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Subprogramme of Farmer Centred Agricultural Resource Management Programme (FARM)

Technical report: Expert group meeting on policy issues in the region for bio and neem (Azadirachta indica) based pesticides development Bangkok, Thailand, 1-3 September 1994*

Prepared for the Governments of the Member States of the Regional Network (Afghanistan, Bangladesh, People's Republic of China, India, Indonesia, Islamic Republic of Iran, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Republic of Korea, Sri Lanka, Thailand and Viet Nam) by the United Nations Industrial Development Organization, acting as executing agency for the United Nations Development Programme

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I. INTRODUCTION

The countries in Asia and the Pacific region are primarily dependent on agriculture. Pesticides have become important and essential input in increasing the food production. However, there are increasing evidence to show that agro-chemicals production, consumption and trade contributes to environmental problems on account of pollution generated during the production process, handling, storage, transportation, unsound disposal measure and unscientific use in the field. The resurgence of new pests, resistance development, contamination of soil, water and air, destruction of predators, parasites and other non - target organisms including wild life brought about the realisation that these chemicals are not exclusively doing the job they are intended to do but also cause damage to the environment. The growing concern for greater protection of the environment all around the world has had major impact on pest management programmes. This aspect is most heavily manifested in the efforts that were made to restrict or eliminate the use of pesticides that persist in the environment over long periods involving risk to various forms of life.

The problems compound with the indiscriminate use of chemical pesticides and have provided strong impetus to produce quality pesticides which are safer and bio-

degradable in nature. The RENPAP has engaged itself towards promoting adoption of "Clean Technologies" revamping of old units to make the production safe, to introduce effective effluent control measures to prevent environmental pollution, strengthening of occupational health and safety in the chemical pesticides production arena, and to promote and develop bio-botanical pesticides as another effective means to reduce the chance of environmental pollution as these are basically natural products and are bio-degradable. In the last regional workshop of RENPAP 1991 held in Bangkok, Thailand "Neem" was selected as the priority botanical pesticide for development by the national, regional and international agencies through promoting exchange, training, R&D and transfer of technology.

The present Expert Group Meeting on Policy Issues in the Region for Bio and Neem (Azadirachta indica) based Pesticides Development in support of Integrated Pest Management was held in Bangkok from Sept. 1-3, 1994. The workshop was organised by UNDP/UNIDO/RENPAP in cooperation with the Department of Agriculture, Royal Govt. of Thailand.

Objectives of the workshop

1. To appraise the policy makers of the member countries of the potentialities of bio-pesticides and botanical pesticides (neem only will be considered) in the management and control of pests on the one hand and

reducing the environmental pollution associated with the application of chemical pesticides on the other.

2. Introduction and proper use of environmentally safe pesticides management and varietal intercultural technology at the grassroot level to increase productivity and to provide comprehensive environmental and health protection.

3. To provide national programmes with up-to-date information on prospects and procedures for commercialisation of bio-botanical pesticides for insects, weeds and plant diseases and to develop with them national strategic plans for bio-botanical pesticide development and commercialisation.

4. Technical prospects for bio-botanical pesticides, what is the status of R&D and commercialisation for the bio-botanical pesticides for the major Asian pest species and what are the future prospects.

5. Safety health and quarantine issues relating to the development, production, use and distribution of bio-pesticides.

6. Case studies from national commercial development of bio-pesticides and neem based pesticides inside and outside Asia.

7. The role of multi-nationals and licensing agreements in the development of bio-pesticides and neem based pesticides.

8. Follow up of the recommendations made in the workshop held on the same subject in Bangkok in December, 1991.

The workshop was attended by 16 participants from 13 member countries of the RENPAP. Delegate from Afghanistan and Sri Lanka could not attend. Experts from GTZ, Germany and USA, representatives from UNIDO, FAO, UNDP Bangkok and observers from Korea and Philippines participated in the meeting. The complete list of participants is attached as Annexure I.

II. OPENING OF THE WORKSHOP

Dr. Dhua, Regional Coordinator, RENPAP in his address recalled the first regional meeting on Bio-botanical pesticides held in Dec. 1991 and mentioned that though the basic work had been done to a great degree but there is lot of scope in the developmental work of biological and botanical pesticides. He said that what remains to be done was essentially the commercialisation of the process and perception of the technology and lead to uniformity in quality and conform to the standard which could be measured accurately in the laboratory as it is done in case of chemical pesticides. While tracing down the synthetic pesticides history from the discovery of organochlorine compounds in 1940s to synthetic pyrethroids, he mentioned

that people started feeling that now we are possibly approaching towards a new safer product which is less mammalian toxic but very-effective in small quantities. Dr. Dhua mentioned that natural products are safer which disintegrate faster and pose no environmental pollution and also safer to those who handle these. While highlighting the qualities of natural products to find a place in IPM strategies of pest control, Dr. Dhua stressed that these products have to be produced in an industrial way and that is why the regional network on pesticides has been taking a very active role to pursue this end. Dr. Dhua briefly mentioned about the 7 components of FARM programme and explained how pesticide sub-programme is complemented with IPM and other sub-programmes.

He expressed his thanks to the governments of the network member countries from whom the programme has been getting very strong support in all possible ways in promoting bio-pesticides and botanical pesticides which will find a place in the market soon. He specially thanked the Royal Govt. of Thailand and Mr. Rumkom, Director General, Department of Agriculture for hosting the workshop in a befitting way.

Dr. John Dixon, FARM Coordinator while welcoming the participants to the workshop said that it was a very important workshop and that it's something that needs treatment not only in three days. It has to be pursued during the next few years or even in the next decade or so

to see its fruit become a natural and effective conclusion. He said it was also a great pleasure for him on behalf of his colleagues in the FARM programme to outline in a very brief form the Farmer Centered Agricultural Resource Management Programme. The programme, focuses on the implementation of agenda 21 throughout the Asia region, and encompasses two very important issues, one is resource degradation and the other is human degradation. The two are ofcourse linked and this workshop will focus on pesticides particularly bio-pesticides and botanical pesticides as alternatives and complements to more traditional pesticide, has a very important role to play on that. The particular entry into the FARM programme for this workshop is the Pesticide Production and Information Sub-programme. He said FARM programme is a programme of 8 Asian countries. Those Asian countries are China, India, Indonesia, Philippines, Srilanka, Thailand and Vietnam. Though the focus lies on 8 countries, other countries are not excluded by any means in participation. He also mentioned that UNIDO and FAO are providing technical support as executing agencies for the FARM programme. He said FARM programme tackles agriculture particularly sustainable agriculture in multi-faceted, multi sectorial way. He explained how each sub-programme of FARM has linked to each other and particularly to the very subject of this workshop on Biobotanical pesticides. For example, bio-technology and bio-diversity sub-programme

holds for spreading up production and even discovery of new bio-pesticides.

Dr. Dixon said as Farmer Centered Programme focuses on works with the women, children, and men at the village level and at the farm level, it beholds us during this workshop to think very carefully about the impacts and benefits of bio-pesticides and botanical pesticides for those persons. He said that neem production is not difficult and so is its processing. It can be done on small scale even at village level. Small farmers and even landless could be easily involved in the entrepreneurship at the village level. So involving farmers, small businessman in village area in a way helps in achieving the objectives of sustainable agriculture of FARM programme.

Mr. Montri Rumakom, Director-General, Department of Agriculture, Thailand in his welcome address emphasised the importance of safe use of pesticides and the need to protect the environment. He appreciated the efforts made by the UNDP/ UNIDO/ RENPAP in usage of pesticide and introduction of environment friendly pesticide products, the latest being the botanical and bio-pesticides. He said that the Department of Agriculture, Thailand was happy to host this regional workshop of greater importance. He welcomed all the participants form the member countries to the workshop.

