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Modern Value of some microbes and ethnobotanical plants especially used as biopesticides

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Abstract : An ethnobotanical survey was conducted for the purpose of standardizing modern use of microbes and traditional use of plants as biopesticides. There is prominent need of documentation for validating the claims of efficacy of these biopesticides for control of various diseases and pest.

The present communication bring out list of plant species and microbes are being reported for the use in organic farming. These microbes and plants used as biopesticides have the highest level of modern and ethnobotanical value, which is usually used especially in the control of plant diseases.

Keywords : Microbes, ethanobotany, biopesticides

INTRODUCTION

Biological control is utilization of pest natural enemies in order to control the pest. Organic farming systems rely on approved practices for the control of plant diseases. Integrated pest management (IPM) is a philosophy of pest management rather than a specific, defined strategy, combining physical, cultural, biological and chemical control and use of resistant varieties. Insects, fungi, bacteria etc, are specific to the host. By crop rotation method, these pests can be kept under control, as they do not get their specific host for continuing their life-cycle. Deep ploughing, changing the time of sowing, change in irrigation system also makes the conditions unfavorable to the pests and they can be controlled. Mixed cropping also helps to control the pest. Still, there are number of optional products that organic farmers can use to reduce the incidence and severity of various plant diseases. There is overwhelming evidence that some of the chemicals do pose a potential risk to humans and other life forms and unwanted side effects to the environment[1,2]. Microbial and botanical pesticides are the important alternatives to minimise or replace the use of synthetic pesticides, as they possess an array of properties including toxicity to the, pest, repellency, anti-feedance, and insect growth regulatory activities against pests of agricultural importance[3-8]. Today there is a global search for alternatives to chemical pesticides and as part of this process there are various efforts to test the efficacy of microbial biopesticides for pest control and crop protection. In general, biopesticides are less toxic, more target specific and shorter half life.

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MATERIALAND METHODS

Microbial biopesticides represent an important option for the management of plant diseases. To assist growers in choosing an appropriate microbial biopesticides a list has been taken from US EPA. A list of these Biocontrol Organism have been tried out *in-vitro* and found to be effective are given below. An interview was conducted in the study area involving many old people and tribal communities. Plant extract were tested for efficacy and tested against pest, weeds and disease. The nomenclature and botanical identity and insecticidal property of the plant species follows Haines, Chopra's, Kritikar and Basu[9-11]. The methods adopted for investigation are those of Schultes and Jain[12-15].

RESULTS AND DISCUSSION

(a) Microbial biopesticides

Bacteria, fungi, oomycetes, viruses and protozoa are all being used for the biological control of pestiferous insects, plant pathogens and weeds. The most widely used microbial biopesticide is the insect pathogenic bacterium *Bacillus thuringiensis* (Bt), which produces a protein crystal (the Bt δ-endotoxin) during bacterial spore formation that is capable of causing lysis of gut cells when consumed by susceptible insects[16]. The δ-endotoxin is host specific and can cause host death within 48 h[17-18]. It does not harm vertebrates and is safe to people, beneficial organisms and the environment[19]. Microbial Bt biopesticides consist of bacterial spores and δ-endotoxin crystals mass-produced in fermentation tanks and formulated as a sprayable product. Bt sprays are a growing tactic for pest management on fruit and vegetable crops where their high level of selectivity and safety are considered desirable, and where resistance to synthetic chemical insecticides is a problem[20]. Bt sprays have also been used on broad-acre crops such as maize, soya bean and cotton, but in recent years these have been superseded by Bt transgenic crop varieties.

Other microbial insecticides include products based on entomopathogenic baculoviruses and fungi. In the USA and Europe, the *Cydia pomonella* granulovirus (CpGV) is used as an inundative biopesticide against codling moth on apples. In Washington State, the USA's biggest apple producer, it is used on 13 per cent of the apple crop[20]. In Brazil, the nucleopolyhedrovirus of the soya bean caterpillar *Anticarsia gemmatalis* was used on up to 4 million ha (approximately 35%) of the soya bean crop in the mid-1990s[21]. At least 170 different biopesticide products based on entomopathogenic fungi have been developed for use against at least five insect and acarine orders in glasshouse crops, fruit and field vegetables as well as broad-acre crops, with about half of all products coming from Central and South America[22]. The majority of products are based on the ascomycetes *Beauveria bassiana or Metarhizium anisopliae.* The largest single country of use is Brazil, where commercial biopesticides based on *M. anisopliae* are used against spittlebugs on around 750 000 ha of sugarcane and 250 000 ha of grassland annually[23]. The fungus has also been developed for the control of locust and grasshopper pests in Africa and Australia[24] and is recommended by the Food and Agriculture Organization of the United Nations (FAO) for locust management[25].

Microbial biopesticides used against plant pathogens include *Trichoderma harzianum,* which is an antagonist of *Rhizoctonia, Pythium, Fusarium* and other soil-borne pathogens[26]. *Coniothyrium minitans* is a mycoparasite applied against *Sclerotinia sclerotiorum*, an important disease of many agricultural and horticultural crops[27]. The K84 strain of *Agrobacterium radiobacter* is used to control crown gall (*Agrobacterium tumefaciens*), while specific strains of *Bacillus subtilis, Pseudomonas fluorescens* and *Pseudomonas aureofaciens* are being used against a range of plant pathogens including damping-off and soft rots[28-31]. Microbial antagonists, including yeasts, filamentous fungi and bacteria, are also used as control agents of post-harvest diseases, mainly against *Botrytis* and *Penicillium* in fruits and vegetables[32].

