ECONOMICS OF COWPEA PRODUCTION IN SELECTED VILLAGES OF KATSINA AND ZAMFARA STATES UNDER INDIGENOUS AND IMPROVED PRACTI CES.

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A *THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS.*

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DEDICATION

This thesis is dedicated to my mother Fadhilat Abdul-Rahman and my Fiancee Fatima Yusuf for their tender love and care.

DECLARATION

I hereby declare that this thesis was written by me and it is a record of my own research work, except where reference is made to published literature and duly acknowledged. It has not been presented before in any application for a degree.

S.A. Rahman

30/6/98
Date

The above declaration is confirmed

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Chairman
Supervisory Committee.

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CERTIFICATION

This Thesis entitled "ECONOMICS OF COWPEA PRODUCTION IN SELECTED VILLAGES OF KATSINA AND ZAMFARA STATES UNDER INDIGENOUS AND IMPROVED PRACTICES" by S.A. Rahman meet the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

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ABSTRACT

Cowpea is an important food crop which gives variety to diet as well as contributing proteins, carbohydrates and other valuable nutrients. It is mostly grown by small-scale farmers as a mixed crop with cereals, especially in the Guinea savanna ecological zone of Nigeria. Intercropping is considered to be one of the major factors contributing to cowpea low production, but most farmers still prefer to continue practising it. Low production of cowpea is also attributed to insect pests which often affect the plant throughout its life cycle. Cowpea growers have for long recognised the usefulness of conventional insecticides, but factors such as availability and cost have kept this technology beyond their reach. Insecticides from Neem leaves are safe, readily available and could bring better crop yields.

The study evaluated cowpea production under both indigenous and improved practices to ascertain their economic profitability, technical feasibility and social acceptability. Thirty farmers were purposively selected from two farming villages in the Guinea savanna zone of Nigeria for the study.

The results indicate that cowpea/millet mixture was the most profitable enterprise. It provided the highest yield of cowpea (308kg/ha) when compare with other cropping systems. The gross margin obtained from the cowpea/millet mixture was N5966/ha. The net farm income for the use of Neem leaf extracts to control insect pests on cowpea was N4079/ha and for the conventional insecticides was N6069/ha. About 50% of the farmers believed that they can increase their crop yields and net incomes with the use of Neem leaf extracts.

It was recommended that low-cost technology should be developed, especially In the areas of inject pests control to encourage farmers in order to increase cowpea production. There is need for further research to improve the effectiveness of Neem leaf extracts by determining its chemical properties to facilitate the recommendation of appropriate dosage.

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Chapter 1

INTRODUCTION

1.1 Insect Pests and Cowpea Low Yields.

Cowpea, like other legume crops is important in the developing world. It gives variety to diet as well as contributing proteins, carbohydrates and other valuable nutrients. About two-thirds of the total world production comes from sixteen African countries. Two countries; Nigeria and Niger produce about 49% of the world cowpea production (Rachie, 1985). Cowpea has been a traditional crop of the Guinea savanna zone of Nigeria and is mostly produced by small scale farmers who grow it inter-cropped with other crops. Low yields are significant attribute of production estimates for this crop. The reasons include heavy biotic pressures; particularly from insects and other pests, which often affect the plant throughout its life cycle.

Cowpea is attacked by many insect pests throughout its geographical range, although the number and their status vary from one region to another (Singh and Allen, 1980). Insects attack cowpea crop from seedling to harvest and can cause economic damage at all stages of plant growth (Singh and Jackai, 1985). The peasant farmers who produce most of the cowpea available in the markets obtain about 200-350kg/ha. No conscious attempt is made to control the pest, except possibly in a few locations where insecticides are used routinely by farmers (Litsinger et al, 1983). In most tropical countries, cowpea can not be grown successfully without at least one or two insecticide sprays. To increase the production of this food crop, researchers and farmers must minimise the damage caused by insect pests.

1.2 Problem Statement

More research has been done in chemical control than in other methods of cowpea insect pest control. New insecticides flood the market every year and insecticide application technology is also changing. Chemical control of cowpea insect pests is not new to peasant farmers and yet it is not widely practised by them (Jackai et al, 1985).

One of the major factors contributing to low yields of cowpea is the lack of adequate protection against damage from insect pests. Cowpea growers have for long recognised the usefulness of conventional insecticides, but factors such as availability and cost have kept this technology beyond their reach. The use of conventional insecticides on cowpea for protection against insect pests is contributing to high cost of production. Hays and Raheja (1977), reported that spraying of sole crop cowpea with chemicals accounted for 27% of the total cost of production. Cowpea producers are also sensitive to the dangers involved in chemical control method and have started to express concern about the continued and increasing use of these chemicals.

The combined formulations of chemicals are considered to have eliminated the need for farmers to purchase more than one chemical and the need for them to decide whether to change from one chemical to another, but the dosages used in combined formulations are high and their cost still prohibitive.

1.3 Justification for the study

Increasing concern is being expressed about the need to increase food production in supporting the nutritional requirement of Nigerian's growing population. The technologies which are being developed to meet this need becomes "inappropriate" to the farmers because they do not take into account the complete farming systems, the capabilities of small farmers and institutional constraints of the farmers. There is need for researchers to turn their interest to development of agricultural indigenous technologies in order to lower the cost of production and raise productivity.

Cowpea production can not become a successful venture (i.e. production can not be both sustained and economic) without the use of insecticides (Jackai et al, 1985). What then becomes important is the need to develop or formulate a strategy for safer and more economic and ecologically sound use of insecticides.

The current level of cowpea production can be raised by intensifying the availability of inputs and improving the manner of their utilization. Development of indigenous technologies such as extracted Neem solution for insect pest control is another way of helping the peasant farmer to improve the cowpea yield; since the conventional insecticides are often not within their reach.

Studies of this nature are important as they compare the use of Neem leaf extracts and conventional insecticides in terms of productivity and profitability which help the farmers to understand that the yields of cowpea can be improved and its cost of production can be lowered using the readily available, safe and natural insecticides from Neem leaves.

Extracting the solution from Neem leaves requires no special skill nor sophisticated machinery.

1.4 Objectives of the Study

The broad objective of the study is to assess effectiveness of Neem leaf extracts and conventional insecticides in controlling insect pests on cowpea crop on the fields.

The specific objectives are:

(i) to determine the farming systems and practices under which cowpea is produced in order to highlight the importance of cowpea production in the study area;

(ii) to compare the effectiveness of Neem leaf extracts and conventional insecticides;

(iii) to evaluate the financial costs and returns of using the Neem leaf extracts and conventional insecticides on cowpea;

(iv) to assess the farmers' reactions to the application of Neem leaf extracts;

1.5 Hypothesis

The hypothesis is that, there is no productivity difference between the application of Neem leaf extracts and conventional insecticides.

Chapter 2

LITERATURE REVIEW

2.1 Reasons for Pest Outbreak

Insect pest management is necessary because occasionally insect populations on a crop plant increase to a density that is considered unacceptable. The criteria on which this judgement is made may be economic, medical or aesthetic and as such are subjects to vagaries of circumstance. The changes in consumer requirements for insect-free produce have been one driving force behind the need to control insect at lower densities than before. Such shifts in consumer standards have meant that some insects are controlled beyond the point at which they are causing physical losses to the crop.

Fulfilling the needs of consumption has been one of the factors influencing the increased importation of foreign products and materials and with them the introduction of exotic insect species. In the absence of their normal natural enemy complex or of environmental constraints, these introduced species may become pests and cause extensive damage to crop. Pests may also be transported to countries in which they are not indigenous by the introduction of new crop types with similar results. In general, it is such changes in agricultural practices as the introduction of new crop species or enlargement and aggregation of fields, use of monocrops and plant density, that have been held responsible for many pest problems. The changes in crop cultivars and the simplification of agroecosystems are the most important factors responsible for pest problems (Risch, 1987).