III. KEY NOTE ADDRESS

Keynote address was given by Dr. C. Richard Edwards on the Development and use of Bio-botanical Pesticides in Pest Management Programmes.

He said that Bio/botanical pesticides will play an ever increasing role in pest management programs in developing ccuntries as we move into the twenty-first century. As we decrease our dependence on synthetic organic pesticides, biorational pesticides and other more biologically intensive pest management tools, such as biological control, behaviour modifying chemicals, cultural control and host plant resistance, will gain in importance and allow us to sustain our production systems. Bio/botanical pesticides could well become as active a player in the pest control arena as pesticides have been for the past fifty years. Synthetic organic pesticides will still have a place in pest management programs, however, products with greater selectivity for the targeted pest, little to no effect on beneficial species, and less impact on humans and the environment will be the norm rather than the exception.

Companies in developed countries that have invested billions of dollars in product development are redirecting much of their investment in future products to safer, more selective compounds, including the move to bio/botanicals. In developing countries, it may take longer to see national

shifts in product development unless governments strongly encourage, or perhaps demand that these changes be made. These are not easy changes since many private companies may have considerable influence within governments and provide needed employment and revenue. However, cottage industries producing bio/botanical products at the local level, with buy-ins from government, industry and local farmers should flourish in many developing countries. This has already taken place to varying degrees in countries such as Thailand, India and China.

Decreasing or redirected governmental budgets, or budgets that experience additional strains due to expanding populations, increased pressure to produce more food, greater emphasis on human health, and needs for improved human services will not allow for, in most instances, the continuation of subsidies for inputs such as imported, or possibly even locally produced pesticides. Even donor agencies show greater reluctance to underwrite the costs of synthetic organic pesticides and in some instances refuse to provide these except under the strictest conditions. Therefore, more affordable pesticides produced at the local level will increase in importance. We can help this process by making bio/botanical pesticides a viable alternative to more toxic and environmentally unfriendly synthetic organic pesticides when companies are making their choices as to the products that they will develop. He said that if companies

produce a product it must be profitable, or at least result in a break even situation. The manufacturing process must be such that biorational pesticides can compete favourably with those that produce synthetic organic compounds. In some instances, they will need to be subsidized to get them up and running.

Bio-botanical pesticides, such as products derived from pathogenic organisms, like *Bacillus thuringiensis* and *Heliothis armigera* NPV, and plants such as *Azadirachta indica*, which are or can be produced at the local level, will provide for a reliable means of managing pest populations in pre-outbreak and outbreak situations without major disruption of natural enemies and effect on human health and the environment. We must remember, however, that for these to be effective we must stress quality control and the development of standardized production procedures. Although *Azadirachta indica* and products derived from pathogenic organisms such as *Bacillus thuringiensis* will be major weapons in our arsenal against pests, we will need to vigorously explore other bio/botanical possibilities to ensure that we have an adequate supply of crop protection products. Additionally, to increase their product life, we will need to use them only when necessary and in such a way that pest resistance is not a factor. Application technology will need to be researched to ensure that maximum

effectiveness is attained, while non-target areas are avoided.

Although bio/botanicals have a great future in pest management programs in developing countries, we must not loose sight of the fact that these are toxic to certain biological organisms and must be treated as such. Some bio/botanical pesticides are, or could be as toxic to humans and other non-target organisms and create environmental problems as with many synthetic organic pesticides. A case in point is the botanical pesticide nicotine. This product is extremely toxic to humans and non-target organisms, if not handled or applied properly. Another is certain subspecies of *Bacillus thuringiensis* which are highly toxic to silkworms. To ensure the safety of bio/botanical products, rigorous testing programs must be carried out by public and private entities. The toxicological properties of candidate materials must be thoroughly researched and the most appropriate formulations and application methods developed.

The development of highly efficacious biorational pesticides is not an easy task. Factors such as culture and maintenance of pathogenic organisms (or products) or type of extraction process for botanicals, laboratory and field testing to determine efficacy and host range, selection of the most appropriate formulation(s),development of pilot plant and later the production facilities, product stability, quality

control in the manufacturing process, toxicological studies, etc., must be addressed. For products derived from *Bacillus thuringiensis* and *Azadirachta indica* many of these factors have been thoroughly addressed and resolved. However, the solution to others have been more difficult to come by. Other bio/botanicals pesticides are in the early stages of development and face many of the same roadblocks as noted above.

As was noted in an Indonesian pest management report, throughout much of the world, fifty plus years of marketing pesticides as preventive treatments for various pest species has created the perception that "the only good bug is a dead bug." With the coming of the Green Revolution, pesticides became a common production input like fertilizers and hybrid seed. This was the result of drastic changes in the agroecosystem that allowed pests that were not previously a problem or those that only occasionally caused concerned but were now greatly influenced by the routine use of synthetic organic pesticides, to become production problems. In most instances, pesticides were indiscriminately applied resulting in the development of resistance and / or the development of secondary pest outbreaks (disruption of the ecological balance). The production system fell under the category of crisis pest management, doing little but going from one outbreak situation to another.

We became "bug warriors". And although our arsenal was impressive, much of the time we were losing the war. A few years ago, those of us who were developing pest management programs began to talk about the need to change the direction of crop protection. Instead of constantly reacting to crisis situation, we began to formulate preventive pest management strategies as a way to reduce the need for expensive and potentially harmful synthetic organic pesticide inputs. In preventive pest management programs, cropping systems are designed to minimise pest problems through careful analysis of all factors associated with the production of a crop(s) and their influence on pest populations. With this change in philosophy or attitude came "biologically intensive" pest management systems. These allowed for the movement toward production sustainability. In a more biointensive pest management system, synthetic organic pesticides are only applied when other management tools, such as biorational pesticides and natural enemies are not effective. Where pesticides are used, they are selected based on the least disruption to natural enemies and the environment. Additionally, pesticides that could result in resistance or resurgence of pests are avoided. Ideally, the pest management strategies that drive the system are mainly biological in nature.

The key to the success of a biologically intensive pest management program is local ownership. If farmers have not

bought into the system, it is doomed for failure. However, to make it sustainable over time, there is a need for a strong national commitment to the program. There needs to be strong policy support at the national level, a commitment of resources, special significance given to human resource development, adherence to sound ecological principles, and utilization of participatory methodologies. When this happens, programs flourish.

Pest management is a "muddy boots" activity. To be successful, one must "get in the mud everyday to make it work." When this happens, the program becomes institutionalised within the infrastructure of the individual farm and farming community. It attains the same level of importance as planting, harvesting, selling commodities, schooling, etc.

The level of involvement in pest management will vary depending upon the types of crops grown and the purpose for which they are produced. Cash crops are a source of income for the individual and/or community. They normally consist of field, vegetable, and/or fruit crops. Subsistence crops are utilized by the single or extended family and include vegetables, with some field crops. Often more emphasis is placed on pest management activities associated with cash crops because of their value to families and communities. Subsistence crops may receive less attention when it comes to pest management. Because subsistence crops are of such

great value to the single or extended family, pest management principles should be applied in these fields as well.

Successful pest management programs utilize all available resources. Both public and private entities have a role to play in successful programs. Pest managers with advanced training are needed to facilitate the transfer of knowledge at both the national and local level. Train the trainer activities are a necessary part of the education process. In many of the more successful pest management programs, farmers have become the catalyst for the transfer of pest management principles and techniques. Farmers training farmers is well suited to many developing countries.

