STUDY ON SOME PLANT EXTRACTS AND THEIR FORMULATIONS AS SAVE, ALTERNATIVE AND BIO- CONTROL MEASURES FOR CERTAIN INSECT PESTS.

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Abstract

The conventional pesticides caused for the time being many problems, some of which the appearance of highly resistant strains of numerous pests, deleterious effects on the environment. At the same time such pesticides are expensive to export for developing poor countries with limited foreign currency. Therefore, the search for bio-active substances which have satisfactory properties concerning their effects on the target pests, not expensive to produce and also environmental safety is nowadays very urgent and not later on.

Plant extracts; neem formulations have more attention in controlling numerous pests. Also they are biodegradable, soft and environmental friendly.

Studies demonstrate that such soft products work by intervening at several stages of pest's life and are known to act as:

1- Feeding deterrence .
2- Deterring females from laying eggs.
3- Inhibiting the development of immature stages.

Insect pests which proved susceptible to plant products, mainly to neem ingredients reach 413 species / subspecies belong to 15 orders, but most of them are lepidoptera (136), coleoptera (79), Homoptera (50) and Diptera (49). It is estimate that about 450-500 insect species have been tested with products of plants specially neem up to now. We should emphasize that formulations and methods of application influence the efficacy of neem and other plant derivatives to a large extent.

A lot of journals and proceedings of scientific meetings presented different ideas about the plant extracts of various plant families as means for control vertebrate and invertebrate pests, specially insects, active compounds isolated and

identified have run the gamut from a simple compound – such as ethane, present in pine needles *(Pinus dinsiflora)* and reported to be the feeding preventive for the beetle, *Monochamus alternatus* – to acids and phenols, terpenic alcohols, alkaloids, lactones and other nitrogen – containing compounds, quinones, and both simple and highly complicated diterpenoid and sesquiterpenoid molecules.

Such biocides derived from plant materials steadily increasing attention of many groups of scientists, farmers, environmental awareness people, business persons and enterprises, and this is as a logical consequence of the undesirable effects of the misuse of synthetic pesticides during the last half of the past century. The growing awareness against hazardous chemical compounds specially agrochemicals has led to a steadily increasing movement towards a more environment-oriented, sustainable agriculture with low or no input of toxic synthetic agricultural chemicals in an attempt to preserve and protect the environment as well as the human health.

It is well known that some botanical pesticides have been in use for long time as pyrethrum, nicotine and derris but others are still in use on a limited scale.

Some plant species of the genera *Azadirachta* and *Melia* which belong to family *Meliaceae* (mahogany family) consider as one of the most promising sources of compounds that possess not only insecticidal properties, but their components are useful also in many other respects.

One of the most promising plant ingredients for integrated pest management in the present, as well as in the near future time is "Azadiractin" which is very complex tetranortiterpenoid obtained from the seed kernel of *Azadirachta indica* and in low concentrations from tissue culture.

Azadirachtin displays an array of effects on various pest species, especially insects acting, *inter alia* as a phago- and oviposition – deterrent, antifeedant, growth retardant, molt-inhibitor and sterilant. It is also disrupts a number of vital physiological processes in insects so that their activity (ability to walk, to jump, to copulate.. etc) is strongly affected. Also its effect on metamorphoses has proved.

It is very important also to refer that despite some conflicting results about toxicity of plant products to warm- blooded animals, there are on the other side a matter of facts should convince most of users that such materials, when free of

contaminants are quite safe to mammals, their residue effects are generally slight and therefore could be considered ecologically tolerable and acceptable.

From one point of view concerning the ecotoxicological and economical standpoints, in general it is only very few amount of azadirachtin (10-20 g) is sufficient to treat one feddan to achieve a satisfactory reduction in pest population, and that the product, decomposes in about one week.

Concerning the multifold other uses of the plants and their products, it is nowadays well established that the processes of botanical biocides followed by other valuable steps are necessary from ecologically and economically standpoints. For example neem cake can be used in feeds for domestic and farm animals after removed of toxic substances. Neem seed crush and deoiled cake use in India, Pakistan and other asian countries as manure and as Nitrification inhibitors. Pure neem oil mixed with other non-edible and edible oils used for production of medical soap, tooth paste, lothion, body and hair shampoo, medical ointments and local contraceptive.

Other uses of some multipurpose trees and / or plants are wood used for house mobiles, for erosion control, for shade and as a "relievers of sickness".

