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Diversity of Biomolecules Having Pest Control Potential of the Plants

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***Abstract* – Many plants have the potential to be act as pesticides. Nature shows a big diversity in its flora. Number of biomolecules present in the plants has a particular pesticidal property. The paper deals with the survey of some of those plants and their probable biomolecules having pesticide properties. These biomolecules have different effects on different pests. Diversity of these biomolecules and belonging plants can be useful for the selection of plants during pesticide production and its application.**

***Keywords* – Pesticides, Biomolecules, Diversity, Flora, Survey.**

I. INTRODUCTION

The green revolution technology characterized by the use of high yielding varieties, chemical fertilizers, pesticides and water have resulted in a great increase in agricultural productivity. The abiotic and biotic components of the environment have been severely affected by the use of synthetic chemical pesticides. Entry of chemical pesticides into the food chain coupled with their bioaccumulation triggers several unforeseen consequences. The indiscriminately used chemical insecticide led to the contamination of water and food sources, poisoning of non-target beneficial insects and development of insect populations resistant to the insecticide.

One of the promising alternatives has been the use of biopesticides. They can replace some hazardous chemical pesticides when incorporated into integrated crop management technology upto great extent. Although potential and scope of biopesticides and biofertilizers for promoting sustainable agriculture has been known for years, organic farming has emerged now in view of the growing demands for the safe and healthy food, and concerns on environmental pollution.

Biopesticides is an appropriate, easily executable, highly useful, economically viable and environmentally suitable method in the ecofriendly microbes, invertebrate and vertebrate management. Biopesticides may be derived from animals (e.g. nematodes), plants (Chrysanthemum, *Azadirachta*) and micro-organisms (e.g. *Bacillus thuringiensis*, *Trichoderma*, nucleopolyhedrosis virus), and include living organisms (natural enemies), their products (phytochemicals, microbial products) or byproducts (semiochemicals) which can be used for the management of pests injurious.

Plants are the big reservoir of the number of biomolecules which can be use in one or more purposes. Every biotic contents of environment can be benefited by these biomolecules in many ways. Likewise there are many compounds or biomolecules in plants which are responsible for the pest control. Survey of some plants showed that there are many plants in our near surrounding having pesticidal property.

II. DIVERSITY OF BIOMOLECULES

The physic nut, *Jatropha curcas* Linn, is a plant that belongs to the Euphorbiaceae family. This plant have high agro-industrial potential in India because the seed produces non-edible oil that can be used as a biofuel. Apart from the biodiesel production, *Jatropha curcas* possess insecticidal or antifeedant properties [1, 2, 3]. *J. curcas*, known for its insecticidal properties, affects the insects of various families, and its ingestion inhibits the growth of several Lepidoptera species [4]. Its contact toxicity was described by Solsoloy [5]. The methanolic extract from *J.curcas* has insecticidal activity against *Helicoverpa armigera* (Lepidoptera) and *Sitophilus zeamais* (Coleoptera) [6], and *Culex quinquefasciatus* (Diptera). Rahuman *et al*. [7] reported the petroleum ether extracts of *J. curcas* showed larvicidal activity. Petroleum ether crude leaf extract of *J. curcas* was shown to have larvicidal effects on vector mosquitoes including *C. quinquefasciatus, An. stephensi* and *A.aegypti* [8, 9].

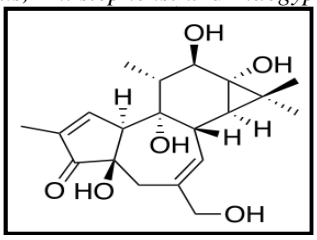

Fig.1. Phorbol

Phorbol compound is present in *Jatropha curcus*, *Euphorbia mili, Euphorbia tirucalli* L. (Euphorbiaceae). Phorbol shows molluscicidal activity against Schistosomiasis-transmitting snails like *Biomphalaria glabrata* and *B. tenagophila* due to **miliamine-L.** Also insecticidal and repellant properties against aphids, grass hoppers and mosquites(10).