Evaluations of programmes where farmers take a more active role in receiving and transferring pest management knowledge show that they are more apt to apply sound pest management principles in their farming operation. That is, to grow a healthy and profitable crop one must utilize good production practices which incorporate preventive pest management methodologies to reduce pest risks. This is done by monitoring pest and beneficial species throughout the season, using production practices that conserve and enhance beneficial, using economic thresholds where available, and making sound management decisions based on economic and environmental considerations. Applying the principles of pest management in one's farming operation usually results

in less use of synthetic organic pesticides, stabilized or increased yields, greater profits, and development of advanced decision making skills.

When farmers take an active role in the development of pest management programs, public officials generally show greater enthusiasm toward supporting and expanding programs. These officials usually increase their pest management skills, become better trainers and implementors, and become highly motivated. By assisting farmers and increasing the level of knowledge at both ends of the spectrum, a true partnership is formed.

IV. ELECTION OF OFFICE BEARERS

Mr. Sothorn Prasertphon of Thailand was elected as Chairman of the Biopesticide section of the workshop , Prof. G A Miana of Pakistan was elected Chairman of the Botanical pesticide section of the workshop and Mr. Kuldip Gurtu of India and Ms. Aida Ordas of Philippines were elected as rapporteurs.

V. ADOPTION OF AGENDA

The agenda as adopted is placed at Annexure II.

VI. COUNTRY REPORTS

Country reports presented by the delegates are summarised below:

Bangladesh

Agricultural production in Bangladesh is largely dominated by rice cultivation. Crop production is faced with various risks and natural disasters including attack by insects, diseases, weeds, etc. Pesticides consumption has increased considerably since 1956. It has increased from 3 MT in 1956 to 7000 MT. With the adoption of IPM programme in the country, indiscriminate use of pesticide has come down. Bangladesh is a riverine country which is intersected by many rivers and covered with numerous rivulets, lakes and ponds, therefore, replacement of conventional chemical pesticides by bio-botanical pesticides would help to a large extent to keep the environment clean. At present no bio-botanical pesticide is under trial or process towards registration. However, various small scale research trials are being conducted by Research Institutes in the country using neem based products. A few firms/ traders have come up with neem based pesticides for registration.

Indonesia

Various bio-pesticides are registered with pesticide regulatory authority in the country. Dipel WP, Delfin WG,

Bactospeine WP, Centari G, Florbac FC (all Bt based) are few of them used in crop management, whereas Beempe 12 AS, Bactis S, Vectobac 4G (all Bt based) are used in public health programmes. Bop 0, 125A, Bop 1, 25L (pyrethrum), Chemfist 5 EC (rotenone), *Trochoderma koningii* are the other bio-pesticide registered in the country. Neem as Botanical pesticides is under process for registration for use in crop protection.

India

There is a good prospect of using botanical pesticides in India. Presently, neem, *Azadirachta indica* is under development for commercial use. Neem is registered provisionally in the country. The complexity of neem compounds precludes their synthetic production in the near future. The most neem derivatives used for insect control include dried leaves, seeds, seed kernel, oil cake, aqueous or organic solvent extracts, partially purified factions, azadirachtin rich formulations, etc.

Neem derivatives affect a wide range of insects. 206 insect species on various crop have been reportedly affected by neem directly.

With the annual seed potential of 0.42 million tonnes, India produces approximately 83000 tonnes of neem oil and about 332000 tons of neem cake annually. Neem cake is in demand for pest control use. Various neem formulations like Replin,

Wellgrow, Nimbosol, Biosol, Neemmark, Achook are available in the Indian market. Various factors have been identified as the bottleneck in the development and production of botanical pesticides.

Because of the complexity of active principals of neem, alternative approach of obtaining bioactive factions from neem seed is therefore, feasible and economically viable. Selection of superior ecotype would be desirable to increase the productivity and quality of neem produce. Use of neem based formulation would offer a selective, harmonious and non-violent approach that fits well in IPM programmes in the country.

Research work has been initiated at the Institute of Pesticide Formulation Technology (IPFT) with regard to the formulation development and quality testing of batch production of neem formulation through bioassay techniques.

Seeing the enormous potentiality of neem, Govt. of India has taken a decision at National level to promote neem products in India.

Iran

A large variety of synthetic chemical pesticides are used in the country to control various pests attacking various crops. In the recent past with the governments new policy to use judiciously the pesticide, to keep environment free from

pesticide pollution to avoid development of pesticide resistance and to keep balance in ecosystem, use of bio-botanical pesticides by the farmers is being encouraged. Decreasing subsidy for chemical pesticides by the government is also one way to drive farmers to adopt IPM with bio-botanical pesticides and other control methods.

Neem tree which is not native to Iran, has been introduced in the Persian gulf region about 50-55 years ago. Neem extract have been used successfully in controlling various insects like alfa alfa weevil (*Hypera postiva*), sugar beet leafworm (*Spodoptera exigua*), cabbage butterfly (*Pieris brassicae*), cutworm (*Agrotis ypsilon*), *Trogoderma granarium*. Fertilizer distribution and pesticide production company (FDPPC) has been studying the neem extract and has plans to produce and develop neem based formulations in the country.

Korea

Plant protection in the country is largely depended upon chemical pesticides. Therefore, sustainable approaches in agricultural production are being emphasised to solve those adverse impacts on farming practices. RDA as the central organisation in agriculture, has recently conducted IPM research aiming to minimise the use of pesticides and to analyse the balance between inputs and outputs. Knowing the ill effects of chemical pesticides, there is a tendency to find the leading naturally occuring compounds for

maintaining the balance in the ecosystem. Lot of research work is being carried out to screen the potential natural sources as bio-pesticides since 1980. A few potent bio-pesticides are ready for commercialisation such as antagonistic living microbe AC-1, bioactive compounds such as heteronitrogenous cyclic compound from castor oil plant, alkaloids from ginkgo tree. Antibiotic microbe isolated from the soil of red pepper field showed a strong antagonism against major diseases in vegetables including red pepper and cucumber.

Malaysia

Role of crop protection chemicals are very important under the new National Agricultural Policy (NAP) of the government which gives high priority to the crops such as rubber, oil palm, paddy, fruits and vegetables. Pesticide market is basically dominated by herbicides having a share of about 76%.

IPM programmes in rice, vegetables and cocoa have been quite well researched, organised and implimented. Several other IPM programmes on other important crops are being tried. IPM focuses more on biological control of pests and diseases and less on judicious use of low volume less persistant pesticides.

Botanical pesticides are presently being encouraged in view of the side effects of synthetic organic chemicals

insecticides. Because of the availability of a wide varieties of plants / herbs known for their insecticidal properties, the prospect of use of bio-botanical pesticides and neem based botanical pesticide have been at various stages of development and testing in the country. Facilities for batch and continuous production of Bt are available at the National University of Malaysia.

Myanmar

Principle of IPM has been introduced on several crops such as rice, groundnut, sesamum, cotton, potato, chickpea and cabbage in Myanmar since 1980.

Though chemical pesticides are still much favoured in the pest control programme, the share of organo chlorine pesticides have been substantially replaced by the organophosphate and the synthetic pyrethroid pesticides.

Neem based pesticides are the only botanical pesticides being produced and used in Myanmar. A pilot Neem Pesticide Plant was commissioned in 1987 with the assistance of GTZ and production of SC formulation started. Target for 1994 was to produce 30000 lt. of 1% azadirachtin SC. Neem pesticide is used effectively against lepidopterous pests of cabbage. Trials of the control of *Epilanchna* pests on cucurbit with neem pesticides also show high effectivenes.

Nepal

IPM programme in Nepal has become part of the government policy during the 8th five year plan. Currently 4 IPM programmes are designed for fruits, vegetables and cash crops. Bt has been found quite effective as bio-agent in IPM for the control of lepidopterous pests.