With the fact that breeders focused their attention more on attaining outstanding yields than on producing insect resistant cultivars (Ferro, 1987), insect out breaks then occurred on cultivars having no natural level of insect resistance when the insecticide umbrella was removed, e.g, the development of insects resistant to insecticides. The reduction of diversity in large crop monoculture, has long been associated with reasons for pest out breaks; the reasons for this are that a monocrop is thought to provide a highly suitable habitat for a pest, thus creating conditions appropriate for outbreaks. However, more recently it has generally been recognised that outbreaks are not an inevitability of such simplicity (Redfearn and pimm, 1987); an idea long recognised in forest entomology. Monocultures do occur in natural ecosystems. The establishment of species in monoculture crop plantations is certainly not a radical departure from this and should not automatically make them more vulnerable to pest (Speight and Wainhouse, 1989).

Insect outbreaks can be triggered through intervention by man, i.e. through the use of insecticides, irrigation, fertilizer or cultivars lacking resistance to insects. Of these, it is insecticide that have had the most widespread influence on insect pest outbreaks. They can be an indirect cause of insect pest outbreaks by a number of means including reduction of natural enemies, removal of competitive species and secondary pest outbreaks, and through the development of insecticide resistant insects.

2.2 Insect pests and crop losses

Even when the damage to a crop appears heavy to the naked eye, the real losses of yield may be small and not necessitate control measures. However, there is wide spread inability among growers and professional agriculturists to distinguish between damage and economic injury (Kumar, 1984). Many a time the farmer spots infestation in the field, or is concerned about crop losses and is inclined to use chemical control measures to be on the safe side. The damage will depend on the stage of the crop. A young crop is usually more often damaged by pests. However, during the period of active growth the plant may be able to successfully withstand the pest attack by rapidly repairing damaged tissues and so exhibit little reduction in yield.

There are various reasons for studying crop losses. Judenko (1972), gave the following reasons:

(1) The establishment of the economic status of specific pests; (2) to determine pest infestation intensity at which control measures need to be applied; (3) to assess the extent to which expenditure for intended control measures is justified, that is, the economics of control measures; (4) to estimate the effectiveness of control measures; (5) to measure the effects of environmental factors on the loss of yield caused by pest attack; (6) to provide information to pesticide operators to enable them to decide on the action to be taken to control the pests; (7) to assess the use of public funds to study pests; and (8) to give a basis for directing future research and agricultural planning.

Pinstrup-Andersen et al., (1976) emphasized that a knowledge of the relative importance of yield-limiting factors assists in establishing effective priorities in channelling research and extension resources and correcting the cause of crop loss. Actually, a knowledge of crop losses helps to focus attention on the harnessing of preventive measures by adoption of good agronomic practices such as growing of resistant varieties, use of cultural control methodologies thereby achieving better control with less use of pesticides.

2.3 Control of Cowpea Pests

To increase the production of cowpea, researchers and farmers must minimize the damage caused by insect pests. A realistic method of control appears to be cultivation of insect-resistant varieties in combination with applications of insecticide in minimal amounts and use of cultural-control methods.

Aphids are a major problem in the dry regions, reducing yield not only directly but also indirectly by transmitting viral diseases (Singh and Ntare, 1985). Resistant varieties have a high level of antibiosis, causing the death of the pests. A large number of breeding lines have been developed combining aphid resistance with high-yield potential and multiple disease resistance. Cowpea resistance to insect pests offers the greatest hope for the peasant farmers but may take several years to develop. Also, it may never be available at reasonable levels to all major pests and its durability can not be guaranteed (Singh and Ntare, 1985).

In the past, insecticides were used by everyone in Africa except traditional farmers with small holdings. Today, all categories of farmers are beginning to use insecticides (Jackai et al, 1985). To optimize production without damaging the environment or endangering consumers, those who use insecticides or are in a position to advise on their use, must consider:

(i) the feeding behaviour of the target pest;

(ii) the activity cycle of the pest, especially the damaging stage;

(iii) the part of the plant attacked

(iv) the mode of action of the chemical (whether, contact, systemic, stomach poison, fumigant or translaminar);

(v) the residual activity of the compound

(vi) the phytotoxicity of the chemical at effective dosages

(vii) the efficacy of the compound.

Getting this information is the responsibility of the researchers and the extension agents who should educate growers. Choosing a wrong chemical can lead to unexpected and costly results. Chemical control is the most readily available technology for the suppression of cowpea pests, but it has disturbing consequences (Luck et al, 1977).

Cowpea is grown in most countries as a mixed crop with cereals (maize, sorghum, millet:); root crops (yam and cassava); okra, cotton etc (Okigbo and Greenland, 1976). These associated crops perform various roles; some serve as hosts for the cowpea pests (Ochieng, 1977); others serve as barriers restricting movement of the pests in the field (Jackai, 1983);

others play roles yet undetermined. Pest problems on cowpeas can be reduced through the use of methods that alter the microenvironment of the pest. The population dynamics of insects are regulated by several factors. The most important is changes in the micro-environment (Jackai, 1983), which can be manipulated by increasing or changing the sequence or pattern of crops in the ecosystem. Companion cropping, which increases crop diversity, changes the insect's habitat (habitat modification) and interferes with the insect's identification of, and responses to, its host plant (Jackai et al, 1985).

When cowpea is grown as a monocrop it is subjected to heavy depredation, and yields are low. However, several works have shown that when cowpea is intercropped, the population of several pests are reduced and yields increased. Karel et al (1982) reported a higher incidence of Maruca testulalis in monocrops of cowpea than when cowpea was intercropped with maize. For pod-sucking bugs, the reports have been mixed: Mattenson (1982) indicated a decrease in number in cowpea-maize plots at locations in south-western Nigeria, whereas at other locations increased numbers have been associated with cowpea-maize and cowpea-sorghum intercrops.

There are other documented cases of pest-population increases with inter-cropping. In northern Nigeria, Mattenson (1982) also recorded higher populations of meliod beetles (Mylabris sp and coryna sp) on cowpea-maize intercrops than monocrop cowpeas and suggested that the insects normally fed on maize pollen and then infested and damaged cowpea flowers as the maize was drying. These apparent contradition on the effects of inter-cropping on insects under score the need for standard crop varieties, sampling techniques, methods of analysis and experimental designs in investigations to evaluate insect responses to cropping systems.

Inter-cropping cowpea with cassava, even though commonly practised, has been given inadequate attention in investigations of the dynamics of insect pests. In studies in Ibadan (Jackai, 1983), however, inter-cropping of two rows of cowpea with one of cassava reduced the populations of thrips and pod-sucking bugs. It did not affect maruca borers. Cassava may be acting as a physical barrier to movement of thrips or an alternative food source for the pod bugs. However, the possibility that cassava is emanating chemicals, or that the cowpea host becomes less apparent to the insects, deserves investigation. The shading from associated crops adversely affects cowpea performance and may also be responsible for the observed population changes. In this system the humidity is known to increase and insolation is reduced inside the crop canopy (IITA, 1982).

Researchers in the tropics have confirmed the value of manipulating the planting date, thus giving scientific credence to the traditional practice of planting early in the rainy season. In recent years entomologists in several countries have stressed the need for developing integrated management strategies for insect control to optimize agricultural production without upsetting the balance of nature. It is understood that:

(a) there are effective insecicides for every insect pest on cowpea,

(b) there are cropping patterns that reduce populations of some pests and others that increase populations,

(c) some damage by insects can be minimized through manipulation of planting dates,

(d) there are cowpea varieties with resistance to one or two insect pests.

