

THE MANY POTENTIAL OF NEEM TREE  
(*Azadirachta indica* A. Juss)

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**ABSTRACT**

The use of indigenous plant material in treatment of diseases in an old age practice. This paper gives an account of the roles played by neemtree (*A. indica* A. Juss) in the treatment of human & veterinary diseases, in pest control, and other agricultural processes as well as its being and as raw material for industrial development.

**INTRODUCTION**

Neem tree (*Azadirachta indica* A. Juss) known as Dogon Yaro in Hausa, belongs to the family

Its actual origin has not been ascertained. It is believed by some people that it originated from the indian sub-continent while others attributed it to the dry forest area throughout the southern and south Eastern Asia including Pakistan, Thailand, Srilanka, Malaysia, Indonesia and Australia; Yet some thought it to have originated from Assam and Burma (Kumar 1988; Ruskin, 1992).

Neem was first introduced into Nigeria in 1928 probably from Ghana. Where it was successfully established in Borno Province, and several thousand seedlings from the first plantation were transplanted in Sokoto, Katsina and Kano Provinces in the 1930's (Ruskin, 1992). It is now widely spread and extensively planted in towns and villages, providing shade and comfort to the inhabitants. Eventhough not indigenous, Neem has become well adapted to the local conditions of the Northern Region. According to Kumar (1988) work carried out in Sokoto has shown that Neem is a fast growing, sturdy tree which can be established without irrigation in many semi-arid regions. It grows well on poor shallow, stony or sandy soils where agricultural crops give low yields or fail altogether, despite application of fertilizers.

Analytical data released by Sokoto Agricultural Development Project has shown that the upland soils of most parts of Sokoto and other parts of the Savannah are low in organic matter and available nitrogen (Kumar, 1988; Jones, 1973). The soils have also been shown to be deficient in available Potassium (Rayer and Haruna, 1985; Saminu, 1989; Rayer (1987). Despite this poor fertility of the soil, the tree thrives best in these parts of the country.

According to Amina, (1983), the tree has become successful and naturalized in the arid and sub-arid states of the Northern Nigeria. She attributed its success to the

water use efficiency of the specie under harsh conditions prevailing in these areas. She also opined that the measure of its success is so much that in Sokoto State alone, 3,500 hectares have been put under the plant as plantation and this constitutes about 45% of the total Government owned tree plantation within the state. This paper highlights the economic values of neem tree with a view to drawing the attention of the Nigeria society in general and Government in particular to the positive and multiple uses of the Neem plant.

## 2. ECONOMIC IMPORTANCE:

The role played by neem in the life of man cannot be estimated. Neem produces different products that have both industrial, medicinal and agricultural potentialities (Kumar, 1988). He also opined that being hard and durable, it is extensively used for building ships, houses and for furniture and other agricultural implements. The major roles of Neem tree can be grouped into:-

### 2.1 ROLE IN CONTROL OF SERTIFICATION/REFORESTATION:

Many parts of the Northern Nigeria are being threatened by desertification. The problem is worst in Sokoto, Katsina, Kano and Borno States. It is mostly caused by overgrazing, bush burning and indiscriminate falling of trees. In order to arrest the situation, Government spends millions of Naira on afforestation programmes. This sum of money is in addition to the aid from International organisations.

Neem tree possesses a lot of qualities that make it an important tool towards achieving the desired goal of desert control. The tree is drought resistant, tolerant and fast growing. The roots penetrate the soil deeply and when injured produces suckers that tend to be especially prolific in dry localities (Ruskin 1992). Kumar, (1988) opined that the powerful and extensiverooting system of the tree has a unique physiological capacity to extract nutrient elements even from highly leached soils. The tree grow well on dry infertile sites or where soils are sterile, stony and shallow and in some acid soil, since the fallen leaves are good for neutralizing acidity in soil (Ruskin, 1992).

Another quality that makes neem good in reforestation programme is that, the tree can easily be propagated. This can be done from seeds either directly on the site or transplanted as seedlings from a nursery. Amina (1983) opined that the plant is endowed with natural adaptive measure of comparative nature to help increase its water use efficiency, and because of its success it is used for afforestation programmes in arid and semi arid regions of the Northern Nigerian. These special features of the Neem make it most suited to its function as re-afforestation species in the desert fringes of the country.