Economic and socioeconomic subjects of multipurpose plants should be take in consideration. These topics have been not consider enough by scientists. Any attempt to introduce novel mean (s) of pest control have been failed because of lack of information about the economic and socioeconomic background responsible for acceptance or rejection by the people concerned. A consideration of economic situations play an important role and is also very important.

Examples about some potentially useful compounds extracted or derived from plant resources:

A wealth of literature has accumulated during the second half of the last century on the subjects of botanical active ingredients, their isolation, identification and synthesis. Such progress would be a monumental task.

Reports on mode of action, recommended dose, efficacy of such products on target and non-target living organisms... etc. were undertaken and existed in comprehensive review of inestimable value.

Recent literature present various types of compounds occurring in plants known to be affected wide range of pest species specially class Insecta.

The major groups of active ingredients of such compounds will be here illustrated.

Phenols: A mixture of 14 different phenolic compounds from sorghum leaves (*Sorghum bicolor*) was found to deter feeding by the locust, *Locusta migratoria*.

Quinones: A number of quinones isolated from the timber of *Dalberiga retusa* are responsible for the resistance of this Panamnian wood to termites. Emodin, a mixture of anthraquinones which deter feeding by a number of insect species, has been isolated from plants of family Rhamnaceae.

Alkaloids and other nitrogenous substances: two or three alkaloidal feeding deterrents for the grassgrub beetle *Costelytra zealandica* were isolated from roots of the resistant pasture plant (*Lotus pedunculatus*). Some alkaloids detterent to feeding by larvae of the african army worms, *Spodoptera exempta* and *S. littoralis* were isolated from the east african plants *Fagara chalybea* and *Xylocarpus granatum*. Other Alkaloids designates "DIMBOA" are well known as a compounds responsible for conferring resistance to feeding by larvae of the corn earworm, *Heliothis zea*, and of the European corn borer. *Ostrinia nubilalis*, upon the resistant corn hybrids.

Canavanine: an antifeedant amino acid, occurring in a number of leguminous plants, not only prevents feeding by several insect species but also severely inhibits the growth and development of larvae of *Musca domestica*, face fly, *M. autumnalis*, horn fly, *Haematobia irritans*, and the stable fly, *Stomoxys calcitrans*, fed diets containing this compound. A proline analogue, which inhibits the growth of *S. littorlis* has been isolated from the foliage of the liliaceous plants *Ruscus hypoglossum* and *Urignea maritima*.

Acids and lactones: several acids are powerful antifeedant for some planthopper species *(Nilaparvata lugens)* has been isolated from barnyard grass, *Echinochola crus-gali*. Dehydroabietic acid and diterpene acid were isolated from mature foliage of jack pine and shown to deter feeding by pine saw fly. Two acidic compounds were isolated from the florets of a resistant variety of sunflower *(Helianthus annuus)*, these compounds deter feeding by larvae of the pink bollwor

moth, *Pectinophora gossypiella*, and the sunflower moth, *Homoeosoma ellectellum*. Lactone compounds (acids) occurring in a number of species of family Compositae, has been known as an insect feeding deterrent, specially for some coleopterous species. Several acidic compounds belong to lactones which isolated from tulip poplar *(Liriodendron tulipifera)* used as detterency to feeding by larvae of the gypsy moth, *Lymantria dispar*.

Terpenes: numerous simple terpene compounds were isolated from the fruits of *Amorpha fruticosa* found to deter feeding by *Locusta migratoria migratoriodis* nymphs, the clorado potato beetle, *Leptinotarsa decemlineata* larvae, the cabbage butterfly, *Pieris brassicae* larvae, and the harvester ant, *Messor structur*.

A good example of feeding deterrence by complex tetranortriterpenoids is the neem tree, the effectiveness of the neem components has been comperhensively reviewed and published allover the world. Azadirachtins in different forms are the most famous natural compounds isolated mainly from the neem seed kernels by different solvents. They affect a wide range of pest species. The structure activity relationships for azadirachtin and some of its derivatives show that the activity is not highly specific to the structure, which suggest the possibility of simpler compounds with comparable activity.

Sensory analyses have been reported on the mode of action of azadirachtin. Several contact chemoreceptors in the maxillary and labial palps of some insect species, i.e. the African desert locust show an increased regular impulse frequency when stimulated by neem extracts.

Experiments were conducted to know the gustatory sensilla in some lepidopterous larvae, using a sample of azadirachtin, these larvae possess deterrent receptors in the medial and / or lateral sensilla styloconica located on the maxillae – when azadirachtin at a concentration of 0.1 M, is applied to the sensilla m.a. the deterrent sensitive neuron in the medial sensillum of the tested *lepidopterous* larvae is stimulated. *Pieris brassica* larvae in the process of feeding contact a 0.001 M,azadirachtin solution, food intake is interrupted and the larvae may start to move to another feeding site. Clorado potato beetle larvae also show behavioral reactions when exposed similarly.

