ISSN 2349-7203
IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
HUMAN

Human Journals
Research Article
August 2020 Vol.:19, Issue:1

Experimental Study on Natural and Chemical Insecticides and Pesticides: Research

ISSN 2349-7203
IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
HUMAN

Patil Anuja*, Mote Bhagyashree, Nadaf Sohel, Sonawane Rushikesh, Nikam Amit

Students, Rajarambapu College of Pharmacy, Kasegaon. Maharashtra, India.

Submission: 21 July 2020
Accepted: 28 July 2020
Published: 30 August 2020

HUMAN JOURNALS
www.ijppr.humanjournals.com

Keywords: chemical and natural pesticides, survey report, chemical tests

ABSTRACT

Synthetic insecticides are very efficient in insect control but can be harmful to the environment and health. Pesticides have now become an essential part of agricultural production they cause disturbances in ecosystem functioning; however, many pesticides are not easily degradable they persist in soil, leach to ground-water and surface water, and contaminate the wider environment, and are toxic for a wide range of non-target organisms. The adverse effects of pesticides on non-target organisms, especially insect's natural enemies and pollinators, have received the most attention in this regard because of their value in integrated pest management (IPM) and pollination processes, respectively. Pesticides can enter the human body through inhalation, oral or dermal exposure, and well documented to be the main cause of several diseases such as cancer, respiratory diseases, skin diseases, endocrine disruption, and reproduction disorders. To reduce the intensive use of pesticides, it is an urgent need to promote organic farming practices and search for effective biopesticides or biological agents to control agricultural pests to reduce the use of chemical pesticides. A useful and informative survey was done to make awareness of the use of biological insecticides. Experimental studies on chemical and natural insecticides and pesticides carried out in rural areas such as Kasegaon, Shene and Tambave.

INTRODUCTION:

Synthetic insecticides:

Synthetic insecticides are very efficient in insect control but can be harmful to the environment and health. They cause disturbances in ecosystem functioning, are toxic for a wide range of non-target organisms and have a high tendency to accumulate in the environment. Because of this, some alternatives are being sought. Many people have questions about the definition of "natural" versus "organic," or misunderstand the terms based on conflicting, misleading, and inaccurate information. The term "natural" conveys a sense of wholesomeness or safety. However, arsenic, strychnine, lead, mercury, nicotine, and other similar compounds used historically as pesticides technically qualify as natural. Today no one considers these compounds wholesome or safe, and they are no longer registered as pesticides.

There are no legal definitions, regulatory oversight, or production standards for products advertised as natural. Although natural products can generally be described as chemical compounds or substances produced by living organisms, the ingredients in many commercially available natural products are made in a laboratory. More importantly, natural insecticides are not more or less dangerous in any way than conventional pesticides. It should therefore not surprise you that the term "natural" is not synonymous with "organic," and not all-natural insecticide products are allowed in organic production.

One of the main problems in agricultural production is crop destruction by pests, mainly by insects. At present, a common way to control insect pests is the use of synthetic pesticides, but they have a negative influence on the natural environment. Synthetic insecticides have a wide spectrum of activity against diverse groups of insects and cause almost complete removal of the pest from the crop area. However, the speed and efficiency of synthetic insecticides are only seemingly positive. There is no possibility to limit the action of these compounds only to crop areas. Significant parts of insecticides applied in different ways penetrate the surrounding farmland ecosystems and act destructively, not only on the invertebrates but also on the vertebrates.

Synthetic insecticides have a long half-life, which causes their retention in the environment for long periods, often several times exceeding the lifetime of different species' generations of animals. Furthermore, these compounds tend to accumulate in different trophic levels of the food net.

When a pregnant woman eats vegetables contaminated with pesticides, the fetus can be exposed to harmful chemicals and cause birth defects. Pesticides can also be neurotoxins which can make a person feel light-headed, dizzy and confused, and it Effects of Pesticides on Adults.

Pesticides can also be neurotoxins which can make a person feel light-headed, dizzy, and confused, and it may reduce body coordination and ability to think in the short run. In the long term, these can result in reduced IQ and learning capacities and the worst case can lead to permanent brain damage.

The small amounts of pesticides that remain in the food supply will cause no immediate reaction but could cause health problems if routinely consumed over a long period. An answer to this is the biofertilizers, an environmentally friendly fertilizer which is being used in many countries Organic farming is a form of agriculture that relies on techniques such as crop rotation, green manure, compost, and biological pest control.

