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RESEARCH ARTICLE

YIELD MAXIMIZATION ON FIELD CROPS WITH PROPER NUTRIENT MANAGEMENT.

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ABSTRACT

In general, B: C ratio is not very much promising in most of the Cereal, Pulses and Oilseeds. But if we go for seed production system of cereal, pulses and Oilseeds than B:C ratios will be high. This is because of higher output values of crops. Applications of FYM@5.0t/ha and 50% recommended dose of NPK fertilizer plus Rhizobium inoculation help in saving 50% chemical fertilizers and increased yield to about 30%. In Assam, the total biomass in the crop field is more and after it's decay; it releases a little quantity of NPK nutrients to the soil system. That is why the recommended fertilizer dose of cereal, pulses and oilseeds are found less in Assam. Fertilizer have contributed significantly towards, increasing agricultural productions world wide).

INTRODUCTION

Fertilizer is an essential source of plant nutrients to improve soil fertility. Post independent India laid emphasis on increased use of fertilizers to realize high yields of all crops. There was a rapid growth in fertilizer consumption, particularly after the introduction of HYVs in mid-sixties. Imbalanced and inefficient use of fertilizer has become a serious constraints in improving the crops yields. The partial factor productivity is now declining and also it has started reducing the farmer's availability. Low fertilizer use efficiently not only affects crop yields and farmer's profit but also poses threat to the environment in many places of India including Assam. Integrated Nutrient Management (INM) i.e. use of chemical fertilizers in conjunction with bio-fertilizers and all Organic sources needs to be promoted. In Assam, the total biomass in the crop field is more and after it's decay, it releases a little quantity of NPK to the soil system. That is why, the fertilizer recommendation of the major field crops and horticultural crops are less if we compare it with Punjab, Haryana, Uttarpradesh, Jharkhand, Tamilnadu, Andhra Pradesh, Karnataka, Bihar etc. Rice is the major crop of Assam. After final land preparation; we generally apply Butachlor or Pretilachlor in the in the puddle field just before transplanted of rice seedlings. This is followed by two hand weeding at 25 and 50 days after transplantations gives better result in most of the improved rice varieties of Assam with a desirable yield of 60-70 qtl/ha. For getting such type of rice yield we need to apply a fertilizer dose of 60-30-30kg/ha of N,P₂O₅ & K₂O together with 50-70qtl of F.Y.M/ha at the time of final land preparation. Half of the Urea fertilizer together with full quantity of single super phosphate & muriate of potash are applied in the puddle field of Winter rice or Summer rice.

Remaining half quantity of Urea fertilizer is applied at maximum tillering stage, panicle initiation stage and flowering stage@10kg/ha. This is actually top dressed at maximum tillering, panicle initiation and at flowering stage of the rice crop in Assam. A good quantity of NPK fertilizer is also applied in Pulses, Oilseeds, Fruits and Vegetables, Spices, Tea gardens etc. Proper time of application and methodology is followed as per the recommendation of Assam Agricultural University as and when it is found necessary. Current Status and Importance: India is the second most populous nation after China with 1.25 billion populations and likely to be more by the 2030. Obviously, Intensification and Diversification programme of Agricultural activities are the only option for meeting the food and nutrition requirements of crop on the mammoth population growth. There are food production uncertainties due to global warming and climate change. In a food grain- driven agriculture, as in India, the impact of inputs such as fertilizers on crops, particularly on food production is of vital importance. Fertilizers have Contributed significantly towards increasing agricultural production, worldwide. In 1951-52, the food grain production was 51 million tonnes, which is increased to 273 million tonnes in 2016-17. During this period (1951-52), the fertilizers consumption increased from around 70,000 tonnes to nearly 30 million tonnes in 2015-16. In 1951-52, the fertilizer consumption in the country was almost 1.50kg/ha; which has now reached to a level of more than 154kg/ha. The current status of nutrient use efficiency is quite low in case of major nutrients like N(30-50%), P(15-20%) & K(7-12%) only. In case of micro nutrients like Zn(2-5%), Fe(1-2%), Bo(2-3%) and Cu(1-2%) in our soil system; which is found to be low.

MATERIALS AND METHODS

The following methodologies are followed in many parts of this country for efficient nutrient management.

- Balanced fertilization for each of the field crops as well as Horticultural crops have so far been
- Evaluated by AAU scientists.
- Integrated Plant Nutrient System: This technology has also developed by scientists of AAU.
- Liming in Acid soil for release of Phosphatic fertilizer has been practiced in eastern India; including Assam, which get fixed as $Al_2(PO_4)_3$ and $Fe_2(PO_4)_3$.
- Recycling of Crop residues: This is also done in several places of Assam as well as North East
- India.
- Selection of best crop rotation for enhancement of food yield.
- Improved tillage management practices for better uptake of applied nutrients.
- Perfect method of application of fertilizer together with split application of NPK fertilizers.

