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Formulation of Biopesticides for Insect Pests and Diseases Management in Organic Farming

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Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs. Biopesticide is defined by the U.S. Environmental Protection Agency (EPA) as a pesticide derived from natural materials. Bio pesticides also known as biological pesticides are pesticides derived from natural materials as animals, plants, bacteria, and certain minerals. Bio pesticides are less toxic and also reduce the pollution problems caused by conventional pesticides.

Introduction

Today the rapid increase in population and demand of food materials has initiated the large use of insecticides and pesticides. These toxic chemicals are resulting in harmful effects and biomagnifications due to which our environment is continuously polluting and fertile lands are acquiring infertility (Gill and Garg 2014). No doubt they are providing expected results such as eradication of insects, pests and diseases but they are also killing useful organism present in soil due to which the fertility of the soil is rapidly declining. The conventional farming practices which uses chemical methods to kill both useful and harmful life forms indiscriminately, resulting in the malfunctioning of food chain and food web. Bio-control is the best method to cope up with the losses done by the chemicals. In these method insects, pests and pathogens are removed using biological methods without harming the environment and other organism. This is based on natural predation rather than introduced chemicals (Gill et al. 2010). The use of bio-insecticides and pesticides also comes under this category. Today due to awareness about the harmful effects of the chemical insecticides and pesticides, most of the farmers are diverting towards the organic farming. Many such plants, waste matter etc. are available from which these bio-insecticides and pesticides can be prepared by using natural means only. Conventional pesticides are generally synthetic materials that directly kill or inactivate the pest. Being single chemical entity, chemical pesticides have resulted in increased resistance in pests.

Preparation of Different Biopesticides

1. Cow urine extract

In India, as farming goes hand in hand with cattle rearing, therefore the cow urine is available easily in the rural areas. It has acquired an important place in the hindu religion since ancient times. Any religious ceremony and rituals can't be performed without cow urine which is commonly known as gomutra. We will here use the cow urine for the control of pests and as a growth promoter for the growing crops.

Collect 5 lit of pure and concentrated cow urine and dilute it with 40 lit of water and spray it using the sprayer in one hectare of field at the evening time.

Due to high content of urea in it which is toxic to most of the organisms, the pests and insects etc. will not attack the leaves and buds of the crop plants. Due to pungent and bad smell of the extract most of the pests and insects which are attracted due to nectar and fragrance get repelled, preventing the plant.

2. Fermented curd water

In many states of rural India milk production is the main occupation associated with the farming also known as dairy management. The dairy products can also prove a major alternative in controlling the insects and pests in farmlands. One of the dairy product known as butter milk or "Chaach" can be used for this purpose. It is made by the centrifugation of curd in which byproduct ghee is also obtained. There is much greater demand of butter milk in the summer season and it gets distasteful if it is kept for more than two days. This distasteful butter milk can be used to make the extract.

Preparation and application: Take the distasteful butter milk and add equal amount of water in it. Keep it for two days in a semi-shaded place. Now take it and add 40 lit of water in 10 lit of the extract to form 50 lit of the solution. Spray this solution in 1 hectare of field in such a way that all plants get bath in the fogging spray in the early morning time.

Effects and advantages: The fermented butter milk contains billions of bacteria that suppress the growth of other bad bacteria, fungi and protozoa. The inhibitors released by these bacteria works against the unwanted pathogens. Moreover, fermented butter milk also contains the useful nutrients for the growth and maturation of the crop plant.

3. Dashparni extract

Materials required: Neem leaves 5 kg, *Vitex negundo* leaves (Lagundi) 2 kg, *Aristolochia* leaves 2 kg, papaya (*Carica papaya*) 2 kg, *Tinospora cordifolia* leaves 2 kg, *Annona squamosa* (Custard apple) leaves 2 kg, *Pongamia pinnata* (Karanja) leaves 2 kg, *Ricinus communis* (Castor) leaves 2 kg, *Nerium indicum* 2 kg, *Calotropis procera* leaves 2 kg, green chili paste 2 kg, garlic paste 250 gm, cow dung 3 kg and cow Urine 5 lit.

Method of preparation: Crush all and mix in 200 lit of water and allowed it to ferment for one month. Shake this mixture regularly three times a day. Filter it after one month. This extract can be stored up to 6 months.

Application: Take this extract in fogging machine and apply it on the plants. The above prepared extract is sufficient for one acre crop.

Effects and advantages: The extract prepared is very useful for the control of wide variety of pests such as thrips, leaf folder, leafhopper etc. Neem which acts as an

ovi-position deterrent, cow dung, and cow urine acts as a bio-fertilizer which helps in enhancing useful microbial activities in soil.