If you cannot afford its cost, make sure to select the vegetables that are least contaminated with pesticides or better yet, create your very own organic garden to ensure that you and your family can have chemical-free veggies whenever you want. This way, you will no longer worry about safety and health. - and restore natural resources. Global food production needs to be doubled by 2020 and just to maintain the present precipitate food consumption. Uncontrolled population growth in developing countries accelerated the imbalance between human needs and the sustainable use of land.

According to studies and researches, pesticides have grave effects on children and these can be measured in several ways. Children’s internal organs are still developing and maturing, so the effects can be seen and measured at present and in the future when they have grown up. The immediate effect is the blockage of important food nutrients for normal and healthy growth among children. When the excretory system of the child is not fully developed and yet he or she consumes fruits or vegetables with pesticides, his or her body may not be able to get rid of the pesticides.

Farmers of the olden days relied on the use of organic farming techniques and methods in cultivating their crops. Natural methods such as crop rotation, companion planting, and the use of compost were all employed to ensure a bountiful and safe harvest. As commercial farming slowly gained popularity over organic farming, the natural methods were replaced with the ones using chemicals for fertilizers, pesticides, and weed killers. The promise of higher yield in a shorter time is the selling point of these chemicals. But heavy reliance on chemicals is starting to take its toll on the vast farmlands and the people's health. Fruits and vegetables are highly nutritious and form as key food commodity in human consumption. They are highly perishable due to their low shelf life. These food commodities are reported to be contaminated with toxic and health hazardous chemicals. When the fruit ripens, many biochemical changes occur. The most obvious of these is the color, aroma and firmness of the fruit. Although illegal in many countries, calcium carbide (CaC2) is used to accelerate the ripening process of fruits. Calcium carbide is the chemical used for the production of acetylene gas during gas welding. But nowadays this process is widely used by the Indian farmers or the fruit vendors for ripening of many fruits like mango, banana, papaya, plums, sapota, apples, avocados, melons, peaches, pears, and tomatoes, pineapples, dates, etc. This allows growers to pick fruit sooner and to handle fruits when they are green and less susceptible to bruising or damage. Calcium carbide combines with moisture in the air to release a gas called acetylene, which acts the same way as the natural ethylene fruits produce when ripening.

Worst Contaminated Vegetables on the Market The vegetables that are heavily-laden with pesticides include lettuce, spinach, peppers, celery, potatoes, carrots, cucumbers, green beans, cauliflower, tomatoes, sweet potatoes, eggplant, broccoli, and mushrooms. Among all of these, celery and lettuce contain the most pesticides while broccoli and eggplants contain the least amounts.

One of the most serious problems associated with the use of synthetic insecticides is the development of insect resistance to these compounds. This process leads to the development of insect populations insensitive to most classes of insecticides.

Resistance to insecticides can be defined as the ability of an individual (and/or a population) to develop insensitivity to the action of toxic compounds to a significantly higher degree than in the basic population and the ability to pass this feature from one generation to the next. The development of resistance is caused by the occurrence of mutations in a population that becomes insensitive to the pesticide. During the influence of constantly acting as a selecting agent, allele conditioning resistance gradually increases its frequency in the population over time. After a specified time, the frequency of allele rises past critical value, which causes a given pesticide to become useless because a significant part of the population does not show sensitivity to it. The feature of resistance is not stable, particularly in populations with high heterozygosity. If the force action of a selecting agent weakens in the populations, the frequency of allele which determines resistance decreases. Intensive use of insecticides is one of the strongest factors responsible for the rapid development of resistance in many species of insects.

The rapid development of resistance also is influenced by overlapping generations (mainly parental females generation with offspring), the presence of haploid and diploid individuals in the population, and the r-type life strategy.

Insecticides are one of the main factors responsible for poisoning humans. Every year there are from 250,000 to 370,000 plant protection compound poisonings globally. The acute poisonings are a particular problem in developing countries where these compounds are common and widely used in subsistence farms. In the case of developed countries, a bigger problem is chronic poisoning.

