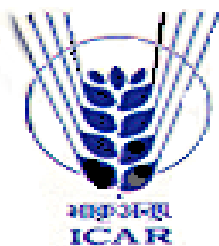


Package for Eco-friendly Pest Management of Brinjal



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Foreword

Concern about environmental safety and sustainability of land productivity is increasing among the scientists, administrators and environmentalists. The strategy adopted during the green revolution era can not be valid any more under the prevailing conditions. A new strategy of living with the nature and nurturing it for sustainable high productivity should be evolved. Eco-friendly pest management shows us the way to effectively use the available natural resources for the benefit of the mankind. Due to the significant increase in the human population, and the consequent increase in the amounts of food and grains produced, many small-scale farmers adopted the use of pesticides as a means of pest control. Chemical control forms the prime and foremost method for the management of insect pests of agricultural and horticultural crops. Prolific use of chemical insecticides significantly curtailed the insect pests in the past but in due course it resulted in the development of resistance to insecticides in insects, environmental degradation and increase in the cost of cultivation. The use of pesticides is being done indiscriminately for production of different crops, fruits and vegetables, which contaminate them to a great extent, especially in vicinity of big cities. Almost five decades of pesticides use have left us at a tragic legacy; severe contamination of our soils and water system, increased cancers, birth defects and other ailments in humans and the emergence of powerful pests which are resistant to chemical pesticides. About 508 insect species have developed resistance against different chemicals. According to the World Health Organization (WHO) approximately one to two million persons are affected every year because of pesticides. Considering such ill effects of pesticides, both the scientists and planners realized the need to reorient the methodology and efforts to overcome these significant yield limiting factors with more eco-friendly manner. This Technical Bulletin “*Eco-friendly pest management practices for Brinjal*” can provide *food security* by preventing and reducing crop losses, promote *self-reliance* by women farmer participatory approach, contribute to *poverty alleviation* by focusing on women farmers and *protect environment and health* by reducing chemical inputs on our unique planet earth.

Authors

India is the world's second largest producer of vegetables next to China. Orissa is the third leading state of India in the production of vegetables followed by West Bengal and Uttar Pradesh. According to the recommendations given by Indian Council of Medical Research (ICMR) an average man with vegetarian or non-vegetarian food habit should consume 125 gram of leafy vegetables, 100 gram of roots and tubers and 75 grams other vegetables. The recommendations for an average woman are more or less same with exception in roots and tubers which should be consumed @ 75 gram per day. Vegetables are the only natural sources of protective food, supplying all the nutrients specially minerals, vitamins and crude fibre.

Botanically brinjal is *Solanum melongena* L., belongs to family *Solanaceae*. It is a leafy plant about 0.5 - 1.0 m in height. The leaves are green to purplish in colour, the flowers have short stalks and are star shaped. The fruits are round or long and can be white green or purple in colour. The fruit contains small rust coloured seeds. Brinjal grows well in areas which are 900 ft above sea level. There should be only slight change in daily temperature and the plants require shade. Irrigation is required during the dry season. Brinjal thrives well in a variety of soils which possess good drainage and are rich in organic matter having pH of 6.0 - 7.0.

Brinjal is planted from seed. The seeds are first planted in a nursery. The seeds can either be planted in polybags or wooden trays. Three parts of loamy soil is mixed with one part of sand. The seeds are planted in rows 5cm apart to a depth of 1 cm and have to be watered every day. The seedlings are ready for transplanting when they are about 5 - 6 weeks old. The recommended planting distance is 60cm between the rows and 60cm between the plants. The plants must be watered at least once a day.

The plant starts to flower 9-10 weeks after planting. The fruits can be harvested 3-4 weeks after flowering. The fruit can be picked every 4 days for about 3-5 months. Orissa is a leading state in respect of the area under brinjal followed by West Bengal, Bihar, Karnataka, Maharashtra, Gujarat and Andhra Pradesh. Brinjal is reported to stimulate the intrapeptic metabolism of blood cholesterol. Leaf and fruit, fresh or dry produce marked drop in blood cholesterol level. Dry fruit is reported to contain goitrogenic principles.