Kensa and Yasmin (2011)[11] who detected alkaloids in *Ricinus communis*. Alkaloids interfere with cell division and presence of these substances might be responsible for the inhibition of *Lemna minor* (common duckweed). The toxic phytochemicals may either damage the DNA or inhibit protein synthesis, photosynthesis and plant growth [12]. Several workers reported the inhibitory role of alkaloids in plants [13]. **Ricinin** is present in *Ricinus communis.* Ricinin has the property of repelling aphids, mosquitoes, white lies, rust mites [14].

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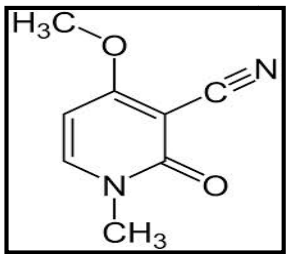

Fig.2. Ricinin

Euphorbia milii is a famous pot-house plant with the orange-red flowering clones. A copious quantity of poisonous, milky sap of *E. milii* contains diterpene esters. The latex of Crown-of-Thorns (*Euphorbia milii* Des Moul. ex Boiss var hislopii, syn, *E. splendens*) seems to be one of the most interesting plant molluscicides that have been tested so far. It is active against mollusks that are intermediate hosts of *Schistosoma* trematodes [15]. The phytochemical fractionation of latex of *E. splendens* showed that **milliamine L**, one of eight substances derived from active fractions, was 100 times as active as miclosamide [16], a chemical compound used for schistosomiasis snail vector control.

Euphorbia tirucalli is an ornamental plant commonly known as Aveloz. The plant belongs to Euphorbiaceae family. The species of Euphorbiaceae is extensively used as a folk remedy by local population of many countries to cure numerous diseases such as cancer, diabetes, diarrhoea, heart diseases, hemorrhages, hepatitis, jaundice, malaria, ophthalmic diseases, rheumatism and scabies etc., *E. tirucalli* is studied extensively by advanced scientific techniques and various bioactive constituents have been isolated from different parts of the plant and analyzed pharmacologically. The plant is reported for hepatoprotective, antimicrobial, antioxidant, insecticidal, larvicidal, molluscicide and antiarthritic activity [17].The major components of *E. tirucalli* latex are triterpenes[18, 19]. Latex contains diterpene esters of the **phorbol, ingenol and 12-deoxyphorbol esters**, reported to be highly active carcinogenic and tumour promoting agents. The fresh latex is reported to contain terpenic alcohol, isoeuphorol, taraxasterol and tirucallol [20]. Dried latex contains Ketone euphorone. Resin is the principle constituent of dried latex of *E. tirucalli.*

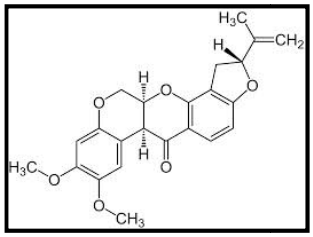

Fig.3. Ingenol

Ingenol compound is present in *Euphorbia milii*, *Euphorbia tirucalli* L. This compound found in most of the species of Euphorbiaceae family. It shows Molluscicidal activity against Schistosomiasis-transmitting snails like *Biomphalaria glabrata* and *B. tenagophila* due to miliamine-L.

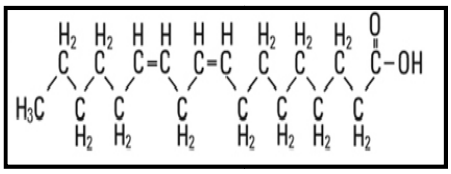

Fig.4. Linoleic Acid

Brassica species are important oil seed crop and have potential for use as green manure crops [21]. **Linoleic acid** found in *Brassica nigra*. It has the property to repel and kills insects, spiders and centipedes.