Groups of insecticides that have the highest tendency to be accumulated in human tissues are organophosphorus and organochlorine compounds. The most vulnerable tissues in this process are adipose and nervous tissue. These compounds were detected also in relatively high concentrations in blood and milk. Over time, the balance between the amount of insecticide accumulated in the tissue and the amount taken into the body and excreted has been determined. In this way, the measurement of insecticide content in tissue shows how the organisms are exposed to insecticides occurring in the environment.

Human exposure to organochlorine insecticides also causes disorders in the hormonal system. These disorders, in particular, are related to sex hormones – oestrogen, androgen, and thyroid hormones. Many organochlorine compounds have oestrogen-like effects. These compounds disturb the balance in the hypothalamus-pituitary – thyroid axis. Increasing the concentration of DDE in the maternal blood raised TSH levels in cord blood of male new-borns.

DDT and its metabolites affected the secretion of placenta hormones. Treatment of the placenta cells by DDT and its metabolites increased progesterone secretion and decreased the human chorionic gonadotropin [20].

The mechanism of action is probably related to the influence of DDT and its metabolites on aromatase activity an enzyme that converts dehydroepiandrosterone to oestradiol. In this way the conversion of progesterone to estrogen was blocked, which led to increased secretion of progesterone. As it was shown, DDT and its metabolites also have estrogenic and antiandrogenic activity [21].

Natural Insecticides:

Natural insecticides can be chemical, mineral, or biological. The common goal of all three is to kill, repel, or otherwise interfere with the damaging behavior of insect pests. Because this purpose corresponds with the legal definition of a pesticide, all-natural insecticide products must comply with federal and state regulations for registration, sales, transport, use, storage, and disposal. Some natural insecticides are allowed for use in certified organic systems if additional organic federal standards are met.

As with any pesticide, it is important to choose a natural insecticide that fits the situation in which you will use it. These products vary in their toxicity to non-target organisms such as fish and bees, as well as their effectiveness at controlling specific insect pests. If used improperly, organic insecticides can harm people and the environment, so do not make the mistake of thinking that products labeled as “natural” are nontoxic.

Natural products have been used to control animal pests, plant diseases, and weeds since ancient times. The biological activity spectrum of natural pesticides is extremely variable, and the selectivity is often achieved by targeted application, often relying on the behavior of the target pest. However, the biological property of a chemical is a function of its structure rather than its origin. The biological activity exerted by a given dose of the compound under given circumstances, especially as related to safety, depends on how the chemical is used. Natural substances used for pest and disease control are generally non-persistent under field conditions. Most of these often-complex molecules are readily transformed abiotically by light and/or oxygen into less toxic products. There are many natural insect control agents, most of which were discovered by the empirical screening of plants and, recently, other natural sources. Moreover, research on insect physiology and behavior made possible the commercialization of chemicals that can be used to manipulate insect development or behavior.

FOLLOW THE LABEL

Always follow the label directions when you use a pesticide, including storage requirements, which insect pest(s) the product is designed to control, how often it can be applied, under what conditions, at what rate, and the personal protective equipment that must be worn during applications. For additional information on reading pesticide labels and maintaining pesticide safety.

Natural Insecticide Categories and Products:

The most common types of natural insecticides used in crop production, followed by related product examples.

Biological: Living organisms that are used to manage pests are called biological controls or biological agents. When a microorganism is packaged and sold to control a pest, it is legally considered a biopesticide and is regulated as such. Multicellular organisms such as beneficial nematodes are an exception; although considered biological controls and packaged and applied similarly to other biological insecticides, they are not regulated as pesticides. When using biological insecticides, carefully follow the instructions on the label to avoid killing the organisms in the product, which would make it ineffective. The advantage of using biological products is that they are less likely to negatively impact non-target organisms, including people.[25-26]Biopesticides are used to control or kill some type of pest. This lesson focuses on insects that harm the agricultural production of animals or plants. Biopesticides can control insect pests by disrupting their mating patterns, attracting them to traps, or being sprayed on the crop as a pest repellant.

There are several advantages to using biopesticides instead of conventional pesticides. While biopesticides are made from naturally occurring substances, **conventional pesticides** are made from synthetic chemicals or agrochemicals. Typically, conventional pesticides are used to directly kill pests rather than control them. In contrast, most biopesticides are used as one component of an integrated pest management approach that enables the gradual control of an insect pest over time. Control is usually accomplished through indirect mechanisms instead of directly killing the insect.