### 2:2 MEDICAL AND VETERINARY IMPORTANT:

Medicinal plants have from time immemorial played and are still playing important role in the treatment of human diseases. The value of neem in human and veterinary medicine is very high. Reports have shown that neem and its products are used in traditional medicine in different parts of the world (Kumar, 1988; Jinju, 1990). The use of its bark and leaves for the treatment of dysentery and malaria is among the traditional practice in Sokoto metropolis. The different extracts do possess antimalarial

activity and may also serve as a ready source of analgesic and antipyretic - compounds (Akubue, 1986; Nwude, 1986). Reports have shown that leaf and seed extracts proved effective against malarial parasite and that one active component "gedunin" is effective as quinine against malaria parasite infected cell cultures (Khalid, et al, 1986; Khalid et al. 1989). It has also been reported that ethanol extract of leaves and seeds are effective against chloroquine sensitive and chloroquine resistant strains of malaria parasite (Badam et al 1987); and that some extracts have anti-inflammatory activity which may be due to its nimbidin contents (Pilla and Santhakwana, 1981; Kumar, 1988).

The oil extracted from neem seeds is an important product. Kumar, (1988) reported that the oil (Margosa oil) is used as an antiseptic and for massage in rheumatism and is also effective in the treatment of skin diseases, while the fruits have property of purifying blood and the leaves used for healing wounds and as vegetables. In different parts of Africa, neem and its products are used in the treatment of stomach pain, yellow fever, vomiting, heartburn and measles (Jinju, 1990). Neem oil has also been shown to possess some antibacterial activities. The oil suppressed several species of pathogenic bacteria including Salmonella typhose and Staphylococcus aureus (Patel and Trivedi, 1962; Schneider, 1986). The oil has been shown to be toxic to Fungi including members of Candida, Trichosporon and Trichophyton (Khan and Wasailw 1978) and is effective in preventing small pox, chicken pox and fowl pox (Rae and Sethi, 1972).

Neem is also used in birth control. It was reported that neem oil acts as a powerful spermicide and has been considered as a potential new contraceptive for women in India (Sinha and Riar, 1985). The oil makes human spermatozoa totally immotile within 30 seconds of contact, and when applied intravaginally before sexual intercourse it prevents pregnancy; but there was complete reversibility in fertility a month after stoppage of the oil application with no deleterious effect on subsequent pregnancies and the resultant offspring (Sinha, et al 1984). It has also been reported that extract of neem leaves reduces fertility in a variety of male mammals with no reported case of impotence or loss of Libido (Sadre, et al, 1984). The use of neem leaves in termination of pregnancy is a traditional practice in different parts of Sokoto and Kebbi State. This is probably the case in different part of the Northern Region where neem tree could be found.

Neem tree is a popular tooth bush in different parts of Northern Nigeria. Though the juice of the twig is bitter, it is believed to possess germicidal and antiseptic properties which prevents incidence of mouth cancer, periodontal diseases and maintain healthy teeth and gums (Kumar, 1988, Elvin Lewis, 1980; Henkes, 1986).

Different derivatives of neem have also been used against various livestock pests. Crushed neem leaves eliminate Maggots when rubbed into open wounds on cattle (Ruskin 1992). Neem oil and seed extracts deterred female blowfly Lucilia Scricata from laying its eggs on sheep and is rubbed as a fly repellent (Ganesalingham 1987). Gill (1972) reported that Azadirachtin exerts ovicidal effect on eggs of blood sucking fly Stomoxys calcitrans.

## 2.3 AGRICULTURAL IMPORTANCE:

Neem possesses a lot of qualities that make it a very good material in agricultural processes. The roles played by neem in agriculture include:

- i. **Use as fodder and Livestock feed:** Neem leaves are not relished by most animals, though camels and Buffalo may consume substantial quantity (Kumar, 1988). Being green throughout the year, Neem serves as an important source of raw material for livestock feed, especially in dry season, and as a source of fodder for cattle.

