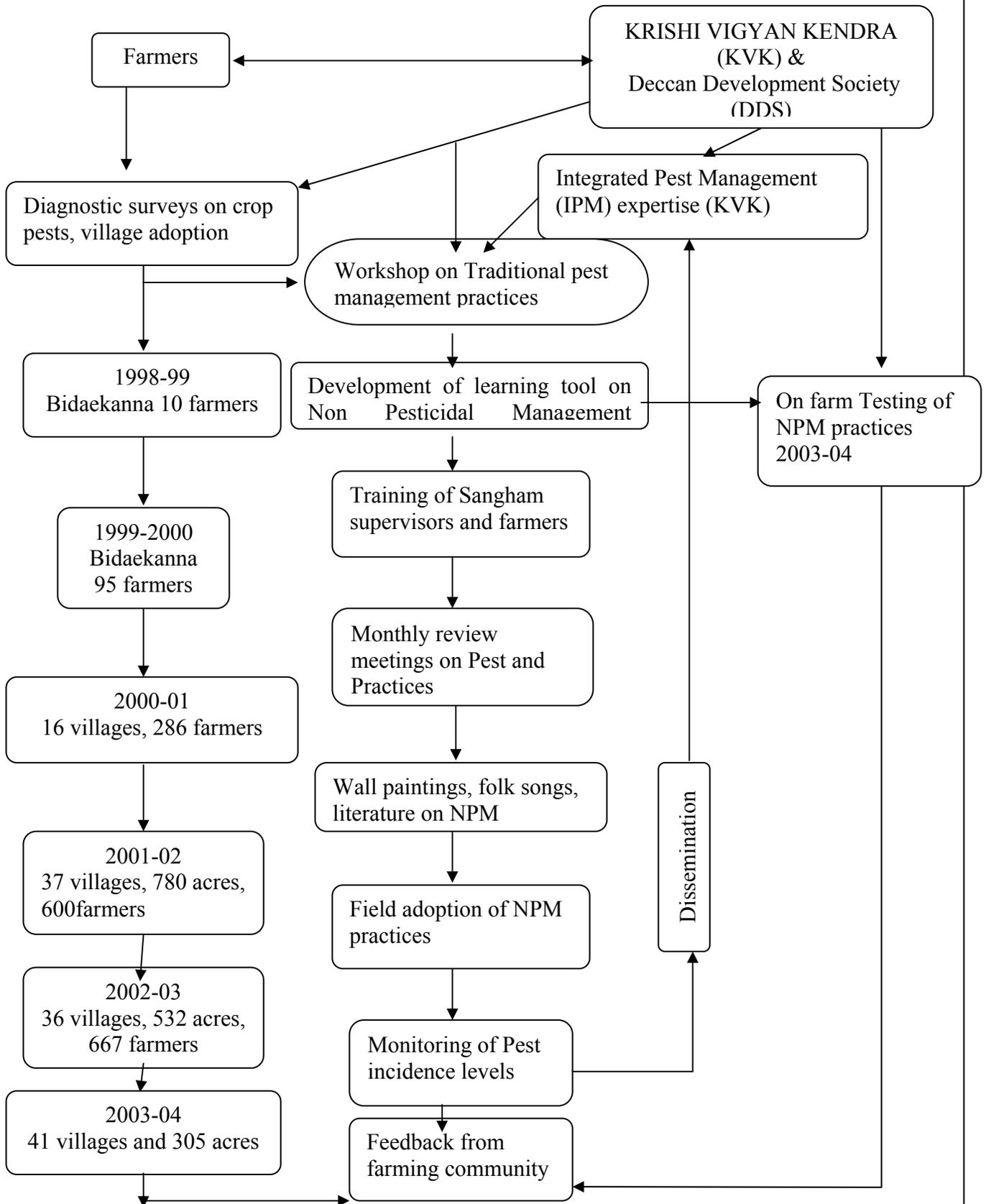


Table 5 Details of crops and cropping systems and major pests and diseases in Bidaekanna village.

FS	Season	Crops and cropping systems in practice	Major pests and disease
Rainfed Red soils	Kharif	<ol style="list-style-type: none"> 1. Pigeonpea + Sorghum + Field bean + Cowpea + Hibiscus + Greengram 2. Sorghum + Bajra + Pigeonpea 3. Greengram + Sorghum + Field bean + Cowpea + Hibiscus 4. Sorghum + Bajra 5. Gingelly + Sorghum 6. Pigeonpea + Sorghum + Gingelly 7. Groundnut + Sorghum + Cowpea + Field bean + Gingelly 8. Dryland paddy + Finger millet 9. Niger 10. Little millet 11. Horse gram 12. Voma 13. Sunhemp 	<ol style="list-style-type: none"> 1. Pigeonpea – Heliothis, black hairy caterpillar, pod fly. 2. Sorghum – White grub 3. Bengalgram – Heliothis 4. Greengram – Aphids 5. Groundnut – White grub, Aphids and Semilooper 6. Safflower – Aphids 7. Sugarcane – Early shoot borer 8. Hibiscus – Black hairy caterpillar 9. Potato – leaf hopper, Aphids 10. Blackgram – Aphids, Semilooper 11. Mustard – Aphids 12. Ginger – Rhizome rot
	Rabi	<ol style="list-style-type: none"> 1. Rabi Sorghum + Safflower 2. Rabi Sorghum + Horse gram 	
Rainfed Black soils	Kharif	<ol style="list-style-type: none"> 1. Blackgram + Gingelly 2. Greengram + fodder sorghum 3. Pigeonpea + Field bean + Blackgram + Sorghum + Cowpea 4. Pigeonpea + Sorghum + Field bean + Cowpea + Greengram + Hibiscus 	<ol style="list-style-type: none"> 11. Mustard – Aphids 12. Ginger – Rhizome rot
	Rabi	Rabi Sorghum + Chickpea + Wheat + Safflower + Linseed + Lathyrus + Lentils + Hibiscus + Dosa Tiga + Mustard.	
Irrigated Black/red soils		<ol style="list-style-type: none"> 1. Sugarcane + Maize + Field bean + Hibiscus + Castor + Chikkudu + Gangavlikura + Sesbania 2. Turmeric + Castor + Brinjal + Tomato + Chikkudu + Hibiscus + Sompu 3. Ginger + Chillies + Castor 4. Onion 5. Garlic + Coriander 6. Paddy 7. Potato 	

