International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; SP6: 165-168

A Anuratha
ICAR Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Needamangalam, Thiruvarur, Tamil Nadu, India

V Vigila
ICAR Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Needamangalam, Thiruvarur, Tamil Nadu, India

M Ramasubramanian
ICAR Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Needamangalam, Thiruvarur, Tamil Nadu, India

R Ramesh
ICAR Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Needamangalam, Thiruvarur, Tamil Nadu, India

Corresponding Author:
A Anuratha
ICAR Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Needamangalam, Thiruvarur, Tamil Nadu, India

(Special Issue -6)
3rd National Conference
On
PROMOTING & REINVIGORATING AGRI-HORTI, TECHNOLOGICAL INNOVATIONS [PRAGATI-2019]
(14-15 December, 2019)

Flood tolerant paddy variety (Swarna sub 1) impart resilience to farmers in flood prone areas of NICRA village, Thiruvarur district, Tamil Nadu, India

A Anuratha, V Vigila, M Ramasubramanian and R Ramesh

Abstract
The study was conducted in Rayapuram and Keezhapattu villages of Thiruvarur district in Tamil Nadu state under National Innovation on Climate Resilient Agriculture (NICRA) project implemented by Krishi Vigyan Kendra, Needamangalam, Thiruvarur district during 2015 to 2018. Recurrent floods have been the principal constraints in food production in these villages affecting mainly rabi during the growing season as well as at the time of maturity. About 71 per cent of total rainfall occurs during monsoon period (September to December). Economics of flood tolerant paddy variety swarna sub 1 was studied in comparison with economics of ruling paddy variety BPT 5204. Farmers of the Rayapuram and Keezhapattu villages of Needamangalam block of Tamil Nadu state are generally cultivating BPT 5204 during monsoon period due to high market price resulting low income which are susceptible to flooding during *rabi*. As an alternative to the flood susceptible paddy variety, farmers of the Rayapuram and Keezhapattu villages were educated by the scientists of KVK, Thiruvarur under "National Innovations in Climate Resilient Agriculture (NICRA)" project to grow flood tolerant paddy variety swarna sub 1 during rabi season. To ensure rice production to climatic variability leading to flood, site specific climate resilient technologies such as flood tolerant paddy variety 'Swarna Sub 1' and mid duration HYV of rice was tested and demonstrated in the project villages. It was necessary to observe the performance of these varieties to the climatic vulnerability as well as farmer's acceptability. The paddy productivity and economic returns under improved technologies were calculated and compared with the prevailing farmers' practice. Results revealed that Swarna sub-1 variety under improved practices recorded higher yield of 21.93%, 9.62% and 9.33% during 2015-16, 2016-17 and 2017-18 and the recommended practice gave higher net returns of Rs 91375,88211 and 88200 per ha and B:C ratio of 2.55,2.31and 2.36 respectively as compared to farmers practice.

Keywords: Swarna sub 1, NICRA, Paddy, Technology gap

Introduction
Rayapuram and Keezhapattu two of the NICRA (National Innovations in Climate Resilient Agriculture) villages belonging to Tamil Nadu state. The village Rayapuram has a population of 3176 (846 farm families/households) with a geographical area of about 920 ha. Paddy is the main crop cultivated during Samba season (September- January). The main problem encountered in the village during this season is submergence of paddy crop for about 10 to 15 days due to high intensive rainfall and cyclones during the period. As a result the farmers in the village lose about 75 per cent of paddy production besides total wastage of paddy straw. Swarna-sub-1 has been shown to withstand floods upto 17 days in agricultural trials.

Swarna sub-1 has high production potential and also resistant to water logged condition. Apart from the improved agronomic practice unawareness of the farmers about the improved high yielding varieties and adoption of proper package of practices are also the reasons responsible for limiting the production and productivity of paddy. Keeping this in view Krishi Vigyan Kendra, Needamangalam (TN) had taken up demonstrations to introduce and popularize sowing of Swarna sub-1 variety of paddy in the real farm situation.

