TECHNICAL BULLETIN

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Integrated Nutrient Management for Intensive Cropping in the Bhola District

Bangladesh has gained self-sufficiency in cereals, but the need to keep intensifying crop production to achieve and sustain food security for the growing population of the country persists. Land and soil resources in Bangladesh have been under a great pressure during the last three decades to produce food crops under increasingly intensive cropping systems. Crop lands have been exploited intensively with high nutrient demanding modern crop varieties to increase crop yields per unit area, but proper nutrient replenishment of soils with essential plant nutrients has not been done, which has resulted in the deterioration of soil health. Farmers are growing multiple crops per year on the same pieces of land without adequate compensation of the plant nutrients removed by crops from the soil. For the production of major food crops about 3.0 million t/year of major nutrients are removed from the soils, this amount is much larger than that added to soils as chemical fertilizers and manure. Most farmers of the country are not aware of the need for soil test based integrated nutrient management for their crops which is the major cause of inadequate and unbalanced use of fertilizers/manure/crop residue recycling and aggravating deterioration of soil fertility and productivity.

Soil organic matter is a key factor in maintaining long-term fertility. Although chemical fertilizers supply plant nutrients, they may adversely affect the physical, chemical and biological integrity of the soil. Depletion of soil organic matter is a major soil fertility issue in Bangladesh, and it has become increasingly difficult to collect and apply organic manure like cow dung, compost, etc. to add organic matter to the soil and improve its fertility. A good option can be crop residue recycling. Soil test based integrated nutrient management (STB-INM) comprising chemical fertilizers and crop residues offers a good opportunity to rationalize crop production practices in intensive cropping systems maintaining optimum soil health. It may be all the more applicable to the cropping situation in the coastal district of Bhola in southern Bangladesh where the cropping intensity is very high. The Bhola Station of the On-Farm Research Division of the Bangladesh Agricultural Research Institute (BARI) implemented a three-years research project in farmers' fields of Bhola designed to study INM for intensive cropping systems.

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Methodology

- Research on INM was carried out in the Sadar and Daulatkhan upazilas of Bhola district; field trials were set up in four sub-blocks in each upazila;
- Sixty-eight cooperator farmers were involved in the field experiments covering 9.07 ha of land;
- Two intensive cropping patterns, popular in Bhola, viz., Wheat-Transplant Aus rice (T. Aus) - Transplant Aman rice (T. Aman) and Mungbean - T. Aus - T. Aman were used;
- The cop varieties used were BARI Gom-28 for wheat, BARI Mung-6 for Mungbean, BRRI dhan48 for T. Aus and BRRI dhan52 for T. Aman rice;
- Pre-planting and post-harvest soil samples from both top soil and sub-soil were collected and analyzed for nutrient status determination;
- STB nutrient doses were applied through combinations of inorganic fertilizers and crop residue incorporation in an INM approach;
- Only 50% T. Aus rice straw was incorporated in the wheat- T. Aus- T. Aman cropping pattern and 100% mungbean stover and 50% T. Aus rice straw were incorporated in the Mungbean- T. Aus-T. Aman cropping pattern;
- Crop yield data were collected and economic analysis of costs and benefits was done.

Results and Outputs

- Developed fertilizer recommendations for Wheat: 111-34-60-12-1-0.25, T. Aus: 70-16-24-8-0.5 and T. Aman: 77-15-11-11-0.5 kg/ha N-P-K-S-Zn-S-B along with 50% T. Aus rice straw recycling in the Wheat-T. Aus-T. Aman cropping pattern; and, for Mungbean: 16-25-13-13-2-0.25, T. Aus: 49-14-8-7-1 and T. Aman: 74-13-5-10-1 kg/ha N-P-K-S-Zn-S-B along with 100% Mungbean stover and 50% T. Aus rice straw recycling in the Mungbean-T. Aus-T. Aman cropping pattern;
- In the Wheat-T. Aus-T. Aman cropping pattern, average garin yields of Wheat, T. Aus and T. Aman were 3.54, 4.69 and 5.10 t/ha, respectively;
- The biological yields of Wheat, T. Aus and T. Aman were 8.85, 11.07 and 11.48 t/ha, respectively in the Wheat-T. Aus -T. Aman cropping pattern while in the Mungbean-T. Aus-T. Aman cropping pattern, these were 3.95, 11.85 and 12.13 t/ha, respectively, for Mungbean, T. Aus and T. Aman;