Infact, the importance of botanical pesticides was realised by the farmers long ago. About twenty different plant species are used by the farmers in various preparations against field crop pest as well as stored grain pests. "Neem", "Melia" and "Teetepali" have been found quite effective and used quite extensively among the farming community. Various neem based formulations imported from India are available in the local market. So far there is no processing / formulating unit for botanical pesticides in the country.

Philippines

IPM has become the core of crop protection policy in the Philippine agriculture. National IPM programme was formally established in May 1993 with a goal to create a critical mass of knowledge and skill and more reliance on biological control methods with reduced pesticide application to a minimum.

Adoption of bio-botanical pesticides in pest control programme in the Philippines is faced with the following problems. :

1. developing confidence in the ability of these agents to control pests

2. insufficient training to ensure that extension staff and farmers understand and adopt reasons for recommended procedures.

Following are the constraints in the development of bio-botanical and neem based pesticides in the country.

1. testing and evaluation protocols not yet clear to regulatory authority and / or registrants

2. inadequate toxicological and environmental impact studies

3. evaluation of biological performance mainly based on crude extracts

4. identification of potential plants sources not fully supported.

5. laboratory facilities and method of analyses need to be developed.

6. training requirements for production workers.

Inspite of these limitations, some bio-botanical pesticides are under development / trial. Efforts have underway to screen Philippine 295 Bt strains against nine major rice pests.

Thailand

Problems of using chemical pesticides are well known. In order to minimise the use of chemical pesticides, Thai government has promoted IPM programme in the country.

In the 7th National Plan more emphasis has been given on the use of botanical pesticides in place of synthetic pesticides. To achieve the goal, the search for natural botanical pesticide is being intensified by 1) exploring natural pesticides that are easily available; 2) selection of botanicals which are used in crude form for small scale, 3) transfer of the technologies to the local formulations, 4) farm demonstration and training to the farmers to make them understand the nature and advantage of botanical pesticides.

Among 300 indegenous plants investigated, neem is the most potent with potentiality to develop at industrial level. Various neem formulations such as Neem Bond-A, Advantage, Nuform, Insttar, Neemix & Biosafe have been produced by a private industry. Large scale production of neem formulation would soon start with annual production of 10,000 lt per year. Neem has been found quite effective in controlling

insect pest like castor leaf hopper, cotton leaf hopper, aphid and red cotton bug.

A detailed report on the biochemical mechanism of detoxification enzyme on some insects to Azadirachtin and other related trials was also presented.

Biological control method have been given the top priority in IPM programme due to the host specificity, narrow host range and safety to environment. Microbial bio-pesicides such as Bt & virus NPV are used as an alternative or in combination with chemical insecticides as a part of IPM programme in the country. Department of Agriculture is looking after the production, implementation and evaluation of bio-pesticides in Thailand, which is then promoted for large scale production by the Department of Agriultural Extension. Entomopathogenic bacteria such as Bt is being produced at pilot plant scale level for use against pests of upland vegetable growing areas. Entomopathogenic viruses like NPVs are effective against a variety of insect pests. A number of pilot plants are being established with a production capacity of 2000 lt. per annum. Entomopathogenic nematode such as *Steinernema carpocapsae* is one of the promising bio-pesticide and its production technology have been transferred to a private sector for commercial production; this biopesticide is reared on a small piece of synthetic spray and available within the aluminium foil package.

Vietnam

IPM has been launched as a National Program in Vietnam since 1991 with the support of UNDP/FAO. The current aim of this programme is mainly concentrated on the control of rice pests. Research work on the utilisation of biopesticides have been initiated since 1970 in order to develop domestic production of Bt. Presently Bt, imported from other countries, is used in large scale to control vegetable pests like *Plutella* & *Pieris*. During the last two years (1993 & 1994) various bio-botanical pesticides including Neem have been tested at field level against crop pests for development work. On account of certain technical problems, bioproduction in Vietnam has not been established and commercialised.

VII. TECHNICAL SESSION

The technical session comprised of various lectures deliverd by eminent scientists in the field of Bio-botanical pesticides. Text of these lectures are as follows :

1. Dr. Prasertphon in his presentation on "Outlook for Bio-pesticide Development in the Asia Region" stated that owing to widespread toxic substance contamination of water, environment, danger of chemical residue on foods couple with insect resistant to chemical insecticides; these problems

have brought attention of scientists to look for substitute for chemicals, such as using of parasites, predators, bio-pesticides, these could be integrated into pest management for certain cases and situations in order to reduce the use of chemicals.

Entomopathogenic Viruses

It is well known that baculoviruses, especially nuclear polyhedrosis viruses (NPV) are highly specific and effective agents for the control of insect pests. Our Biological Control Laboratory has in the stock of more than 15 NPV of different insects. However, only three NPV are currently propagated for the field application:

1) NPV of *Heliothis armigera*
2) NPV of *Spodoptera exigua*
3) NPV of *Spodoptera litura*

For those NPV in the collection, we have stored and kept them ready for propagation when and if the outbreaks of that particular pest take place. As it is known that insect viruses can be propagated by the use of living insect hosts or tissue cultures. And therefore it requires trained and skilled personnel to handle and supervise the NPV production.

Current production of cotton bollworn NPV is being propagated in living insect host of *Heliothis armigera*

larvae, of which the larvae are reared on artificial diets. The production cost for insect host is about 1 US cent per larva. Total cost for NPV production of one liter is about 20 US dollars at concentration of $2x10^9$ PIB/ml. The NPV production is concentrated on this pest. Since it widely attacks many economic crops, namely cotton, soroghum, tomato, asparagus, union, okra, grape, chilli and tangerines.

NPV of *Spodoptera exigua* (Hybner)

This insect has many common names according to localities and host plants, eg. beet armyworm, lesser armyworm, fales armyworm, small cotton worm, linseed caterpillar, pigseed caterpillar, and small willow moth. It has been preported that about 51 plants are attacked by this pest.
The production of this NPV has been done in the same manner that of *H. armigera* NPV. Since the incubation period of this virus is rather slow, about 5-7 days; therefore application should be started as soon as the insect's eggs are present on plants. For effective control dose, a rate of 9.38×10^9 PIB/ha is recommended.

The production of insect virus has intensified, he reported that a new extension wing of building will be added to accommodate the virus research group. When all facilities and management are completed, we expect to produce about

2000 liters of virus suspension for field application each year.

Inspite of new facilities for virus production he said that still there is a budget constraint, lack of qualified personnel; so virus production will not meet the farmers' demand. Training is provided to the interested persons who shall produce the virus for their own uses. This service has rendered much benefit to farmers.

He gave an outstanding example of self made virus for control of insect. In southern part of Thailand, at Surat Thani, there was an outbreak of oil palm leave eating caterpillar slug *Darna furva* Wilemen, the infested area was about 16,000 acres. The company used chemical aerial application. One chemical application would cost them around 80,000 US dollars. Later on the insect became resistant to insecticide, and cause several problems, such polination, contamination of waters, health hazard.

There was reporting a virus attack this insect, so a team of virus group went down to Surat Thani to investigate and train company personnel how to produce and use this virus to control *Darna furva* Eventually, the company has managed to bring down the insect under the control with cost of one tenth of the chemical application. This is a very good example of using insect virus.

The Biological Control Research group of Department of Agriculture has also rendered a service to train scientists from neighbouring countries in areas of biological control as well.

Entomopathogenic Fungi

At present, green muscarcine fungus, *Metarrhizium anisopliae* has been studied and used for control of rhinocerous beetle grubs, *Oryctes rhinoceros*.

The fungus was cultivted on steamed paddy rice and then dried and ground up as powder. The recommended dose is 200-400 grams per 2x2x0.5 meter of decomposed plants' debris. This will control the grubs between 59.38% to 95.74% depending upon locations.