NUTRITIONAL INFORMATION

| COMPONENT | PER 100 GRAM EDIBLE PORTION |
|---------------|-----------------------------|
| Food energy | 24.0 kilo calories |
| Moisture | 92.7 percent |
| Protein | 1.4 gm |
| Fat | 0.3 gm |
| Carbohydrates | 4.0 gm |
| Calcium | 18.0 mg |
| Phosphorous | 47.0 mg |
| Iron | 0.9 mg |
| Vitamin A | 122.0 International Unit |
| Thiamin | 0.04 mg |
| Riboflavin | 0.11 milligram |
| Niacin | 0.9 mg |
| Ascorbic acid | 12.0 mg |

From the dawn of the history of mankind, we know that our natural environment has been the source of our progress and development. Although, science and technology has progressed far, human beings are now subjected to live in a much polluted environment and unhealthy conditions. Unfortunately, our

environment is deteriorating day by day, until one day; it will become a threat to human existence. Today, the main causes of human deaths are cancer and diseases of the heart and brain. Surveys show that 75% of cancer is caused by environmental pollution and various carcinogenic chemicals absorbed by humans.

We are the ones who are continuously destroying our very own living environment. Man cannot live without even one of the essential elements of life—air, soil, water and sunlight. It should be realized that humans need to co-exist in harmony with natural environment in order to survive.

Several types of insects attack the plant and fruit, which can also be afflicted with diseases. Shoot and fruit borer (*Leucenodes orbonalis*), ash weevil (*Mylocerus subfaciatus*), gall midge (*Asphondylia* sp.), leaf feeding beetle (*Henosepilachna vigintioctopunctata*), leaf hopper (*Amrasca bigutula bigutula*), aphids (*Aphis gossipii*) and red spider mite (*Tetranychus cinnabarinus*) are some important pests of brinjal. For quality production of brinjal serious attention must be paid to empower the farmwomen and farming society for Eco-friendly pest management, which is the most important concern of the whole world today.

Eco-friendly pest management package for Brinjal

1. Deep ploughing in summer season helps in exposing resting stages of pests to sunlight.
2. Collection and destruction of egg masses, larvae and adult of Hadda beetle, tobacco cutworm, etc.
3. Apply Neem (*Azadirachta*) / karanj (*Pongamia*) cakes @ 250 kg/ha at the time of land preparation for controlling root knot nematode, ash weevil and termite infection. Repeat cake application at 30-40 DAP

- (days after planting) and 90-100 DAP to manage fruit borer, midge, hoppers and thrips. The pesticidal effect of karanja controls 30-40% nematodes, which causes wilt and also provides nutrient to the crop.
4. Soil solarization after irrigation with 60-100 gauge black polythene sheets in nursery beds for about 15-21 days, helps in killing weed seeds, nematodes, and resting stages of insects and diseases.
 5. Clean planting material, preferably reliable seeds should be used.
 6. Soak the seeds of brinjal in 3 day old butter milk for 6 hours before seeding. This results in 80% germination of the seeds.
 7. Seed treatment with *Trichoderma viridae* / *T. harzianum* @ 2g /100 g of seeds to prevent seed and soil borne infection of fungal diseases.
 8. Raised nursery beds at least 10 cm for good drainage thereby avoid damping off in solanaceous nurseries by preventing soil borne fungi i.e. *Pythium*, *Phytophthora*, *Rhizoctonia* etc.
 9. Drenching of hukka water, once in a week keeps various insect pests away from the nursery. Spraying of hukka water is also effective to control the pests on transplanted seedlings. Hukka water contains nicotine sulphate which acts as controlling substance for caterpillars and other pests.
 10. Dusting of wood ash @ 20 kg/acre with hand or duster on seedlings in the nursery as well as on the young seedlings protects the plants from pest and disease attack.