With all the above in mind, one can proceed to formulate a package that will optimize production and at the same time minimize insecticide uses and, thus, overall production costs.

2.4 Economics of Insect Pests Control

The importance of insect pests to farmers depends upon the amount of crop damage they cause and the resulting reduction in quality and quantity. The symptoms caused by insect pest attack are by themselves unreliable guide to the overall effect of insect pest on a crop. Total loss of or extensive damage to some of the plants in a field may have little effect on overall yield. This is because other plants in the field may gain from lack of competition and compensate for the loss by additional growth (Hill and Waller, 1990). The most effective way of assessing pest damage is to take many samples of plants and to separate them quickly into different, easily distinguished, categories of infestation.

The economical control measures against pests must cost less than the value of the increase in crop yield that the control measures produced. Alternatively, there must be some other long-term advantage. Thus, the extensive use of pesticides on staple food crops is not generally practised because even though yields may be substantially increased, the value of the extra produce does not offset the costs involved (Hill and Wallers, 1990).

The potential benefit from controlling insect pests of plant must depend on the magnitude of the losses caused by the absence of and the efficiency of the control measures. These factors vary from season to season. The control measures which are economical in one year may be uneconomical in the next. There is, therefore, a high degree of uncertainty about the economics of any specific control measure (Dent, 1991).

It is important to forecast pest infestation where possible so that control measures can be planned in advance with maximum efficiency. Successful forecasting techniques should be based upon detailed knowledge of the biology and ecology of the pest concerned. Accurate pest forecasting is very difficult and there is need for the population dynamics of insects to be fully understood.

The production of food and export materials is of vital importance to the economy of every nation. Some countries attempt to forecast crop production by an early warning system based on rainfall, even though this is only one of a number of constraints affecting yield. Insect pests can cause substantial yield losses; so if pests can be monitored and their abundance predicted, and if their effect on yield is known, it is possible to forecast prospective yields (Walker, 1984). Such information would be of great value for government in planning and budgeting for fluctuations in product availability and demand. The accuracy and consistency of the forecast will directly affect the yield and profits of the farmer. The value of a forecast scheme and the importance of its accuracy can be assessed in economic terms (Watt, 1983).

2.5 Economic Thresholds.

In order to consider using economically feasible control measures against pests, reliable information is needed on yield losses as a result of pest attack. For this purpose a knowledge of economic thresholds is essential. Economic thresholds are defined as levels of pest damage which warrant the use of plant protection measures (Chiang,1979). The ability to determine an economic threshold of an insect pest on a crop is dependent on distinguishing the different infestation levels and the degree to which each level influences the harvested crop (Stern, 1973). According to Talpaz and Frisbie (1975) a threshold is a dynamic measure which may vary with infestation level, value of yield, cost of control and time of assessment. In practice the problem simply boils down to the fact that we should be able to obtain an accurate estimation of pest population levels that ultimately can be related to crop-loss figures.

According to Dent (1991), quoting stern et al. (1959), the concept of action threshold defined three categories of economic threshold relevant to decision making in pest management. These are:

i. The threshold for economic damage (ED), the amount of damage that justifies the cost of artificial control;

ii. The economic injury level (EIL), the lowest population density that will cause economic damage,

iii. The economic threshold (ET), the level at which control measures should be implemented to prevent an increasing pest population from reaching the economic injury level.

The economic threshold of a pest population is the density where a pest control measure is merited because the cost of the procedure are equal to those of the damage that is prevented (Gutierrez, 1987). Pest population levels that can be tolerated within a cropping system can vary because of crop harvesting schedules and inherent crop tolerance to pest attack. Economic threshold may also vary from area to area, among cultivars, and even between farms that are in the same area but under different management systems. Application of the economic threshold in determining the need for control action has helped producers reduce the number of pesticide applications or other control measures and increased net profits to the individual grower.

Although the economic threshold concept serves as basis for decision making in insect pest management, the determination of such thresholds have proved to be one of the weakest components in management programme with the result that very few research based thresholds have been developed (Poston et al., 1983). There are four basic factors determining the economic threshold; these include, costs of control, market value of harvested product, proportionate damage per yield loss per individual insect and the effectiveness of control (Poston et al., 1983).

2.6 The Role of Insect Pest Management

Insect pest management like integrated pest management requires an interdisciplinary approach to research, development and implementation. Such inter-disciplinary research is difficult for scientists trained as specialists within the confines of a particular subject. This is partly because scientists trained in different subjects perceive problems in different ways which hinder communication and collaboration. Scientists from different disciplines will only collaborate effectively if they have sufficient knowledge and understanding of each other's subjects (Dent, 1991) and can begin to perceive problems in ways that may be contrary to or different from their own specialist biases.

An understanding of the factors that influence the population dynamic of an insect species and the way in which cropping system differ from natural ecosystems, can provide an indication to the type of strategy that should be employed in the management of a pest (Dent, 1991). Management of an insect pest in a crop system can be achieved if the technique used reduced both the initial number infesting the crop and the rate of population growth. The size of the initial numbers may be reduced by cultural and agronomic practices such as removal of alternative hosts, or through host plant resistance affecting host attraction. The rate of population growth may also be reduced through agronomic practices such as plant spacing, intercropping and reducing plant palatability for the insect. These factors are all density independence and hence will only reduce overall population levels. Should population density continue to increase, then natural enemy populations would ideally start to regulate the population size. Pest management practices would seek to augment the size of natural enemy population in crop systems. However, should natural enemies fail to regulate the pest population and its number reached a level where it was economically viable to use insecticide, this could be applied to reduce the pest population size.

Hence, the components of insect pest management that can be used to reduced pest numbers are host plant resistance, cultural or agronomic practices,natural enemies and insecticide use. For any particular pest or cropping system, the number of components that are needed for control, and the way in which they are applied, will be different. The optimal management strategy can only be determined with reference to the ecology of the pest and its interactions with the crop management components.

Integrated pest management integrates chemical applications with cultural methods, breeding for pest resistance and biological control. It also aims to incorporate pest control in an economical manner by using low-cost materials. Insect pest management programmes will only be adopted by farmers if they fit the farmers' need and expectations. To ensure that management programmes are effective, entomologists must have sufficient knowledge of socio-economic and farming systems or a level of understanding required to collaborate effectively with social scientists

2.7 The Neem Tree

Neem is a member of the mahogany family Meliaceae. It is today known by the botanical name Azadrachta indica A Juss. In the past, however, it has been known by several names,and some botanists formerly lumped it together with at least one of its relatives. The result is that the older literature is so confusing that it is sometimes impossible to determine just which species is being discussed.

Neem trees are attractive broad-leaved evergreen, that can grow up to 30m tall and 2.5m in girth. Their spreading branches forms rounded crowns as much as 10m across. They remain in leaf except during extreme drought, when the leaves may fall off. The short; usually straight trunk has a moderately thick, strongly furrowed back. The root penetrate the soil deeply, at least where the site permits and particularly when injured, they produce suckers. This suckering tends to be especially prolific in dry localities.

The fruit is a smooth, ellipsoidal drupe, upto almost 2cm long, when ripe, it is yellow or greenish yellow and comprises a sweep pulp enclosing a seed. The seed is composed of a shell and a kernel (Sometimes two or three kernels), each about half of the seed's weight. It is the kernel that is used most in pest control. The leaves also contain pesticidal ingredients, but they are much less effective than those of the seed (National Research Council, 1992). A Neem tree normally begins bearing fruits after 3-5 years, becomes fully productive in 10 years, and from then on can produce upto 50kg of fruits annually. It may live for more than two centuries.