4. Neem-cow urine extract

Materials required: 5 kg of neem leaves, 5 lit of cow urine, 2 kg of cow dung, 100 lit of water. Crush all ingredients and ferment for 24 hours with intermittent stirring, filter and squeeze the extract and dilute to 100 lit of water. Use this extract to fill in the spray machine and spray it over one acre of the crop.

Effects and advantages: Neem is a broad spectrum pesticide and even compatible with most chemical pesticides. Neem works by intervening at several stages of the life of an insect. It may not kill the pests instantaneously but incapacitate it in several other ways. Neem acts in various ways like as antifeedant, repellent, growth inhibitor, and as ovi-position deterrent. Cow urine has high content of urea in it which is toxic to most of organisms, the pests and insects etc.

5. Mixed leaves extract

Materials required: 3 kg of neem leaves, 10 lit of cow-urine, custard apple leaves 2 kg, 2 kg papaya leaves, 2 kg pomegranate leaves, 2 kg guava leaves.

Method of preparation: Crush all of ingredient and add 5 lit of water in it. Boil the above mixture 5 times after some intervals of time till the mixture becomes half of the initial. Keep it for 24 hours, filter and squeeze the extract. This can be stored in bottles for 6 months.

Application: Dilute the above prepared extract 2-2.5 lit in 50 lit of water. Fill the diluted solution in fogging machine and spray it in one acre area.

Effects and advantages: Guava leaves have achieved a special place in ayurveda due to its medical use for curation of some diseases. Pomegranate leaves have resistive nature against many insects due to presence of some special compounds in it.

6. Chili–garlic extract

Materials required: *Ipomea batatas* (Morning glory) leaves 1 kg, 500 gm hot chili, 500 gm garlic, 5 kg neem leaves, 10 lit cow urine.

Method of preparation: Crush all ingredients and boil the suspension till it becomes half of the initial. Filter and squeeze the above extract and store it in glass or plastic bottles.

Application: Take 2-3 lit of the extract and dilute it with 50 lit of water. Now mix it thoroughly and use it as a foliar spray for one acre of crop.

Effects and advantages: Garlic contains sulphur which is an antibacterial. Chilli has the property to avoid fungal and bacterial infection due to its preservative property.

7. Tobacco with other plant extracts in cow urine

Take ½ kg garlic, ¼ kg chilli and ¼ kg of ginger. Grind all these ingredients into a paste with considerable quantity of water. Take 250 ml neem oil, 250 ml tobacco extract and 100 ml asafoetida extract. Dissolve the extracts of garlic, chilli, ginger, neem, tobacco, asafoetida in 72 hours old cow's urine (5 - 6 lit) and dilute with 50 - 60 lit of water. Before spraying, add an emulsifier at the rate of 4 ml per lit. This quantity is recommended for an acre.

8. Seed treatment with rhizome powder and cow's urine

Boil 10 lit of water and cool it. Next morning, add 4 lit of cow urine and 200 gm of rhizome powder to the cooled water and stir it well. Then add seeds which are to be sown

in this solution and mix it well. Remove the damaged seeds which float on the surface of the solution. Allow the remaining seeds in the same solution for 15 minutes. Filter the solution and separate the seeds. This seeds can be sown directly in the field. This gives protection and resistance against pathogen and pests. 1 lit of cow's urine and 50 gm of rhizome powder is required for treating 1 kg of seed.

9. Papaya fruit extract

To control rats, pieces of papaya fruit are spread near the bunds of the field. Papaya has a chemical substance which cause tissue damage in the mouth of the rats feeding on it. For one acre, 3 fruits are required.

10. Lantana leaf extracts (Baloliya)

1 kg of lantana leaves are cut into small pieces and ground with 250 ml of water to make it into a paste. Filter the material by adding another 250 ml of water. Add a suitable emulsifier and stir well. Then dilute in 10 lit of water, and spray. This solution is effective against insect pests, and diseases caused by fungi, virus, termites, nematodes and bacterial.

11. Neem seed powder extract

The neem powder obtained by crushing 400 gm of seeds and dissolved in 2 lit of water and stirred well. Then allow the solution to soak for about 12 hrs. The resulting solution is filtered through a thin cotton cloth, and diluted with water to bring the solution to 10:1. Add 20 ml of soap solution (20 gm) before application to the crop. It will facilitate uniform spread of the neem solution. The solution is suitable for the control of pest and fungus attacks.

12. Gliricidia leaf extract

500 gm of *Gliricidia sepium* leaves (Gliricidia) are crushed with a mortar-pestle, and soaked overnight in 10 lit of water, then filter and add another 10 lit of water to the filtrate. Spray on infested crops.