11. Root dipping in Dimethoate 0.02% for 6 hours before transplanting for the control of little leaf disease by avoiding jassids infestation in early stages of the crop.
12. Cutting of roots of brinjal before transplanting is effective to overcome infertility problem in brinjal up to 60-70%.
13. Cow dung with 10 kg of Kochila (*Strychnos nux-vomica*) seed powder and 25kg Kochila leaf are put in a compost pit of 10 x 3 x 3 feet by mixing thoroughly. Then 10 liters cow urine is added to the pit for 10 consecutive days and covered with soil. After 2 months the compost becomes ready. This compost (5 g) is added to each plant once at the time of sowing and at 45 days after planting. Due to its repellent action, incidence of shoot and fruit borer is reduced.
14. Sprinkle of wood ash in kitchen garden on vegetable crops, spread it around plants to ward off pests and to enhance nutrients status of the soil. Wood ash is a source of phosphorus for plants and it also acts as a physical poison causing abrasion of epicuticular waxes and thus exposing pests through desiccation. Ash dust acts as antifeedant for insects, causing dehydration in soft bodied insects ultimately leading to their death.
15. Dig a pit of required size in barren field itself to mix cow dung, cow urine, chilli and garlic in sufficient water. These are kept in the pit for at least 10-15 days for proper decomposition. Then the decomposed mixture is sprayed in Brinjal at 15 days interval.
16. Apply crude oil or kerosine oil @ 4 liter/ha with irrigation water for the control of termite.
17. Use pit fall traps @ 10 traps/ha.

18. Use yellow pan/sticky traps for sucking pests @ 10 traps/ha.
19. Maintain crop weed free up to 4-6 weeks after planting.
20. Grow cowpea or pulses on the bunds to buildup natural enemy fauna.
21. Conserve predators like Coccinellids , Syrphids, Spiders, Carabids, Staphylinids, Dragonfly , Damselfly, Miridbugs, Nabidbugs, Reduviid bugs, Anthocorid bugs, Geocorid bugs, and Parasites like *Pristomerus testaceus*, *Cremastus flavoorbitalis*, *Bracon greeni*, *Phanerotoma* sp and *Campyloneurea* sp on *Lorbanalis*; *Pristomerus euzopherae* against *E.perticella*; *Microbracon psarae* against *Psra bipunctalis*; *Chrysonotomyia appannai*, *Chrysocharis johnsoni*, *Elasmus* sp., *Pedioblus feveolatus*, and *Tetrastichus ovulorum* against *Epilachna* sp; *Aphidius* sp. on aphids; and *Eurotoma* sp.on *sphondylia* sp.
22. Install bird percher @ 50/ha to encourage birds to feed on pests.
23. Crop rotation with non-host crop for root knot nematode e.g. Sorghum, sesamum, wheat and barley.
24. Intercropping with onion and garlic is recommended for nematode control.
25. Plant Marigold (yellow flower), in 1: 4 ratios with brinjal in the field to save the crop from root knot nematodes.
26. For the control of nematode *Chamanthi* (*Chrysanthemum coronarium*) , a flowering plant is raised on the borders of tomato fields.