Plant pathogens are being used as microbial herbicides. No products are currently available in Europe. Two products, 'Collego' (*Colletotrichum gloeosporioides*) and 'DeVine' (*Phytophthora palmivora*) have been used in the USA[33]. Collego is a bioherbicide of northern jointvetch in soya beans and rice that was sold from 1982 to 2003[34]. DeVine is used in Florida citrus groves against the alien invasive weed stranglervine. It provides 95-100% control for about a year after application[35-36].

A list of these Biocontrol Organism have been tried out and found to be effective are given below.

Table-I : Selected promising microbial biopesticides.

Biocontrol Organism	Crops	Target Disease	Efficacy (Crop/Disease)
Bacteriophages	Tomatoes and pepper	Bacterial spot	pepper
Pseudomonas spp	Apples, Pears, lemon, grapefruit	Biological decay	Sweet potato
Bacillus subtilis	Cotton, peanuts, Soybeans, Wheat, Barley, Peas and Beans	Alternaria, Aspergillus, Rhizoctonia, Fusarium and others	Wheat/Fusarium crown rot Pea/Fusarium Bean/Rhizoctonia
Trichoderma spp	Leafy vegetable, pome fruits	Fusarium, Rhizoctonia	Potato, Dry beans,tomato
Streptomyces viridochromogenes	Grass and broad leaf weed	Potent inhibitor of glutamine synthetase	
Alternaria altenata	Herbicide		

(b) Biochemicals

Plants produce a wide variety of secondary metabolites that deter herbivores from feeding on them. Some of these can be used as biopesticides. They include, for example, pyrethrins, which are fast-acting insecticidal compounds produced by *Chrysanthemum cinerariaefolium*[37]. They have low mammalian toxicity but degrade rapidly after application. This short persistence prompted the development of synthetic pyrethrins (pyrethroids). The most widely used botanical compound is neem oil, an insecticidal chemical extracted from seeds of *Azadirachta indica*[38].

Two highly active pesticides are available based on secondary metabolites synthesized by soil actinomycetes. They fall within our definition of a biopesticide but they have been evaluated by regulatory authorities as if they were synthetic chemical pesticides. Spinosad is a mixture of two macrolide compounds from *Saccharopolyspora spinosa*[39]. It has a very low mammalian toxicity and residues degrade rapidly in the field. Farmers and growers used it widely following its introduction in 1997 but resistance has already developed in some important pests such as western flower thrips[40]. Abamectin is a macrocyclic lactone compound produced by *Streptomyces avermitilis*[41]. It is active against a range of pest species but resistance has developed to it also, for example, in tetranychid mites[42].

In India especially, rural area, there is a very old and strong tradition for the use of plants for their treatment in different pest control and plant protection. The soil management practices and pest and plant protection research was carried out in department on the basis of interview of tribal people. Information collected from those people and confirmed by in *In-vitro* and *In-vivo* research work. Pest is a major problem both in the field and stores and can cause loss of major crop yield.

Advantage of plant pesticides

1. It is non poisonous to human and livestock.
2. Short half life
3. They do not kill friendly pest
4. Environment friendly and do not pollute soil water and air
5. Cheap
6. Easy to handle and prepare
7. Many active ingredients in a same composition
8. Repellents, Anti-feedants, Oviposition, metamorphosis inhibitors

To assist farmers interested in doing organic farming with appropriate plant pesticides following table was developed.

Table-II : Plant pesticides for the control of plant pathogens.

Plants from which pesticidal active ingredient obtained	Chemicals	Crop tested	Effective Against
Sunflower	Heliannuol-A and Guaianolides	Lettuce, barley	Weeds
Parthenium hysterophores	Parthenin, Terpens	Ageratum conyzoides (Batish et al,1997)	Weeds (Cassia tora L.), Avena fatua and Bidens pilosa
Leaves *of Artemesia annua*	Sesquiterpene lactones-artemisinin, arteannuin-B and arteannuic acid	Amaranthus retroflexus, Ipomoea lacuunosa and portulaea oleracea	
Gunja (*Abrus preatorius*)	Valine, choline, Gallic acid		Mosquito
Babul (*Acacia arabica*)	Tannin, alkaloids, Arabic acid, Malic acid		Termite, storagegrain pest
Bel (Aegle *marmelos*)	Citronella, eugenol, limonene		
Piyaj (*Allium cepa*)			Root knot nematode
Lashan (*Allium sativum*)	Sulphur containing amino acid (allicin)		
Neem (*Azadirchta indica)*	Azadirachtanin		
Chili(*Capsicumannum*)	capsicin		
Ban tulsi (*Croton bonplandianum*)			Kala bhangra
Cotton(*Gossypium arboreum)*	Gossypetin		

Some more plants are also used as biopestisides Safed siris (*Albizia procera*), Piyaj (*Allium cepa*), Ghritkumari (*Aloe vera*), Satynashi or katari (*Argemon Mexicana*), Sarso (*Brassica napus*), Palas (*Butea monosperma*), Madar (*calotropis gigantia*), Kumbhi (*Careya, arborea*), Kachalu or Arbi or Taro (*Colocasia esculenta*), Haldi (*curcuma longa*), Datura or Thone apple (*Datura stramonium*), and Suryamukhi (*Helianthus annuus.*) The names of the mentioned plants were obtained from literature survey.

CONCLUSION

Therefore the knowledge conserved with these tribal people is of an immense potential and before these knowledge go in oblivion needs to be conserved. Our ecosystem must be fully protected and scientifically conserved otherwise it would be too late to take care of our plant and animal biodiversity. Apart from scientific endeavors, legislations and mass awareness would have great bearing towards conservation of biodiversity. Summing up we present below some of the special feature and highlights of our efforts1.A large amount of literature has been collected and processed to identify traditional practices relating to pest control and plant protection. 2, A variety of microbial inoculants and related products are produced but these are still not legalized. 3, These biopesticides have limited target range than chemical pesticides.

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