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# Indigenous Biobed Technology to Limit Point Source Pollution

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The point source contamination of pesticides is becoming a major threat to environment, as the amount of pesticides discharged by spraying equipment can have a significant impact on water sources. Splashes and spills of pesticide during sprayer loading, as well as the greater amounts of liquid produced during sprayer cleaning, can harm water quality unless appropriate safeguards are in place. Pesticides that reach water can harm aquatic life and have an impact on drinking water sources, which in turn leads to pressure for further regulation and controls on their use. In India and South-East Asian countries, there is currently no safe technique for safe disposal of wastes generating from those devices. Among the different techniques available elsewhere, the biobed system is the simplest method for faster and safer dissipation of pesticides. This approach is based on better pesticide adsorption in the biomix, followed by faster breakdown of pesticides in a co-metabolic manner by the resident microbes. This technology is not suitably modified for tropical and subtropical countries. A biobed system needs to be developed for this region to reduce the point contamination. A prototype is developed and standardized to decontaminate commonly used pesticides at a faster rate. In order to do so, we conducted a number of experiments to identify the components of indigenous biomix and to check the efficiency to degrade pesticides in this climate situation. We only used resources that are inexpensive and readily available throughout India to make an indigenous biobed system. Most of the farmers of south East Asia use the knapsack sprayers and other small spraying equipment, a small biobed will suffice to safely mitigate a large number of pesticides within a short period of time.

## Developmental stages of biobed

### A. Selection of biomixture

The original biobed in European countries consists of wheat straw, peat and soil at the ratio of 50:25:25. Recent studies had shown that replacing and partial change in the substrate ratio can enhance the efficiency of the biobed system. To make it more adaptable in our region we have prepared five types of mixture and efficiency was tested to degrade a mixture of three pesticides. Below mentioned 5 biomixtures were tested to select the more efficient one.

There was negligible amount of pesticides recovered from all biobed column after 90 days of incubation and the biomixture D (Paddy straw: Soil: FYM:: 2:1:1) was screened out as the most efficient one.

**Table 1. Biomixtures and their major properties**

| Biomixture | | | Major properties |
|---|---|---|---|
| Name | Components | Volumetric Ratio | |
| A | Paddy Straw: Soil: FYM | 1:1:1 | -Pesticides dissipated at a moderate rate<br>-Good sorption capacity |
| B | Paddy straw: Vermi-compost: Soil | 1:1:1 | -Pesticide leaching was more |
| C | Paddy Straw: Soil: FYM:Vermi-compost | 1:1:1:1 | -Reduced leaching of pesticides |
| D | Paddy straw : Soil: FYM | 2:1:1 | -Efficient biomixture for pesticide degradation<br>-Ample amount of sorption capacity |
| E | Paddy straw: Soil: Vermi-compost | 2:1:1 | -Slowest dissipation rate<br>-Good sorption capacity |

## B. Efficiency study against fungicide

The fungal population plays a vital role in biobed system for faster dissipation of pesticides. Biomixtures are mainly developed to mitigate pesticides by flourishing fungal population. However, recent research has found that using too many pesticides, particularly fungicides, has a negative influence on the fungal population, reducing the efficiency of the biomixture system. We conducted an exploratory investigation to determine the impact of a fungicide (carbendazim) on microbial activity and insecticide degradation (imidacloprid). Both the pesticides are commonly used in rice cultivation. Both the pesticides treated over our selected biomixture at 100 times of their recommended dose. During this study we found that, pesticides treated alone dissipated at faster rate, as compared to pesticides treated in mixture. Though the carbendazim degraded faster rate as compared to imidacloprid, the dissipation rate of imidacloprid was affected due to carbendazim application. Whereas, the half-life of carbendazim was minimally affected by imidacloprid application. Although as a fungicide, carbendazim had some negative impact on the biomixture efficiency, but the residual life of both the pesticides reduced considerably in the biomixtures.

## C. Establishment of indigenous biobed

A set of 60 cm PVC column was filled with biomixture D on a 3 cm layer of rice husk biochar to adsorb pesticides from leachate. Pesticide was treated and conditions were optimized for upscaling.

## D. Salient features of biobed:

1. The biomixtures contain rice straw, manures, soil and rice husk biochar
2. Rice straw, farm yard manure and soil was premixed at a volumetric ratio of 2:1:1.
3. Size of the biobed depends on the size of the farm & frequency of pesticide usage
4. Top 10 cm of the column adsorbed and degraded pesticides most efficiently
5. The system could degrade 70% of applied pesticides (applied 100 times of the field recommended doses) within 15 days

6. Rice husk biochar (with high surface area and adsorption sites) retained the outgoing pesticides
7. Microbial growth support pesticide degradation

## Installation and maintenance of biobed at farm level

### 1. Preparation of biobed

We are proposing two models of biobed for farm level application.