2.8 Effects of Neem Extracts on Insects.

The growing accumulation of experience demonstrates that Neem products work by intervening at several stages of an insect's life. The ingredients from this tree approximate the shape and structure of hormones vital to the lives of insects (Warthen, 1989). The bodies of these insects absorb the Neem compounds as if they were the real hormones, but this only blocks their endocrine systems. The resulting deepseated behavioral and physiological aberrations leave the insects so confused in brain and body that they can not reproduce and their populations plummet.

Increasingly, approaches of this kind are seen as desirable methods of pest control. Pest do not have to be killed instantly if their populations can be incapacitated in ways that are harmless to people and the plant as a whole. The effects of the Neem extracts are not the same on different insect species, (Adler et al., 1985). Neem 's complexity of ingredients and its mixed modes of action vastly complicate clarification. Moreover, the studies to date are hard to compare because they have used differing tests, insects, dosages and formulations. Further, the materials used in various tests have often been handled and stored differently taken from differing parts of the tree, or produced under different environmental conditions.

National research Council (1992), reported that various Neem extracts are known to act on various insects in the following ways:

1. Disrupting or inhibiting the development of eggs, larvae or pupae.
2. Blocking the molting of larvae or nymphs.
3. Disrupting mating and, sexual communication.
4. Repelling larvae and adults.
5. Deterring females from laying egg.
6. Sterilizing adults.
7. Poisoning larvae and adults.
8. deterring feeding.
9. Blocking the ability to "swallow" (that is, reducing the motility of the gut.
10. Sending metamorphosis away at various stages.

Neem extracts have proved as potent as many commercially available synthetic pesticides. They are effective against dozens of species of insects at concentrations in, the parts - per - million range (National research Council, 1992). At present, it can be said that repellency is probably the weakest effect, except in some locust and grass hopper species. Antifeedent activity (although interesting and potentially extremely valuable) is probably of limited significance; its effects are short-lived, and highly variable. Blocking the larvae from molting is likely to be Neem's most important quality. Eventually, this larvicidal activity will be used to kill off many pest species.

2.9 Disadvantages of Neem Extracts as Insecticides.

Although the possibilities seem almost endless, nothing about Neem is yet definite. The scientists who are most enthusiastic over the plant and its potential admit that at this stage the evidence to support their expectations is tentative. Even within the world of pest control its eventual place is by no means clear.

The greatest impediments to Neem's commercial development may simply be a general lack of credibility, or even awareness, of what it is and what it can do (Jotwani and Strivastava, 1981). Neither the public, the majority of pesticide manufacturer, nor the health-care community in industrial countries now appreciate the plant or its promise.
This is due in part to a lack of experience, in part to lack of industrial interest (caused notably by the difficulty of patenting natural products), and in part to a lack of laboratory data to substantiate the claims.

Another difficulty is caused by the fact that many of the Neem trees scattered around the world are (for all intents and purposes) genetically distinct. This means that conclusion drawn from one may not be exactly applicable to the others. Extracts from neighbouring trees, for instance, may differ in their mixture of ingredients.

Compared to conventional insecticides, the wait for Neem to act may seem endless. Insects treated with it die by delayed action. Although their destructive ability drops fast as the Neem materials take effect, they may continue living for two weeks. Eventually, however, the next generation fails to emerge and the population collapses. Although the end result may be more devastating than that from conventional insecticides, people used to seeing rapid knockdown may be initially disappointed, or even discouraged. This lack of quick effect poses a challenge for promoting Neem in pest-control markets where people have come to expect instantaneous result.

The fact that Neem extracts are natural products does not mean that they are benign. Indeed, there is evidence that they can affect certain aquatic life. Most studies with fish in laboratory tests have shown no deleterious effects, but in one trial both tadpoles and the mosquito eating fish-gambusia died when Neem extracts were applied to the water (Jotwani and Strivastava, 1981). Although using Neem will seldom harm beneficial insects, there are few cases of negative effects. There is for instance, a report of it affecting the larvae of hover flies. Also, there may be other subtle secondary effects. Bees and Butter-flies drinking nectar from Neem-dosed plants might, for example, pick up traces of Neem components, leading to reduced reproduction. The same may be said of insects that feed on other insects.

It is one of Neem's most exciting features that its compounds are systemic. However, they are not systemic in all plants species. Potato plants, for example, do not take up the main active ingredient; azadirachtin, whereas beans do (Schmutterer, 1990). This introduces yet another uncertainty. Each plant species may have to be checked individually. Also, the acidity of the soil or the level of enzymatic activity in the plant may affect the length of time that Neem compound remain effective inside the plant tissues.

Chapter 3

RESEARCH METHODOLOGY

3.1 Study Area

This study was conducted in two farming villages of two states (Katsina and Zamfara) in Northern Nigeria. The villages are Daudawa in Katsina state and Yandoton Daji in Zamfara state both in the Guinea savanna ecological zone. The major ethnic groups in this study area are Hausa and Fulani with Hausa dominating in population. The major occupations are crop farming and cattle rearing but greater percentage of the dwellers engage in farming. The crops grown are cowpea, groundnut, sorghum, millet, maize, cotton and vegetables. The cropping pattern is usually mixed, with few farmers practising sole cropping. The common mixtures are millet/cowpea, sorghum/cowpea, sorghum/groundnut, maize/cowpea, cotton/cowpea, sorghum/millet/cowpea etc.

3.2 Sampling Techniques

The two villages; Daudawa and Yandoton-daji were purposively selected for this study because the farmers in these villages have a long term experience with on-farm studies, especially for cowpeas.

A sample of thirty farmers from the two villages (fifteen from each village) who agreed to grow at least 0.1 ha of sole cowpea according to recommended practices were selected for the on-farm trials. The same group of farmers was used for the survey of traditional cowpea cropping systems using structured questionnaire and scheduled interview.

3.3 Data Collection

The data were collected based on 1996/97 cropping season. Using detailed questionnaire and on-the-spot observation, daily input and output data were collected on all the project fields with the assistance from Institute for Agricultural Research (IAR) Enumerators officially stationed in the study area. The researcher also visited the fields as frequently as possible for personal observation and monitoring.

Specifically data were collected on the following:

(i) Quantity of inputs such as seed, fertilizer, conventional insecticides and Neem leaf extracts.

(ii) Labour input used for clearing, ridging, planting, fertilizing, weeding, remoulding, spraying, harvesting and threshing.

(iii) Cowpea grain yields.

Another set of questionnaire was structured and administered to the same group of farmers who participated in the on-farm trials to survey the traditional cropping systems under which cowpea was produced in the study area to highlight the importance of cowpea crop production. Data were collected on the following:

(i) Farming systems and practices under which cowpea is produced.

(ii) Labour input used for clearing, ridging, planting, manuring, fertilizing, spraying, harvesting and threshing. All these operations were considered under categories of participants such as Adult Male, Adult female, children and in forms of family and hired labour.

(iii) Other production inputs such as seeds, fertilizers, manures and chemicals.

(iv) Number and size of fields or farms.

(v) Crop production (yields).

3.4 Technology Tested

A variety of cowpea (IT90K-82-2) was distributed to the participating farmers. The 0.1 ha of plot for each farmer was subdivided into three sub-plots. The IT90K-82-2 cowpea variety was planted on the three sub-plots on the same date and using the same seed rate (two seeds in each hole). single super Phosphate (SSP) fertilizer was applied at a rate of 50kg/ha.

One sub-plot was sprayed with conventional insecticides, the second with Neem leaf extracts while the third was left unsprayed (as a control). The conventional insecticide (Diazinon 40EC) was sprayed at a rate of 100ml per 20 litres of water from five weeks after sowing, to control insect pests. One thousand and Four hundred grammes (1400gm) of crushed Neem leaves was soaked overnight in 20 litres of water and then sieved. The resulting extracts was sprayed without further refinement for the same purpose.