Training of farmers on various non-pesticide management options

At the very beginning in the first week of June, a training program on “Scientific method of neem seed collection, processing and storage” was conducted for the NPM farmers so that neem seed kernel extracts can be made out of quality neem seed collected for spraying

on pigeonpea as a prophylactic measure. As a result of this, the group collected 120 kg of good quality neem seed kernels. On June 30th another training was conducted regarding NPM options in pigeonpea to familiarize the pest control with locally available low cost botanical products such as Annona, Chilly+ garlic extract, Tobacco wastes. A review meeting was also conducted to discuss about the crop growth and pest problem encountered by farmers. On 24-10-1998, another training program was conducted for demonstration farmers on neem seed kernel extract preparation and field application. Regular, field days at fortnightly interval were conducted in successful NPM farmer's fields with other Non-NPM Farmers in the village for field identification of harmful and beneficial insects in the village and spreading the NPM concept.

Harmful and beneficial organisms population data on Pigeonpea 1998-1999.

With the participants of the field day, pests and beneficial insect counts were taken for visualizing direct effects. For this purpose, 10 plants were randomly selected and the number counted separately.

In NPM farmers field:

Pests & Beneficial organisms	September		October		November		December	
Fortnights intervals	1	2	1	2	1	2	1	2
<i>Helicoverpa</i> populations (number)	0	0	3	8	24	52	33	23
Beneficial organisms ³ number	24	82	94	116	260	312	204	131

In Non-NPM farmers fields

Pests Beneficial organisms	September		October		November		December	
Fortnights interval	1	2	1	2	1	2	1	2
<i>Helicoverpa</i>	0	0	5	8	35	72	54	41
Beneficial organisms	24	71	86	99	175	229	109	85

Table 6 Details of yield and income in NPM and Non-NPM fields in 1998-99 in Bidaekanna village.

Sl.No	Name of the farmer	Pigeonpea Yield (Kg/ ha)	Total cost of cultivation (Rupees)	Gross income (Rupees)	Net income (Rupees)	Plant protection expenditure (Rupees/ ha)
NPM Farmers						
1	Tuljamma	200	2650	5600	2950	125
2	Sammamma	175	3575	4900	1325	250
3	Paramma	175	3575	4900	1325	250
4	Vimalamma	225	2525	6300	3775	125
Non NPM						
1	Ramappa	113	4675	5040	865	1500
2	Siddappa	150	4787	5320	533	1500

³ Beneficial organisms include spiders, ants, wasps, ladybird beetles etc.

From above table it is evident that plant protection cost was very high in case of Non-NPM farmers and still yields are very low. IN CASE OF NPM, farmers due to adoption of different options the plant protection costs were very low. Yields of some of the farmers are very encouraging. In the year 1998-99, the pesticide use was also came down drastically to 30-40 liters. This is mainly due to failure of the pesticides to control pests and increase in awareness among farmers due to NPM program in village.

iii) Up Scaling of NPM program during 1999-2003

The Krishi Vigyan Kendra had conducted a series of dialogues with farming community where DDS was in operation in popularizing the NPM concept systematically after success with dalit farmers of Bidaekanna village of Jharasangham mandal during 1998-99 cropping season. The conditions under which the pigeonpea crop was grown and the farming community that was focussed is given in box 4.

BOX 4 Area and Farmers Profile

The conditions under which Pigeonpea where NPM of pigeonpea was followed in six mandals of more than 80 villages are as follows;

- Divergent soils (Shallow red to deep black vertisols)
- Average rainfall 700-800 mm.
- Undulating to plain slopy lands
- Pigeonpea is the main crop grown in Kharif with varied proportions of sorghum, millets, Niger, different pulses in a mixture.
- Genetic diversity of Pigeonpea is more
- Small and Fragmented land holdings
- Poor resource base, low income groups
- Farmers had rich knowledge base in rainfed agriculture

iv) Sensitization of farmers about hazards of Pesticides

Before conducting the program, KVK activated the women farmer groups (popularly known as sangham) through PRA techniques, folk songs and regular training's in KVK. The program has given more focus to dalits (resource poor) and women farmers, as these are vulnerable to global changes. Theses are the people marginalised in the pre and post green revolution.