Biopesticides are usually less toxic than conventional pesticides. Most are capable of affecting only the target species or closely related species instead of broadly killing all organisms that come into contact with them. Additionally, biopesticides are often effective at low doses, and they decompose quickly.

1. Botanical: these are extracted compounds from plants to use as botanical insecticides for thousands of years. There pest insect pre-infestation insect body cavity hyphae accumulation at insect joints (white bloom) Some compounds harvested from chrysanthemum species were used to manage insect pests. Botanical insecticides are usually harvested by macerating (soaking and separating) plant tissues high in the active ingredient and distilling (evaporating and condensing) the specific active compounds. [27-28]

Examples of botanical insecticides:

1. Garlic, Pepper, Cinnamon, and other Plant-Essential Oil Products. Commercial products that contain various plant extracts such as garlic, hot pepper wax, and cinnamon are available and registered for use on some crops and ornamentals.

2. Neem: In addition to its categorization as a botanical, neem is also a plant-derived horticultural oil. The neem tree is native to India and is the source of hundreds of products, including insecticides made from the extracts of the seeds and bark. The primary insecticidal extract is azadirachtin. When azadirachtin is used for pest management, it can act as an insect repellant, an antifeedant (interferes with feeding), and a growth regulator (interferes with molting and growth). When neem oil or neem soap is used, it poisons upon contact much like other soaps and oils. In some cases, neem can also be a systemic insecticide (when applied to the soil).

3. Fermented microbes: It can be fermented to produce an insecticide such as avermectins, a fermented product of *Streptomyces avermitilis* used in baits for household insect pests. The best-known home gardening product of this type is spinosad. Metabolites of Saccharopolysporaspinosa, a soil-inhabiting bacteria that is fermented, are the basis for this new class of insecticide. The fermentation process has been industrialized to produce commercial insecticides. Spinosad has composed of spinosyns A and D. The fermented product is very toxic to caterpillar pests such as cabbageworm, cabbage looper, diamondback moth, armyworm, and cutworm, as well as fruit flies such as spotted wing drosophila.

Spinosad can act on a susceptible insect's stomach and nervous system. It is primarily ingested by feeding insects but can have some efficacy when sprayed directly on insects.

4. **Horticultural Oil:** Horticultural oils were used for insect control as early as 1763 and are still popular today. Such control agents are often petroleum-based; however, plant-based oils considered acceptable in organic farming are also available. Horticultural oils work by disrupting insect feeding and egg-laying when the pest is entirely coated. Eggs covered with oils are prevented from the gas exchange, which suffocates the developing pest.

5. **Mineral:** Insecticides developed from elemental (mineral) sources mined from the earth are classified as natural products and often cost less than other processed or harvested insecticides. The toxicity of mineral-based insecticides depends on the chemical properties of the mined elements. Some mineral insecticides such as sulfur are registered for organic use and have relatively low toxic effects on people and non-target organisms. In contrast, lead arsenate is a natural mineral product that was canceled as a pesticide in 1988 due to its toxicity and persistence in the environment.

MATERIAL AND METHODS:

Sample preparation

Sample preparation converts samples into an acceptable form for measurement without loss or unintended alteration. It is an essential aspect of any analytical work and may vary depending on the matrix to be analyzed. Sample preparation starts from the field, storage, preservation, and transportation, all of which must occur without changing the physical and chemical composition of the original sample. When choosing a sample preparation technique, one should try to easily remove analytes of interest from the sample with a minimum of steps and good recoveries.

Samples such as vegetables are normally stored in inert and airtight containers to prevent them from being exposed to environmental elements or interfering substances. Samples may also be wrapped in aluminum foil. During sample preparation most vegetables are blended.[29]

Extraction methods:

A wide range of extraction techniques is used for the extraction of insecticides from environmental samples. Mostly used liquid-liquid extraction or solid-liquid extraction techniques.

The mixture is shaken for some minutes and allowed to settle for the two separate layers to form.

