Lessons Learnt from Organic Farming Research at ICAR Research Complex, Barapani, Meghalaya

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Organic farming is a system of production that relies on animal manures, organic wastes, crop rotations, legumes and aspects of biological pest control. It avoids (or legumes excludes) the use of synthetically produced fertilizers, pesticides, growth regulators and livestock additives. It emphasizes the ecological production management system that promotes and enhances biodiversity, biological cycles and biological activity of the soil. The essence of organic farming is to feed the soil rather than the crops to maintain optimum soil health with its vibrancy and resilience. Thus, making the soil capable of supplying all the essential nutrients to the crop for its proper growth and development. Organic farming aims at sustaining and increasing the productivity by improving the soil health and over all improvement of agro ecosystem.

However, for the success of organic crop production, the principal elements need to be considered are: -

1. Maintaining a living soil i.e., good soil health.
2. Making available all the essential plant nutrients in the required quantity.
3. Attaining sustainable high yield.
4. Organic mulching for conservation.

Initially, the North Eastern States were identified for promoting organic farming. These states were selected because the land is almost virgin and the crops are grown virtually organic. There is lot of scope for organic agriculture in the hills especially in the north eastern region of India. Firstly, the use of inorganic fertilizers and chemicals is meager in the region. The farmers of the region, in general and hill farmers in particular are having apathy towards use of agro-chemicals (Table-1). Secondly, the fruits of green revolution could not benefit the farmers of the NER as the system of production in the region remained low input-low risk-low yield technology and the average yield of most of the crop remained far behind the average productivity of the country It is assumed that the difference in production gap due to adoption of organic agriculture is expected to be negligible; rather there is scope for enhancing productivity with good organic management, the organic premiums would boost earning of the farmers of the region. Thirdly, it is an added advantage that all the households are maintaining livestocks (pig, poultry, cattle, goats, etc.) producing sufficient quantity of on-farm manures, which could be efficiently used for organic agriculture. Moreover, the north eastern states being the one of the

mega biodiversity receiving very high rainfall (2000 mm to 11000 mm per annum) leads to profuse production of biomass including weeds, shrubs and herbs. Some of these species could be efficiently used in organic production. The strength of north eastern region for organic farming can be summarized as under.

- North Eastern Region (NER) is home to some niche crops like Assam lemon, Joha rice, Medicinal rice and Passion fruits.
- North Eastern Region (NER) accounts for 45% of total pineapple production in India.
- Sikkim is the largest producer of large cardamom (54% share) in the world.
- North Eastern Region is the fourth largest producer of oranges in India.
- One of the best quality ginger produced in the North Eastern Region.
- Extent of chemical consumption in farming is far less than the national average.
- 18 lakh ha of land in NER can be classified as "Organic by Default".
- Agri-Export Zone (AEZ) set up in Tripura for organic cultivation of pineapple.
- Another Agri-Export Zone (AEZ) established for ginger in Sikkim.
- Promotional schemes for agriculture and related industrial investments for NER.

Table-1: State wise consumption of plant nutrients per unit of gross cropped area in the North Eastern Region (kg/ha)

State	2000-01				2001-02			
	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total
Arunachal Pradesh	1.4	0.6	0.4	2.4	1.6	0.9	0.4	2.9
Assam	18.7	9.2	7.8	35.7	19.2	10.6	9.1	38.8
Manipur	85.2	10.6	6.2	102.0	86.5	12.0	6.4	105.0
Meghalaya	9.0	5.0	0.5	14.5	10.5	6.2	0.5	17.2
Mizoram	4.7	4.8	2.8	12.4	4.9	5.2	3.6	13.7
Nagaland	0.8	0.5	0.1	1.4	1.1	0.8	0.2	2.1
Sikkim	5.0	3.1	0.5	8.5	5.0	3.5	1.2	9.7
Tripura	15.5	4.0	1.2	20.7	16.5	8.6	5.3	30.5
All India	56.7	21.9	8.1	86.7	58.7	22.8	8.7	90.1

Experimental Results Obtained at the ICAR Research Complex for NEH Region, Barapani (Meghalaya)

Some of the organic manures locally available in the North Eastern Region were tested at the ICAR Research Complex, Barapani, Meghalaya. The major nutrient contents of different organic sources were analyzed and experiments were conducted using these sources in different field experiments. Various experiments were carried out on organic farming, ecological farming and natural farming in wetland rice. The results of all these experiments are given below:

1. Homestead organic farming on raised and sunken beds

Studies on homestead organic farming with rabbit excreta and the organic source of nutrient supply showed that not only productivity of crops can be sustained and also the cropping intensity as high as 300 % can be achieved under medium land with proper land configuration. The yield of rice during both the pre-*kharif* and *kharif* seasons increased during the subsequent seasons. During pre-*kharif* season IR-64 produced 43.2 q/ha of grain yield in 2005 compared to 35.5 q/ha grain yield in 2003. Vivek Dhan-82 and VL Dhan-61 found to be promising during late *kharif* season as a second crop. The performance of different crops in the subsequent year (2004) was also promising. The performance of crops on raised bed are given below

Organic farming on raised & sunken beds

Table.2.Performance of different crops on raised beds during pre-*kharif* and *kharif* seasons under organic farming system[5] (2004).

Crops	Pre- *kharif* season		*Kharif* season	
	Yield (q/ha)	REY (q/ha)	Yield (q/ha)	REY (q/ha)
Tomato	163.0	261.0	-	-
Potato	253.3	253.3	--	---
French bean (Pole type)	219.1	438.2	231.2	462.4
French bean (Bush type)	102.0	204.0	105.4	210.8
Coriander (green leaf)	102.7	821.6	-	-
Carrot	258.6	517.0	-	-
Maize (Green cob)	67,875 nos.	135.7	-	-

2. Low input in-situ fertility management in wetland.

A field experiment was conducted in wet land condition during rainy seasons (*Kharif*) of 2003 and 2004 at Umiam (950 m MSL), Meghalaya to evaluate the production potential and physiological activities of rice (*Oryza sativa L.)* cultivars under *in situ* fertility management with and without weeding. Crops were grown with minimum tillage (one puddling / one tillage) and one hand weeding in wetland conditions. Grasses and other weeds available in the plots during pre-*kharif* and post *kharif* season were incorporated into the soil. Only one hand weeding was done for individual crop. No

fertilizer and other agro-chemicals were used. The performance of crops in the third year was highly promising (Table- 5a & 5b). No external input i.e., fertilizer, pesticides, etc. were applied except fresh *Azolla* biomass @ 250 g m^{-2} which was incorporated 7 days after transplanting. Highest grain yield was recorded in cv. RCPL 1-87-8 (37.0 q/ha) followed by cv. Vivek Dhan 82 (31.99 q/ha) and Mendri (30.9 q/ha) and found significantly superior to cv. Manipuri (26.60 q/ha) and RCM-9 (8.6 q/ha). The increase in yield due to one hand weeding at 30 DAT was maximum in cv. Vivek Dhan-82 (52.8 %). Microbial population in in-situ fertility management experiments (Bacteria, 129 x 10^4/g, rhizobium, 61.6 x10^4/g and PSM, 39.9 x 10^4/g) were found much higher than that found under inorganic fertility management.

In-*situ* fertility management in wetland rice

3. Production potential of crops under natural, organic, integrated and inorganic fertility management under raised and sunken beds:

Among raised bed crops in pre-*kharif* season, highest yield of tomato was recorded in inorganic (270.1 q/ha) followed by integrated (235.2 q/ha) and organic (182.7 q/ha) fertility management.

For French bean, carrot and potato the trend was almost similar. During following *kharif* season, upland rice variety Bhalum 1 was grown in raised beds. Yield of Bhalum 1 was maximum under organic (33.94 q/ha) followed by integrated nutrient management (31.97 q/ha).

Crop production under raised & sunken beds

In sunken bed IR-64 (44.5 q/ha), Krishna Hamsha (40.85 q/ha) and Sahsarang (40.56q/ha) yielded maximum under 100 % inorganic followed by integrated nutrient management during pre-*kharif* season. Whereas, Vivek Dhan 82 (31.54q/ha) and VL Dhan 61 (31.97q/ha) was found promising during late *kharif* season on sunken beds.