500 gm of Gliricidia leaves together with 7 pods of chilli and 3 onion bulbs are chopped and ground with a mortar-pestle. Then soak them overnight in 10 lit of water. Strain the mixture; add another 10 lit of water to the solution. Spray on the infested plants. This solution is effective against insects and acts as a repellent and antifeedant.

13. Onion bulb extract

Boil 1 kg of chopped onion bulbs in 1 lit of water and keep for 24 hrs. Then dilute the filtrate with 10 lit of water and spray on infested plants. This extract will be helpful in spraying against leaf eating pests like caterpillars, aphids and some diseases.

14. Calotropis leaf extract (Wara)

1 kg of leaves is crushed with mortar-pestle. Add 1 lit of water to this paste, and filter. 10 lit of water is added before spraying. Calotropis solution is active against insect pests and act as a repellent and antifeedent.

15. Pongamia leaf extract (Karanj)

Soaked 1 kg of *Pongamia pinnata* (Karanja) leaves in 5 lit of water for 12 hours. The following dry leaves are crushed and grounded, and the extract is filtered through a cotton cloth. Then add a soap solution as an emulsifier to help the extract to stick well to the leaf surface. This extract is beneficial against the leaf eating caterpillar.

16. Marigold extract (Das-petiya)

Mix ½ to ¾, plastic bucket (volume 15 lit) full of flowering plants (with leaves and stems), with water and leave for 8 days for fermentation. Strain the mixture with about 2-3 lit of water, then stir with a suitable emulsifier. To increase effectiveness it can be mixed with tomato leaves. This solution is effective against pests, nematodes, and diseases. Mixture of marigold and chilli, garlic and onion extracts can also be used. This solution is active against eggs and larvae of insect pests.

17. Datura leaf extracts (Attana)

Chop 1 kg of datura leaves into small pieces and then ground with 250 ml of water to make a paste. Then filter through the cotton cloth with another 250 ml of water. Dilute in 5 lit of water. Datura seed can also be used. This solution is active against insect pests, diseases and mites etc.

18. Broad spectrum formulation 1

Materials required: 3 kg fresh crushed neem leaves, 1 kg neem seed kernel powder, 10 lit of cow urine, 500 gm green chilies and 250 gm of garlic

Take a copper container and mix 3 kg neem leaves, neem seed kernel powder with 10 lit of cow urine. Seal the container and allow the suspension to be ferment for 10 days. After 10 days boil the suspension, till the volume becomes half of the initial. Now ground 500 gm of green chilies in 1 lit of water and keep overnight. In another container crush 250 gm of garlic, add 1 lit of water and keep it overnight. Next day mix the above boiled extract, chili extract and garlic extract. Mix it vigorously and filter it. Store the concentrate in glass or plastic containers.

Dilute 250 ml of concentrate with 10 lit of water and mix it thoroughly. Now use it as a foliar spray on the crop.

Due to the formation of complex compounds of Cu in this formulation which are poisonous for many bacteria, fungi, protozoa etc., it is very useful for microbial control. The compounds produced by the fermentation of the above extract are poisonous to many micro-organisms and insects.

19. Broad spectrum formulation 2

Materials required: 5 kg neem seed kernel powder, 1 kg karanj seed powder, 5 kg chopped leaves of besharam (*Ipomeas* sp.), 5 kg chopped neem leaves, 10-12 lit of cow urine.

Method of preparation: Suspend 5 kg neem seed kernel powder, 1 kg karanj seed powder, 5 kg chopped leaves of besharam and 5 kg chopped neem leaves in a 200 lit drum. Add 10-12 lit of cow urine and fill the drum with water to make 150 lit. Seal the drum and allow it to ferment for 8-10 days. After 8 days mix the contents and distil in a distiller.

Application: Distillate obtained from 150 lit liquid will be sufficient for one acre. Dilute in appropriate proportion and use as foliar spray.

Effects and advantages: Neem effectively controls common pests like thrips, whitefly, leaf folder, bollworms, aphids, jassids, pod borer, fruit borer, stem borer, leafhopper, caterpillars, and diamond back moth. Karanj contains poisonous chemicals in it and can be used to check microbial growth. The solutions prepared here be mixed well with soap solution at the rate of 10 g/lit of extract before spraying. It is recommended that the

application or spraying of the all the botanical pesticide should be carried out only in the late afternoon of the day.

Conclusion

More and more quantities of chemicals are used for agriculture intensification to feed an ever growing population. In fact the pest induced loss is on the rise despite increasing usage of pesticide. Pesticide residue, pesticide resistance etc, have forced many to shift focus on to more reliable, sustainable and environment friendly agents of pest control, the bio pesticides. In view of this demand and Government's efforts to mitigate climate change, biopesticides are going to play an important role in future pest management programme.

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