The mixture stands for 10-15 min**.**

REQUIREMENTS:

1. Mortar
2. Pestle
3. Beakers
4. Funnel
5. Glass rod
6. Filter paper
7. China dish
8. Water bath
9. Tripod stand
10. Fusion tubes
11. Knife
12. Test tube
13. Samples of fruits and vegetables
14. Alcohol
15. Sodium metal

16. Ferric chloride solution

17. Ferrous sulfate crystals

18. Distilled water and

19. Dilute Sulphuric acid

SAMPLE:

1. Dodka (ridge groundluffa) *Luffa aegyptiaca*

2. Kobi (cabbage) *Brassica oleracea*

3. Flower (cauliflower) *Brassica oleracea*

4. Brinjal *Solanum melongena*

5. Cucumber: *Cucumis sativus*

6. Tomato - *Solanum lycopersicum*

EXPERIMENT PROCEDURE:

1. Heat a small piece of dry sodium in a fusion tube, till it melts. Then take different types of fruits and vegetables and cut them into small pieces separately.

2. Transfer the cut piece of various fruits and vegetables in mortar separately and crush them.

3. Take different beakers of each kind of fruit and vegetables and place the crushed fruits and vegetables in these beakers, and add 10ml of alcohol to each of these. Stir well and filter. Collect the filtrate in a separate china dish.

4. Evaporate the alcohol by heating china dishes one by one over a water bath and let the residue dry in an oven.

5. One of the above residues from the china dish to the fusion tube and heat it till red hot. Drop the hot fusion tube in a china dish containing about 110ml of distilled water. Break the

tube and boil the contents of the china dish for about 5 minutes to cool and filter the solution. Collect the filtrate.

6. To the filtrate add 1ml freshly prepared ferrous sulfate solution and warm the contents. Then add 2-3 drops of ferric chloride solution and acidity with the dil. Hydrochloric acid if a blue or green precipitate or coloration is obtained, it indicates the presence of nitrogen present in the insecticides.

7. Repeat the test of nitrogen for residue obtained from other fruits and vegetables and record the observations.

RESULTS:

Here we take a test for 2 samples of vegetables.

Table No. 1: The sample contains Synthetic insecticide: -

Sr. No.	Name of vegetable	Observations	Test for the presence of Nitrogen	Presence of synthetic Insecticide/Pesticide
1	Dodka (ridge grourdluffa)	Blue ppt	+ve	Yes
2	Kobi (cabbage)	Blue ppt	+ve	Yes
3	Flower (cauliflower)	Blue ppt	+ve	Yes

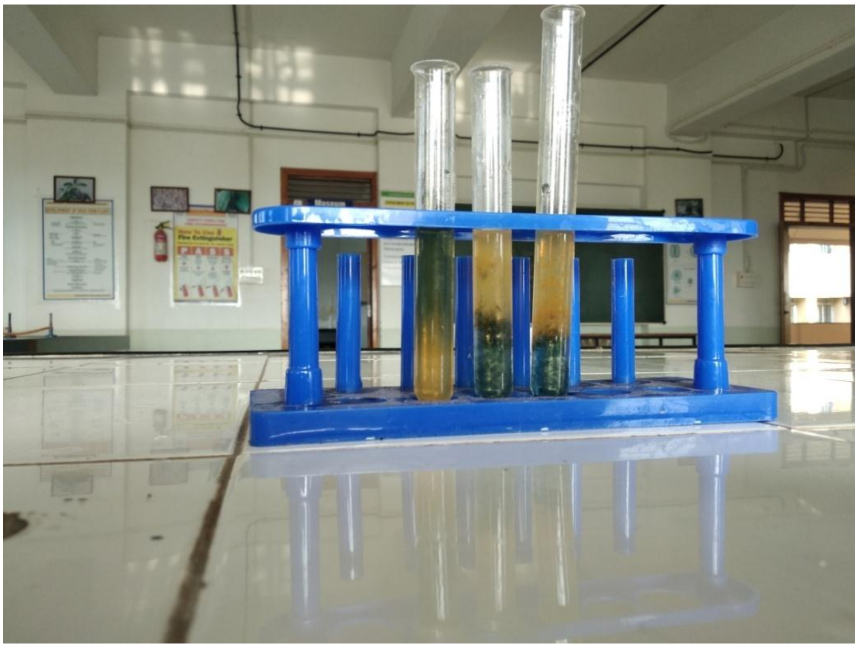

Figure No. 1:

Table No. 2: Sample contains Natural insecticide: -

Sr. No.	Name of vegetable	Observations	Test for the presence of Nitrogen	Presence of synthetic Insecticide/Pesticide
1	Dodka (ridge grourdluffa)	No blue ppt	-ve	No
2	Kobi(cabbage)	No blue ppt	-ve	No
3	Tomato	No blue ppt	-ve	No
4	Cucumber	No blue ppt	-ve	No

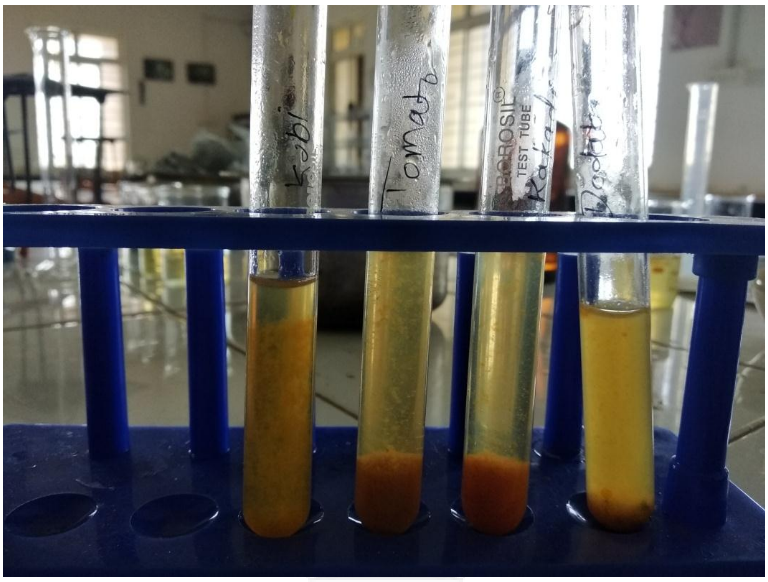

Figure No. 2:

DISCUSSION:

Environmentally Responsible and Sustainable Biopesticides have restricted entry interval or re-entry timeREIs between 0-4 hours, making them safer for your workers. They also usually have no pre-harvest intervals; in many cases, treated plants can be harvested immediately after application, Effectiveness & Efficiency Biological fungicides (biofungicides) are living, "breathing" microbes that naturally keep disease-causing pathogens from damaging and destroying plants. Once applied to the plant, biofungicides can grow on or near the root, stem or foliar surface, protecting the plant from a vast array of pathogens. That said, most biofungicides are preventative, so it is important to use them early in the production cycle - before diseases invade plant tissues and become established. Biofungicides can be successfully used at any time during production if they are applied to disease-free plants. If a disease problem already exists, a chemical fungicide should be applied first to eradicate the pathogens before applying a bio fungicide to extend the protection of the plant. (Note: Check to be sure the biofungicide is compatible with the chemical fungicide used.) So, yes, chemical agents are needed if a plant has already been infected with a pathogen. However, biofungicides are proven to be extremely effective at protecting plants from getting a disease. Using biopesticides can combat chemical pesticide resistance. Because most biopesticides have multiple modes of activity, there is less chance of insects or pathogens developing resistance to that chemical. Biopesticides are an excellent fit for integrated pest management (IPM) programs. Growers can incorporate biopesticides, which have a completely different mode of action, into a rotation with chemicals to combat resistance and increase safety. Benefits of Biopesticides - Help reduce use and cost of chemicals - Help reduce resistance to pesticides - Lower REI - Safer to use - Furthermore, biopesticides are generally considered exempt from tolerances (maximum residue limits), which means that residues on leaves and fruit are considered harmless. Sustainability is becoming much more than just a buzz word or passing phase. More and more businesses are becoming educated on the rationality behind this movement. Pursuing sustainability might not only have a positive effect on the environment but may also improve a company's overall operation and profits. Considering all the benefits of biopesticides, they fit very well into most sustainability programs.

CONCLUSION:

Using biopesticides can combat chemical pesticide resistance. Because most biopesticides have multiple modes of activity, there is less chance of insects or pathogens developing resistance to that chemical. Biopesticides are an excellent fit for integrated pest management (IPM) programs. Growers can incorporate biopesticides, which have a completely different mode of action, into a rotation with chemicals to combat resistance and increase safety.

Samples which were analyzed during the survey are mentioned here:

1. Brinjal belongs to the family Solanaceae and is known under the botanical name Solanum melongena L. The family contains 75 genera and over 2000 species, out of which, about 150-200 are tuber bearing and belong to section Tuberarium.