Materials and Methods

Demonstrations were conducted on 95 farmers' fields of NICRA villages of Rayapuram and Keezhapattu of Thiruvarur district during *rabi* seasons of 2015-16 to 2017-18 on medium to deep black soils with low to medium fertility status under rice based cropping system. The improved variety Swarna sub -1 was procured from Tamil Nadu Agricultural University, Coimbatore for demonstration purpose. In case of local check plots, existing practice of transplanting was followed by the farmers. The whole package approach demonstrated to farmers through demonstration trials included components such as improved variety, line transplanting, recommended seed rate, seed treatment, weed and water management, fertilizers and plant protection measures (Table 1). In the demonstration plots critical inputs in the form of improved seed of swarna sub-1 variety and *pseudomonas* were provided to the farmers. Traditional practices were maintained in case of local checks. The farmers involved in demonstrations were facilitated by KVK scientists in performing proper field operations like timely sowing of nursery, transplanting, spraying of pesticide and harvesting. During this period extension activities like field days, farmers' trainings, diagnostic visits, etc. were undertaken which benefitted to the farmers.

Table 1: Improved production technology and Farmers practices of Paddy under Demonstration

S. No	Technology	Improved practices	Farmers practice	GAP (%)
1.	Variety	Swarna Sub -1	BPT -5204	Full gap
2.	Land preparation	Ploughing and Levelling	Ploughing and Levelling	Nil
3.	Pre emergent herbicide	Pendimethalin @2.5 l/ha	No herbicide	Full gap
4.	Seed rate	40 kg/ha	75 kg/ha	Partial gap
5.	Seed treatment	Biofertilizers & *Pseudomonas*	No seed treatment	Full gap
6.	Fertilizer dose	INM	Indiscriminate application	Partial gap
7.	Irrigation	Alternative wetting & drying	Surface irrigation	Partial gap
8.	Plant protection	IPM	Indiscriminate application	Full gap

The yield data were collected from both the demonstration and farmers practice by random crop cutting method. Qualitative data was converted into quantative form and expressed in terms of per cent increase in yield [5]. The data was further analysed by using simple statistical tools. The extension gap, technological gap, technological index [8] along with the benefit cost ratio were worked out as given below:

Technology gap = Potential yield - Demonstration yield
Extension gap = Demonstration yield - Farmers' yield

$$\text{Technology index (\%)} = \left\{ \frac{\text{Technology gap}}{\text{Potential yield}} \right\} \text{ x } 100$$

Results and Discussion

Constraints in paddy production

Before conducting the demonstrations preferential ranking techniques were utilized to identify the constraints faced by the respondent farmers in paddy cultivation. The ranks given by the different farmers are presented in Table 2. The finding indicate lack of suitable flood tolerant varieties (84.63%), sucking pest incidence (Leaf folder & Stem borer) (80.27%) and delayed sowing (73.34%) were there major constraints. Similar findings were reported by [9]. Based on the constraints, the demonstrations were conducted with high yielding paddy variety (Swarna sub 1) and other major critical inputs for cultivation.

Table 2: Ranks given by farmers for different constraints.

Sl. No	Constraints	RBQ	Overall Rank
1.	Lack of flood tolerant varieties	84.63	I
2.	Sucking pest incidence (Leaf folder & Stem borer)	80.27	II
3.	Delayed sowing	73.34	III
4.	Water logging	71.20	IV
5.	Non adoption of seed treatment	66.00	V
6.	Inadequate nutrient management	63.20	VI
7.	Weed infestation	54.22	VII
8.	Bacterial leaf blight	51.76	VIII
9.	Labour shortage	36.00	IX

Performance and yield

Crop Performance and Yield

The yield of paddy recorded under demonstration was 60.92, 57.2 and 60.26 q ha^{-1}during *rabi* 2015-16, 2016-2017 and 2017-18 respectively (Table 3). The yield enhancement due to the improved practices was to the tune of 21.93, 9.62 and 9.33 per cent over farmers' practice. Yield enhancement in rice and other crops under demonstration has amply been documented by [3] and [10].

Table 3: Impact of improved production technology on productivity of Paddy

Year	No. of demonstration	Area (ha)	Demo	Local check	% increase in yield over local check
2015-16	15	6	60.92	49.95	21.93
2016-17	50	20	57.28	52.25	9.62
2017-18	30	12	60.26	55.12	9.33
Total	95	38	178.46	157.32	40.88
Average	31.7	12.7	59.5	52.4	13.6

Technology gap

The technology gap means the differences between potential yield and yield of demonstration plot. The technology gap of demonstration plots were 9.08, 12.72 and 9.74 q/ha during 2015-16,

2016 -17 and 2017-18 (Table 4) respectively. On an average technology gap under three year demonstration was 10.5 q/ha. The technology gap observed may be attributed to dissimilarity in the soil fertility status, crop production, protection practices and local climatic situation.