PRA was conducted with the trainees on impact of pesticides on pests, natural enemies over a period. On the ground, a rectangle box was drawn with chalk powder representing the cropped field. Small circles, triangles were chosen to represent the pests

and natural enemies in the field before pesticide sprays. After pesticide sprays there was decrease in both the populations. However, over a period there were more pests and fewer predators indicating imbalances. This was brought in to notice of the farmers about the hazards of pesticides in agriculture ecosystems. This has driven peoples to learn non-pesticide management options.

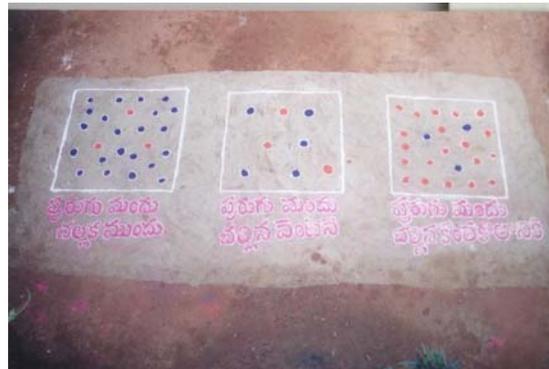
BOX 5 *Helicoverpa* outbreak – Possible reasons.

India has witnessed serious outbreaks of *Helicoverpa armigera* during last two decades. More than 400 farmers have killed by themselves since December 1997 in AP, Karnataka and Maharashtra Vidarbha region when their crops devastated by *Helicoverpa*. They could not clear heavy debts incurred for procuring pesticides and fertilisers. There were also several factors for farmers' suicides. The main reasons include use of spurious pesticides supplied on credit by local pesticide dealers, improper spray delivery systems like Ultra low volume/ low volume sprayers), tank mixing of three or four different pesticides, frequently at sub-lethal doses by farmers contributed to the serious outbreaks witnessed in 1980s. Weather factors also aggravated the outbreaks. Pest outbreak on Pigeonpea and chickpea, was due to unseasonable and heavy rains and large no of cloudy days in November 1997 when the crop was in flowering and pod formation stage. Continuous rainfall also succeeded in reducing the efficacy of pesticides.

Photo 1 PRA showing the effect of chemical pesticides on pests and natural enemies



Photo 2 Close-up view of Effect of Chemicals



vi) Innovative Approaches Followed

The KVK has facilitated 23 group-training programs of 2 day duration during the flowering period of pigeonpea in KVK campus. The details of training courses conducted were presented in the Table 4. The farmers were taught about the different NPM methods for *Helicoverpa* management within their resource base. In addition to this practical demonstration on NSKE preparation, Tobacco decoction preparation, Cow dung + Urine solution preparation and application, Pheromone traps installation and change of lures etc. was organised and concepts of pest buildup, resistance to pesticides was pictorially explained to the farmers. Slide show presentation and small video film of 10 minutes duration made by the Community Media Trust on various Herbal Extracts was also shown to the farmers. The various innovative approaches followed are presented in photographs (Photos 3-5).

Photo 3 Folk dance on NPM for Effective communication to illiterate masses in program villages



Folk dances played a key role in spreading the NPM concept to illiterate mass both culturally and socially acceptable form. Community Media Trust, Pastapur an autonomous rural women videographers had documented the folk dances for use in future trainings at Krishi Vigyan Kendra.

Photo 4 Method Demonstration to Sangham Supervisors on Pheromone traps installation



Photo 5 Wall Poster on NPM of Helicoverpa



Since most of the trainees are illiterate, the folk dances (Burrakatha) with Warangal group were organized during night hours on Non Pesticidal Management and video shows were arranged for easy understanding (Photo 3). After the training program, the farmers were taken to field visits to some of the NPM farms and NPM demonstration unit of KVK instructional farm, Raikode. During the field visits, identification of pest, place of egg laying and life cycle was explained to the farmers. The identification of beneficial organisms and their role in pest control was explained to the participants.

Table 8 Training programs conducted on Pest management of Pigeonpea

Year	No of courses	No of participants		Total
		Male	Female	
1998-1999	10	82	139	221
1999-2000	2	7	40	47
2000-2001	5	42	296	338
2001-2002	2	20	35	55
2002-2003	4	50	121	171
Total	23	201	631	832

In addition to these training wall paintings on Pest management were taken up in the mandal head quarters covering the cluster villages for dissemination to non participating farm families (Photo 5). Besides, trainings on NPM of Pigeonpea, Chickpea and various botanical pesticides preparation, field demonstrations were also laid in KVK instructional farm, regular field days were also implemented for dissemination of the technology. Literature on crop protection, wall paintings, and folk dances were also utilized in transferring the technology to farming community.

- ❖ Demonstrations: Field demonstrations were laid at KVK instructional farm at Raikode in an area of 1 ha every year showing various NPM options on Pigeonpea crop pests.
- ❖ On farm testing of NPM practices were carried out 2003-04 at Gopanpally in an area of 10 ha.
- ❖ NPM field days were conducted once in year with the help of CWS
- ❖ A workshop on Neem was organized with CRIDA scientists on utilization of Neem products in agriculture during 2003.
- ❖ Wall poster writing on NPM was taken up in 6 villages in 2000-01.

IV. DIRECT IMPACT OF NPM PROGRAMME

1. DEVELOPMENT OF MASTER TRAINEES

Krishi Vigyan Kendra has trained the DDS Project staff and Sangham Supervisors on various NPM options in the year 2000-2001. Their role in spreading the concept in different operation villages was both horizontal and vertical and formed as integral part in implementing the crop insurance program.