3.5 Analytical Tools

The tools of analysis used for this study were:

(i) Descriptive statistical analysis (frequency distribution table, arithmetic mean and standard deviation).

(ii) Budget analysis (partial budgeting and Net Farm Income analysis).

(iii) Analysis of variance (ANOVA).

3.5.1 Descriptive Statistical Analysis

This was used to satisfy objectives (i) and (ii) by using:

Frequency Distribution Table: to group the total number of farmers sampled into number of classes with respect to variables like farm size, and cropping patterns.

Arithmetic Mean: to determine the average values of variables such as quantity of inputs used and outputs produced.

Standard Deviation: to determine how the values of inputs and output spread around their respective mean values.

Arithmetic mean is expressed as:

$$\bar{X}=\frac{\sum X_i}{n}$$

where,

$\bar{X}$	=	Arithmetic mean
X_i	=	Individual observation
n	=	number of observation
$\sum$	=	Summation sign.

Standard deviation is expressed as:

$$S=\sqrt{\frac{\sum (X_i-\bar{X})^2}{n-1}}$$

where,

S	=	standard deviation
$\bar{X}$	=	Mean
X_i	=	Individual observation
n	=	Number of observation
$\sum$	=	Summation sign.

3.5.2 Budget Analysis

This was used to satisfy objectives (iii) and (v) through:

Partial Budgeting: to compare the added costs and benefits of conventional insecticides with that of Neem leaf extracts. Partial budgeting is a method of organizing data and information about the costs and benefits from some change in the technologies being used on the farm. Partial budgets are useful tools for analysing small changes in farming systems and required less information than a whole farm budget or an enterprise budget. The goal is to estimate the difference in benefits or losses expected from the technologies. Table 3.1 illustrate the format used for the conventional insecticides and Neem leaf extracts.

Table 3.1: Partial Budgeting Format.

1. Additional benefits	List the items of income from the conventional insecticides that will not be received from the neem leaf extracts.
2. Reduced costs	List the items of expense for the Neem leaf extracts that will be avoided with the conventional insecticides.
3. Sub-total increases	Add lines 1 and 2
4. reduced benefits	List the items of income from the Neem leaf extracts that will not be received from the conventional insecticides.
5. Additional costs	List the items of expense from the conventional insecticide that are not required with the Neem leaf extracts.
6. Sub-total decreases	Add lines 4 and 5.
7. Difference	A positive (or negative) difference indicates that the net benefits of the conventional insecticides exceed (or are less than) the net benefits of the Neem leaf extracts by the amount shown.

<u>Net Farm Income Analysis</u>: to compare the profit obtained from the application of conventional insecticide with that of Neem leaf extracts. This type of analysis is used where all of the relevant data on costs and benefits have been collected and it requires valuation of both fixed and variable inputs.

The Net farm income as expressed by Olukosi and Erhabor (1988).

NFI = TR - TC

where,

NFI = Net Farm Income

TR = Total Revenue

TC = Total Cost.

3.5.3 Analysis of Variance

This was used to determine whether the differences in productivity among the samples are statistically significant or not and therefore, satisfying objective (ii). Table 3.2 shows a format for the analysis of variance.

Table 3.2: Format for Analysis of Variance.

Source of variation	Degree of Freedom	Sum of squares	Mean square	F
Treatments	K-1	$SS_{(Tr)}$	$MS_{(Tr)}$	$\frac{MS_{(Tr)}}{MSE}$
Error	K(n-1)	SSE	MSE	
Total	Kn-1	SST		

Where,

F	=	Variance ratio
$MS_{(Tr)}$	=	Treatments mean square
MSE	=	Error mean square
$SS_{(Tr)}$	=	Treatments sum of squares
SSE	=	Error sum of squares
SST	=	Total Sum of squares
K	=	Number of Treatments
n	=	Number of observations.

Chapter 4

RESULTS AND DISCUSSION

4.1 Cowpea Production Survey

4.1.1 Traditional Cowpea Cropping Systems.

The major cropping Systems identified in the study area are presented in Table 4.1. These are sole cowpea, cowpea/cotton, cowpea/groundnut, cowpea/maize, cowpea/millet, cowpea/groundnut, cowpea/sorghum and cowpea/millet/sorghum. Sole cowpea was the most common among the farmers; 40% in Daudawa village, 60% in Yandoto village and 50% for the both villages. Relay cropping might have contributed to this; cowpea which is mostly grown as a second crop might have been left on the field as sole crop after completing the harvest of the first crop. The survey was conducted at later stage of the cropping season when much of cereals have been harvested.

About 29% of the total hectares cultivated in Daudawa village was devoted to cowpea/cotton and about 24% in Yandoto village. For the two villages, about 27% was allocated to cowpea/cotton and about 20 % to cowpea/millet.

Table 4.1: Cropping systems, farmers and Hectares Cultivated.

	Daudawa Village		Yandoto Village		Both Villages	
Cropping system	Proportion of farmers (out of 15)	Hectares cultivated (%)	Proportion of farmers (out of 15)	Hectares cultivated (%)	Proportion of farmers (out of 30)	Hectares cultivated (%)
CP	40.00	16.13	60.00	16.87	50.00	16.78
CP/Ct	33.33	29.03	53.33	24.20	43.33	26.57
CP/Gn	13.33	8.06	6.67	2.41	10.00	4.89
Cp/Mz	13.33	12.90	13.33	9.64	13.33	11.19
Cp/Ml	26.67	16.13	46.67	24.20	36.66	20.28
Cp/Sg	13.33	12.90	6.67	7.23	13.33	9.79
Cp/Ml/Sg	6.67	4.84	13.33	15.66	13.33	10.49

Source: Field Survey Data, 1996.

Note: CP = Cowpea,
Ct = Cotton,
Gn = Groundnut,
Mz = Maize,
Ml = Millet,
Sg = Sorghum.

4.1.2 Inputs Requirement

The amount of fertilizer used for the seven types of enterprise ranged from 26 to 50 kg per hectare while manure was between 510 and 940kg per hectare. For both villages, chemical insecticides was used for sole cowpea (0.6 litre per hectare) and cowpea/cotton mixture (0.8 litre per hectare) as presented in Table 4.2. In the two villages sole cowpea required the highest labour input of 406 man-hrs per hectare followed by cowpea/cotton mixture with 404 man-hrs per hectare. However, in Daudawa village, cowpea/millet/sorghum mixture required the highest labour input of 409 man-hrs per hectare as shown in Table 4.2.

Table 4.2: Farm enterprises and the amount of inputs used per hectare.

	Daudawa Village					Yandoto village					Both Villages				
Farm Enterprise	Seed (kg)	Fert. (Kg)	Manure (kg)	Chemical (l)	Labour (Man-hr)	Seed (Kg)	Fert.(Kg)	Manure (Kg)	Chemical (l)	Labour (man-hr)	Seed (kg)	Fert. (Kg)	Manure (Kg)	Chemical (l)	Labour (man-hr)
Cp	23	26	723	0.7	407	22	33	859	0.5	405	22	30	805	0.6	406
	10					10			0		10				
Cp/Ct	30	27	940	0.8	406	29	40	583	0.8	404	30	35	720	0.8	404
	10					11					10				
Cp/Gn	14	33	900	-	366	12	40	-	-	364	13	35	600	-	366
	11					14					12				
Cp/Mz	14	50	580	-	370	15	50	480	-	373	14	50	530	-	371
	11					10					11				
Cp/Ml	12	43	868	-	389	14	46	510	-	382	12	45	640	-	385
	9					10					9				
Cp/Sg	11	30	600	-	405	8	33	900	-	390	10	30	700	-	400
Cp/Ml/Sg	6					7					6				
	6	50	690	-	409	9	35	723	-	399	8	40	745	-	402
	10					7					8				

Source: Field Survey Data, 1996

4.1.3 Costs of Production.

Considering the two villages together, the highest cost of production per hectare was obtained for cowpea/cotton mixture (₦10,125) and sole cowpea (₦9,863), while the least cost of production was obtained for cowpea/groundnut mixture (₦8,264) as shown in Table 4.3.

