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Agronomic Rice Production and Research in India

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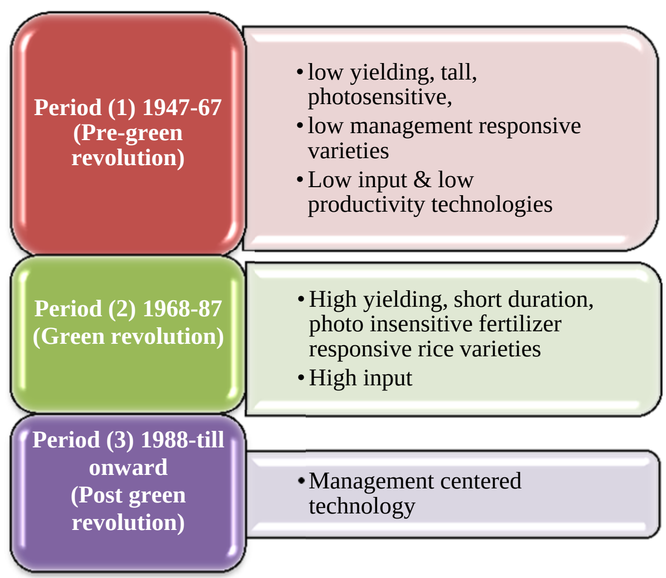
Abstract—*Rice is the most important cereal crop in India that holds the key for food security. In India, rice is grown in an area of about 42.41 m. ha with a production of about 104.4 m .tons. (Anonymous, 2013) . With an average annual population growth rate of 1.8 percent and per capita consumption estimated to be 400 gm of rice per day, demand for rice is expected to reach 127 m tones by 2025. Agronomic research on rice in India was started in 1911. Agronomic research on rice focused on management centered technology, may be divided into three periods : (i) For low yielding, tall, photosensitive, low management responsive varieties (up to 1966), (ii) Green revolution period involving high yielding, short duration, photosensitive fertilizer responsive rice varieties (up to 1987) and (iii) management centered technology from 1988 onward. During the early years, research was focused on development of production technology i.e. agro-techniques, tillage and crop establishment etc. Some of the research highlights of this period are:- In eastern India, mid July planting was found to be optimum for kharif season. Rice crop usually matures in about 25-30 days after flowering and should therefore harvested in time especially when the varieties used are of shattering type (Mahapatra and Padalia, 1971).The research efforts during green revolution period (1968-1987) lead to high yielding, photo insensitive, short duration and input responsive rice varieties. In the post green revolution period (1988-onwards) the research was more focused on resource conservation technology viz. zero tillage, aerobic rice, crop residue management, site specific nutrient management, use of leaf colour chart and crop diversification (soil, water, fertilizers), substitution in classical " rice-wheat", " rice-rice" system to rice based farming systems. The primary goal of this are reducing the use of chemical fertilizers and other harmful chemicals to provide contamination free healthy crop and safe environment (Mahapatra and Behera, 2012)*

1. INTRODUCTION

In India, rice is grown in an area of about 42.5 m ha. with a production of about 104.5 m. tons [2]. Rice is the most important cereal crop in India that holds the key for food security. With an average annual population growth rate of 1.8 percent and per capita consumption estimated to be 400 gm of rice per day, demand for rice is expected to reach 127 m tones by 2025. Agronomic research on rice in India was started in 1911 but the coordinated agronomic experiments scheme was instituted with establishment of model agronomic research centers in the country during year 1955 in different agro climatic –regions.