2. *Luffa aegyptiaca*, the sponge gourd, Egyptian cucumber, or Vietnamese luffa, is a species of Luffa cultivated for its fruit. The plant is an annual vine, native to South Asia and Southeast Asia.

3. Tomatoes

The tomato is the edible, often red, berry of the plant *Solanum lycopersicum*, commonly known as a tomato plant. The species originated in western South America. ... While tomatoes are fruits botanically classified as berries they are commonly used as a vegetable ingredient or side dish.

4. Cauliflower is one of several vegetables in the species *Brassica oleracea* in the genus Brassica, which is in the family Brassicaceae. ... The cauliflower head is composed of a white inflorescence meristem. Cauliflower heads resemble those in broccoli, which differs in having flower buds as the edible portion.

5. Cabbage (*Brassica oleracea* or B. oleracea var. capitata, var. ... acephala) is a member of the genus Brassica and the mustard family, Brassicaceae.

FUTURE PERSPECTIVE:

In addition to the continuous search for new biomolecules and improving the efficiency of the known biopesticides, recombinant DNA technology is also being used for enhancing the efficacy of biopesticides. A better understanding of genes from microorganisms and crop plants has enabled the isolation of genes effective against particular pests. Fusion proteins are also being designed to develop next-generation biopesticides. This technology allows selected toxins to be combined with a carrier protein which makes them toxic to insect pests when consumed orally. The fusion protein may be produced as a recombinant protein in substitutes. The human and environmental safety of the biopesticides and compatibility with integrated pest management systems will drive continued expansion of this industry. The industry has recognized the need to work together and has formed the Biopesticide Industry Alliance (BPIA), with a mission to improve the global market perception of biopesticides as effective products. BPIA plans to develop industry standards for product quality and efficacy.

REFERENCES:

1. TILMAN D., CASSMAN K. G., MATSON P. A., NAYLOR R., POLASKY S. Agricultural sustainability and intensive production practices. Nature.418, (6898), 671, 2002.

2. BASIOUNY A. L., HAMADAH K. S., TANANI M. A. Efficacy of the wild plant Fagoniabruguieri (Zygophyllaceae) on acid and alkaline phosphatase activities in the desert locust Schistocercagregaria (Orthoptera: Acrididae). Egyptian Academic Journal of Biological Sciences.2, (2), 1, 2010.

3. VAN DER GAAG N. Pick your poison. New Internationalist.58, (323), 9, 2000.

4. TIRYAKI D., TEMUR C. The fate of pesticides in the environment. J. Biol. Environ. Sci. 4, (10), 29, 2010.

5. DAMALAS C. A., ELEFTHEROHORINOS I. G. Pesticide exposure, safety issues, and risk assessment indicators. Int. J. Environ. Res. Public. Health.8, (5), 1402, 2011.

6. ISHAAYA I. Biochemical processes related to insecticide action: An overview. In: ISHAAYA I., Ed. Biochemical processes related to insecticide action. Heidelberg: Springer Verlag Berlin, pp. 1-16, 2001.

7. MEGALLY N. Y., EMAM E. S., SWELAM E. S. Furocoumarin and quinolone alkaloid with larvicidal and antifeedant activities isolated from Rutachalepensis leaves. J. Nat. Prod. 2, 10, 2009.

8. HIRAYAMA C., KONNO K., WASANO N., NAKAMURA M. Differential effects of sugar-mimic alkaloids in mulberry latex on sugar metabolism and disaccharidases of eri and domesticated silkworms: Enzymatic adaptation of Bombyxmori to mulberry defense. Insect Biochem. Mol. Biol. 37, (12), 1348, 2007.

9. GADE G., GOLDSWORTHY G. J. Insect peptide hormones: A selective review of their physiology and potential application for pest control. Pest.Manag.Sci. 59, (10), 1063, 2003.

10. LENORMAND T., BOURGUET D., GUILLEMAUD T., RAYMOND M. Tracking the evolution of insecticide resistance in the mosquito Culexpipiens. Nature.400, (6747), 861, 1999.