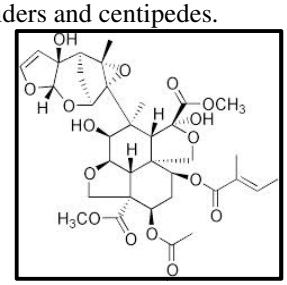

Fig.5. Azaditachtin

Many biologically active compounds have been isolated from neem (*Azadirachta indica*), including **triterpenoides, azadirachtin** [22] and **melantriol** [23] which reduces the feeding of insect. Azadirachtin-E is the most effective insect growth regulator [24]. **Azadirachtin** is an example of natural chemical defence by plant, affecting feeding through chemoreception (deterrence) and toxic effect [25]. It is a tetranortriterpenoid plant limonoid that is oxidized with many reactive functional groups in close proximity to each other [26]. Azadirachtin possesses insecticidal, ovicidal, antifeedant and growth inhibiting effects against many insect and storage pests. [27-33]

Tagetes species possess the following secondary metabolites in their flowers, seeds, and roots: **alilanisol, anetol, limonene, methyl eugenol, and β-karyophyllene** that are toxic to insects, mites, nematodes, bacteria, fungi, and viruses. Such compounds have been reported to be present in *Tagetes* essential oil, and they belong to certain groups of hydrocarbons, alcohols, ethers, aldehydes, ketones, esters, carotenoids, flavonoids and thiophenes. [34]. *Citrus* plant (Rutaceae), *Azadirachta indica* (Meliaceae), *Tagetes erecta* (Asteraceae), etc. contains **Limonene**. This biomolecule consist of neurotoxins, insect growth regulators and repellants and fumigants property.

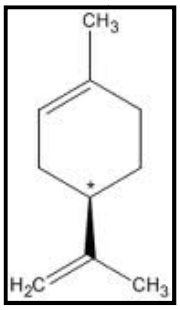

Fig.6. Limolene

Crotolaria retusa (Fabaceae) evoking mortality of *Callosobruchus maculates* by 96h of exposure to its

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extracts [35]. **Pyrrolizidine, such as Monocrotaline, Retusine, and spectabiline** found in *Crotolaria retusa*. *Dalbergia paniculata* (Fabaceae) is rich in rotenone. **Rotenone** shows insecticidal, used as fish poison. *Indigofera tinctoria* also contain rotenone, the extracts of which were found to be effective against larvae of *Anopheles stephensi. I. indica* shows antitumour [36-38], larvicidal and insecticidal [39, 40], anticonvulsant (41) and

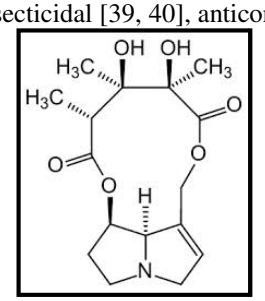

Fig.7. Monocrota-line

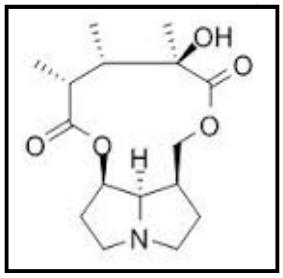

Fig.8. Retusine

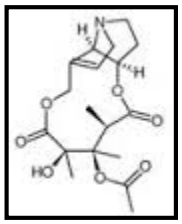

Fig.9. Spectabiline

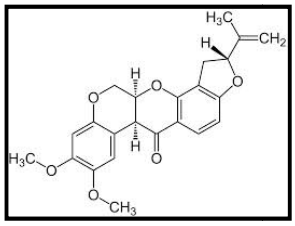

Fig.10. Rotenone

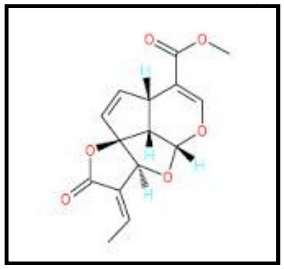

Fig.11. Plumericin

snake venom [42] activities have been reported. Phytochemically, from this plant species, blue dye indigo [43, 44], rotenoids, flavonoids and histamine [45, 46], galactomannan, indirubin [47] and trigonelline [48] have been reported. **Plumericin and Isoplumericin** are found in *Plumeria rubra* (Apocynaceae). These molecules show molluscidal, antibacterial and also algicidal activity.