AGRONOMIC RESEARCH ON RICE:-



Pre –green revolution period:-

Earlier agronomic research was on tillage, establishment for direct seeded and transplanted rice of low yielding tall, low input responsive varieties. The main research focuses during the pre-green revolution period are :-

In agro techniques:-

Deep ploughing and sub soiling are required to increase the clay content of surface layer and facilitate drainage. Optimum treatment given to rice nursery to get young and sturdy seedlings. In eastern India, mid july planting is optimum for *Kharif* season. For dalua season (Dec-may) planting the coldest period gives lower yield and therefore should be avoided. Shallow depth of planting(up to 3cm) with 2 or 3 seedling/hill Seedling with four leaves best suited for transplanting. High yielding var. usually perform better under close spacing (15 x 10 cm-20 x 15 cm) especially dalua. Rice crop usually matures about 25-30 days after flowering and harvested in time especially when the varieties used is shattering type [10]

Soil fertility and nutrient management

For soil deficit in P and K , fertilizer recommendation should be done according to soil test value. On an average the improved tall varieties responded to 60 kgN, 30 kgP_2O_5, 30 kg K2O [9]

Water management:

Only 45.3% of rice area is irrigated to supplement irrigation. On an average 1.25 cm of water per day is required by rice (Dastane et. al 1967). On average water requirement is about 63 cm during *Kharif* (0.67cm/day) and 103 cm during dalua season (1.02cm/day). Rice produces 38-75 kg grain/ha cm of water [7]. Reduction in yield was due to suppression of tillering when submerged at seedling establishment to tillering stage and due to poor emergence of panicle, when submerged from tillering to flowering stage [12].

Weed management:- The losses in yield caused by weeds range between 9-51 % in case of irrigated rice depending upon agro climatic condition [3]. However proper weed control during nursery is essential for vigorous, weed free seedling [11].

Green revolution period (1968-1987)

With the advent of high yielding, photosensitive, input responsive rice varieties, short duration varieties, the research was oriented. On the different rice plant types and their agronomic requirement, production technology for extensive multiple location and for rice based cropping systems

Developmental study:-

Emergence and growth of different tillers are generally governed by date of emergence of leaf on mother tiller. First primary tiller emerged from axil of lower leaf of mother tiller at initiation of five leaf stage in all varieties during *Rabi* and *Kharif* seasons. Early formed tillers contributed more to grain yield/ plant that late formed one. thus developmental study undertaken soon after introduction of dwarf high yielding varieties for developing the management practices of soil, crop, water, fertilizer and agro chemicals. During green revolution period (1968-87), dwarf short duration varieties are introduced not only for “on station” but also on farm testing farmer’s field. AICRIP had program on evaluation in rice growing area of India during period [1].

Nitrogenous fertilizers:-Ammonium fertilizer more suitable, stable in rice when placed in reduced zone (5cm). NO_3-N not applied in reduced zone because denitrified and lost so apply in oxidized zone. Half of N applied within week of transplanting rice,1/4th should applied at time of initial tillering and rest one fourth (15-20) days before flowering rice varieties

Phosphatic fertilizers:- Form of phosphatic fertilizer is not important, but in high acidic, SSP is not as good, on alkaline, rock phosphate is inferior. In general, level of P_2O_5 recommended half of that of N, but not hold good for deficient in P.

Potassic fertilizers:- Rice needs K in larger quantity and for longer period. K content in Indian soil are larger so response of rice to K is low. For new variety, K is recommended, rice crop demand balance ratio of N, P, K (120, 60,60).

Micro nutrients:-

Zn deficiency problem occur in calcareous soil so application of $ZnSO_4$ 25 kg/ha is recommended, spray (10 kg of Zn/ha). Fe toxicity occur in acid soil (tiny spots), remedied by lime application. Thus N, P, K depletion is more with high yield variety. Thus need to maintain soil fertility and judicious use of chemical fertilizer in conjunction with organic manure

Post green revolution period (1988-2011):-

During this period emphasis on Resource conservation technology, hybrid rice technology and crop diversification/ (soil, water, fertilizers) substitution in classical “rice-wheat”, “rice-rice” system to rice based farming systems for livelihood improvement of Indian farmers (significant shift from seed centered to management centered technologies)

Hybrid rice:- National project of hybrid rice launched in December 1989 and result from this are: - 46 hybrid (29-public, 27-private sector) has been released. Popular are “PA 6444”, “PHB 71”, “Pusa RH 10”, “Shayadri”, “DRRH2

Aerobic rice cultivation:-

Cultivation of rice in unpuddled, direct seeded without standing water (need based irrigation as like wheat & maize) Combines features of high yielding irrigated lowland and drought tolerant upland cultivars.