Average yields of different crops in project fields and nearby farmers' fields

Cropping pattern	Crop and variety	Project fields		Nearby farmer s' field s	
		Grain yield (t/ha)	Straw/stover yield (t/ha)	Grain yield (t/ha)	Straw/stover yield (t/ha)
Wheat -T. Aus -T. Aman	Wheat: BARI Gom -28	3.54	5.32	3.07	4.59
	T. Aus: BRRI dhan48	4.69	6.38	3.68	5.06
	T. Aman :BRRI dhan52	5.10	6.73	4.58	6.14
Mungbean -T. Aus- T. Aman	Mungbean: BARI Mung -6	1.27	2.68	0.97	2.24
	T. Aus: BRRI dhan48	4.99	6.86	3.65	5.00
	T. Aman: BRRI dhan52	5.24	6.89	4.53	6.05

- In the Wheat-T. Aus-T. Aman cropping pattern, the gross return was Tk. 244790/ha, the total variable cost was Tk. 137950/ha, the gross margin was Tk. 106840/ha, the benefit-cost ratio (BCR) was 1.77 and the marginal benefit-cost ratio (MBCR) over the nearby farmers' practice was 3.07.
- In Mungbean-T. Aus-T. Aman cropping pattern, the whole pattern gross return was Tk. 234070/ha, total variable cost was Tk. 124780/ha, the gross margin was Tk. 109290/ha, BCR was 1.88 and MBCR over nearby farmers' practice was 6.94;
- In the Wheat-T. Aus-T. Aman cropping pattern, soil organic matter (SOM), total N and avialable P, S, Zn and B increased whereas K decreased in the top soil; in the sub-soil SOM, total N and available P, S, Zn and B increased;
- In the Mungbean-T. Aus-T. Aman cropping pattern, SOM, total N available P, S and Zn increased whereas K decreased in both the top soil and sub-soil;

Soil nutrient status (sub-block average) before and after experiment

Soil sample collection	Soil depth	pH	SOM (%)	K (meq / 100g soil)	Total N (%)	P	S	Zn	B
						µg/g soil			
Before expt.	0-15 cm	6.8	2.21	0.18	0.110	4.62	12.31	1.02	0.77
After expt.		6.7	2.29	0.21	0.115	4.68	12.38	1.03	0.79
Change		-0.1	0.08	-0.02	0.005	0.06	0.07	0.01	0.02
Before expt.	15-30 cm	6.5	2.06	0.16	0.103	4.03	8.81	0.69	0.47
After eept.		6.5	2.10	0.17	0.105	4.05	8.85	0.7	0.47
Change		0	0.04	0	0.002	0.02	0.04	0.01	0
Before expt.	0-15 cm	7.1	2.37	0.23	0.119	5.95	13.72	0.6	0.97
After expt.		7.0	2.55	0.21	0.128	5.99	13.77	0.63	0.97
Change		-0.1	0.18	-0.02	0.009	0.04	0.05	0.03	0
Before expt.	15-30 cm	7.0	1.95	0.19	0.098	5.46	9.07	0.37	0.64
After expt.		7.0	2.09	0.17	0.104	5.49	9.23	0.41	0.64
Change		0	0.14	-0.02	0.006	0.03	0.16	0.04	0

Benefits and Outcomes

- In the Wheat-T. Aus-T. Aman cropping pattern, the average Wheat, T. Aus and T. Aman yields increased by 15.15, 27.54 and 11.35%, respectively over those in the nearby farmers' fields;
- In the Mungbean-T. Aus-T. Aman cropping pattern, average Mungbean, T. Aus and T. Aman yields increased by 31.38, 36.68 and 15.59%, respectively over those in the nearby farmers' fields;

- Increasing crop yields increased farmers' incomes and improved farmers' livelihoods;
- The STB-INM practice with a combination of chemical fertilizer application and crop residue recycling improved soil fertility;
- During the tenure of the project, 240 farmers were trained on STB-INM practices for intensive cropping systems; 2288 farmers, researchers, extension officials participated in field days and observed first hand the benefits of STB-INM.

Recommendations

- The STB-INM with crop residue recycling is a cheap, eco-friendly easily applicable technology that needs to be fine-tuned for different AEZs of the country;
- Researchers and policy makers need to seriously think about ways and means to ensure conservation of potassium in soils under intensive cropping systems;
- One pulse crop, if possible Mungbean, should be included in the cropping pattern to maintain soil health;
- DAE can help farmers get their soils tested for STB fertilizer dose calculations; farmers' awareness needs to be raised with pilot production programs consisting of training, field days, exposure visits, etc.

This technical bulletin has been prepared on the basis of technical information available from a completed CGP project of KGF, the details of which are given below:

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