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# DOABLE TECHNOLOGIES

## Raised and sunken bed technology

In north east, there is large area (about 2.0 lakh ha) under marshy condition. About 1.5 lakh ha marshy land is found in Assam followed by Meghalaya 15,500 ha and other hill states of NER. Crop production is not possible due to waterlogging, undecomposed organic matter and swampy condition. Raised and sunken bed technology in low land and marshy land was developed for increased productivity and cropping intensity. Ratio of raised:sunken bed worked out to be 40% area under raised bed and 60% area under sunken bed. Traditionally, only one crop of rice use to be grown in lowland. With the adoption of permanent raised and sunken bed technology cropping intensity could be raised even at 300%.


- Raised and sunken bed size (width) of 2:3 (raised:sunken bed) was found optimum for 3-5 feet deep marshy land. This ratio does not require transportation of soil from outside the area. However, maximum productivity was recorded with 4:1 raised and sunken bed ration, which was 3.07 times higher than 1:1 ratio.
- The heights of the raised beds above the moisture/water level were standardized. When water stagnates in the field a raised bed height of 30-40 cm registered maximum yield. While without water stagnation 20-30 cm, height registered maximum yield of the crops grown on raised beds.
- Maize based cropping systems for permanent raised bed indicated that the system productivity in terms of maize equivalent yield (MEY) improved markedly with the adoption of two or three crop in a sequence. Maximum MEY of 115.90 q/ha was observed with maize-pea crop sequence, which was 4.37 per cent higher over maize-fallow cropping systems. Maize - frenchbean - radish was next to it, which registered 89.46 q MEY/ha.
- The performance of rabi crops grown on permanent raised beds were also evaluated. It was observed that the yield of crops like groundnut, rajmash, toria and mustard significantly improved when grown o permanent raised bed as compared to upland rice terraces.

## Double cropping of rice

Traditionally only one crop of rice (monocropping) is taken by the farmers at mid altitude (950msl). This is mainly because of long duration varieties and early onset of winter,

that results spikelet sterility. Two crops of rice were successfully grown under the mid altitude of Meghalaya. Suitable high yielding varieties for pre-*kharif* season *viz.*, Krishna Hamsha were identified giving more than 4.5 t/ha grain yield. The pre-*kharif* rice was followed by the short duration varieties (Vivek Dhan 82) giving yield 3 – 3.5 t/ha. Ratooning of pre-*kharif* rice also produced considerable grain yield (2.5 – 3 t/ha), which could be a cost effective double cropping technology for wetland rice. By adopting this technology, at least 1 lakh tonne of additional food grain can be produced at mid altitude condition.

## Conservation agriculture in rice fallows

In rice fallows, pea and lentil crops were grown under zero tillage. Among various pea varieties tried, IPFD 99-13 recorded maximum green pod yield (41 q/ha) followed by IPFD 1-10- (32.9 q/ha), IPFD -99-25 (30.32 q/ha) and HUDP (17 q/ha). Among the lentil varieties tried, DPL-15 recorded maximum seed yield (10.9 q/ha) followed by DPL 62 (8.71 q/ha) and IPL 406 (4.8 q/ha) under zero tillage.


**Pea and Lentil sown under zero tillage in lowland rice fallows**

**Toria under zero tillage after rice in upland condition**

**Organic Farming (NPOF)**

**Management of soil fertility in important vegetable crop based multiple cropping systems**

- Supply of nutrients on the basis of N equivalent through integrated i.e., ½ each of FYM and vermicompost was found best for improving productivity and soil health in vegetables based cropping system. However, sole application of FYM also found at par with integrated nutrient management.

**Potato, Tomato and French bean** **Maize + Soybean (2:2)**

- System productivity (q/ha) in terms of maize equivalent yield (MEY) was found maximum in maize + soybean - tomato cropping system under integrated ($^1/_2$ FYM + $^1/_2$ VC) nutrient management practices.
- Maize + soybean – tomato cropping system was found to give higher productivity and income.

**Insect pest and disease management under organic farming**

- Maximum yield of maize and soybean was recorded with the application of derisom (3 ml/l) alone or in combination with panchagavya (3%) and cow urine (10%) whereas maximum fruit yield of tomato was recorded with panchagavya (3%) + lantana leaf extract (10%) + vermiwash (10%).
- Sole application of panchagavya (3%) or in combination with lantana leaf extract (10%) and vermiwash (10%) was found effective in minimizing the percent disease index (PDI) and percentage of insect damage in maize, soybean and tomato. Application of neem oil (5 ml/l) and derisom (3 ml/l) was also found effective in controlling stem borer, Monolepta and Epilenchna in maize and leaf folder, flea beetle and Mylloceros in soybean.