System of Rice Intensification

The French Jesuit Father Henri De Laulanie in Madagascar invented the System of Rice Intensification. It involves the use of certain management practices which together provide better growing conditions for rice plants, particularly in the root zone, than those for plants grown under traditional practices. SRI is one of the important methods for increasing productivity of rice without using much external inputs and this method is best suited for small and marginal farmers, which looks an ideal technology under the scenario of Himachal Pradesh, where 80% farmers are small and marginal.

SRI is an important RCT because of the following advantages:

Higher yields: raise output by 50% or more due to: Increased tillering, Increased panicle length and density, Increased grain filling and grain weight

Significant reductions in: Seed requirements -- by 30-50% , Water requirements -- by 25-50%

Dependence on agrochemicals

1. More healthy and tasty rice is produced
2. Less crop duration--15 days
3. Costs of production -- lower by 10-25%
4. Farmer's income -- raised by 50-100%

Kumar (2007) at Malan, HP in an experiment recorded higher paddy yield under ICM (62.5 q/ha) followed by SRI (59.2 q/ha) over conventional transplanting method (51.5 q/ha).

2. MAJOR RESOURCE CONSERVATION TECHNIQUES (RCTS)

There are many techniques may be considered as RCTs but few important are:

CONSERVATION TILLAGE

Conservation tillage practiced mainly to conserve soil and moisture. 30% of crop residue must left on the soil surface in conservation tillage. The high soil moisture content under conservation tillage is due to both improved soil structure and decrease in the evaporation loss due to crop residue mulch cover. Increase in the available water content under conservation tillage, particularly in the surface horizon, increases the consumptive use of water by crops and hence improves the water use- efficiency.

It can be practiced in various ways, such as:

Zero Tillage/No Tillage: Zero tillage or No-till farming is defined as farming where the soil is left relatively undisturbed from harvest to planting. It is an extreme form of minimum tillage in which tillage operations are reduced to the extent that tillage is only for seeding. Primary tillage is avoided and secondary tillage is restricted to row zone only. It is now being adopted on >95 mha area worldwide. Countries with largest area are South America (47%), followed by Brazil. The current and potential area is 2.0 m ha and 10 m ha under zero tillage in India, respectively. It is very helpful in the area of intensive cultivation where a turnaround period between two crops is really very less and thus it can facilitate timely sowing.

Advantages of the zero tillage are as follows:

1. Beneficial in areas where wind and water erosion is high.
2. It can be used if the timing of tillage operation is too difficult.
3. Timely planting gave yield advantage approximately 2 q/ha for a week advanced sowing in wheat crop
4. Reduces soil erosion and improves soil health.

Minimum Tillage: Minimum tillage as the practices aimed at reducing to the minimum necessary for ensuring good seed bed, rapid germination, satisfactory stand and favourable condition for growth of the plant. Tillage can be reduced by omitting the operation which don't give much benefit comparing to cost or by combining different tillage operations like seed cum fertilizer drill.

Laser land leveling

Laser land leveler not only minimizes the cost of leveling but also ensures the desired degree of precision. It is a precursor of resource conserving technique and a process of smothering land surface (± 2 cm) from its average elevation using laser equipped dragged buckets. It leveled the surface having 0 to 0.2 % slope so that there is uniform distribution of water takes place and thus enhance resource use efficiency.