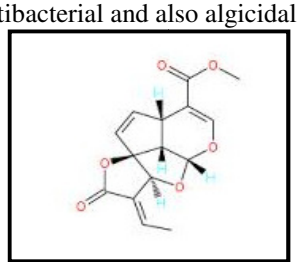

Fig.12. Iso-Plumericin

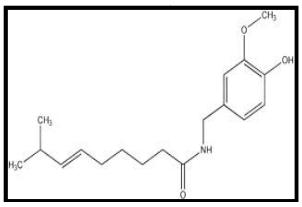

Fig.13. Oleoresin

M. O. Oni in 2010 highlights in his paper the results of investigation on three application rates of *Capsicum annum* Miller and *Capsicum frutscens* L. fruit and seed powders in the control of *Callosobruchus maculatus* in stored cowpea and *Sitophilus zeamais* in stored maize. **Oleoresin** and Capsaicin can be found in *Capsicum annum* (Solanaceae). Chilies are used as stored grain protectants. The pungency of the Oleoresin, capsaicin due to which a burning sensation is produced acts on the insects especially the soft bodies ones.

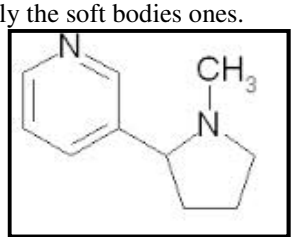

Fig.14. Nicotine

The larvicidal activity of leaf extracts of *Nicotiana tabacum* (Solanaceae) was evaluated against the dengue vector, *Aedes aegypti* (L.) [49]. *Nicotiana tabaccum* (Solanaceae) contain **Nicotine** which is a contact insecticide but act principally as a fumigant and a stomach poison for vegetable and fruit pests which are soft-bodied and minute, such as aphids, flies, leaf hoppers, thrips, red spiders, snails, slugs and cabbage butterfly larvae.

The essential oil obtained from the aerial parts of *Hyptis verticillata*, was found to be dominated by the sesquiterpenoids cadina-4, 10(15)-dien-3-one (15.1%) and aromadendr-1(10en9one(squamulosone)(30.7%). The oil exhibited chemosterilant activities against Rhipicephalus microplus, and toxic action against adult Cylas formicarius [50]. Molluscicidal activity against snails was obtained from a methanol extract of the plant at a concentration of 50ppm [51] *Hyptis verticillata* (Lamiaceae) contain **Squamulosone**, which when incubated with the fungus *Curvularia lunata*, six metabolites were produced. All

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these aromadendranes showed insecticidal activity against the sweet potato weevil *Cylas formicarius elegantulus*.

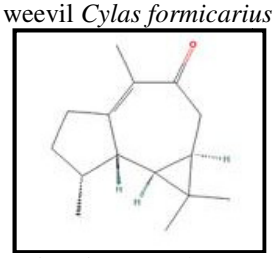

Fig.15.Squamulosone

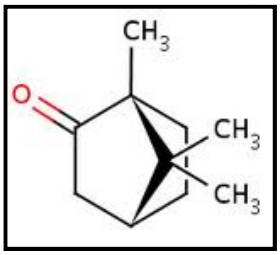

Fig.16. Camphor

The essential oils of *Oscimum americanum* was shown to be as potent in the larvicidal activity against *Aedes. aegypti* and caused 100% mortality at a concentration of 100 ppm. These results are very promising in creating new effective and affordable approaches to the control of *Aedes* mosquito and, thus, of dengue fever [52]. **Camphor and Citral** are two main compounds found in *Ocimum americanum* (Lamiaceae). The essential oils of the leaves and seeds are repellant, toxic or growth inhibitory to many insects.

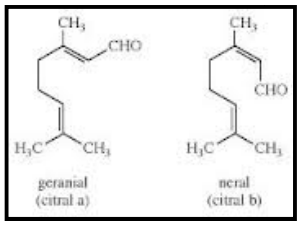

Fig.17. Citral

The insecticidal [53] and insect repellant activities [54, 55] of *Cymbopogon nardus* (L.) Rendle (Poaceae) (known as "Ceylon citronella") oil against Sitroga cerealella (Oliver) have been reported. Mosquito-larvicidal activity of *Cymbopogon nardus* oil against six mosquito species was previously reported by Ranaweera. The study describes the larvicidal activity of *Cymbopogon nardus* oil and its fractions against *Culex quinquefasciatus* mosquitoes and it also caused 50% mortality of *Anopheles stephensi* larvae [56].