Table 4.3: Farm enterprises and costs of inputs used per hectare.

Farm Enterprise	Daudawa village						Yandoto Village						Both Villages					
	Seed cost (₦)	Fert. cost (₦)	Manure Cost (₦)	Labour cost (₦)	Chemical cost (₦)	Total cost (₦)	Seed cost (₦)	Fert. cost (₦)	Manure cost (₦)	Labour cost (₦)	Chemical cost (₦)	Total cost (₦)	Seed Cost (₦)	Fert. Cost (₦)	Manure Cost (₦)	Labour Cost (₦)	Chemical Cost (₦)	Total Cost (₦)
CP	460	156	362	8140	840	9958	440	198	430	8100	600	9768	440	180	403	8120	720	9863
Cp/Ct	200 315	162	470	8120	960	10,227	200 451	240	292	8080	960	10223	200 315	210	360	8080	960	10125
Cp/Gn	200 252	198	450	7320	-	8420	220 216	240	-	7280	-	7956	200 234	210	300	7320	-	8264
Cp/Mz	220 210	300	290	7400	-	8420	280 225	300	240	7460	-	8505	240 210	300	265	7420	-	8435
Cp/Ml	220 168	258	434	7780	-	8860	200 196	276	255	7640	-	6567	220 169	270	320	7700	-	8678
Cp/Sg	180 132	180	300	8100	-	8892	200 95	198	450	7800	-	8744	180 120	180	350	8000	-	8830
Cp/Ml/Sg	120 84 120	300	345	8180	-	9149	70 126 84	210	362	7930	-	9832	120 112 96	240	373	8040	-	8981

Source: Field Survey Data, 1996

Note: Inputs prices.
(a) Seeds (i) Cowpea = ₦20/kg (v) Millet = ₦14/kg (d) Labour = ₦20 per man-hr
(ii) Cotton = 10.50k/kg (vi) Sorghum = ₦12/kg (e) Chemical = ₦1200 per litre.
(iii) Groundnut = ₦18/kg (b) Fertilizer = ₦6/kg (iv) Maize = ₦15/kg (c) Manure = **₦500 per tonn**

4.1.4 Cowpea Mean Yield in Mixture of Other Crops

The mean yields of cowpea recorded under sole cropping were 650kg/ha in Daudawa village, 708kg/ha in Yandoto village and 685kg/ha for the both villages. Among the crop mixtures, highest cowpea yields were recorded for cowpea/millet mixture in Daudawa village (373kg/ha); cowpea/sorghum in Yandoto village (385kg/ha) and from the two villages 308kg/ha was recorded as cowpea yield in cowpea/millet mixture as presented in Table 4.4. For both villages, the least cowpea yield was obtained from cowpea/millet/sorghum mixture (195kg/ha).

Table 4.4 Mean Yield of Cowpea in Mixture of Other Crops

	Daudawa village		Yandoto village		Both villages	
Cropping Systems	Cowpea (kg)	other crop (kg)	Cowpea (kg)	Other crop (kg)	Cowpea (kg)	other crop (kg)
Cp	650		708		685	
Cp/Ct	296	641	302	615	300	625
Cp/Gn	240	273	204	321	228	289
Cp/Mz	293	392	198	609	245	500
Cp/Ml	373	601	271	609	308	606
Cp/Sg	238	597	385	600	286	598
Cp/Ml/Sg	205	216	190	363	195	314
		448		310		356

Source: Field Survey Data, 1996

Note: Cp = Cowpea, Mz = Maize
Ct = Cotton, Ml = Millet,
Gn = Groundnut, Sg = Sorghum.

4.1.5 Gross Margin Analysis

In economic terms, higher gross margins per hectare were recorded for cowpea/millet mixture (₦7414) and cowpea/sorghum mixture (₦6156) in Daudawa and Yandoto village respectively. From the Table 4.5, cowpea/millet mixture for the both villages considered together had the highest gross margin of ₦5966 per hectare, followed by cowpea/sorghum mixture with ₦4066 per hectare.

Table 4.5: Farm Enterprises and the gross margin per hectare.

Farm Enterprise	Daudawa Village			Yandoto village			Both villages		
	Rev. (₦)	TVC (₦)	GM (₦)	Rev. (₦)	TVC (₦)	GM (₦)	Rev (₦)	TVC (₦)	GM (₦)
Cp	1300	9958	3042	14160	9768	4392	13700	9863	3837
Cp/Ct	12971	10227	2744	12805	10223	2582	12875	10125	2750
Cp/Gn	9714	8420	1294	9858	7956	1902	9762	8264	1498
Cp/Mz	11740	8420	3320	13095	8505	4590	12400	8435	3965
Cp/Ml	16274	8860	7414	13946	8567	5379	14644	8678	5966
Cp/Sg	11924	8892	3032	14900	8744	6156	12896	8830	4066
Cp/Ml/Sg	12500	9149	3351	12602	8832	3770	12568	8981	3587

Source: Computed from Field Data, 1996

Note: Rev. = Revenue,
TVC = Total Variable Cost,
GM = Gross Margin

Output Prices: Cowpea = ₦20/kg
Cotton = ₦11/kg
Groundnut = ₦18/kg
Maize = ₦15/kg
Millet = ₦14/kg
Sorghum = ₦12/kg

4.2 The On-farm Evaluation of Neem Leaf Extracts and Convntional Insecticides

4.2.1 Labour Requirement

The labour used for clearing, ridging, planting, weeding, remoulding and fertilizing remained the same for the three treatments in each village. The major areas ofdifference in labour requirement were harvesting and threshing operations and this was as a result of yield difference among the three treatments on each field.

From the Table 4.6, the average total labour used for cowpea production on one hectare of land under the spray of conventional chemical, Neem leaf extracts and 'No-spray' were 310 man-hrs, 293 man-hrs and 270 man-hrs respectively in Daudawa village while 302 man-hrs, 289 man-hrs and 270 man-hrs were used in Yandoto village.

Table 4.6 Labour input for cowpea production in Man-hrs per hectare.

	Daudawa Village			Yandoto village			Both villages		
	C.I	N.E.	N.S	C.I	N.E	N.S	C.I.	N.E	N.S
Maximum	329	321	298	336	314	295	329	321	298
Minimum	279	268	247	277	274	256	277	268	247
Average	310	298	270	302	289	270	302	291	270
Standard Deviation	15	15	16	15	12	14	15	14	14

Source: On-Farm Study, 1996

Note: C.I = Conventional insecticide
N.E = Neem leaf extracts
N.S = 'No-spray'

4.2.2 Cowpea Yields

The average yield of cowpea per hectare under the influence of conventional insecticides, Neem leaf extracts and 'No-spray' condition in Daudawa village were 751kg, 555kg and 351kg respectively. In the same order, 649kg, 520kg and 359kg were recorded in Yandoto village. considering the two villages together, the average yield of cowpea under the use of conventional insecticide was 679kg/ha; Neem leaf extracts 537kg/ha and 'No-spray' was 355kg/ha as presented in the Table 4.7.

Table 4.7 Cowpea Yields in Kilogrammes per Hectare

	Daudawa Village			Yandoto village			Both villages		
	C.I	N.E.	N.S	C.I	N.E	N.S	C.I.	N.E	N.S
Maximum	920	720	596	762	625	454	920	720	596
Minimum	534	343	192	514	400	234	514	343	192
Average	751	555	351	649	520	359	679	537	355
Standard Deviation	143	148	140	78	78	66	170	118	108

Source: On-Farm Study, 1996.