Entomopathogenic Nematodes

Entomopathogenic nematodes in Family Steinernematidae offers much promise as biological agents because of their high virulence and broad host range. Especially *Steinernema (=Neoaplectana) carpocapsae* has a high potential for controlling of insects, since it can kill the insect within 48 hours; utmost importance is that this nematode can be mass propagated on a simple and cheap artificial media.

Artificial medium for Nematode Propagation

Dog food (CP brand)	45%
Water	50%
Pork lard	5%
Agar	1%

List of Insect Pests being controlled by *S. carpocapsae*

Spodoptera exigua

Spodoptera litura

Trichoplusia ni

Plutella xylostella

Hellula undalis

Heliothis armigera

Oxyodes serobiculata

Galleria mellonella

Cossus sp.

Microchlora sp.

Agrotis ipsilon

Sesamia inferens

Cosmopolites sordidus

Odoiporus longicollis

Cylas formicarius

Cnaphalocrosis medinalis

Meridochis sp.

Microcerotermes crass

Serious pest for Longong *Lansium domesticum* are bark eating caterpillars, *Cossus*, and *Microchlora* spp. can be effectiveely control by *S. carpocopsae*

Another pest, stripped flea beetle grub on chinese redish can be easily controlled by this nematode.

Entomopathogenic bacteria

Due to the problem of insect resistant to chemical insecticides, *Bacillus thuringiensis* Berliner was introduced into Thailand around 1970, especially for the control of vegetable pests. Currently about 13 commercial B.T. products are available in the market both in form of flowable concentrate (FC) and Wettable powder (WP). Its potency is ranging from 8,000 to 8,800 IU/mg for FC and form 10,000-16,000 IU/mg for WP. Due to high price of imported B.T the Department of Agriculture has initiated to build a pilot plant to produce B.T., the pilot plant is partially completed, and a formal opening ceremony was held on 22 Aug. 1994 in Chiang Mai province, Thailand. Fermentor has a total capacity of 500 liters with working capacity of 350 liters. We are at present able to produce flowable concentrate formulation.

Installation of necessary equipment would be soon completed and become fully operational within one year time from now, by that time they would be able to produce wettable powder

and flowable concentrated formulations for a large scale field experiments.

About the development of B.T. production at Mahidol University he said that a group of scientists in this university, are involved in the improvement of the virulence of the B.T. strain by employing genetic engineering.

Concluding his presentation he said that public anxiety and government awareness about insecticide residues in food, contamination of water, in environment and coupled with pests resistance and the need to minimise pesticide residues in the exported foodstuffs, the trend of using bio-botanical pesticides will play a major role in the integrated pest management.

At present, development work of Bt, Baculoviruses, entomopathogenic nematode, fungi, including botanical pesticide for practical application would continue in order to reduce the use of chemical insecticides in this region.

2. Prof. Xie Tian Jian of P.R. China made a presentation on "Commercial Production and Application of BT Insecticides".

Bt Insecticide he said is the most produced and the most widely used microbial insecticide in China. In 1964 the first workshop was established in Wuhan. Since then Wuhan has been the main base for producing Bt insecticide. During the past several years, Bt output has grown steadily. For

example, in Microbial Pilot Plant, Hubai Academy of Agricultural Sciences, the output was 800,000 kg in 1990, 1000,000 kg in 1992 and 1,285,000 kg in 1993. Bt insecticide has been used for control of agriculture, forestry and public health pests among twenty-eight provinces and big cities. Bt insecticide has shown good results and has been exported to South East Asia. Along with the development of Bt commercial production and application, the Chinese government, research workers, producers and users have known more advantages of Bt insecticide. Only agriculture byproducts are used as main medium ingredients. Bt does not pollute environment and does not destroy ecological balance. There is no doubt that the output of Bt insecticide will keep growing in late 1990's.

COMMERCIAL PRODUCTION

1. **Strain** :Bt galleriae strain was used for production in 1960's. Bt galleriae, Bt wuhannensis, Bt dendrolimas, HD-1 and 7216 were used in 1970's. HD-1 was the main strain in 1980's.

2. **Fermentation** : Agriculture by-products are used as main material, such as defatted soybean cake, peanut cake, cotton seed cake and so on. Some kinds of waste material are also used successfully for production of Bt mosquitocide. At early stage, the concentration of nutrient ingredients was between 3-4%, and spore count was about $20x10^8$/ml. in the

recent production the concentration is maintained at 7-9% with and spore count 50-70x10^8 / ml. Most fermenters used for Bt commercial production are 5,000-7,000 liters. With the market growing, 20,000 liters fermenter has been used.

3. **Phage**: Phage once threatened Bt commercial production seriously. The failure rate caused by phage was even as high as 30% in a typical factory which had to be closed finally. Now almost no damage is happened by phage. For example, the failure rate was 1.5% in 1986 and zero in 1987. The main measures taken include strengthening air filter system, heating spore suspension before inoculation, changing two stages fermentation to one stage fermentation and so on.

4. **Formulations and recovery procedures** : Different formulation must be processed with different recovery technique. In 1980's, flowable formulation was produced mainly in China. The flow chart applied in Microbial Pilot Plant, Hubei Academy of Agricultural Sciences was as follows:

Soil culture -- slant seed -- fermentation -- screening -- centrifuging -- formulating -- quality checking -- packing.

Comparing with powder formulation, flowable formulation consumes less energy to produce and its recovery rate is higher. So the production cost is lower. But the stability is not as good as powder. Usually, the storage period is one year. Flowable formulation is very popular in China. About

70-80% of total amount of Bt insecticide belongs to flowable formulation which is produced at Microbial Pilot Plant, Hubai Academy of Agricultural Sciences.

Wettable powder of 6,000 IU/mg has been produced with spray drying technique. Wettable powder is easy to transport and also very stable. Membrane, granule and briquet formulations have been studying for control of mosquitos. Membrane formulation will be specially used to treat larvae habitat of water container in South China.

5. **Quality Control** : Several years ago, spore count still was quality standard for Bt insecticide in China. It has been replaced by bioassay resently. There were two procedures according to Bt strains and testing insects. For Bt kurstaki product, cotton bollworm was testing insect. For Bt galleriae product, diamond backmoth was testing insect. Bt producer could get standard sample (CS3ab, CS5ab) in China when they run bioassay. It has been shown that bioassay was very important for developing Bt production. Based on bioassay, the potency of liquid formulation was 2500 IU / ul, wettable powder was 600 IU/mg and 32000 IU/mg, techical powder was over 50000 IU/mg.

APPLICATION

He mentioned that low cost stimulates farmers to use Bt insecticide for control of pests. During the past several years, the area treated with Bt insecticide was about 300,000 heectares each year. Bt has been used against variety of pests including grain crop pest, cash crop pests, vegetable pests, forest pests and mosequitoes.

1. **Grain crop pests** : In north China, granule of Bt insecticide has been applied to control corn borer for more than twenty years. Flowable formulation is also sprayed by airplane recently. It is very effective to control rice leaf tier. rice leaf minor and sorghun spotted borer. Progress has been made with the mixture of bt and chemical for control of rice stem borer.

2. **Cash crop pests** : Good results were got using Bt insecticides for the control of tobbacco budworm, tea caterpillar & soybean caterpillar. High dosage of Bt can work well for control of cotton bollworm. Recently, it has been replaced by mixture of Bt and chemical which results in lowering the control cost . This method is quite successful in Hubai province.

3. **Vegetable pests** : This is the most successful area in China. Usually more than 90% of mortality can be achieved in spring, summer and fall for control of caterpillar and diamond backmoth. He mentioned that nearly 50% of these

pests are controlled now in big cities such as Shanghai, Beijing and Lanzhou. The control cost of applying Bt insecticide is now less than chemicals. It is also very effective against pickle worm and so on.