Lantana camara Linn. (Verbenaceae) is a hardy, evergreen, straggling shrub with characteristic odour. It is a perennial shrub and all parts of this plant have been used traditionally for several ailments throughout the world. The leaves of this plant were used as an antitumeral, antibacterial, and antihypertensive agent [57]. Roots for the treatment of malaria, rheumatism, and skin rashes [58]. Several tri- terpenoids, flavonoids, alkaloids, and glycosides isolated from this plant are known to exert diverse biological activities9. Extract from the leaves of *L. camara* possessed larvicidal activity [59] while extract from flowers of the plant showed repellent activity against mosquitoes [60, 61]. **Iridoid** is the compound present in *Lantana camera* which repels mosquitoes.

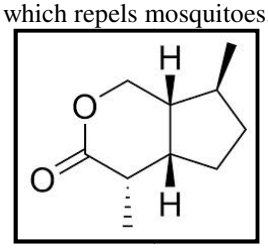

Fig.18. Iridoid

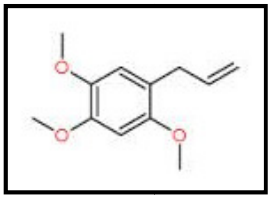

Fig.19. γ-asarone

Volatile oil of *Caesulia axillaris* (Asteraceae) shows antifeedant activity against insects *Spodoptera litura* and *Achoea janata*, due to **γ-asarone.**

Thiophenes present in *Eclipta alba* Hassk. (Asteraceae). *Eclipta alba* (L.) Hassk is a widely distributed herb in tropical countries. The herb is rich source of ascorbic acid. It is a good source of thiopene derivatives which are effective against nematodes. The extracts of root, shoot and the whole plant showed namaticidal activity against nematode species *like Meloidogyne graminicola, M. incognita* and *Rolylenchulus* Sp. due to the presence of thiophenes, thienyls [62].

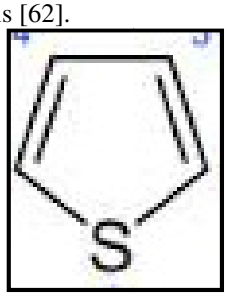

Fig.20. Thiophenes

The bioinsecticidal activity of organic extracts of *Tagetes erecta* L. (Asteraceae) was evaluated on neonate larvae of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) (J. E. Smith) a major maize pest in the world. The acetone leaf extract (500 ppm) of *T. erecta* induced an antifeedant effect, causing a 50% reduction of larval weight in comparison with the control. Larval weights were drastically reduced at 7 d, but even more so at 14 d, when *T. erecta* extracts also caused substantial mortality **Tagetone** is the compound found in *Tagetes erecta*

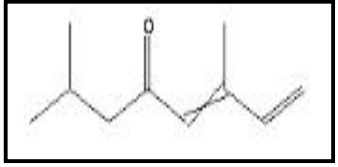

Fig.21. Tagetone

(Asteraceae) found larvicidal, growth regulator and adulticidal like against *Culex quinquefasciatus*, etc. Almost all species of *Tagetes* are insecticidal, repellant, fungicidal and nematicidal [63]. *Vetiveria zizanioides* comes under the family *poacea* and the scientific reports do however exist of repellent compounds present in

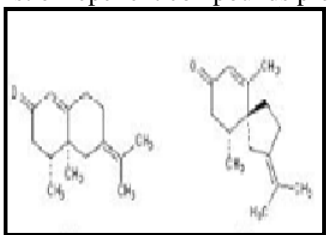

Fig.22. Vetivones

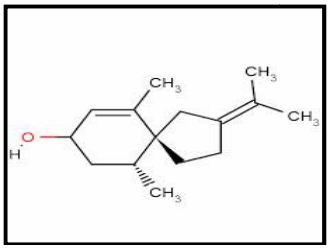

Fig.23. Vetiverols

vetiver oil extracted from roots of vetiver grass. Vetiver oil is a complex essential oil that consist of several hundreds of compounds of which six are reported to possess insect repellent properties [64]. **Vetivones and Vetiverols** are the compounds of plant *Vetiveria zizanoides*(Poaceae) which might be responsible for insect killing.