**In-*situ* fertility management in wetland rice**

The farmers of the north east has apathy towards use of agro-chemicals in crop production. In-*situ* fertility management technology by recycling crop and weed biomass was developed in wetland rice. Soil fertility including the growth of micro-flora improved over the years. By adopting this technology, yield can be increased by at least 25 % over the farmers practice.


**IPNS technology for rice and maize**

IPNS technology with locally available Eupatorium weed and Alder leaves was demonstrated on rice and maize based cropping system in farmers field. Use of 50% NPK along with 5 tonne biomass of Eupatorium / Alder / ha gave productivity equivalent to application of 100 % inorganic nutrient supply system. The favourable climatic conditions in the region allow huge growth of weeds and shrubs and these can be effectively recycled into crop production for improving productivity and maintaining soil fertility.

**Increase in cropping intensity**

Cropping intensity can be increased up to 300 % from present level of 120% by combining short duration cereals, vegetables, legumes and oilseed cultivars. Among the


promising cropping sequences, maize + soybean (2:2) – radish – potato, maize + soybean (2:2) – French bean – carrot, maize + soybean (2:2) – carrot – French bean found successful. Cropping intensity of 200 % was also achieved with rice – tomato, rice – potato, rice – mustard, rice + soybean – tomato, rice + groundnut – tomato. This would not only increase productivity, but would also increase employment and farm income.

**Recycling of locally available biomass in crop production through composting**

Suitable composting techniques for the locally available weed biomass i.e., *Eupatorium adhenophorum, Lantana camara and Weed mixture* and *Rice straw* were developed. Two composting procedures tried were T1: Microbial enriched compost (MEC) - Biomass + cowdung (1:1) + Compost culture with Cow dung slurry (prepared by mixing fresh cowdung: virgin soil: well rotten compost in a ratio of 1:1:0.5) and T2: Microbial and nutrient fortified compost (MNFC) - T1 + Rockphosphate @ 2.5% + Neem cake 1%. Four substrates and two methods of composting were used to produce eight types of compost. Compost culture consisted of combination of microbes i.e., P-solubilizer (*Bacillus polymyxa*, *Pseudomonus striata*), Cellulose decomposer (*Aspergillus awamori*) and free living N- fixer (*Azotobacter* spp). Rockphosphate was used for P-enrichment and neem cake was used for N-enrichment of the

compost. Standard composting procedure was used. Compost culture was added in the pit after about a week of filling the pit with substrate and cowdung to avoid exposing the microbes to excess heat generated from the materials. After one month the addition of compost culture to the pit was repeated along with turning the materials. Within about 100-120 days good quality composts were prepared. The nutritional composition of prepared composts were analyzed and used in low land rice. In over all the composts could be ranked as Rice straw > Eupatorium > Weed mixture > lantana compost based on the nutritional status. Results revealed that all the composts, FYM and recommended NPK improved the grain yield of rice significantly over control. Highest grain yield (45.6 q/ha) was recorded with rice straw enriched with microbes and organic sources of nutrients (MNFC) followed by the *Eupatorium* compost (44.41 q/ha) enriched with MNFC. Both of these treatments were at par with recommended NPK (44.07 q/ha) but significantly superior to FYM (41.90 q/ha) and control (31.98 q/ha).

**Bioorganics for Crop Production**

Bioorganics are plant extracts developed for the specific crops, as a seed treatment and foliar application for boosting vegetative growth and enhancing yield

**Ginger:** Bioorganic : $GF_1$

The product is highly effective for controlling soft rot of ginger and up to 85-90% of crop can be saved from ravage of soft rot disease. Also, the formulation helps in early sprouting and establishment of crop. On an average 30-50 % more pseudostems appears in treated crop. The harvested rhizomes are free from disease and having superior self life.

Untreated ginger crop

Disease free Ginger Crop with GF1

**Bioorganic for rice seed treatment**

312 types of bioorganics tested in rice for finding herbal growth promoter. The extracts were tested in petridish (0.5 - 4% concentration). Nine extracts, namely, RCHE 374L, RCHE 355L, RCHE 84L, RCHE84R, RCHE 377L, RCHE 441L, RCHE 378L and RCHE 71L resulted in higher root and shoot growth. The two best performing materials were RCHE 84L and 84R, which when treated with rice seed at 2% concentration resulted in 185% and 221% more root growth, whereas, shoot was elongated by 180% and 200% more over control.