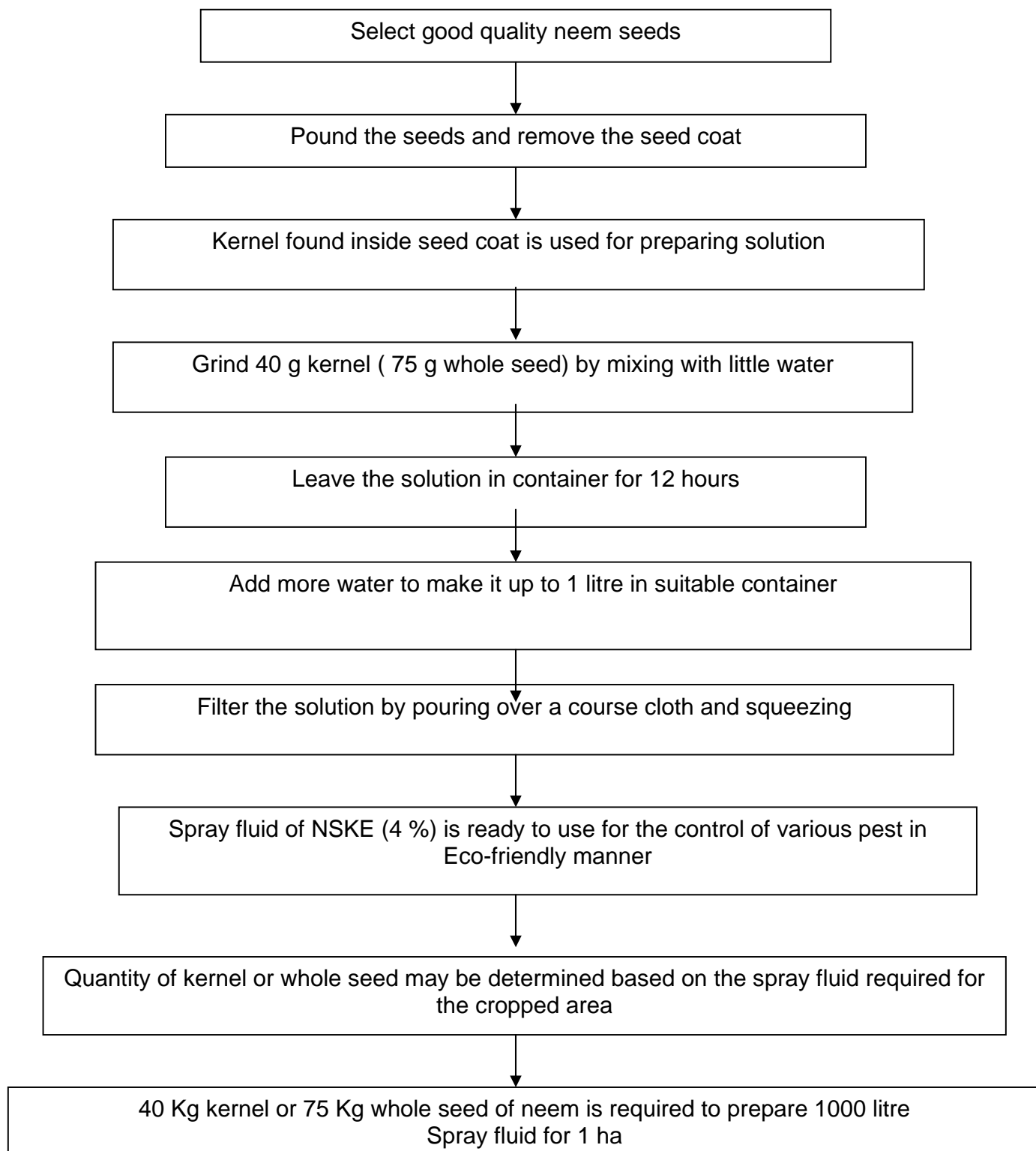
27. Crop rotation with French beans reduces the bacterial wilt disease.
28. Soil drenching and spraying of turmeric in combination with hing (*Asafoetida*) @ 1g and 0.1 g respectively /liter of water considerably reduce the infestation of wilt in brinjal. Seedling root dip in turmeric and hing solution is also very effective.
29. Sorghum bicolor (Johnson grass) is grown as fodder crop in April –May. After harvesting the crop, brinjal is planted by keeping roots of Johnson grass in the field. This results in zero incidence of wilt disease in moderately infested plots.
30. Avoid excess use of water for disease management.
31. (i) About 1.5 kg leaves of custard apple (*Anona squamosa*) are ground and approximately 200 ml of water is added to it, well mixed and filtered. The filtrate is kept aside. (ii) About 500 gram of dry fruits of chilli (*Capsicum annum*) are soaked in water overnight and filtered. (iii) About 1kg of neem fruits (*Azadirachta indica*) are crushed and soaked in 2 litres of water overnight and the extract is filtered. These 3 filtrates are added to 10 litres of water and mixed thoroughly and sprayed on the crop @ 35-40 litres / 0.16 ha (one bigha) for the management of pest and diseases.
32. Ringworm infestation causes deformities in brinjal fruits. Root treatment with mustard oil cake in water has been found to reduce the deformities.
33. Sprinkling of fresh milk of goat with a sprayer has been found effective to reduce leaf curl disease in brinjal with in a week.