(Nwude, 1986). The leaves contain a lot of minerals that are important for healthy growth. The leaves are generally rich in calcium, iron and vitamin A, and the bark contains phosphorus, sulphur, iron and vitamin A (Kumar 1988). Neem seeds are used in production of neem cake. Kumar, (1988) opined that the cake is profitably used in poultry diet.

ii) **Neem as Source of Fertilizer:** Neem products serve as an important source of fertilizer. The use of leaves as organic manure is a common practice in some parts of Sokoto State. Neem cake is also regarded as good organic fertilizer (Kumar, 1988). The cake has been shown to contain more nitrogen, phosphorus, potassium, calcium and magnesium than farm yard manure or sewage sludge (Radwanski and Wickens, 1981). This is very important considering the fact that nitrogen encourages vegetative development of plants, while phosphorus influences the plant vigor and improves the quality of crops and potassium enhances the plant resistance to disease, insect attack, cold and other adverse conditions - (Kumar, 1998). According to Redknop (1981) tomato plants mature several weeks earlier and produce numerous and long branches when mulched with neem leaves. This indicates that use of neem and its products as fertilizer helps improve the physical conditions of the soil.

iii) **Use in Pest Control:** The use of neem tree as an insecticide has been researched as early as 1960's in many countries (Van Emden 1974). The use of indigenous plant material to protect agricultural produce from pests during storage is among the traditional methods in different parts of Sokoto State. Reports have shown that neem leaves provide protection to stored maize, cowpea and other legumes, for at least 6 months (Zchrer, 1984, Kumar, 1988; Dennis 1990). Kumar (1988) opined that dried leaves protect wheat, sorghum and rice against stored product pests for 135 days while neem kernel powder gives protection to cereal and legume seeds for 180 to 330 days against beetles.

The use of neem products has attracted the attention of scientists in many countries. Different extracts have been used against a number of pests. In earlier work, it had been reported that neem seed kernel possesses extraordinary repellent properties against desert and migratory locust (Pradhan et al 1963). Neem leaf extracts were found to be highly toxic to bean weevil *Callasobrochus maculatus* (Odeyemi et al, 1981; Kumar, 1988); and to *Sitophilus zeamais* (Dennis, 1990). Saxena, et al (1981a) reported a drastic reduction in feeding by brown plant-hopper, (*Nilaparvata lugens*) on rice plants treated with neem seed oil. The oil significantly reduced the longevity, fecundity and oviposition of the plant hopper. Report has also shown that the oil deterred feeding by rice leaf folder *Cnaphlocrosis medinalis* (Saxena et al, 1981b).

A compound called Azadirachtin has been found to be a powerful feeding deterrent to *Schistocerca gregaria* and is generally non-toxic to vertebrates (Kumar, 1984). Also, Schmutterer and Freres (1990) Quoted by Ruskin 1992, reported solitarization of the gregarious locust nymphs by neem oil. The juveniles failed to form massive moving marauding plagues, they become solitary, lethargic and almost motionless thus extremely susceptible to predators. Azadirachtin has also been found to be an effective prophylactic against insects such as Colorado potato beetle, European Corn Borer (Lange and Feuerhake, 1984; Arnason et al, 1985; Cited by Ruskin 1992). Neem extracts were found to kill cockroach nymphs, inhibit adults from laying eggs, retard the growth of oriental brown banded and German cockroaches (alder and Uebel, 1985). The extracts are also effective against a number of mosquito species - including *Anopheles* and *Aedes* (Ruskin 1992). The larvae stop feeding and die within

24 hours after treatment. According to Muley (1978) the extract also killed Melania Scabra (Snail) which is a vector of lung fluke, a parasitic flat worm that encysts in the lungs of livestock and man.

Plant viruses that pose threat to agricultural productivity have also not been left out. Neem extracts seemed to be effective against transmission of plant viruses. Neem oil significantly lower the incidence of ragged stunt virus diseases in rice (Saxena et al, 1981b). It has also been shown that a mixture of neem oil with custard apple interfere with transmission of tungro virus another rice pest (Miriapan and Sexana., 1984). Saxana et al 1984) reported that rice field treated with urea and neem cake were found to be lower in viral diseases than those treated with urea alone.

iv) Use in Control of Nematodes: Nematodes attack nearly all cultivated plants. They cause a lot of damage to crops. As a result, the plant withers, leaves drop and eventually death may follow. Neem and its products might provide a safer alternative for the control of nematodes since synthetic nematicides proved to be toxic. Neem cake along with an organic fertilizer give consistent and significant control in reduction of nematode in root tissue, and reduce the egg laying capacity of females (Kumar, 1988). He also opined that, the cake has a definite nematicidal effect on golden nematodes of potato and cause highest reduction in population of stem boring nematodes. Dev Kumar et al, (1985) reported that neem kernel extract inhibits the eggs of root knot nematodes from hatching and the larvae from emerging. According to Rossner and Zebitz (1987) tomato plants were improved by neem products, though there was no significant difference in number of some nematodes species in the soil.