Electrophysiological studies have shown that deterrents may act on the chemoreceptors and thus alter the sensory massage sent to the CNS. Once the characteristics of the chemoreceptory system of certain species are known, electrophysiology provides a reliable and rapid method for screening certain compounds for possible deterrent properties.

On the other hand egg laying by the cabbage pest *Crocidolomia binotalis* (Lepidoptera: pyralidae) gravid females was dettered when neem-treated cabbage leaves were offered as oviposition sites in choice experiments. Field trials showed that the protection offered to cabbage plantations by neem treatments was as good as insecticide of *Bacillus thuringiensis* treatments, as assessed by the number of infested plants, larval and moth density, as well as the distribution of eggs in treated and untreated plots in field trials.

Tetranychus urticae females were transferred to bean leaf disks which had bean sprayed previously with different concentrations of Neemtzal-T (5% azadirachtin) and NeemAzal-T/S (1% azadirachtin). All the concentrations were strongly repellent, they also reduced egg-laying during the first day by 50% , 4 days later the number of eggs / female / day was also reduced. NeemAzal-T/S showed more best results than NeemAzal-T.

Results obtained from some experiments used neem suspension sprayed on different crops and its residual effect on *Spodoptera littoralis* larvae revealed that larval feeding rate on cotton was two to three times lower than on sugar beet or lucerne. The highest activity was obtained with neem seed and oil at 1% concentration for phagodeterrence of *S.littoralis* larvae on sugar beet leaves, it was 1 day and extended to 8 days after treatment.

Laboratory experiments with *Locusta migratoria* and *Schistocerca gregaria* showed that feeding was completely inhibited at very low concentrations: 0.005% for *L. migratoria*, and 0.001% for S. gregaria.

Very few quantitative experiments have been conducted to measure the effects of azadirachin on medical and veterinary pests of general health as lice, house flies, bed bugs, fleas, house cricket and in general on human and domestic animals ectoparasites.

Effect of difference concentrations of azadirachtin on house cricket showed that high concentrations of azadirachtin increased the mortality of cricket, but mortality may be due to starvation rather than toxicity, since toxic effects seem to be more immediated.

Also azadirachtin caused feeding inhibition, but the matured nymphs of house cricket (7^{th}- instar nymphs) were less sensitive to the same concentrations that had affect the early nymphal stages specially the 1^{st} instar nymphs. Burn dry neem leaves or seeds with paddy husk or neem oil drive away mosquitoes and other insects with the fumes. Leaves are placed among woolen clothes as a protectant against moth attack.

Many different groups allover the world are convinced that any good planed neem project will lead to the creation of new jobs, increased more safe food production, the acquisition of new technical and scientific skills, improved environmental conditions, and, thus a better way of life. We added also if all apply consistently some of available resources to such projects, some years later in the regions of Egypt where these projects will be initiated, the economy as well as the environment will take a distinct turn for the better and the road to relative prosperity will be opened to some of the most deprived citizens of our country.

Further uses of certain plant species as neem tree can reduce carbon dioxide and production of oxygen.

The intensive assimilation activity of such plants may contribute at least to some extent to the reduction of CO_2 in the air and consequent slow down global warming. They steadily produce oxygen by the foliage, therefore are called an air purifier.

In case of neem tree, recently in India, it was observed that this tree tolerate heavy pollution of the air by CO_2, SO_2 and other gases in cities with heavy car trafic, whereas other well-known ornamental trees are badly damaged by these pollutants.

Some commercial products derived from certain plant resources :

1- Field Marshal
2- Jawan Crop Protector
3- Margocide – CK
4- Margocide – OK
5- Moskit
6- Neem Based Emulsifiable Concentrate, Dust, water Dispersible Powder
7- and Granules.
8- Neemhit
9- Neem Oil Emulsion
10- Neem Plus
11- Neem Top
12- Neemark
13- Neemasol
14- Neemgold
15- Neemguard
16- Neemrich I and Neemrich II
17- Neemol, Neemosan and Neempourn
18- Neemta 2100
19- Nimba
20- Nimbecidine
21- Nimbosol
22- Nimlin
23- Phytowin and Replin 555
24- RD-9-Repelin
25- Sukrina
26- Swaticure
27- Vapacide
28- Wellgro

Effect of certain neem treatments on adult longevity (Male and Female) of potato tuber moth *(Phthorimaea operculella)*