4. **Forest pests** : Nearly 90% of mortality can be obtained for poplar looper, poplar caterpillar, oriental math, orange dog and so on using Bt insecticide. It is about 80% for control of pine caterpillar. Bt also works well for control of bag math.

5. **Mosquito** : Bt had been used for control of mosquito for five years in Hubei province. It was highly toxic to *Anapheles sinesis* and *Culex fatigans.*

PROSPECT

The price of Bt insecticide is so low that the control cost of using Bt is cheaper than that of using chemicals for several pests, such as cabbage looper, carn borer etc. The amount of natural enemies on using Bt area is obviously more than that on using chemical area so that less insecticide is used on using Bt area. He said these economic reasons will encourage farmers to use more and more Bt insecticide. During 1990's the Bt output will grow up steadly.

3. Dr. Hellpap of GTZ Germany made a presentation on "Current Status and Prospects of the Registration ofBotanical Pesticides in Germany".

He said that synthetic chemical pesticides have repeatedly been issue of controversy in the public media of Germany. Half a year ago for example pesticide residues (specially lindane) found in baby food caused a lot of concern among families. Several companies had to withdraw their baby food products from the market. Recently newspapers and television programmes reported about intoxications and allergic reactions caused by pyrethroids which were used in small electric evaporators to control mosquitoes. It was demanded to observe more carefully the sideeffects of pyrethroids and to restric ttheir use. Some regional governmentts already decided to ban completely all synthetic pesticides in home gardening. Due to the negative image the demand for chemical products will definitely decrease on the medium and long term, Bio-and botanical preparations could theretically fill this gap and conquer a significant share of the pesticide market. However, upto now bio and botanical pesticides play only a marginal role in the pest management in Germany. The number of officially registered biproducts is low. One reason is, that the registration requirements are extensive and costly. Small companies which are very much committed to bioproducts cannot afford them, whereas bigger companies focus their activities more on chemical products. Furthermore, many biopesticides and botanicals are only suitable to control one or a few target organisms. Thus, the potential demand is limited not justifying high research and registration costs.

Some scientists and experts including from the GTZ project "Production of Natural Insecticides" are proposing to reduce and modify the registration procedure specially for botanicals. The discussions is quite controversial. Some people think that this would give too much credit to the natural substances, which sometimes are also extremely toxic.

Nevertheless it is obvious, that botanical pesticides differ from synthetic chemical products in several ways, which are relevant for registration.

- they are almost never a single substance like the synthetic products, but crude materials, such as dried powders of seeds leaves or roots, or they are extracts or formulated oils. All have in common, that they consist of a mixture of substances, including main and secondary active ingredients and other secondary plant metabolites.

- natural organic substances specially chemically complex active ingredients of botanicals decompose quickly to simple compounds. There are relatively susceptible to UV-light, to chemical and microbiological degradation in the soil, water and air. Due to this, there is no risk of an accumulation of complex organic natural toxins or of toxic metabolites of the active

ingredients in the food chain or that they stay for years in the soil or aquatic system.

- plant species with pesticide properties are a normal component of our natural environment. Consequently, we have certain experiences with them. Our knowledge may be traditional, popular or scientific. In any case we can use the informations to evaluate more precisely the properties of the different plant species.

The pecularities of botanicals are not taker enough into account by the current registration procedure and they require special guidelines like in the case of microbial pesticides. But it is a long way to reach that aim in Europe.

Current status of botanicals

In the EEC and in Germany botanicals are actualy still considered as chemical pesticides. That means, that all informations and tests requested for synthetic products are in principle also in force for the registration of botanicals.

Normally the following informations have to be supplied.

A. Identity of the active substance.

- name; structural formula, molecular mass; method of manufacture (synthesis pathway); specification of purity;

identity of isomers impurities and additives and concentration.

B. Physical and chemical properties of the active compound

- melting / boiling point, relative density; vapour pressure; appearance; absorption spectra; solubility in water/ organic solvents; stability under different conditions, flammability, flash point, surface tensions; explosive properties, oxidizing properties.

C. Further information on the active substance

- type of pesticide; area of application, mode of action, biological activity against target pests; phytotoxicity; emergency methods in the case of an accident (i.e. method to destroy the active compound)

D. Analytical methods for determination of the active compound and important metabolites, residue analysis

E. Toxicological and metabolism studies on the active substance.

- acute (oral, percutaneous, inhalation, intraperitoneal, skin); short-term toxicity (28-days); chronic toxicity (oral, mutogenicity); reproductive toxicity (i.e. teratogenicity studies); metabolism studies in mammals; supplementary studies (i.e. toxic effects on livestock and pets, medical data (i.e. diagnosis of poisoning, treatment)

F. Residues in or an treated products, food and feed

- metabolism of the active compound in the plant; behaviour of residue of the active substance and its metabolites from the time of application until harvest or outloading of stored products; uptake and distribution in / on plants; estimation of the potential and actual exposure through diet and other means; feeding and metabolism studies in livestock (if residues remain in or on crops); effects of industrial processing and household preparation on the residues.

G. Fate and hebaviour in the environment

- rate and route of degradation in soil, water, air, adsorption and desorption in different soils and water, mobility.

H. Ecotoxicology

- acute oroal and short-term toxicity to birds, fish water flea, algae, bees, beneficial arthropods, earthworm, and non-target soil organisms, protected fauna and flora.

Considering this list it is obvious that the fulfilment of the registration requirements is only possible with relatively high research and financial resource. The only chance to avoid this, is to agree with the registration authorities, that some data don't have to be presented.

The EEC directive for the registration of plant protection products concedes, that:

"certain pieces of information which would not be necessary owing to the nature of the substance or of its proposed uses need not be supplied in such cases, or where it is not scientifically necessary or technicaly possible to supply information, a justification which is acceptable to the Commission in accordance with Article 6 must be submitted."

This exception rule gives every member country the possibility to treat botanicals in a special way and to modify the guidelines for chemical pesticides. However, the special treatment is not defined. Consequently, it depends very much from the policy of the responsible institutions in each country what kind of data and tests are requested for botanicals. This varies not only from country to country but also from one botanical pesticide to the other. Therefore, it is almost impossible for companies to know in advance what they have to do to fulfill all necessary requirements. In each single case it will be the result of a dialog between the company and the registration authorities.

As an illustration it is interesting to look at the already registered botanicals and the neem insecicides. In Germany only three natural organic plant materials are officially registered as pesticides.

- pyrethrins
- lecithins
- rapeseedoil

In the case of pyrethrum products information are available on almost all the requested topics. Most data were supplied by the organization of the pyrethrum producers, so that no company had to bear the financial burden alone. Tests were carried out either with extracts (i.e. the toxicological tests) or with pure active ingredietns (i.e. metabolism studies). Pyrethrum products are defined by the content of Pyrethrins I and II which make a high percentage of the extract. Other substances are not taken into account. Pyrethrum products are therefore relatively easy to standardize.

For the registration of lecithin and rapeseedoil the companies had to define precisely the chemical composition of the product. What kind of lecithin and rapseedoil will be used. They had not to present detailed data on toxicological and metabolism studies, on residues in or on treated plants, food and feed, on fate and behaviour in the environment and on ecotoxicology, because both plant products are used in food/ or animal fodder.