## 2.4 INDUSTRIAL USES:

Neem produces a lot of products that are of commercial importance. In some parts of the world a number of products are manufactured on commercial scale. The oil obtained from seeds is used in lamps, soap making, tooth paste and other non edible products (Ruskin, 1992; Kumar 1988). Kumar, (1988) reported that the soap and tooth paste are in great demand in Asia, because of their germicidal quality and effectiveness in the control of ring worm, scabies and other skin diseases.

Neem is a very good source of timber. The timber is durable and seldom attacked by termites. It is resistant to wood worms and has been used as fence post and poles for building ships, houses, for furniture and agricultural implements (Kumar, 1988). Neem also provide useful fuels. It serves as source of fire wood in different parts Northern Nigeria. The charcoal from neem is used in the production of ink for writing and is also used by black smith. The charcoal is of excellent quality with calorific value only slightly below the coal from Enugu mines (Ruskin, 1992). Thus with little research, the quality of the charcoal may be improved, and put to use which may be another source of revenue.

Neem is also used in the manufacture of cosmetics. In India, people perceived neem as a beauty aid and the powdered leaves are major component of some widely used facial cream, while the oil is used in nail polish, and as lubricants (Ruskin, 1992). The flowers from neem tree are small, white and scented. They yield nectar and therefore attract honey (Kumar, 1988). The nectar serve as raw material for honey production. According to Kumar (1988) in addition to Sucrose or Glucose, honey derived from neem also supplies Iron, Sulphur, Copper, Vitamins B<sub>6</sub>, B<sub>12</sub> and folic acid. The author also opined that 200gm of the honey is as nourishing as 1.135kg of milk or 10 eggs or 425gm

of boneless cod fish. In some parts of Northern Nigeria people also use/ripe seed because of their sweetness.

### **CONCLUSIONS AND RECOMMENDATIONS:**

The Potentials of neem in the control of pests and diseases, desertification and in increasing the quality and quantity of agricultural products, and in population control deserved much attention. Despite these immense potentials, little work is in progress in Nigeria in the use of this multipurpose species.

The problems posed by hunger, diseases, insect pests and population control are so vast most especially in developing countries like Nigeria. Neem tree might be the key to the solution to these problems. Research should be geared towards making positive exploitation of the species. Attention should be paid in the following areas:

#### **i. HUMAN AND VETERINARY MEDICINE:**

Although millions of people use neem tree and its products in the treatment of various diseases, much needs to be done in order to improve the quality of the products and to check their effectiveness against a number of diseases most especially with regards to their antibacterial, antiviral and antifungal qualities.

It is generally believed that extracts of neem are effective against a number of parasites. To test the efficacy of these extracts and their safety to the environment and other living organisms including human is of paramount importance. The extracts were shown to be toxic to guinea pig and rabbit, and reduce the rate of growth of goat and guinea pigs (Sadre et al 1984; Ali, 1987). Children have also been found to develop signs of a diseases similar to Reye's syndrome when they were given doese (5-30ml) of neem oil (Sinniah et al, 1982 Sinniah et al, 1985). Sinniah and Baskaran, 1981) reeported that dosage as small as 5ml have killd infants. According to Ghandi et al (1988), the oil has shown toxicity at does as low as 14-24ml per kg of body weight in animal studied. Therefore, neem and its products use as medicine should be treated with caution, most especially neem oil.

Since neem affects a number of organisms including bacteria, viruses, molluscs, insects etc. the tree may open a door for more Laboratory work on medicinal and veterinary uses of the species.

#### **ii. AGRICULTURAL RESEARCH:**

Neem is an important source of good fertilzer and also affects a number of insect pests. Research is needed to ascertain the role of neem in replenishing soil fertility, as this will boost agricultural productivity.