Table 9 some of the master trainees, villages and area coverage during 2003-04

S.No	Year	No trainees developed	No of villages covered.	Area coverage (Acres)	Average income (Rupees)
1	1997	2	2	20	1000
2	1999	1	6	71	4800
3	2000	12	32	300	500
4	2001	2	15	20	300
5	2002	2	6	43	2150
6	2003	8	21	182	525
	Total	27	82	636	

For example, some of the master trainers like Sri Mosess, Janardhan and Suresh were employed in crop insurance program and other trainees were played instrumental role in implementing the NPM program where DDS was in operation. These master trainees has to record the various pest control measures taken from time to time in to the passbook and estimate the loses incurred despite NPM options followed for crop insurance program. Others were paid by the DDS directly for monitoring the various pest control measures followed by the premium holder. As per the records available, the master trainees have covered 636 acres in 82 villages during 2003-04.

2. ESTABLISHMENT OF NEEMOIL EXPELLER UNIT

The KVK has imparted training on Quality collection, utilization of neem seed to DDS women sangham farmers. These women farmers were motivated to procure and maintain a *ghani* type neem seed-crushing unit with the assistance of Manjeera Gramina Bank. Further, the KVK has also made efforts to popularize the machinery developed by CRIDA for NSKE preparation.

Box 6 Women Enterprise - Neem oil Expeller unit.

Zaheerabad is endowed with plenty of neem trees and found everywhere in homesteads, field bunds, roadside and wastelands. The tree comes to flowering in February - March and fruit shedding starts with the onset of monsoon. The fruits in the villages were quite often collected by the poor and bring their collection to the different market yards in the district. They often collect the fallen fruits on the ground which are contaminated with the soil, leaves and twigs and some times dry them or bring them as it is. In the Zaheerabad market yards itself around 1000- 1200 metric tons of neem fruit is traded and are priced in between Rs 80- 130 per quintal. But, the commercial neem cake after extraction of oil is sold Rs 600 per quintal in fertiliser shops. Most of the women collect the seed during season and trade them at a meagre price equivalent to wage labour. The buyers are intern selling the fruits to Neem based industries located at Guntur, Lathur, Shadnagar, Hyderabad at higher price. Neem seed collectors feel that they are naturally endowed and never feel that buyers less valued them. Keeping in view of this, the Sanghams were motivated to install a neem oil expeller unit at Hoti -B and Algole with the thrift amount collected. Manjeera Grameena bank a subsidiary of State Bank of India come forward to finance the equipment. The women sanghas were organised to purchase Ghani type expeller with crushing capacity of one ton per day with oil recovery of 8-10 per cent. Thus, these neem seed collectors were organised by DDS to run a neem oil expeller unit with substantial gains. These units were now supplying "Azadirachtin" rich (more than 800 ppm) neem oil needed for crop protection competitively lower price than the market under the brand name of Deccan Neem oil and Deccan neem Powder.

Neem oil Expeller Unit at Hoti- B village, Operated by Women Sangham of DDS



3. CROP INSURANCE PROGRAMME

Deccan Development Society has initiated a scheme called "crop insurance scheme" in from 1998-99 cropping season for Pigeonpea and Chickpea farmers. This scheme is designed to follow the various NPM options by the farmer and any losses due to the pest despite practicing methods would be compensated. The set of documents executed in crop insurance program is shown in Photo 6 & 7. More details of the crop insurance program can be seen in the box -7 given below.

Photo 6 Crop Insurance Scheme - Security to Pigeonpea and chickpea farmers

డారుపేరు :	
మండలం :	
పట్టణం పేరు :	
భీమా ఎకరాలు :	
మట్టి రకము :	

పంటభీమా పట్టణం పుస్తకము

భీమా సంవత్సరం : _____

పంట : _____

సంఘం మొబరు / బయటి మొబరు : _____

పి.డి.యస్.మొబరు / ఇండిఫర్మల్ మొబరు / కౌలుభూమి మొబరు : _____

చేటా ఎక్సన్ ఓడ మొబరు : _____

Photo 7 Crop Insurance Certificate

డెక్కన్ డెవలప్ మెంట్ సొసైటీ, పస్తాపూర్

పంటల భీమా పత్రము.....సం॥

..... మండలం..... గ్రామమునకు చెందిన క్రిందికి
 తర్ర / తండ్రి క్రి గారి వద్ద
 వెంబరు లో ఎకరాలు పంట చేసుకున్నాను.
 పైన తెలిపిన పంటకు ఎకరములకు పంట భీమా పైసలు ఎకరమునకు
 రూపాయలు లొప్పన మొత్తం రూపాయలు తేదీ నాటికి
 కట్టి రసీదు తీసికొంటిని. రసీదు వెంబరు గలదు.
 ఈ క్రింది షరతులకు ఒప్పుకొని ఎప్పటికప్పుడు ది.డి.యస్. వారు చెప్పినట్లు చేస్తూ నా పంటను పురుగునుండి కాపాడుకుంటాను.