11. HAMMERSTROM R. J. Insect resistance to insecticides. Public Health Rep. 73, (12), 1126, 1958.

12. YU S. J. Biochemical characteristics of microsomal and cytosolic glutathione s-transferases in larvae of the fall armyworm, Spodopterafrugiperda (J. E. Smith). Pestic. Biochem. Physiol. 72, (2), 100, 2002.

13. SILVA A. X., JANDER G., SAMANIEGO H., RAMSEY J. S., FIGUEROA C. C. Insecticide resistance mechanisms in the green peach aphid Myzuspersicae (Hemiptera: Aphididae): A transcriptomic survey. PLoS One.7, (6), e36366, 2012.

14. SPRINGATE S., COLVIN J. Pyrethroid insecticide resistance in british populations of the cabbage whitefly, Aleyrodesproletella. Pest. Manag. Sci. 68, (2), 260, 2012.

15. PARIS M., DESPRES L. Identifying insecticide resistance genes in the mosquito by combining AFLP genome scans and 454 pyrosequencing. Mol. Ecol. 21, (7), 1672, 2012.

16. SHAD S. A., SAYYED A. H., FAZAL S., SALEEM M. A., ZAKA S. M., ALI M. Field evolved resistance to carbamates, organophosphates, pyrethroids, and new chemistry insecticides in Spodopteralitura Fab. (Lepidoptera: Noctuidae). J. Pest Sci. 85, (1), 153, 2012.

17. MCKENZIE J. A. Ecological and evolutionary aspects of insecticide resistance. Genet. Res. Camb. 68, 183, 1996.

18. GAO Y., LEI Z., REITZ S. R. Western flower thrips resistance to insecticides: Detection, mechanisms and management strategies. Pest Manag. Sci. 68, (8), 1111, 2012.

19. HULSHOF J., KETOJA E., VANNINEN I. Life history characteristics of Frankliniellaoccidentalis on cucumber leaves with and without supplemental food. Entomol. Exp. Appl. 108, (1), 19, 2003.

20. REITZ S. R. Biology and ecology of the western flower thrips (Thysanoptera: Thripidae): The making of a pest. Fla. Entomol.92, (1), 7, 2009.

21. PERERA M. D., HEMINGWAY J., KARUNARATNE S. P. Multiple insecticide resistance mechanisms involving metabolic changes and insensitive target sites selected in anopheline vectors of malaria in Sri Lanka. Malar. J. 7, 168, 2008.

22. HEMINGWAY J., HAWKES N. J., MCCARROLL L., RANSON H. The molecular basis of insecticide resistance in mosquitoes. Insect Biochem. Mol. Biol. 34, (7), 653, 2004.

23. NAUEN R., DENHOLM I. Resistance of insect pests to neonicotinoid insecticides: Current status and future prospects. Arch. Insect Biochem. Physiol. 58, (4), 200, 2005.

24. ALYOKHIN A., SEWELL G., CHOBAN R. Reduced viability of colorado potato beetle, Leptinotarsadecemlineata, eggs exposed to novaluron. Pest Manag.Sci. 64, (1), 94, 2008.

25. DURAND R., BOUVRESSE S., BERDJANE Z., IZRI A., CHOSIDOW O., CLARK J. M. Insecticide resistance in head lice: Clinical, parasitological and genetic aspects. Clin. Microbiol. Infect. 18, (4), 338, 2012.
26. BOYER S., ZHANG H., LEMPERIERE G. A review of control methods and resistance mechanisms in stored-product insects. Bull. Entomol. Res. 102, (2), 213, 2012.
27. Cloyd, R.A., N.A. Kalschuer, K.E. Kemp, C.L. Galle, and S.R. Keith. 2009. Effect of Commercially Available Plant-Derived Essential Oil Products on Arthropod Pests. Journal of Economic Entomology 102(4): 1567- 1579.
28. Cranshaw, W.S., and B. Baxendale. 1999. Insect Control: Horticulture Oils. Colorado State University Extension Fact Sheet 5. 569.http://www.ext.colostate.edu/pubs/ insect/05569.html.
29. Cranshaw, W. and R. Hammon. 2013. Grasshopper Control in Gardens and Small Acreages. Colorado State University Extension Bulletin 5.536. http://www. ext.colostate.edu/pubs/insect/05536.html/.
30. DeBach, P., and D. Rosen. 1991. Biological Control by Natural Enemies. 2nd ed. New York: Cambridge University Press.