The basic concept of Integrated Nutrient Management is to maintain or adjust plant nutrient supply to achieve a given level of crop production by optimizing the benefits from all possible sources of plant nutrients. The basic objectives of IPNS are to reduce the inorganic fertilizer requirement and to restore organic matter in soil system; there by enhancing the nutrient use efficiency.

RESULTS AND DISCUSSION

The Integrated Plant Nutrient Supply has already been practiced in many places of Assam. The results are as follows (2009-16): During 2009-10, many cropping systems were followed in Cachar & Karimganj under the Barak Valley Zone of Assam with the technology of Assam Agricultural University. All total 105 numbers of Farmers were selected for doing research trials in Farmer's field. All balanced Fertilizer doses were applied in the farmer's field of Cachar & Karimganj together with 6-7 t/ha of FYM during 2009-10. The area of Lower Assam suffers from Chronic flood problem every year and many farmers unable to grow kharif rice properly. Now they have started to grow Boro paddy (Summer rice) after the flood. But the Farmers of this areas are not getting Foundation /Certified seeds also regularly.

That is why, Assam Agricultural University has taken a program on production of quality seed production of Boro Paddy (cv-Joimati & Kanaklata) at LRS, Mandira in 2010-11. Here also Balanced fertilizer dose together with FYM @5-6t/ha is applied at the time of final land preparation. Foundation/Certified seeds were sold during October-December in each calendar year. Seeds were sown in nursery bed during November and starts Transplanting during December to January. The Boro paddy (Summer rice) is harvested during May-June, every year. The yearly production of Boro paddy (Summer rice) is sown below:

Table 1. Integrated Nutrient Management in Crops and Cropping Systems in Assam

Cropping Systems	IPNS Strategy
Rice-wheat	Green manuring of rice with Dhaincha (<i>Sesbania rostrata</i>) equivalent to 60kg fertilizer N along with 40KgN/ha produces yield equivalent to 100KgN/ha. In Sandy-Loam –Soil, incorporation of <i>Lantana camara</i> for 10-15 days before transplanting of rice helps to increase the N-use-efficiency. Application of 75%NPK+25%NPK through Green manuring or FYM @6.0t/ha to rice and 75%NPK to wheat crop.
Rice(w)-Rice(S)	Use of organic sources, such as FYM, Compost, Green manuring, Azolla etc meet 25-50% of N in Kharif rice and can help in curtailing NPK fertilizers by 25-50%. Application of 75%NPK +25%NPK through Green manuring or FYM @6.0t/ha to winter rice and 75%NPK to Summer rice. A successful inoculation of BGA@10kg/ha provides about 15-30kgN/ha.
Rice-Potato-Greengram.	Used 75%NPK fertilizers with 10 t FYM/ha in Rice and Potato. Residues of this system allowed to take by Green gram as third crop together with 50% of the recommended fertilizers of Urea and SSP fertilizers in Green Gram.
Rice-Potato-Groundnut.	-Do-
Pulses	Integrated use of FYM@5.0t/ha and 50% recommended NPK fertilizers plus Rhizobium inoculation helps in saving 50% chemical fertilizers and increased yield to about 30%.
Oilseeds (Rapeseeds & Mustard)	Substitutes 25-50% of chemical fertilizers through application of FYM@ 10 t/ha to get higher yield and FUE

Table 2. Variety of different crops with fertilizer dose, spacing and sowing time in cropping systems

Crops.	Variety	Fertilizers (NPK) Doses (Kg/ha)	Price(Rs/qt)	Spacing	Sowing Time.
Rice(w)	Suwasini	80-40-40	1200.00	20cmx15cm	15-7-09(T)
Rice(A)	Disang	40-20-20	1050.00	20cmx15cm	16-5-10(T)
Capsicum	California wonder	70-40-60	6500.00	45cmx45cm	11-11-09(S)
Rajmah	Uday	30-40-20	6000.00	30cmx20cm	09-11-09(S)
Brinjal	Longai	50-50-50	5000.00	50cmx45cm	10-11-09(T)
Knolkhol	Winner	80-60-50	3500.00	45cmx30cm	08-11-09(T)
Tomato	Avinash	70-40-60	4200.00	50cmx30cm	06-11-09(T)
Potato	Kufrijyoti	60-50-50	1500.00	50cmx15cm	10-11-09(T)
Chilli	Pusa Juwala	70-80-80	5000.00	45cmx45cm	10-11-09(T)
Pumpkin	Arka chandan	75-80-80	1000.00	2.5mx10m	15-11-09(S)