In the first method, a pit needs to be digged and it will be preferred if it is nearby the washing area. The minimum distance of the pit should be 10 m away from the surface water and 250 m away from drinking water facility. The area of pit depends on the size of farm and spraying. But the depth of the biomix always should be 60 cm including the biochar layer. The pit should be lined properly with plastic layers to prevent leaching of pesticides to ground.

The other option is a ready to use biobed system and can be used anywhere in the field. For this, polyethylene plastic drum of (length 90 cm and diameter 55 cm) will be used. In this system, biomix will be filled up to the height of 60 cm including the 3 cm biochar at the bottom of the drum. A valve will be inserted at bottom of each biobed drum to collect leachates for further use.

### 2. Preparation of biomixture and filling up the pit

The components of biomixture should be mixed properly according to their appropriate ratio. Soil, straw and FYM ratio should be of 1:2:1. The pit should be filled with the biomixture and will be left for incubation before loading of pesticide contaminated waters.

### 3. Use of biobed

The washing area need be connected through a channel to biobed area for the pit system. For the drum system, washing should be done at the top of the drum. The top area of biobed should be protected from direct sunlight and rain for better efficiency.

### 4. Maintenance of biobed

The degradation of biomixtures happen over times, so it needs to be replaced with freshly prepared one. Our suggestion is refilling till the 60 cm depth with fresh biomixture for every six months. The biomixtures with refilling could be used for maximum three years. Thereafter, a fresh set up should be made. The spent biomixture can be used for landfilling, potting mix and as well as compost.

## Precautions

1. The biobed pit shouldn't be water logged, because water logging condition can reduce the microbial activity which arrests the pesticide dissipation rate.
2. The depth should be around 60 cm. Increased depth will reduce the microbial population and similarly shallow depth can cause water logged easily and the water can easily overflow from the biobed system.
3. The plastic liner should be thick enough to prevent leakage due to puncture and the biobed should not be established near any water bodies.
4. It should be10 m away from any surface water or water drain.
5. It should be 250 m from any spring, well or borehole.

## Country Context of Potential Industry

Reduction of chemical pesticides load in the environment is a challenge. In India, it is more precarious due to small land-holding. Our technology is suitable for small landholding. The prescribed technology can be customized and fitted everywhere.

## Upscaling

This can be promoted among farmers by several farmer training programme. Incentives should be given to farmers from government bodies to establish this indigenously prepared biobed system in their farming areas. Centre and state government, farmers, pesticide retailers, pesticide manufacturers can adopt this technology.

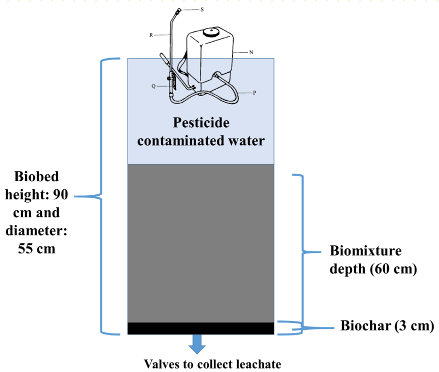


**Fig 1. Schematic diagram of a biobed system**

## FAQS

- ***What is the maximum volume that can be treated in a biobed?***
  The fundamental specification is based on a biobed surface area of one square metre. Biobed system with one square metre can treat 1000 litres of liquid in each year.
- ***How often may a biobed be filled?***
  It could be utilised for three years once it's been filled. Degradation of biomass will happen over time. Degraded biomass should constantly be replenished in every six months.
- ***How often do I need to empty a biobed?***
  A biobed system could be used for three years once it is replenished in every six months.
- ***Should the biobed be covered?***
  Open biobed system is always preferred. Cover may be provided to keep rain water from entering.
- ***How do I maintain a biobed?***
  Every six months, the degraded material can be replenished with biomix to retain the biobed depth at a minimum of 60 cm.
- ***What can I do with the treated washings?***
  Pesticides are rarely found in the leachates. They could be used for irrigation of the plants.
- ***What happens after three years or operating a biobed?***
  The spent biomix could be used in landfilling, potting mix and as well as compost.

**N.B. - The technology is approved by the institute and uploaded in the Krishi Portal (201637152474093).**

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