There was about 92% yield gain from the application of conventional insecticide (Diazinon 40EC) while a 52% yield gain from the application of Neem leaf extracts when compared with 'no-spray'. The yield gain between the conventional insecticide and Neem leaf extracts was about 40%.

4.2.3 Statistical Difference in yield

Analysis of variance (ANOVA) was used to test the hypothesis that there is no difference statistically among the treatments. The data from the two villages were considered together. There was a significant difference statistically in the yields of cowpea among the three treatments at 1% probability level (using the analysis of variance). The result of the analysis of variance is presented in Table 4.8.

Table 4.8 Analysis of Variance (ANOVA) on Cowpea Yield for the two villages together.

Source of Variation	Sum of squares	Degree of freedom	Mean sum of square	F
Among samples	159×10^4	2	79.5×10^4	44.20
Within sample	158×10^4	87	1.8×10^4	
Total	317×10^4	89	3.6×10^4	

F critical at one percent probability level = 4.61.

Source: On-Farm Study, 1996.

The t-statistic determined, indicate that there is a significant difference statistically between conventional insecticide and Neem leaf extracts; Neem leaf extracts and 'No-spray' at 1 % level of probability. The t-calculated values are shown in Table 4.9.

Table 4.9: The t-statistic.

	t-calculated	Difference
C/E	3.7	Significant
C/N	8.8	Significant
E/N	6.3	Significant

T-critical at 1% probability level = 2.8

Source: On-farm Study, 1996

Note: C/E = Conventional insecticides verses Neem leaf extracts.

C/N = Convention insecticides verses 'No-spray'

E/N = Neem leaf extracts verses 'No-spray'.

4.2.4 Partial Budget.

The partial budgeting was applied to compare the added costs and benefits of conventional insecticides with that of Neem leaf extracts. The cost of using Neem leaf extracts as a control measure against insect pests on cowpea was ₦469/ha (including the sprayer depreciation). The cost of using the conventional insecticide (Diazinon 40EC) was ₦1019/ha. In Daudawa village, the added revenue from use of Neem leaf extracts was ₦4080/ha while that from use of Diazinon 40EC (conventional insecticide) was ₦8000/ha. In Yandoto village, the added revenue from Neem leaf extracts was ₦3220/ha while added revenue from the conventional insecticide was ₦5,800/ha. The partial budget is presented in Table 4.10. the positive difference indicates that the net benefit of conventional insecticide exceed the net benefit of the Neem leaf extracts by the value shown. In Daudawa village, the value was ₦3370; Yandoto village the value was ₦2030 and for the two villages was ₦2290 per hectare.

Table 4.10: The partial budgeting for Neem leaf extracts and conventional insecticide application

Items per hectare	Daudawa village		Yandoto village		Both villages	
	C.I.	N.E	C.I.	N.E.	C.I.	N.E
Added benefits	8000	4080	5800	3220	6480	3640
Reduced costs	469	1019	469	1019	469	1019
Sub-total increases	8469	5099	6269	4239	6949	4659
Reduced Benefits	4080	8000	3220	5800	3640	6480
Added Costs	1019	469	1019	469	1019	469
Sub-total decreases	5099	8469	4239	6269	4659	6949
Differences	+3370	-3370	+2030	-2030	+2290	-2290

Source: On-farm Study, 1996.

Note: C.I. = Conventional Insecticide
N.E. = Neem leaf extracts.

4.2.5 The Net Farm Income.

In Daudawa village, the net farm income for the use of conventional insecticide (Diazinon 40EC) was ₦7181/ha while for the use of Neem leaf extracts was ₦4151/ha. The net farm incomes recorded in Yandoto village for the use of conventional insecticide and Neem leaf extracts were ₦5301 and ₦3531 per hectare respectively as shown in Table 4.11.

From the two villages, ₦5901 and ₦3831 were recorded as the net farm income per hectare for the use of conventional insecticide and Neem leaf extracts respectively. The use of conventional insecticide as a measure of controlling insect pests on cowpea increased the net farm income by 446%, while the Neem extracts with about 255%.

Table 4.11: The Costs and Returns Analysis for Conventional Insecticide and Neem Leaf Extracts Application.

Items per hectare	Daudawa village			Yandolo village			Both villages		
	C.I.	N.E.	N.S	C.I	N.E	N.S	C.I	N.E.	N.S
Variable costs (N)									
Seed	300	300	300	300	300	300	300	300	300
Seed dressing	20	20	20	20	20	20	20	20	20
Fertilizer	300	300	300	300	300	300	300	300	300
Insect pest control	790	240	-	790	240	-	790	240	-
Labour	6200	5860	5400	6040	5780	5400	6040	5820	5400
Fixed Cost (N)									
Sprayer depreciation *	229	229	-	229	229	-	229	229	-
Total Cost (N)	7839	6949	6020	7679	6869	6020	7679	6909	6020
Returns									
Yield (kg)	751	555	351	649	520	359	679	537	355
Price (N/kg)	20	20	20	20	20	20	20	20	20
Gross income (N)	15020	11100	7020	12980	10400	7180	13580	10740	7100
Gross margin (N)	7410	4380	1000	5530	3760	1160	6130	4060	1080
Net Farm income (N)	7181	4151	1000	5301	3531	1160	5901	3831	1080

Source: On-Farm Study, 1996.

Note: Prices of inputs:

a. seed = ₦20/kg
b). Fertilizer = ₦6/kg
c). Labour = ₦20/man-hr
d). Chemical = ₦900/litre.

* Straight line method was used to determine the sprayer depreciation.

The market price for the sprayer was ₦6080 and the salvage value assumed at the end of five years was ₦1500. It was also assumed that the sprayer was used on 4ha of land. The depreciation per hectare was calculated to be ₦229.

4.2.6 Farmers' Reactions

About 50% of the farmers preferred the use of Neem leaf extracts to control cowpea insect pests. The reason given by them was that they found it difficult to get the best chemical (conventional insecticides) at a price within their reach. The other 50% preferred conventional insecticides but complained that most of them could not read and understand how some of these conventional insecticides can be used, particularly, in terms of the rate of application.

About 83% of the farmers believed that they could spray Neem leaf extracts on their own without looking for somebody to spray for them, since it is safe and can hardly cause any damage to the plants. The remaining 17% suggested that they should be organised and trained on how to apply insecticides without causing any problem to their crops and themselves. In addition they would like to be given a list of good conventional insecticides which can provide almost equal output level to prevent them from buying those that are harmful and adultrated.

About 73% of the farmers complained that they still found some insects surviving after spraying Neem leaf extracts and they believed that those insects could still cause damage to their crops while the remaining 27% believed that Neem leaf extracts was effective since it reduced the population of the insects and has minimized the extent of damage on their fields. They also observed that those insects surviving were inactive. The Table 4.12a and 4.12b illustrate the farmers' reactions.

Table 4.12a: Farmers' Reactions in Favour of Neem Extracts or Conventional Insecticides

	Neem Extracts		Conventional insecticides	
	No. of farmers	Percentage	NO. of farmers	Percentage
Preference	15	50	15	50
Reasons				
Available	30	100	–	–
Cheap	30	100	–	–
Easy to spray	25	83	5	17
Safe	25	83	5	17
Control insect	8	27	22	73
Increase Yields	13	43	17	57

Source: On-farm Study, 1996.

The commonest complaint from the farmers against conventional chemicals was the high cost and non-availability of the products within their environments. This is not the case with Neem leaf extracts, which is more cheaper and more readily available.