- ఒకే రకం పంట కాకుండా వివిధ రకాల పంటలను కలిపి పెట్టుకుంటాను. అందులో పురుగులను రాకుండా చేసే చెట్లు, ఉదాహరణకు ఆముదము, బంతి, తులసి, దోసకాయ తీగలు, ధనియాలు కూడా చేసుకుంటాను. పంట చేసులో తల్లి పురుగు పెట్టిన గుడ్డు ఎప్పటికీ చూస్తూ నాశనం చేస్తూ, మంటలు పెట్టి తల్లి పురుగులను చంపి పురుగులను తగ్గిస్తాను.
- కానుగ, బేపరము, సితాఫలం, అత్తవరం, యాపాకు మొక్క, కపాయం, మిరపి ఎరిగెళ్ళ, గ్యాసనూని లావణము, మొదలగు వాటిని సరియైన సమయమున కొట్టి పురుగును తక్కువ చేసుకుంటాను.
- పురుగు అయినపుడు కనిపెట్టి చేతితో పిరిచేస్తాను. ఈ విధంగా కనిసం 3 పొద్దు కొడతాను.
- సర్కారు ఎరువు, సర్కారు పురుగు మందుల వాడకం చెయ్యను. పాత పద్ధతులను చేసుకుంటాను. ఉదాహరణకు ఒక్క ఎకరానికి 50 కిలోల వేప విత్తనాలు జమ చేసుకొని వాటి రసం తీసి పంటకు కొడతాను. పై విధంగా చేసిన పద్ధతులని సరిగ్గా చేసినట్లయితే పురుగుల పంట నష్టం జరిగితే క్రింది విధంగా నష్ట పరిహారం ది.డి.యస్. ద్వారా ఇవ్వబడును.

వేసగ పంటకి ఎకరానికి :
 పంట 2 సంవలు పండితే ఏం రాదు.
 పంట 1 1/2 సంవలు పండితే రూ. 500లు వస్తాయి.
 పంట 1 సంవి పండితే రూ. 1000లు వస్తాయి.
 పంట 1/2 సంవి పండితే రూ. 1500లు వస్తాయి.
 పంట ఏమీ పండకుంటే రూ. 2000లు వస్తాయి.

తొగలి పంట ఎకరానికి :
 ఒక సంవి పండితే రూపాయలు ఏం రావు
 నగం సంవి పండితే రూ. 750
 పొద్దు సంవి పండితే రూ. 1,125
 ఏమీ పండకుంటే రూ. 1,500.

సంతకము

BOX 7 Crop Insurance – Security to Pigeonpea and Chickpea farmers against Helicoverpa
Deccan Development Society has made effort to build confidence with Non Pesticidal Management among the communities in scheme called pantabheema (Crop Insurance) that was started in 1998 for Pigeonpea and Chickpea farmers. This scheme facilitates pigeonpea and chickpea farmers to insure their crop against loss or damage due to pests despite NPM options followed. According to the scheme, farmer has to insure his crop with a barest one time premium of Rs 100 with the DDS and he has to follow the NPM practices starting right from summer Ploughing, mixed cropping, no chemical pesticide sprays, ecosystem adopted local varieties with a host of other crops, trap crops, pest monitoring with pheromone traps, protecting the crop with botanical pesticides, hand picking and other indigenous practices invoke. For deprived farmers support was also extended in the form of crop inputs such as neem cake, neem oil, and pheromone traps, lending of sprayer etc. Sangham supervisors monitor the farms closely from time to time and they also have to record the practices followed in a passbook called *Pantabheema pattereddar passbook, which was kept with premium holder*. The booklet is very elaborate contains the details of landholder, village, mandal, soil type, crops raised, insurance year, whether cropped in PDS lands or Food Security Member or land lease program member and also the various options followed with date and signature of premium holder and Sangham supervisors. Supervisors and Sangham committee member also has to enter crop and pest scenario from time to time and finally the decision is also vested with them regarding how much crop is lost due to pest and how much compensation need to pay to premium holder as per the terms and conditions.

Terms and Conditions to get Compensation:

Even if farmer has followed the NPM options, the crop yields are lower than the set yield say for example 100 Kg in pigeonpea, 200 kg in chickpea farmers were compensated by the DDS as per the insurance agreement norms as below;

In case of Pigeonpea, if the yield realised was 100-kg per acre: No compensation,

50-kg yield: Rs. 750/-.

25-kg yield: Rs. 1125/-.

Whole crop loss: Rs. 1500/-.

In case of Chickpea, if the realised yield 200 kg per acre: No compensation,

50 kg: Rs. 500/-.

100 kg: Rs. 1000/-.

150 kg: Rs. 1500/-.

Whole crop loss: Rs. 2000/- Will be paid by the Sanghams to the premium holder. The insurance is settled with in a month after crop harvest. This program had made a kind of security to the farmer to follow the chemical free pest management and build faith in farming community. Every year more than 400 farmers were insuring their crop with Sangham in respective villages. This kind of security is not offered by any pesticide industry to farmer except farmer has to take his own life in the event of crop failures. During the year 2003-2004, 343.5 acres were insured and collected premium amount of Rs 34,350. Out of 343.5 acres insured, 115 acres were eligible for insurance claim of Rs 24,375. This was due to moisture stress faced due to early monsoon withdrawal that has contributed for low yields in shallow red soils.

4. ECONOMICS OF NPM OF PIGEONPEA

Economics of Pest management in different farms was also studied in the selected farmer's in different farmers fields and year wise average data collected from 10 NPM farmers and 5 check farmers (Non NPM) on Pigeonpea along with intercrop yields, cost of plant protection, gross income per hectare data is presented in the following table (Table 11).