Neem insecticides are not registered in Germany and Europe in contrast to the USA. There are several big constraints, which are difficult to overcome. First, most neem

insecticides are chemiically not well defined and standardized. Often we only know, that this or that product is an alcoholic extract or a neemoil preparation containing a definite amount of Azadirachtin and perhaps Aflatoxin. The registration authorities in Germany consider this characterization as insufficient. They claim that biological and toxicological data from such an extract are not necessarily representative for the product because the extract may vary according to the seed origin, time of harvest, quality of the raw material and so on. They therefore, ask for a kind of chemical fingerprint of the extract including data about the content of triterpenoids and other important ingredients, which allow an identification of the product. Second, the registration authorities accept only data which were gained about the specified product. Thus, for example toxicological data about neem seed water extracts are not considered as representative for alcoholic extracts. Third, many tests have not been carried out according to the registration guidelines. Fourth, there are some doubts if Azadirachtin should be considered as the only active substance of neem products. It is well known, that other substances such as Nimbin, Nimbidin, Salanin also have a certain insecticidal effect. On the other hand it would increase tremendously the costs if detailed data about these substances would have to be supplied too. Already in the case of Azadirachtin we masure only the content of Azadirachtin A which is one of

11 Azadirachtin isomers. He said that if we would consider other active ingredients, too, chemical studies would become still much more difficult. Fifth, there are only very few data about the chronic toxicity of neem products, about residues in or on food and feed, and about the fate and behaviour of the active ingredients in the environment.

He said that a German company has calculated that about 500,000 DM (or about 300,000 US $) would be necessary to study these questions and to carry out all necessary tests which are requested for the registration of a neem insecticide. Nobody in Germany upto now has invested this amount of money.

Future Prospects of the registration of botanicals.

Several experts in Germany think that the current registration requirements for botanicals are too exaggerated and inadequate. It prevents that products, which are safe for human beings and relatively harmless for the environment, can come on the market. Therefore, one year ago a working group ws formed to draw up new guidelines for the registration of botanicals. The proposal was finished 6 month ago and presented to the German government. It differentiates between three types of data a) data, which have to be presented in any case, b) data whhich have to be supplied only if it makes sense, and c) data, which are necessary under certain conditions.

To the first type of data belong informations about the identity of the product and its physical and chemical properties, which characterise it. It does not necessarily mean to define always one or more active compounds. In some cases it may not be able to correlate the effect of the botanical pesticide to specific ingredients. Nevertheless, it is needed a kind of chemical fingerprint of the product including data about possibly toxic impurities. Otherwise tests results and informations about single samples are not representative and the consumer has no guarantee that the product has always more or less the same properties. A precise characterization is only possible, if the botanical is standardized. Data on the content of active ingredient alone would be insufficient. Also in the case of neem more studies have still to be carried out specially about this issue.

Furthermore, informations about target organisms, target crops, mode of action and side effects on yield are necessary to avoid improper applications by the consumer. Regarding toxicological and environmental aspects it is requested to supply in any case data on the acute toxicity of the product to mammals, birds, fish and other beneficial organisms. There are enough examples of highly poisonous natural substances, which should not be applied to food crops even when they are very effective against pests.

If at least one major active substance can be identified, it should be chemically and physically described and analytical methods presented.

If the botanical pesticide proved to be toxic to mammals, analytical methods should also refer to toxicologically relevant ingredients. If this is not possible or misleading biological test methods have to be developed to determine toxic effects even at low concentrations.

Among the type of data which are considered necessary under certain conditions are informations about short-term toxicity, chronic toxicity, residues in or on treated products, food and feed, fate and behaviour in the environment and short-term ecotoxicity. If the botonical passed successfully all acute toxicity tests, no data have to be supplied on the above mentioned aspects. In the case of a suspected harmful effect, the product has to be examined first in short-term toxicity tests. If the results confirm the findings of the short-term tests, the product has to go through chronic toxicity studies.

In addition to that, data on residues have to be presented. For each botanical pesticide it should be decided whether the sudies on residues are carried out chemically with toxicologically relevant substances or with the help of biological test systems. The same refers to data on fate and behaviour of the product in the environment.

Finally in the case of a suspected harmful effect on beneficial organisms in acute toxicity tests, the product has to be examined also in short-term studies.

While summarising his talk he emphasised that in the first level, basic information about the product, its chemical, biological and toxicological properties have to be supplied. The costs to get these informations are resonable as many sophisticated and expensive tests are excluded at that level, If the product is suspected to be harmful to man and / or the environment, the requirements for data will increse and may reach the same levels as synthetic chemical pesticidess. He felt that the proposed guidelines offer a much better chance for botanicals to come on the market without disregarding the risks for the human health and the environment.

PROPSED REQUIRED DATA FOR THE REGISTRATION OF BOTANICALS

A. **Identity of the active substance :**

necessary	nec.if meaningful	conditionally necessary
- name	-structural formula	
- meth. of manufacture	-molecular mass	
- specification ofpurity	-identity of isomers	
- identity of impurities additives and concentr.		

B. Physical and chemical properties of the active compound:

necessary	nec. if meaningful	conditionally necessary
- relative density	-melting/boiling point	
- apparance	-vapour pressure	
- flammability	-absorption spectra	
- flesh point	- solubility in water/	
-surface tension	-organic solvents	
-explosive properties	-stability under diff.	
-oxidizing properties	conditions	

C. Further information on the active substance

necessary	nec. if meaningful	conditionally necessary
- type of pesticide		
- area of application		
- mode of action		
- biological activity against target pests		
- phytotoxicity		
- emergency methods in the case of an accident		

D. Analytical methods for determination of the active compound and important metabolites, residue analysis

As botanical pesticides are in general not pure single substances, the analytical methods should refer only to toxically important ingredients or the most important active ingredient. However, the exclusive consideration of only single substances can be misleadinng in many cases. Consequently, in each single case it should be decided whether chemical analysis of single substances have to be carried out or if biological tests are more useful.

E. Toxicological and metabolism studies on the active substance

necessary	nec. if meaningful	conditionally necessary
-acute (oral percutaneous inhalation, intraperitoneal, skin) -medical data (i.e. diagnosis of poisoning, treatmemt)		-short term toxicity -chronic toxicity (oral, mutagenicity) -reprod. toxicity (i.e. teratogenicity studies [metabolism studies in mammals] -supplementary studies (i.e. toxic effects on livestock and pets)

F. Residues in or on treated products, food and feed

Data on residues don't have to be presented, if the botanical product is used by man or animals as foodstuff, cosmetic or medicine or proved to be non-toxic. If residue analysis are necessary they are limited to toxicologically relevant substances or the residue behaviour has to be examined by biological testing systems.

conditionally necessary:

-[metabolism of the active compound in the plant]
-[behaviour of residue of the active substance and its metabolites from the time of application until harvest or outloading of stored products]
-[uptake and distribution in/on plants]
-[estimation of the potential and actual exposure through diet and other means]
-[feeding and metabolism studies in livestock (if residues remain in or on crops)]
-[effects of industrial processing and household preparation on the residues]

G. Fate and behaviour in the environment

Data don't have to be presented, if the natural substances of the product are traditionally used in agriculture or naturally act on the environment without causing harmful effects.

If data on fate and behaviour in the environment are necessary they are limited to toxicologically relevant substances or the product has to be examined by biological testing systems.

conditionally necessary
-[rate and route of degradation in soil, water, air]
-[adsorption and desorption in different soils and water]
-[mobility]

H. Ecotoxicology

necessary	nec. if meaningful	conditionally necessary
-acute oral toxicity to birds, fish, water flea,algae, bees, beneficial arthropods, earthworm,and non-target soil organism, protected fauna and flora.		-short-term toxicity

VIII. CONCLUSION AND RECOMMENDATIONS

Conclusion

Having discussed the recommendations made in the last Bio and Botanical pesticide meeting held in 1991 at Bangkok, the meeting concluded that significant progress has been made in the region with regards to the development, registration, production and usage of bio-pesticide *Bacillus thuringiensis* (Bt) and botanical pesticide based on neem.