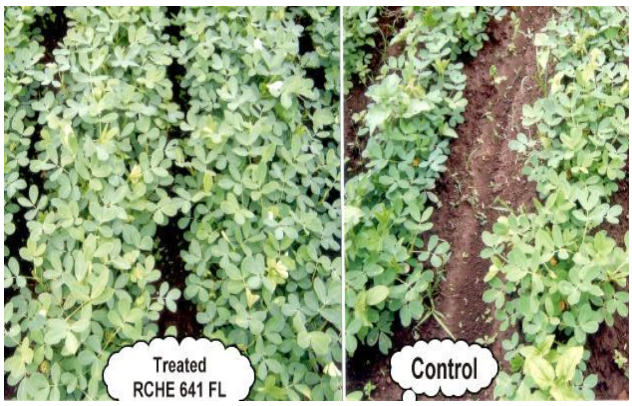
Soil fertility in general was found to be improved in organic and integrated plots at the end of the first year.

4. Use of botanicals on crop production

Field trial of selected bioorganics (23 nos.) was undertaken during the *Kharif* season. In oilseed crop, the response of bioorganics was prominent in case of mustard. The mustard was grown on rainfed dry terraces during *rabi* season without any irrigation. Out of 14 different bioorganics, only 4 gave promising result viz., RCHE 377L, RCHE 507L RCHE 583S and RCHE 620 L. Highest yield was recoded with RCHE 583 S (83% over control). However, the straw yield was recoded highest in case of RCHE 620L

Mustard 34 days after sowing **Control plot** **Bioorganic treated plot**

Soaking of groundnut seeds with bioorganics RCHE 641 FL, RCHE 558L, RCHE 22L, RCHE 538R and RCHE 625L resulted in significantly higher yield over control. The highest yield advantage recorded with RCHE 641FL (33.88% over control). However, the top growth (Haulm weight) was highest with RCHE 558L (19.17%) over control**.**



Groundnut crop at 20 days after sowing **Groundnut at pod formation stage**

In soybean, 22 different bioorganics were selected for field trial on the basis of the petridish and pot screening. Seeds were soaked with the bioorganics for 24 hours before sowing, the concentration of the bioorganics used were 1.5% to 2.5%. Six bioorganics i.e., RCHE 79L, RCHE 56FL, RCHE 301L, RCHE397L&INF, RCHE490L and 611L recoded promising result. The highest pod yield was recorded with 397L and INF (39.6% over control) followed by RCHE 301 L (27.9%), RCHE 79 L (26.9%). However, the highest vegetative biomass was observed in the case of RCHE 56FL (27% over control)

5. Effect of organic and natural farming on soil characteristics.

Studies on the microbial and nutrient contents of soil showed that there was improvement in soil quality (Table.6). Available nitrogen, phosphorus and potassium in raised bed was found higher in organic as well as integrated treatment in the initial year which were increased in the current year. Lower values of these nutrients were found in the soils of sunken beds compared to their raised bed counterpart. Population of bacteria, *Rhizobium* and PSM were found more in the soils of organic treatment. More microbial populations in organic, natural and integrated treatment probably mineralized the unavailable form of nutrients enhancing their availability.

Table 3. Soil fertility as influenced by different nutrient management practices under raised (R) and sunken (S) bed system.

Treatments	Available N (kg/ha)		Available P (kg/ha)		Available K (kg/ha)		pH		Organic carbon (%)	
	R	S	R	S	R	S	R	S	R	S
Natural	166.2	171.3	2.5	1.7	272.3	250.3	5.0	5.4	3.1	2.9
Organic	181.9	185.0	2.8	1.9	285.1	260.2	5.3	5.6	3.4	3.1
Integrated	181.9	194.7	2.7	2.3	291.5	264.4	5.1	5.3	3.4	3.1
Organic	169.3	178.6	2.3	1.5	282.1	259.2	5.1	5.4	3.2	2.9
Initial Status*	144.3	-	1.41	-	246.0	-	2.31	-	1.7	-

* Status before land configuration

Table. 4. Microbial population (count/g soil) of soil under natural, organic, integrated and inorganic fertility Management (Determined by serial dilution soil plate count).

Treatments	Bacteria	Rhizobium	PSM
Natural	29.4 x 10^4/g	17.4 x 104/g	14.6 x 104/g
Organic	67.5 x 10^4/g	31.2 x 104/g	26.0 x 104/g
Integrated	43.2 x 10^4/g	22.7 x 104/g	18.2 x 104/g
Organic	18.4 x 10^4/g	5.7 x 104/g	7.1 x 104/g

The results of different experiments indicated that the productivity of crops under organic farming and natural fertility management either maintained or improved over the years.Thus, it can be very well established that there is lot of scope for sustaining productivity of crops by improving soil quality through organic and natural farming.