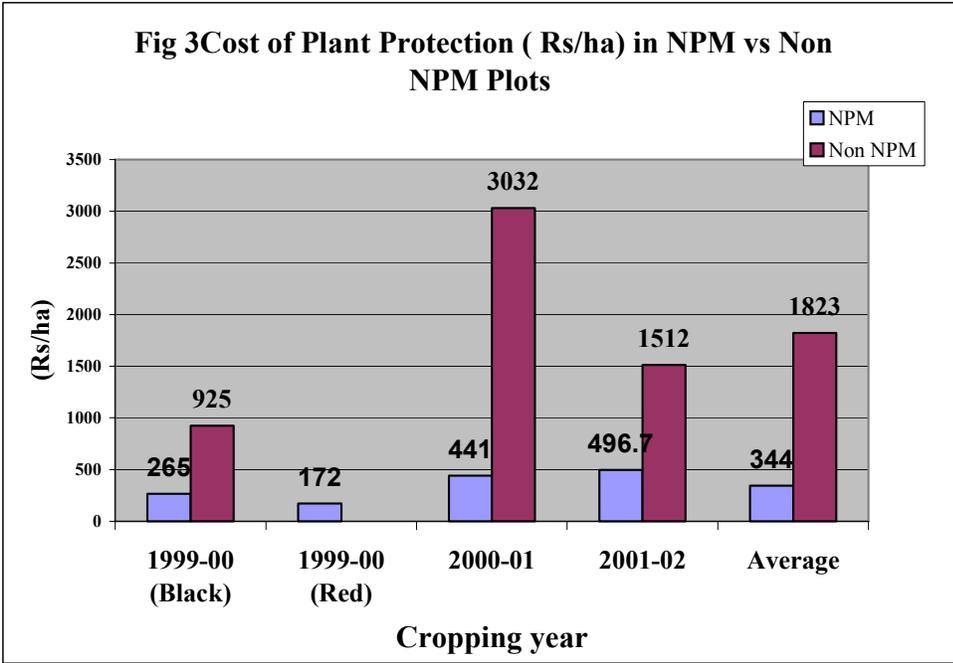
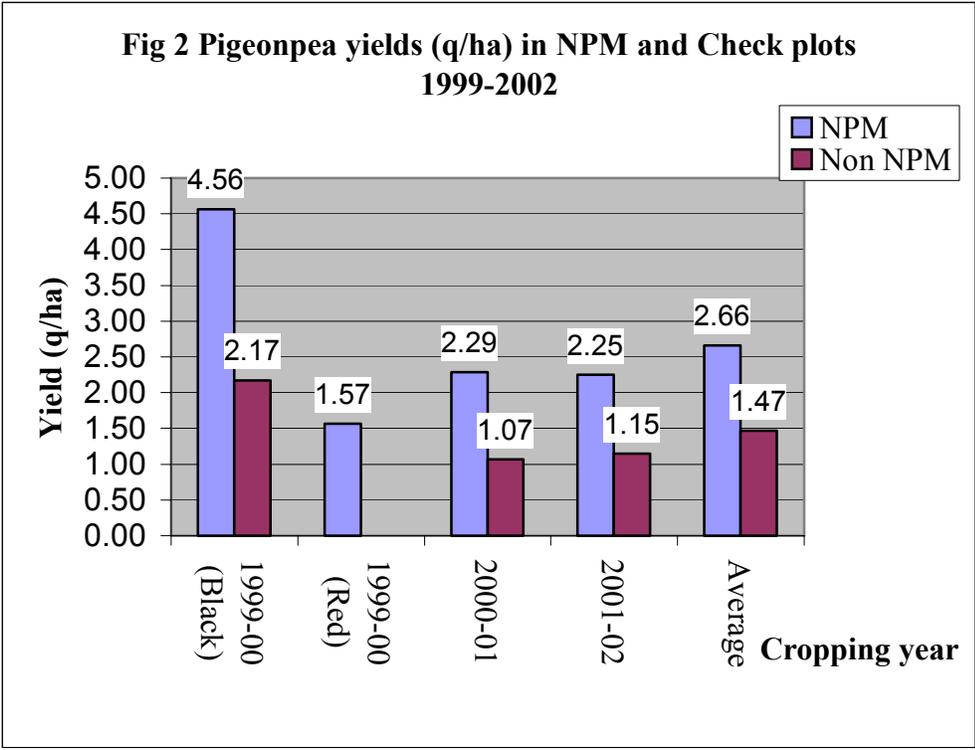
Table 10 Pigeonpea crop yields, Plant protection cost, Net returns in NPM vs. Check plots (3 years average)

Year	Yield (q/ha)				Cost of plant Protection Pigeonpea Rs./ha.		Total cost of cultivation Rs./ha.		Gross income Rs./ha.	
	Pigeonpea		Intercrop		NPM	Non NPM	NPM	Non NPM	NPM	Non NPM
	NPM	Non NPM	NPM	Non NPM						
1999-2000 (Black soils)	4.56	2.17	3.37	1.97	265	924	3,250	4,021	18,556	5,670
1999-2000 (Red soils)	1.57	*	3.48	*	172	*	1,436	*	4,883	*
2000-2001	2.29	1.07	11.53	4.60	441	3,032	4,525	7,629	8,398	7,119
2001-2002	2.25	1.15	7.99	3.45	496	1,512	1,843	4,488	4,087	4,608
Average	2.66	1.47	6.59	3.34	343	1,823	1,823	5,380	8,981	5,800

- **Non-NPM check plots were not studied during 1999-2000 in red soils.**

The data reveals the following;

The yields of pigeonpea in black soils were more than red soils and this is due to better moisture retention capacity. The intercrop yields were also higher in NPM than Non NPM in all the years. Year wise NPM and Non NPM plots data and cost of plant protection are shown graphically (Fig 2 and 3). The average yields of Pigeonpea are 2.66 and 1.47 quintals per hectare and inter crop yields are 6.59 and 3.34 quintals per hectare respectively. There was yield advantage with NPM practices as well as comparatively low cost of plant protection (RS 344 per ha) than non-NPM (Rs1823 per ha).