The use of plant material as pesticides is widely spreading, probably due to danger posed by synthelic/chemical pesticides. According to Kuamr (1988) excessive use of pesticide in modern land and water amangement has posed a potential health hazard not only to livestock and wild life, but also to aquatic anaimals, birds and even to human beings. Some of the pesticides are persistant and the residue may accumulate in human and animal tissue. Hence alternative control strategies for the future need to be reviewed. The use of indigenou plant material may offer a solution. Therefore, the potentials of neem as a source of pesticides should be fully exploitaed. Research is needed on the methods of formulation and application of the extracts, their effects on pests and toxicity to human and livestock, and quatic organisms. Research is also

needed on the biology and ecology of the pests in order to avert the tendencies to resistance to the extracts.

People also need to be enlightend on the potentials of neem as a pesticides.

Since different neem extracts possess nematicideal properties extensive research is needed so as to be able to develop safer control strategies against nematode species, and also to ascertain the degree of effectiveness of the various extracts.

Since the leaves and neem cake, are a good source of fertilizer, and demand for food is increasing with increase in population, there is need for extensive research on the use of neem as fertilizer.

### iii) INDUSTRIAL USES:

Different products of neem are of commercial importance. Neem oil and neem cake are some of the most important products used as raw materials in industries. The oil is use in soap making and in the manufacture of tooth past, cosmetices and lubricants. Since there are millions of neem trees in different parts of the North, setting up of industries will be of benefit not only to the inhabitants of the area, but to the country in general.

Research is also needed to look into the possibility of producing improved varieties of neem in order to improve the quality of the aroma in the flowers. This will make honey processing a lucraticve and attractive business.

In the end, it is believed that if the tree is to be fully and positively exploited, it will go a long way towards solving the greater problems of unemployment, malnutrition, hunger and disease, not only in Nigeria, but also in other parts of the world.

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## REFERENCES:

- Alder, V. E. and E.C. Uebel, 1985. Effects of Formulation of neem extract on Six species of cockroaches (Orthoptera: Blaberidae, Blattidae and Blattellidae) Phytoparasitica 13(1):3-8.
- Akubue P.I. 1986: Nigerian Medicinal Plants: Pharmacology and Toxicology. Pages 53-63. In Abayomi S. (ed) The state of Medicinal Plant Research in Nigeria. Ceedings of a workshop Ife-Nigeria. 1986
- Ali B.H. 1987. The Toxicity of Azadirachta indica leaves in goats and guinea pigs. Minary and Human Toxicology 29(1):16-19.
- Amina A. 1983, Studies on stomatal behaviour in Azadachta indica A. (Juss). Bsc ch proeject, UDU Sokoto Nigeria.
- Badam L. R. F. Deolankar, M.M. Kulkarni, B.A. Nayasampgi and U.V.Wagh, 1987. In Vitro antimalarial activity of Neem (Azadirachata indica A. Juss) Leaf and seed extracts. Indian Journal of Malariology 24:111-117.
- Dennis, S. H. 1990. Pests of stored products and their control Bethaven press London. page 219-220.
- Devkumar, C., B. K. Goswami and S.K. Mukerjæ, 1985, Nematicidal principles from neem (Azadirachta indica A. Juss) Screening of neem Kernel fractions against Meloidogyne incognita (Kofold and white) chitwood. Indian Journal of Nematology 15(1): 121-124:
- Elvin Lewis M. 1980. Plants used for teeth cleaning throughout the world. Journal of Preventive Dentistry 6:61-70.
- Ganesalingham, V.K. 1987 Use of the neem plant in Srilanka at the farmers level. pages 95-100 in Schmutterer and Aschcar (eds) Natural pesticides from neem trees (Azadirachata Indica Juss) and toher tropical plants.
- GHANDI M.R. LAL A. Sankaranarayanan, C.K. Banerjee, and P.L. Sharama 1988, Acute toxicity study of the oil from Azadirachta indica seed (Neem oil) Journal of Ethnopharmacology 23:39-51:
- Gill, J.S. 1972, Studies on insect feeding deterrants with special references to the fruit extrcts of the neem tree Azadirachta indica A (Juss). Phd Thesis University of London, pp. 263.
- Henkes R. 1986. The Neem tree: a farmer's friend The Furrow October 16. 1986.
- Jinju M.H. 1990 African Traditional Medicine. A case study of Hausa Medicinal plants and therephy. Gaskiya Coop Limited Zaria Nigeria pp. 30-88.
- Jones, M.J. 1973, The organic matter content of the Savannah soil of West Africa. Journal of Soil Science 24(1) 43-53.
- Khalid S.A. H. Duddeck and M.Gonzales-Sierra 1989 Isolation and Charaterisation of an antimalarial agent of the neem tree Azadirachta indica. Journal of Natural Products 52 (2) 922-926.
- Khalid S.A. A. Farouk, T.G. Geary and J.B. Jensen 1986. Potential antimalarial candidates from African plants: an invitro approach using plasmodium Falci-parum. Journal of Ethnopharmacology 15:201-209.
- Khan M. and S. W. Wassilew 1987. The effect of raw material from the neem 'Tree, neem oil and neem extracts on fungi pathogenic to humans.