34. Brinjal is affected by disease which leads to rotting of the fruit and ultimately the plant dries up. In order to prevent infestation spraying of *Kunwarpatha (Aloe vera)* is used. A solution is made of 1litre of water and 8 crushed leaves of *Aloe* have been found effective.
35. Release *Chrysoperla carnea* @ 2 grubs/plant for the control of aphids and other soft bodied insects early in the season.
36. Spray *Bacillus thuringiensis var. kurstaki*, the commercial preparation @500g/ha against lepidopteron pests.
37. Rice starch and animal urine are spread for the control of biting and chewing type insects.
38. Tender bamboo shoot is cut into small pieces and kept in a pot with water. After 2- 3 days, it is applied or sprayed on the crop. After 15 days of transplanting it is applied at 15 days interval and about 100 liters is used/ ha. These 10 kg tender bamboo shoot are used for 100 liters of water for the control of different pests.
39. Select less susceptible varieties like SB 17-4, PBR-129-5, Punjab Barsati, Arka Kasumkar, Pusa purple round, Punjab Meetam, Pusa Purple Long and Surti Gota for shoot and fruit borer.
40. Frequent use of ash dust early in the morning on the crop reduces the incidence of shoot and fruit borer. This application hampered the egg laying of insects.
41. Avoid overdose of Nitrogenous and Phosphatic fertilizers which will reduce the incidence of fruit and shoot borer.

42. Clipping of damaged shoots in early stage twice in a week and piercing the hard wire in the holes of shoots in order to kill the hidden borer in the shoot and Removal of damaged shoots, fruits, and fruit borers and their destruction.
43. Use of 2 meter high thatch barrier or live barrier like maize on all four sides of the plot provides better protection against shoot and fruit borer..
44. Inundative release of *Trichogramma chilonis* @ 50 000/ha five times starting from flower initiation stage at weekly interval against shoot and fruit borer.
45. Spray of 4% NSKE (Flow chart for the preparation of NSKE is given in the last of the text) or 1% neem / pongamia soap for sucking and leaf mining pests in early stages of the crop and for borer incidence in later stage of the crop.
46. The seed extract of Kochilla (*Strychnos nux-vomica*) is found effective in controlling more than 75% of brinjal fruit borer (*Leucinodes orbonalis*) when brinjal pieces treated over 60 minute and fed to borers.
47. Decoction of Ranbeli (*Feronia hyperthusa*) bark has been found effective against fruit and shoot borer of Brinjal. Spraying of Ranbeli bark extract at growth and fruiting stage @ 12.5 kg bark soaked in 50 litres of water for 24hours and diluted to 500 litres with water / ha has been found reducing the incidence of fruit and shoot borer.
48. Growing of *Chrysanthemum coronarium* as border crop in the main field of brinjal has been found effective to reduce the incidence of fruit borer.

49. Shoot borer can be controlled by the help of *Calotropis* plant. Whole plant of madar (*Calotropis procera*) except the root is ground and placed at the irrigation source.
50. Tobacco – soaked water with soap is effective for the control of shoot and fruit borer. Tobacco is soaked in water overnight and extracted liquid is filtered and sprayed on the crop with soap or detergent powder. The ratio of water and tobacco in solution is 10:2.
51. Fruit and shoot borer is controlled by spraying the root extract obtained from 10-12 kg of *vaira* root and diluting with 500 liters of water.
52. Dilute solution of *sindwar* leaves extract and chilies powder is sprayed on the leaf once a week for the control of fruit borer.
53. Stem borer can be controlled by broadcasting ash of *ashan* (*Terminalia crenulata* Syn. *T. tomentosa*) wood.
54. Use of coconut dust and wood ash in vegetable seeds, particularly in Brinjal helps to save seeds from pest / disease damage in storage.
55. Seeds of brinjal may be stored in bamboo up to one year after wrapping with *shevni* leaves.
56. Phytosanitation to reduce sources of inoculums such as removal of plants after final harvest, volunteer plants.

**FLOW CHART FOR THE PREPARATION OF 4% NEEM
SEED KERNEL EXTRACTS (NSKE) FOR ECO-FRIENDLY
PEST MANAGEMENT**



The National Research Centre for Women in Agriculture (NRCWA), established in 1996 under the aegis of Indian Council of Agricultural Research

(ICAR) with its headquarters at Bhubaneswar, Orissa and sub-centre at Bhopal, Madhya Pradesh, in India. The present mandate of the center is “To identify gender issues and test appropriateness of available farm-technologies/ programmes / policies with women perspective for promoting gender mainstreaming in research and extension for empowerment of farmwomen and capacity building of scientists, planners and policy makers to respond to the needs of the farm women.”

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