5. PEST STATUS IN NPM FARMS

Regular field visits were conducted with the KVK team and Sangham Supervisors of the respective villages on emerging moth populations, pest predator counts, economics etc conducted to know the impact of the program. Periodical moth catch data collected from the farmer's field in different years is presented in the table-12. In general, there is less moth emergence in 2002 than in 2001 and 2003 years. The pest populations were more in December with gradual raise in day temperatures. There is much infestation of *Helicoverpa* in 2001 and crossed the recommended ETL level 4 in almost every day except in October. Despite of high Pest status in 2001, NPM fields recorded higher pigeonpea yields than the check plots.

Table 11 Number of adult *Helicoverpa* moths catch in the pheromone traps during the crop growth period in different years⁴.

Meteorological Week	Average adult moth catch in the traps/day		
	2001	2002	2003
1st Week of October	4.24	1.33	5.25
2nd Week of October	3.62	3.64	4.25
3rd Week of October	3.78	5.78	3.77
4th Week of October	3.03	2.67	3.77
1st Week of November	5.78	4.26	6.75
2nd Week of November	8.72	1.33	2.50
3rd Week of November	6.53	2.27	1.00
4th Week of November	10.78	5.75	5.25
1st Week of December	9.46	4.58	5.00
2nd Week of December	9.56	1.33	4.50
3rd Week of December	9.27	4.72	7.85
4th Week of December	8.78	5.78	6.25

⁴ Average of 4 village farms (Raipally, Metalkunta, Basanthpur and Kalbema) for 2001 and 2002. In 2003, data from Raipally farms only.

6. HELICOVERPA INCIDENCE LEVELS IN NPM AND NON- NPM PLOTS

Pests incidence levels between NPM and Non-NPM Plots were studied in December 2001 at late flowering stage in selected farmers by following random sampling procedure for eggs/larvae presence on branches, number of pods damaged by the *Helicoverpa* caterpillars and presence of beneficial insects in a participatory way. The data is presented in table 13. The study indicated that equal number of branches in both the fields. However, more number of eggs/larvae is present in non-NPM plots (16 larvae on 20 plants) than NPM plots (12 larvae on 20 plants). There was a much damage of pods in Non NPM plots (about 3 pods out of 22 pods counted) and there was no pod damage in NPM plots. This clearly indicated that the NPM strategy is more helpful to farmers concerning pest control. There was also good number of beneficial insects were counted in NPM plots than in Non NPM plots.

Table 12 Harmful and beneficial insect counts and Pigeonpea pod damage in NPM Vs check plots.

Farmer and Practice	No. of Branches	No. of Larva on 5 Branches		Pods on 5 Branches		Beneficial insects for Crop	
		Eggs/larva	Others	Healthy pods	Damaged pods	Lady Bird Beetle	Spiders
P.Lalitamma, Raipally (D) NPM Plot	15.00	0.6	0.1	22.75	0	0.7	0.6
S Chandraiah, Raipally (D), Check plot	14.65	0.8	0.15	23.1	2.55	0	0

7. KNOWLEDGE LEVELS

A questionnaire and flash cards were prepared to assess the knowledge levels with in the farming community where NPM concept spread was taken place; The following response were recorded in the Raipally village where the concept spread was taken place during 1999- 2000.

Questions/ Flash cards	No of correct responses	
	NPM farmers	Non NPM farmers
Neem oil Usage	10	10
NSKE Preparation	9	7
NPV Preparation	8	6
Trap crops	10	7
Usage of adjuvant	10	8
Bird perches	10	8
Pheromone traps	8	6
Resistant varieties	10	8
ETL Levels	7	4
Time of Application of Botanical Pesticides	10	10
	92	74
Identification of Natural enemies (Flash cards)		
1) Ants	10	10
2) Chrysopa	7	7
3) Preying mantids	8	8
4) Lady bird beetles	10	8
5) Wasps	10	10
	45	45

In both the cases, the sample sizes were fixed at 10 and are randomly selected. The response shows difference in knowledge levels between the farmers practicing NPM and Non NPM farmers who have got the information from other sources (through master trainees/ demonstrations / wall poster writings). The awareness levels were equal with regard to the identification of natural enemies and more with regard to the NPM practices in case of farmers who have trained at KVK than others were. This clearly shows that, there was spread of NPM concept and awareness with in the village.