- In Natural pesticides from neem trees and other tropical plants Schmutterer and Ascher (eds) 1987. pages 645-650.
- Kumar R. 1984 Insect pest control with special referece to African Agriculture, ELBS. Edward Arnold pages 241-243.
- Kumar S.G. 1988 Neem trees: The unexploited wealth of Northern Nigeria A paper presented at the State Workshop on Agricultural Sciences S.T.C. Sokoto Nigeria 27-28th July pp. 1-14.
- Miriapan V. and R.c. Saxena , 1984 Gustard apple oil, neem oil and their mixture: effect on survival of Nephotettix Virescens and on rice tungro virus transmission. In natural pesticides from neem tree (Azadirachta indica A. Juss) and other tropical plants. Schmuttere ans Ascher (eds) pages 413-429 1984.
- Muley, E.V. 1978 Biological and chemical control of the snail vector Melania Scabra (Gastropoda: Prosobrachia) Bulletein of Zoological Survey of India 1:1-15.
- Nwude, N. 1986: Veterinary aspect of medicinal plants research in Nigeria. Pages 97-112. In Abayomni Sofowora (ed) the State of medicinal plants research in Nigeria, 1986.
- Odeyemi O. Osowunmi, and O. Akinnasi. 1981 Laboratory evaluation of toxicity of either extract of neem plants (Azadirachta indica to the Cowpea beetle Callosobrochus macuatus F. Rep. Nigerian stored prod. Res. Institute Technical report No. 4, 53-55.
- Patel R.P. and B.M. Tribedi 1962. The invitro anti-bacterial activity of some medicinal oils. Indian Journal of Medical Research so: 218-222..
- Pradhan, S. Jotawani, M.G. and Rai B.K. 1963. The repellent properties of some neem products. Bulletein of RE. Reg. Lab. 1(2) 149-151
- Radwanski, S.A. and G.E. Wickens. 1981. Vegetative fallow and potential value of the neem tree (Azadirachta indica In Tropics. Economic Borany 35(4): 398-414:
- Rae, A. and M.S. Sethi, 1972. Screening of some plants for their activity agaisnt vaccinia and fowl Pox virus. Indian Journal of Animal Science 42:1066-1070.
- Rayer A.J. 1987: Studies on some co-chemical parameters of the surface oil of Borno State. Annals of Borno. 11:253-268.
- Rayer A.J., B.U. Haruna 1985. Studies on distribution of total and available nitrogen in soil of South Chad Irrigation Project Area of Borno State. Annals of Borno 10:105-111.
- Redknap R.s. 1981: The use of crushed neem berries in the control of some pests in the Gambia. pages 205-214 in Schmutterer and Ascher (eds) Natural pesticide from the neem tree (Azadirachta indica A Juss) Proceedings of a conference.
- Rossner J, and C.R.W. Zebitz (1987a) Effect of neem products on nematodes and growth of tomato (Lycopersicon Esculentum) plants pages 611-621 in Schmutterer and Ascher (eds) 1987.
- Ruskin, F.R. (ed) 1992 Neem A Tree for solving global problem Natural Acad press Washington D.C.
- Sadre, N.L., V.Y. Deshpande; K.N. Mandulkar and D. H. Handal 1984. Male antiferlility activity of Azadirachta indica A Juss (Neem) in diff. species. Pages 473-482. In Natural pesticides from neem tree and other tropical plants. Schmutterer and Ascher (eds) 1984.