Extension gap

Extension gap means the differences between demonstration plot yield and farmers yield. Extension gap of 10.97, 5.03 and 5.14 q/ha was noticed during 2015-16, 2016 -17 and 2017-18 (Table 4) respectively. On an average extension gap under three year demonstration programme was 7.01q/ha which emphasized the need to educate the farmers through various extension programs i.e. demonstration for adoption of improved production and protection technologies, to revert the trend of wide extension gap. More and more use of latest production technologies with high yielding varieties will subsequently change this alarming trend of galloping extension gap.

Technology index

Technology Index indicates the feasibility of the evolved technology in the farmers' fields. Lower the value of technology index, higher is the feasibility of the improved technology [1]. The technology index varied from 13.91 to 18.17 per cent (Table 4). On an average technology index was observed 15 per cent during the three years of demonstration programme, which shows the efficacy of good performance of technical interventions. This will accelerate the adoption of demonstrated technical intervention to increase the yield performance of paddy.

Table 4: Impact of paddy var Swarna sub 1 on potential yield, demonstration yield, farmers yield, technological gap, extension gap and technology index

SI. No	Potential yield (q ha^{-1})	Demonstration yield (q ha^{-1})	Farmers yield (q ha^{-1})	Technological gap	Extension gap	Technology index
1.	70.00	60.92	49.95	9.08	10.97	12.97
2.	70.00	57.28	52.25	12.72	5.03	18.17
3.	70.00	60.26	55.12	9.74	5.14	13.91
Average	70.0	59.5	52.4	10.5	7.0	15.0
Total	210.0	178.5	157.3	31.5	21.1	45.1

Economic Return

Data in Table 5 reveals that the cost involved in the adoption of improved technology in paddy varied and was more profitable. The cultivation of paddy under improved technologies gave higher net return of Rs. 55458, 50019 and 50834 per ha respectively, as compared to farmers practices (Rs 42668, 43365 and 50834 per ha in 2015-16, 2016-17 and 2017-1 respectively). An average net return and B: C of demonstration field is Rs 52104 per ha and 2.41 respectively as compared to farmers practice (Rs 45662 per ha and 2.34). Similar findings were reported by [6] and [2]. The benefit cost ratio of ICM of paddy under improved cultivation practices higher than farmer's practices in all the years and this may be due to higher yield obtained under improved technologies compared to local check (farmers practice). These finding are in line with the findings of [4] and [7].

Table 5: Economics of improved technologies and farmers practice in paddy

Year	Total cost of cultivation (Rs.ha^{-1})		Gross Returns (Rs.ha^{-1})		Net Returns (Rs.ha^{-1})		B:C ratio	
	Improved technology	Local check	Improved technology	Local check	Improved technology	Local check	Improved technology	Local check
2015-16	35917	32258	91375	74925	55458	42668	2.55	2.32
2016-17	38192	37100	88211	80465	50019	43365	2.31	2.18
2017-18	38352	37366	96416	88200	50834	50834	2.36	2.51
Average	37487	35575	92001	81197	52104	45622	2.41	2.34

Conclusion

It is concluded from the study that there exists a wide gap between the potential and demonstration yields in paddy mainly due to technology and extension gaps and also due to the lack of awareness about new technology in paddy cultivation in Thiruvarur district of Tamil Nadu. The yield potential of paddy cultivation increased to a great extent by conducting demonstration of the proven technology. This substantially increased the income as well as the livelihood of the farming community of the Thiruvarur district of Tamil Nadu. This variety of paddy (Swarna sub 1) gained a momentum in up scaling the paddy productivity which created a impact on farming community.

Acknowledgment

KVK, Needamangalam, Thiruvarur is thankful to the Director, ICAR-ATARI, ZONE-X, Hydrabad for providing fund for conducting the demonstrations an farmers who always show faith in the KVK.

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