Advantages of laser land leveling are as follows:

- It saves irrigation water and increase water application efficiency up to 50%
- Improve crop establishment and improve uniformity of crop maturity
- Increase cropping intensity by about 40%
- Facilitate management of saline environments
- Increase cultivable area by 3 to 5% approx as area under bunds is not required
- Reduce weed problems and improve weed control efficiency
- Increase crop yields for example in wheat 15%, in sugarcane 42% and in rice 61%.

Furrow irrigated raised bed (firb) planting :-

The judicious and safe use of inputs (fertilizer, water, herbicides) is having great importance. Planting rice on raised beds reduced water use by 32% compared to conventional permanent flood in northern Australia.

Advantages of the FIRB planting are as follows:

- It promotes crop diversification.
- Saves irrigation water by 25-35 %
- Saves N and seed rate up to 25%

Crop residue management :

Conservation agriculture practices require a critical level of crop residues to enhance or maintain soil properties and to minimize land degradation. There is large potential of residues to incorporate in soil in Rice-Wheat cropping system because crop harvested through combine harvester left loose residues in the field which create problem in seeding with traditional Zero-till drills and due to this problem farmer burns the residues either fully or partially resulting in environmental pollution and deterioration of soil health.

Advantages of crop residue retention are as follows:

- Increases soil carbon content and also improve soil nutrient retention capacity
- It conserve soil moisture and moderate soil temperature
- Enhances soil microbial activity
- Reduced bulk density and soil strength
- Increases soil infiltration rate
- Avoids environmental pollution being caused due to burning

PRECISION FARMING

Precision Farming is the application of technologies and principles to manage spatial and temporal variability associated with all aspects of agricultural production for improving production and environment quality.

Concept of precision farming is very simple; it involves placing the right input, in right amount, at right time, at right place and in right manner.

Components of Precision Farming

1. Global Positioning System (GPS)

GPS is the computer based versatile navigation aid depend on satellite. All phases of precision agriculture require positioning information and it can be provided by the GPS. GPS provides the accurate positional information, which is useful in locating the spatial variability with accuracy

2. Geographical Information System (GIS)

GIS is an organized collection of computer hardware, software, geographical data and personnel designed to efficiently capture, store, update, manipulate, analyse and display all forms of information. It is the brain of precision farming system and it is the spatial analysis capabilities of GIS that enable precision farming

3. Remote Sensing

Remote sensing has been used in soil mapping, terrain analysis, crop stress, yield mapping and estimation of soil organic matter, Remote sensing at high resolution can be of great use in precision farming because of its capacity to monitor the spatial variability. The role of satellite remote sensing in PF is to acquire spatially- and temporally-distributed information to identify and analyze crop and soil variability within fields

4. Variable Rate Applicator

It is an automated system in which sensed information is used to influence the system's state to meet an objective. Consists of farm field equipment with the ability to precisely control the rate of application of crop inputs and tillage operations.

5. Crop Scouting

In season observation of crop condition may include, weed patches (weed type and intensity), insect and fungal infestation (species and intensity), flooded and eroded areas by using GPS receivers. These observations also helpful in explaining of yield map.

6. Farmer

Farmer is the most important component of farming and farming cannot be imagined without farmer. For assessing and managing the variability, decision-making is the key factor, and it is to be done in consultation with the farmer

Site Specific Nutrient Management

It enables farmers to optimally supply their crop with nutrients, in SSNM only the gap between total needs of crop for nutrients and indigenous soil supply is filled.

Precision N management tools

Precision N management is also known as smart N management. There are mainly two instruments used for smart N management :

Chlorophyll meter or SPAD meter: Plant leaf greenness is determined by N a concentration which in turn is correlated with crop yield. It displays a 3-digit SPAD value proportional to the amount of chlorophyll present in the leaf by measuring the transmittance of the leaf in two wavelengths (600-700 nm and 400-500 nm).