Table 3. Gross return, Net return, B: C ratios, REY and System Profitability of Diversified Cropping system

Cropping System	Gross return (Rs/ha)	Net return (Rs/ha)	REY(qt/ha)	B:C ratios.	System Profitability Rs/ha/day)
Rice(w)-fallow	47,472.00	32,022.00	2.07:1	87.73
Rice(w)-Rice(A)	80,547.00	51,697.009	27.77	1.79:1	141.64
Rice(w)-Capsicum	2,18,472.00	1,89,572.00	142.50	6.56:1	519.38
Rice(w)-Rajmah	2,19,472.00	1,91,442.00	143.30	6.82:1	524.50
Rice(w)-Brinjal	8,55,972.00	8,26,242.00	674.00	27.80:1	2,264.00
Rice(w)-Tomato.	7,95,072.00	7,61,572.00	623.00	22.73:1	2,086.50
Rice(W)-Knolkhol	7,29,972.00	7,00,242.00	569.00	23.55:1	1,918.00
Rice(w)-Potato	1,60,522.00	1,30,922.00	94.20	5.42:1	358.70
Rice(w)-chilli	3,84,972.00	3,56,742.00	281.25	12.64:1	977.38
Rice(w)-pumpkin	1,58,571.00	1,35,641.00	75.27	5.92:1	371.62

Table 4. Year wise Production and Productivity of Boro rice (Summer rice) at LRS, Mondira

Sl No.	Years.	Fertilizers(Kg/ha)	Area(Ha)	Production(qt)	Productivity(q/ha)
1	2010-11	60-40-30 NPK	4.0	220.00	55.00
2	2011-12	60-40-30 NPK	4.0	206.40	51.60
3	2012-13	60-40-30NPK	3.5	181.30	51.80
4	2013-14	60-40-30NPK	3.5	192.37	54.96
5	2014-15	60-40-30NPK	2.6	125.22	48.16
6	2015-16	60-40-30NPK	2.6	120.22	46.24
7	2016-17	60-40-30NPK	2.6	125.00	48.08
8	2017-18	60-40-30NPK	1.3	055.35	46.13

Table 5. Gross return, Net return, B: C ratios of Foundation/Certified seeds in respect of Boro Paddy.

Sl No.	Years	Gross returns(Rs)	Net returns(Rs)	Area(Ha)	B:Cratios.
1	2010-11	5,99,400.00	4,49,550.00	4.0	3.94:1
2	2011-12	5,57,280.00	4,65,508.00	4.0	3.90:1
3	2012-13	4,89,510.00	3,75,550.00	3.5	2.91:1
4	2013-14	5,19,399.00	4,10,120.00	3.5	3.90:1
5	2014-15	3,38,094.00	2,34,065.00	2.6	3.48:1
6	2015-16	3,24,594.00	2,18,185.00	2.6	3.58:1
7	2016-17	3,37,500.00	2,25,250.00	2.6	3.40:1
8	2017-18	1,21,808.00	84,808.00	1.3	3.29:1

CONCLUSION

In all trials, fertilizers were utilized judiciously for different types of crops. But if we go for seed production system of cereal crops, pulses and oilseeds than Benefit: Cost ratios will be high. This is because of higher out put values of crops. Farmers will be highly benefitted with such type of technology. For getting high yield of cereal crops, pulses and oilseeds; we have to apply inorganic sources of fertilizers together with 6-7 tonnes/ha of FYM in all types of Land in Assam. This is in conformity with the findings of Basumatary and Talukdar (1997). For producing about 12 to 15 tonnes of Foundation/Certified seeds of Boro Paddy (Summer rice), we need to purchase a fertilizer quantity of 5 quintal of Urea, 10 quintal of Single Super Phosphate and 2.5 quintal of Muriate of Potash in each year. Besides this we have to purchase 2-3 litres of Butachlor as weedicides in the crop field of Boro Paddy. The native soil contains high quantity Potash. So, the requirement of Potash in Lower Assam is Low. After the calculation, it is evaluated that with the cost of one Kg of Urea, SSP and MOP we get the profit of Rs.40/-;Rs.53/-and Rs.24.30/-only respectively in producing Certified Seeds of Boro paddy (Summer rice) as per the market value of the product (rice grain).

Thus, proper nutrient management practices will help most of the farmers in producing quality type of seeds of cereals, pulses and oilseeds in Assam. Similar findings were also reported by Porpavai *et al.* (2009).

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