The expert group meeting having taken into consideration the various types of interpretation given to Integrated Pest Management (IPM) and in order to avoid confusion, deliberated on the issue. Thereafter the meeting adopted the commonly accepted philosophy of IPM as that being an integration of all available pest regulating (insects, pathogens, weeds, nematodes, vertebrates, etc.) strategies including the judicious use of low risk/ low volume pesticides into sustainable production system in a way that there would be minimal or no effect on humans and the environment while providing economically sound means of managing pests.

Recommendations:

Bio-Pesticides

* Having taken into consideration the need for establishing Bt production facilities in the region and

realizing the need for trained man-power and having taken into account the lack of expertise in the region the meeting recommended : manufacturing facilities should be undertaken only after providing adequate training and developing necessary expertise and getting financial support.

* Having realized the need to increase the farmers' confidence on the use of bio-pesticides and having considered the necessity for adequate quality control of Bt products the expert group recommended that protocol for demonstration of effectiveness of Bt at the field level and on techniques for quality control of Bt products should be developed in the region. The group further recommend establishment of collaborative arrangements in the network to obtain and exchange better strains of Bt.

* The network having been offered facilities for training, quality control and transfer of technology recommends interested network member countries to establish contact with Prof. Xie TianJian of the Bt Research Development Centre at Hubei Academy of Agricultural Sciences, Wuhan, People's Republic of China.

* The Group further recommended UNIDO/RENPAP Secretariat to play the linking role for this purpose and seek

assistance for this purpose from the International Agencies.

* Having realised the importance of initial assistance for technology transfer to the member countries the Group recommended that UNIDO may provide the assistance for setting up joint ventures through their investment promotion scheme.

* Having noted the need for information collection and exchange on the development, registration, production and usage of bio and botanical pesticides and production and usage recommends that UNIDO/RENPAP should publish a bi-annual bulletin for distribution among the member countries of the network.

Botanical Pesticides

* The expert group meeting having agreed that from the available information the neem based pesticides are environmentally friendly and having noted that the neem plant has been in use in the regions for decades and also having considered that the registration of the product in the United States of America and India and realizing the fact that neem is being produced and used as a pesticide in Thailand, Myanmar and China without registration the Meeting recommended that the countries having raw materials undertake commercial scale production and promotion, the meeting further

recommended that the RENPAP member countries should have simplified registration procedure without insisting on a full fledged toxicological data in view of extensive testing carried out in USA, India and Germany, However, to ensure quality and performance, bioefficacy tests and azadirachtin content and confirmatory tests for absence of aflatoxins should be included in the registration procedure.

The meeting having noted that Registration of pesticides is within the mandate of FAO the group requested the FAO Representative for approval by the FAO meeting to be held on the subject in October 1994 in Bangkok.

* Having realised the various difficulties experienced by the different groups working on neem, the group recommended that UNIDO/RENPAP collaborating laboratories be identified on the pattern of CIPAC/RENPAC procedure of collaborative testing for quality control. The Group further recommended that UNIDO/RENPAP/UNDP/FAO extend necessary technical assistance for upgradation and maintenance of the facilities in such identified laboratories.

* Having taken into account the absence of standard criteria for the quality and bio-efficacy of neem pesticides the group recommended that the UNIDO/RENPAP/FAO establish a standardised criteria for

the member countries in this regard. The group further recommended that the collaborating laboratories extend help and assistance to the industries and scientific laboratories engaged in the bio-assay and chemical assay for neem pesticides.

* The Group having noted the need for commercial viability of the neem producing units recommended that integrated production of neem based products including oil, medicinal, fertilizer etc. products be pursued. The group further recommended that UNIDO/FAO/UNDP and other agencies may be approached to assist the member countries in the development and production of neem based products by providing pilot plant, laboratory equipment and the training of personnel.

* Having considered the need for bringing together producers, processing companies and traders and having taken note of existence of Pyrethrum boards operating in many pyrethrum producing countries the group recommended that a Neem Board in the pattern of Pyrethrum boards be established in the region. The Group further recommended that a central data bank on botanical pesticides may be established and for this necessary computer facilities may be provided to Prof. G.A. Miana, Dept. of Chemistry, Gomal University, D.I. Khan, Pakistan.

Annexure I

LIST OF PARTICIPANTS

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Annexure II

UNDP/UNIDO/RENPAP
EXPERT GROUP MEETING ON POLICY ISSUES IN THE REGION FOR BIO AND NEEM BASED PESTICIDES DEVELOPMENT, BANGKOK
1-3 SEPTEMBER 1994

PROGRAMME

September 1, 1994

8.30 - 9.00	-	Registration of Participants
9.00 - 9.30	-	Welcome Address : Statement from UNIDO/RENPAP - Regional Coordinator, Statement from UNDP/UNIDO/FAO/FARM programme, Inaugural address - Mr. Montri Rumakom, Director General, Dept. of Agriculture, Vote of thanks.
10.00 - 10.45	-	Development and Use of Bio-Pesticides in the Management of Pests - Prof. Richard Edwards - Dept. of Entomology Purdue Univ. USA.
10.45 - 11.00	-	Coffee Break
11.00 - 11.15	-	Election of office bearers, adoption of agenda and arrangements for the meeting.
11.15 - 12.30	-	Country Paper presentation
12.30 - 13.30	-	Lunch
13.30 - 17.00	-	Country Paper presentation continued (with 20 minutes tea break)

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9.00 - 9.45	-	Outlook for Bio-Pesticides Development in the Asia Region by Dr. Sothorn Prasertphon, Thailand
9.45 - 10.30	-	Development and Production of Bio-Pesticides by Prof. Tian Jian, PR China.
10.30 - 11.0	-	Coffee Break

11.00 - 12.30	-	Panel Discussion
12.30 - 13.30	-	Lunch
13.30 - 14.14	-	Botanical Pesticide Development - Neem and Policies in Germany - Dr. Carsten Hellpap, GTZ, Germany
14.25 - 15.00	-	Botanical Pesticide - An Overview - Prof. Miana, Pakistan.
15.00 - 15.30	-	Tea Break
15.30 - 17.300	-	Panel Discussions

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9.00 - 9.30	-	Follow up of the recomendations made in the last meeting held in December 1991 in Bangkok.
9.30 - 10.45	-	Presentation of Panel Discussion reports
10.45 - 11.45	-	Coffee Break
11.45 - 12.30	-	Recommendations, Workplan and linkage with FARM Programme
12.30 - 13.30	-	Adoption of report
15.30 - 16.30	-	Closing session

UNIDO COMMENTS

The report gives an account of the proceedings of the Expert Group Meeting (EGM) on Policy Issues in the Region for Bio and Neem (Azadirachta indica) based Pesticides Development. This is a continuation of earlier meeting conducted in Bangkok during 1991. The EGM was very timely in the sense that many member countries of the network are very keen to develop bio-and botanical pesticides to compliment synthetic pesticides. The Technical Coordinator Unit in Thailand has already made enormous progress in commercializing bio-and botanical pesticides based on pilot experimental studies. The meeting discussed in detail the problems associated with the development of bio-and botanical pesticides due to lack of interest by multinationals and at the same time they are worried with the promotion of neem as a pesticide due to imposition of conventional registration requirements. The EGM felt that there should be a uniform policy within the region to promote neem based pesticides because it was used for centuries in the region for both pesticidal and medicinal uses. The meeting also discussed the confusion over the definition of the Integrated Pest Management (IPM) and in order to avoid such a confusion, deliberated on the issues and adopted commonly accepted philosophy of IPM which is very relevant to the region and also outside the region. The meeting made recommendations separately for bio and botanical pesticides so that the member countries could take the issues separately and develop the pesticides according to the needs and availability of raw materials.

The meeting is definitely a step forward in the right direction to promote low risk pesticides in support of IPM.