Leaf Colour Chart (LCC): It helps farmers to determine the right time of N application. Simple and easy to use and inexpensive alternative to chlorophyll meter as chlorophyll meter is expensive (Rs. 65000). Measures leaf color intensity which is related to leaf N status

Future lines for agronomic research in India:-

Rainfed ecosystem:-

Crop management practices and the problems encountered due to institutional and weather based constraints in low productivity blocks shall help in formulating research priorities.Contingent crop planning for excess and deficient periods. Agronomic manipulation of micro climate variation.

Rice based farming system:- Farm productivity and sustainability. Livelihood security of small and marginal farmers, alternate agricultural production system. Rice based farming system for cost effective and farmers friendly

Crop management:- Choice of photo insensitive, short duration varieties. Suitable crop genotypes for sequential and inter cropping system under varying ecological conditions. Optimum cultural practices for direct /transplanted rice under agro ecological systems

Conservation agriculture:- Tillage and crop establishment with the least effect to the soil. Cost effective technologies for in situ crop residue management.

Soil health and nutrient management:- Precise site specific nutrient management, Balanced nutrient supply for intensive farming and management of problem soils, Vast potential for efficient recycling of municipal wastes, farm kitchen and organic waste

Water management:- Water management of upland rainfed, aerobic rice. Water use efficiency high yielding short duration varieties, Changing method of establishment, Multiple use of water.

Weed management:-

Crop weed competition, weed ecology, persistence of weed, method of weed control, mode of action of herbicides, resistance of weed to herbicides.

3. CONCLUSION

Agronomic research was started in the early years and it will be continue until the rice crop will grow. It will never ends but research focused will change depends upon the priority of the human being, technologies and resources available for the agriculture and today's requirement is sustainability and resource conservation.

REFERENCES

[1] AICARP., "*Annual Reports of the All India Coordinated Agronomic Research Project*, ICAR", New Delhi, 1978.

[2] Anonymous., "Reserve Bank of India", 2013 *http:://dbie.rbi.org.in*.

[3] Bhan, V.M., Weed control in drilled rice" In: *Proceedings of National Symposium in Increasing Rice Yield in Kharif Season*, CRRI, Cuttak, 1978, pp 431-437.

[4] Dastane, N.G., Vamadevan, V.K., and Bhatia, P.C., "Water management in rice", Indian *Farming* 1967, **17**(3): 19-20.

[5] Kanwar, J.S., and Mahapatra, I.C., "Recommendation of 4th annual workshop of all India co ordinate agronomic experiment scheme (ICAR)", *Indian Farming*. 1971, **20**(12):35-37.

[6] Kumar, R., "Evaluation of system of rice intensification (SRI) and integrated crop management (ICM) in transplanted rice. 2007.

[7] Lenka, D., "Response of TNI rice to water management practices and nitrogen fertilization in dry season", *Indian Journal of Agricultural Sciences* 1971, **41**: 166-172.

[8] Mahapatra, I.C., and Behera, U.K., "Farming system: A potential approach for development of agriculture and livelihood of security of small and marginal farmers of India", In: *National Symposium on Rice Based Farming System for Livelihood Security under Changing Climate Senerio* College of agriculture, Chilplima, OUAT, Bhubaneswar. Februray, 2012, pp. 1-7.

[9] Mahapatra, I.C., "Recent advances in rice agronomy", *Indian Farming* 1969, **19**(5): 21-25.

[10] Mahapatra, I.C., and Padalia, C.R., "Improved Agronomic Practices for Increasing Rice Production", In: *Proceedings of Symposium on Science and India's Food Problem*. ICAR, 1971, pp 347-355.

[11] Mukhopadhyay, S.K., "Weed control in lowland rice under submergence", In: *Proceedings of National Symposium in Increasing Rice Yield in Kharif Season*, CRRI, Cuttak. 1978, pp-301-310

[12] Pande, H.K., Mitra, B.N., and Ghosh, B.C., Flood susceptibility of semi-dwarf rices and their suitability for low-lying areas. In: *Proceedings of International Rice Workshop*. IRRI-Philippines, 1978, pp. 185-189.