Treatments	Mean Longevity(in days)		Reduction percentage Of longevity	
	Female	Male	Female	Male
Powder :				
P 1	8	6	38.0	19.
P 2	7.7	5.7	40.8	18.6
P 3	6.7	5	48.5	28.6
Control	13	7		
Solution :				
S 1	7.7	5.7	40.8	18.6
S 2	7	5	46.2	28.6
S 3	6	3.7	53.8	47.1
Control	13	6.7		
N. Azal-F :				
N.F 1	5.7	4	51.3	40.3
N.F 2	4	3	65.8	55.2
N. F 3	2.7	2	67.9	70.1
Control	13	6.7		

Longevity " Female " (F = 11.63). Longevity " male " (F = 6.85).
P = powder (1,2,3 g. neem powder/20 g. Talk powder) . S =Solution (1,2,3 g. of neem powder in 20 ml water) . N.F =NeemAzal-F (5%) (1,2,3 ml / Later)

Effect of certain neem forms on deposition of eggs and on emerged adults of potato tuber moth *(Phthorimaea operculella)*

Treatments	Mean Number of Deposited eggs	Mean Number of emerged	Reduction percentage of	
			Deposited eggs	Emerged adults
Powder :				
P 1	20.3	17.7	27.5	31.1
P 2	19.7	16.7	29.6	35.0
P 3	16	13.3	42.8	48.2
Control	28	25.		
Solution :				
S 1	19	14.7	31.4	42.8
S 2	17	13	38.6	49.4
S 3	11.3	7.7	59.2	70.0
Control	27.7	25.7		
N.Azal-F :				
N.F 1	15	9	44.4	64.0
N.F 2	9	4.7	66.7	81.2
N.F 3	4.7	1.7	82.6	93.2
Control	27.7	25.		

Deposited eggs (f = 13.83) adults (F = 18.28)
P = powder (1,2,3 g. neem powder/20 g. Talk powder) . S =Solution (1,2,3 g. of neem powder in 20 ml water) . N.F =NeemAzal-F (5%) (1,2,3 ml / Lwater)

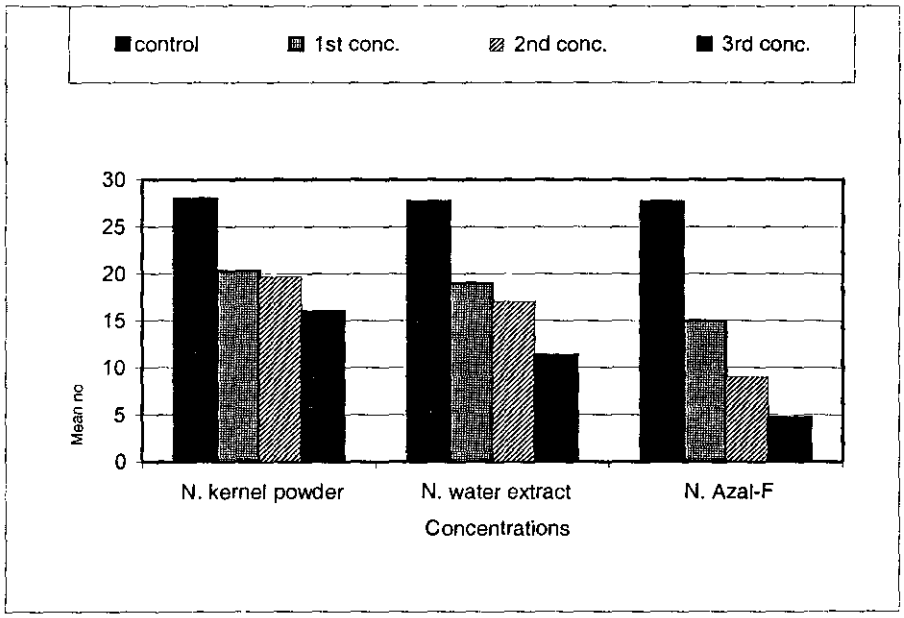
Trifolio Gmbh , company , lahnau (F.R.G) .