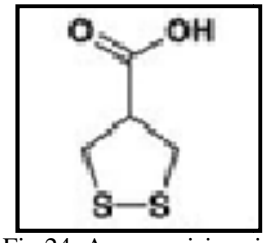

Fig.24. Asparaguisic acid

One component of vetiver oil kills formoson termite. Farmers use mulch of dried chopped roots and tops as insecticides in Thialand [65]. **Asparaguisic acid** of *Asparagus racemosus* (Lilliaceae) occurs in roots found to be nematicidal [66].

III. Conclusion

The biomolecules were found diversely in different plant species. Survey shows that maximum biomelecules belongs to class terpenes such as, Phorbol, Ingenol, Azaditachtin, Limolene, Iridoides, Plumericin, Iso Plumericin, Camphor, Citral, Tagetone, Sequamulosone, Vetiverol etc. having pest control potential. After terpenes many alkaloids also reported as pesticide like Monocrotaline, Retusine, Spectabiline, Nicotine. Also Asparaguisic acid, Linoleic Acid belongs to carboxylic group shows pesticide properties. Likewise isoflavone-Rotenone, Resin- Oleoresin (with essential oil, Ether- γ-asarone, Benzene- Thiopenes, ketone-Vetivone shows the effect on pests.

This research survey also help to know that many of the families show the dominancy of the number of plants used for the same purpose. On the basis of the tentative number of species belongs to the particular family, the dominancy of the families can be identified. The prominent families observed were, Euphorbiaceae, Crotonaceae, Rutaceae, Casealpiniaceae, Meliaceae, Fabaceae, Apiaceae, Apocyanaceae, Asclepidiaceae, Solanaceae, Acanthaceae, Lamiaceae, Varbanaceae, Asteraceae, Poaceae, Zingiberaceae, Liliaceae, etc. The graph (Fig.25) informs the dominancy and less prominent families with maximum number of species available in the particular family which has pest control potential. Nagpur district flora was used for this purpose.

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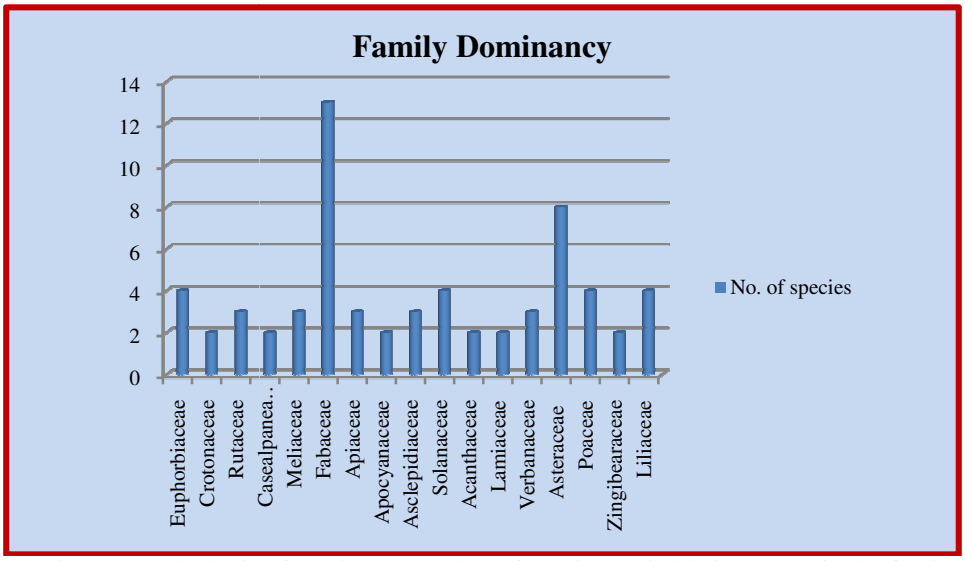

Fig.25. Family Dominancy on the basis of maximum number of species available in the particular family which has pest control potential.

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