8. FARMERS PERCEPTIONS

An interview schedule was prepared and survey was conducted with NPM practicing farmers and their house holds in KVK adopted village Raipally during March 2004. The main objective is to record the perceptions of the farmers on various NPM options in terms of practicability, labor, expenditure and role of women farmers (gender) involvement in particular option. The Practicability is measured in terms of easiness or difficulty. Labour and cash involvement was measured in terms of saving or consuming. Role of women was measured in terms of neutral or consuming. The results were pooled to express the options in these relative terms with above 60% similar responses.

Sample size: 10 NPM practicing House holds

Table 13 Perceptions of farmers on various NPM options

Options	Practicability	Labour	Cash	Gender
1. Deep Summer Ploughing	Easier	Consuming	Consuming	Neutral
2. Burning of farm wastes	Difficulty	Consuming	Saving	Consuming
3. Resistant Varieties	Difficulty	Saving	Consuming	Neutral
4. Crop rotation	Difficulty	Saving	Consuming	Neutral
5. Trap cropping	Easier	Saving	Saving	Consuming
6. Bird perches	Easier	Saving	Saving	Saving
7. Light Traps	Difficulty	Saving	Consuming	Neutral
8. Jaggery solution spray	Easier	Saving	Saving	Consuming
9. Broadcasting of puffed rice	Easier	Saving	Saving	Consuming
10. Pheromone traps	Difficulty	Saving	Consuming	Neutral
11. Neem oil spray	Easier	Consuming	Saving	Consuming (Very Little)
12. Neem seed Kernel extract	Difficulty	Consuming	Saving	Consuming
13. Chilli Garlic Extract	Difficulty	Consuming	Saving	Consuming
14. Cattle dung + Urine Extract	Difficulty	Consuming	Saving	Consuming
15. NPV Virus spray	Easier	Consuming	Saving	Consuming
16. Hand Picking	Easier	Consuming	Consuming	Consuming
17. Shaking of branches	Easier	Consuming	Consuming	Consuming

The survey results reveal the following;

- ✓ Practicability: Easier options: 9 out of 17 options
- ✓ Labour: Saving options: 9 out of 17 options
- ✓ Cash involvement: saving options 10 out of 17 options studied
- ✓ Gender: Neutral options 5 out of 17 and in more than 12 options women were involved.

Most Widely practiced NPM options are

- ✓ Deep Summer Ploughing
- ✓ Bird perches
- ✓ Installation of Pheromone traps
- ✓ Neem Oil spray
- ✓ Hand Picking and Shaking

V. Visible Gains of the NPM

Crop protection is a complex process, which requires an understanding of the interaction between the environments, methods of farming and predominant system of cultivation. Hence crop protection cannot consist in only one specific measure, but requires a suitable combination of methods depending on crop, climate and region. Farmers have been following the series of ecological options, which were based on their own knowledge systems, and put back to them in more organized way. Consequently, farmers are reaping good harvests free from any pesticide residues. The spread of NPM concept has been both vertical and horizontal and transformed into movement in all the DDS operation villages. Using locally available, low cost inputs and traditional knowledge, farmers are managing the devastating pest *Helicoverpa* with good yields and simultaneously adding to over all improvement of the environment.

Overall achievement of the program

- ❖ NPM is slowly becoming a matter of faith with the communities with whom DDS work instead of another program.
- ❖ Improved the knowledge of farmers regarding pests and natural enemies.
- ❖ Expertise regarding various botanical pesticide preparation increased in farming community.
- ❖ Created a large group of master trainers both in the organization and also in the farming community who can play a vital role in horizontal spread of NPM concept.
- ❖ Reduced the dependency of farmers on the external inputs.
- ❖ Helped in systematizing non-chemical management of pests that the resource poor farmers of Zaheerabad traditionally followed.

VI. SUMMARY

The Krishi Vigyan Kendra, Medak district has implemented the Non Pesticidal Management of Pigeonpea in Zaheerabad region with the active participation of resource poor and illiterate farmers. The Various indigenous practices for pest management collected from the farmers and KVKs approach is described in this document with illustrations. Comparative Economics of the pest management, pest populations monitored were given with the random data collected from the farmers.

The KVK has developed a learning tool for Pest Management with the indigenous practices collected from them and adding the scientific components such as pheromone traps, HNPV spray for tackling the pest. Several PRAs and Group Discussion were held with the farmers on local varieties vs. improved ones with their own parameters evolved showed that Nalla togari (Local variety of Short duration) was much suited for them. KVK has facilitated the 23 group training courses covering 832 participants. In the training, farmers were sensitized on effect of pesticides on pest and predator populations through pictorial representations and folk dance shows. Later, Participatory pest and predator counts taken in NPM and Non NPM demonstration farms in farmers fields to build confidence levels. The plant protection costs in the demonstration was also very much reduced than the check plots and ensuring the biodiversity had brought a higher net returns to the farmers. In the present scenario of pest management, the NPM has offered the farmers to tackle the *Heliocoverpa* populations in environmentally safe, ecologically sustainable, economically beneficial and socially acceptable form.

VII. ACKNOWLEDGEMENTS

This is the experience of external Support Sustainable Agriculture program, which is implementing the Non Pesticidal management (NPM) in partnership with Krishi Vigyan Kendra in six mandals of Medak district. This deals with particular reference to Pigeonpea crop, which is highly pest susceptible. EED, Germany; Christian Aid, U.K; Find Your Feet, U.K., and Center for World Solidarity, Secunderabad has provided financial support for implementing the Non Pesticidal Management of Pigeonpea since from its inception. Our Sincere thanks for their financial and technical support extended all through the study years.