Effect of ANSKE (*50 g . NSP/L water**) on 3 rd instar larvae and on resulting pupae and adults of *M. domestic* after feeding on treated standard rearing medium :

ANSKE Conc. (%)	% larval mortality	Mean L3 Duration (in days)	Deformed Pupae %	Avg. wt of Pupae (mg .)	Deformed Adult Emergence (%)
0	2	3.0	2.0	23.3	12.0
0.1	19	3.3	48.0	21.4	18.7
0.2	10	3.3	36.0	19.8	39.4
0.3	14	4.0	48.0	17.0	52.8
0.4	10	4.7	40.0	12.1	75.0
0.5	20	5.3	50.0	10.9	No Adult emerged
0.6	12	6.0	38.0	11.6	
0.7	12	6.0	44.0	9.0	
0.8	12	6.0	24.0	9.1	
0.9	18	6.2	20.0	8.7	
1.0	16	6.5	28.0	8.0	

* ANSKE = Aqueous Neem Seed Kernel Extract
** NSP = Neem Seed Powder L= Litre

Effect of certain neem treatments on deposition of eggs Of potato tuber moth *Phthorimaea operculella* .



REFERENCES

1. Ana Rosu; Alaxendru Vladimirescu, Gabriela Nicolescu, and Ibrahim M. Kelany(2001): Studies on New Sources of Phytochemical Pesticides by Biotechnological means. Practice Oriented Results on Use of Plant Extracts and Pheromenes in Integrated and Biological Pest Control, Proceeding of the 10th Workshop 'Cairo, Egypt 11-12 Feb.2001.Eds.H.Kleeberg and I.M.Kelany

2. El-Maghraby, M.M.A.; and Kelany, I.M. (1992): Effect of aqueous neem seed kernel extracts, *Azadirachta indica* A. Juss, Meliaceae on the cotton leaf worm, *Spodoptera littoralis* (Boisd). Egypt. J. Biol. P. Cont. 2 (1). PP 69-76.

3. Kelany, I.M.; Desoky, E.A. (1994): Molluscicidal effect of Neem Azal-F on certain fresh water snails. Practice Oriented Results on Use and Production of Neem Ingredients and Pheromones. Proc. 3rd Workshop, pp. 85-88 Germany.

4. Kelany I.M.; El-Deep, M.A.; and El-Fishawi, A.A (1991): The effect of aqueous Neem, *Azadirachta indica* A. Juss, seed kernel extracts on the house fly, *Musca domestica* L. Egypt. J. Biol. P. Cont. 1 (1). pp 121-28.

5. Kleeberg,H.and Kelany,I.M (2001): Practice Oriented Results on Use of Plant Extracts and Pheromones in Integrated and Biological Pest Control. Proceeding of the 10th Workshop 'Cairo, Egypt 11-12 Feb.2001.

6. Mossalam, I.; Desoky, E.A.; and Kelany, I.M. (1994): Laboratory trials with aqueous neem (*Azadirachta indica A. Juss*) seed Kernel extract in controlling fresh water snails. Practice Oriented Results on Use and Production of Neem Ingredients and Pheromones. Proc. 3rd Workshop. PP. 77-84 Germany.

7. Omara, Shadia, M.; and El-said, A.A. (1999): Effect of two different NeemAzal formulations on spiny bollworm, *Earias insulana* Boisd. in festing cotton plants at Khattara region, Sharkia governorate, Egypt. Zagazig J. Agric Res. 26 (6) PP. 175 1-62.

8. Omara, Shadia, M.; Kelany, I.M.; and Kleeberg, H. (1997): Effect of an aqueous neem seed kernel powder extract (ANSKPE) and Neemazal-F on *Liriomza congesta* (Becker) and *Aphis craccivoira* (Koch) infesting broad bean at zagazig region, Sharkia governorate, Egypt. Parctice Oriented Results on Use and production of Neem Ingredients and Pheromones, Proc. Of 5th Workshop. PP. 223-36, Germany.

9. Ruskin, F.R. Bostid (1993): Neem, A tree for solving global problems. National Acad. Press, Washington, D.C. P. 141.

10. Shmutterer, H. (1995): the Neem tree-Source of Unique Natural Products for Integrated Pest Management, Medicine, Industry and other Purposes. Weinheim, New York, Basel, Cambridge, Tokyo. P. 696.

11. Shmutterer, H.; and Asher, K.R.S. (1987): Natural pesticides from the neem tree and other tropical plants. Proc. Of 3rd International Neem Conf., Nairobi, Kenya. P. 704.

12. Shmutterer, H.; and Asher, K.R.S. (1984):Natural pesticides from the neem tree (*Azadirachta indica A. Juss*) and other tropical plants. Proc. Of 2nd International Neem Conf. FRG. P. 587.

13. Schmutterer, H.; Asher, K.R.S.; and Rembold, H. (1980): Natural pesticides from the neem tree (*Azadirachta indica A.Juss*). Proc. 1st International Neem Conf. FRG. P. 297.