Table 4.12b: Farmers' Reactions against Neem Extracts or Conventional Insecticides

	Neem Extracts		Conventional insecticides	
	No. of farmers	Percentage	NO. of farmers	Percentage
Not available	–	–	30	100
Costly	–	–	30	100
Required skill and knowledge	5	17	25	83
Harmful	5	17	25	83
Insect still survive	22	73	–	–

Source: On-farm Study, 1996.

Chapter 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Policy makers need a better understanding of the technical and economic constraints facing cowpea producing farmers if they are to achieve the crucial objective of increasing the production of staple food crops and meet the nutritional requirement of Nigerian populace. Towards this end, research was conducted in two phases (cowpea production survey and on-farm evaluation of Neem leaf extracts as insecticides for cowpea production) during the period of 1996 cropping season. A total of thirty (30) cowpea producing farmers were selected from two villages of two states in Northern Guinea savanna ecological zone of Nigeria. These villages are Daudawa in Katsina state and Yandoton-daji in Zamfara state.

The results of cowpea production survey in Daudawa Village indicated that cowpea/millet mixture was more profitable (with Gross Margin of ₦7414) than other cropping systems. The least Gross Margin (₦1294) was recorded for cowpea/groundnut mixture. The results from the on-farm trials in this village indicate a 58% yield gain and about 315% profit gain from the application of Neem leaf extracts as a measure of controlling insect pests on cowpea. The net benefit of conventional insecticide exceeded that of Neem leaf extracts with about ₦3370 per hectare.

In Yandoto village, the survey recorded the highest Gross Margin for cowpea/sorghum mixture (₦6156); followed by cowpea/millet mixture (₦5379) and the least for cowpea/groundnut mixture (₦1902). The results from the on-farm trials indicate a 45% yield gain and about 204% profit gain from the application of Neem leaf extracts. The net benefit of conventional insecticide exceeded that of Neem leaf extracts with about ₦2030 per hectare.

For the two villages together, the results of cowpea production survey indicated that sole cowpea was grown by about 50% of the farmers. This could be attributed to relay cropping which is common in the study area under which cowpea is mostly grown as second crop and the first crop harvested before the cowpea is established. In the economic terms, the highest Gross Margin per hectare was recorded for cowpea/millet mixture (₦5966). A high revenue was obtained for sole cowpea, but the high cost of production made the sole cowpea to be less profitable as compared to cowpea/millet mixture. The results from the on-farm trials indicate a 52% yields gain and about 255% profit gain from the application of Neem leaf extracts. The net benefit of conventional insecticide exceeded that of Neem leaf extracts with about ₦2290 per hectare.

However, about 50% of the farmers preferred the use of Neem leaf extracts to control cowpea insect pests. This is because, it is cheaper, readily available and easy to spray. The only complaint from the farmers against the use of Neem leaf extracts as insecticides was that they still found some insects surviving after spraying and believed that those insects could still cause damage to their crops.

5.2 Conclusion

Cowpea crop is prone to severe insect pest attacks right from seedling stage to harvest. The production of this crop can not be both sustained and economic without the use of insecticides. The conventional insecticides are not within the reach of resource poor farmers because of the high cost and non-availability of the products.

In order to help the farmers to improve the production of cowpea, there is need to develop effective, low-cost and available technology for insect pest control. The results from this study demonstrated that the use of Neem leaf extracts as indigenous insecticides was effective resulting in 52% and 255% yield and profit gain respectively when compared to 'No-spray' cowpea. However, this was not effective as conventional insecticides which had 92% and 446% yield and profit gain respectively. Some of the farmers who participated in this study believed that they can increase their crop yields and net incomes with the use of Neem leaf extracts.

5.3 Recommendations

There is need for development of low-cost technologies; especially in the areas of pest control in order to encourage farmers to increase cowpea production. Improved package of crop mixtures should also be extended to farmers to help them improve and sustain the cowpea yields.

There is need for further research to improve the effectiveness of Neem leaf extracts in controlling insect pests in cowpea production. Its chemical properties should be determined to facilitate the recommendation of appropriate dosage. Extension services should be used to encourage farmers to use Neem leaf extracts in controlling insect pests on their crops since the conventional insecticides are beyond the reach of most of them.

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APPENDIX

QUESTIONNAIRE FOR COWPEA PRODUCING FARMERS.

VILLAGE:________________ FARMER'S NAME:________________

SEASON:________________ DATE:________________

A. CROPS AND CROPPING PATTERNS

Field No.	Sole Cowpea	Mixed Cropping					
		First Crop		Second Crop		Third Crop	
	Field Size in Hectare	Name	Hectares	Name	Hectares	Name	Hectares

B. INFORMATION ON INPUTS USED

(i) Seeds

			Improved seed				Local seed			
Field Number	Farm size in hectares	Name of crop	Name	Unit used	No. of unit	Cost (₦/unit)	Name	unit used	No. of unit	Cost (₦/unit)

Unit used: Kg, Bag, Tyia, Basket, Basin etc.

(ii) Fertilizers and Manures

Field Number	Farm size (Ha)		Name of Crop	Fertilizer			Manure		
				Unit used	No. of unit	Cost (₦/unit)	Unit used	No. of unit	Cost (₦/unit)

(iii) Chemical

Field Number	Farm size (Ha)	Name of crop	Insecticides			Fungicides			Nematicides			Herbicides		
			Name	Unit	Cost	Name	Unit	Cost	Name	Unit	Cost	Name	Unit	Cost

C. LABOUR INPUT

(i) Clearing

Field Number	Farm size (Ha)	Date of Operation	Family Labour				Hired Labour		
			Male adult	female adult	child	Hours	Male adult	Female adult	Hours

(iii) Ridging

			Family Labour				Hired Labour		
Field Number	Farm size (Ha)	Date of Operation	Male adult	female adult	child	Hours	Male adult	Female adult	Hours

(iv) Planting

Field Number	Farm size (Ha)	Date of Operation	Family Labour				Hired Labour		
			Male adult	female adult	child	Hours	Male adult	Female Adult	Hours

(v) Fertilizer Application

Field Number	Farm size (Ha)	Date of Operation	Family Labour				Hired Labour		
			Male adult	Female adult	Child	Hours	Male adult	Female adult	Hours

(vi) Spraying

Field Number	Farm size (Ha)	Date of Operation	Family Labour				Hired Labour		
			Male adult	Female adult	Child	Hours	Male adult	Female adult	Hours

(vii) First Weeding

Field Number	Farm size (Ha)	Date of Operation	Family Labour				Hired Labour		
			Male adult	Female adult	Child	Hours	Male adult	Female adult	Hours

(viii) Second Weeding

Field Number	Farm size (Ha)	Date of Operation	Family Labour				Hired Labour		
			Male adult	Female adult	Child	Hours	Male adult	Female adult	Hours

(ix) **Remoulding**

Field Number	Farm size (Ha)	Date of Operation	Family Labour				Hired Labour		
			Male adult	Female adult	Child	Hours	Male adult	Female adult	Hours

(xi). <u>Threshing</u>

Field Number	Farm size (Ha)	Date of Operation	Family Labour				Hired Labour		
			Male adult	Female adult	Child	Hours	Male adult	Female adult	Hours

D. INFORMATION ON PRODUCTION (OUTPUT)

(i) Sole Cowpea

Field Number	Unit Used	Number of Unit Harvested

(ii) Mixed Cropping harvests

	First Crop			Second Crop			Third Crop		
Field Number	Name	Unit	No. of Unit	Name	Unit	No. of Unit	Name	Unit	No. of Unit

Note: Unit for harvest could be Bag (big, small), Bundle, Kunshin, Basket, Basin, Tonns, Kg etc.