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Enhancement in farmers' income through introduction of submergence tolerant variety Ranjit sub-1 in Morigaon district of Assam

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Abstract

Morigaon district of Assam receives plenty of rainfall during the monsoon season leading to intermittent flooding. This results in loss to the paddy crop grown during the kharif season. Considering the situation KVK Morigaon introduced Assam Agricultural University developed submergence tolerant varieties of Ranjit Sub-1 and Bahadur Sub-1 through an On Farm Trial programme in the year 2016. The crop survived a submergence period of 12 consecutive days. After successful implementation of the OFT programme, KVK Morigaon conducted large scale demonstrations of Ranjit Sub-1 in an area of 157 hectares covering 430 numbers of flood affected farmers of the district under APART (Assam Agribusiness and Rural Transformation Project)-IRRI (International Rice Research Institute) project of KVK during the year 2020 and 2021. Some of the demonstration programmes were conducted in collaboration with a Farmers' Producer Company (FPC) named POOHAR. The variety performed well in the demonstration programme and attracted other flood affected farmers of the district. It was observed from the pooled data that Ranjit Sub-1 recorded a 20.04% increase in yield as compared to the farmers' grown varieties. Mean value of technology gap, extension gap and technology index observed were 495 kg/ha, 920 kg/ha and 8.25% respectively. Average net income gained by the farmers during 2020 and 2021 was Rs. 28,120.00 and Rs. 26,000.00 respectively, whereas the farmers' grown varieties recorded net income of Rs. 16,480.00. and Rs. 15,560.00 during 2020 and 2021 respectively. Due to the growing demand of quality seeds of submergence tolerant varieties, the POOHAR FPC came forward and implemented a seed production programme under APART-IRRI project of KVK in the year 2021 and 2022. In both the years they were able to sell 90.05 tons of paddy seeds of Ranjit Sub-1 along with other submergence tolerant varieties of Bahadur Sub-1, Swarna Sub-1 and Bina Dhan 11 amounting Rs. 38,37,931.00. The Ranjit Sub-1 variety was also widely spread in the district through the efforts of the District Agriculture Office (DAO), Morigaon. During the current kharif season, the DAO, Morigaon is conducting demonstration of Ranjit Sub-1 in 3500 hectares of area covering 8750 numbers of farmers.

Keywords: Kharif Paddy, Submergence, Ranjit Sub-1, On Farm Trial, APART (Assam Agribusiness and Rural Transformation Project), IRRI (International Rice Research Institute), Farmers' Producer Company (FPC), Yield, Technology gap, Extension gap, Technology index, Economics

Introduction

Rice is the staple food of Assam and most of the farmers are engaged in its cultivation. Globally, among the various agricultural commodities, production of rice ranked third after sugarcane and maize (Suthar *et al.*, 2016) [7]. It is consumed as staple food in many countries of the world. Morigaon district is agro climatically located in Central Brahmaputra Valley Zone of Assam and extends from 26°15'N to 26°5'N latitude to 92°00'E to 95°5'E longitude. Agriculture and allied activities are the major source of income of most of the farmers in the district. Out of the total population in the district, 75.20% are involved in farming activities (Deka, 2022) [1]. Rice is extensively grown during kharif season in an area of 44115 ha with a production and productivity of 84363000 tons and 1980 kg/ha respectively (Directorate of Statistics and Economics, Govt of Assam, 2014-15). However due to the aberrant climatic conditions like flood during kharif season the production and productivity of paddy in the district is affected. The district receives plenty of rainfall during the monsoon season leading to intermittent flooding. According to the reports of the Indian Meteorological Department, the mean annual rainfall of Morigaon district is 165.80 cm. On the other hand, the district receives 68.76% of annual rainfall during the monsoon season leading to flooding in the district (IMD, 2020). In the year 2021, 288 villages were inundated by flood affecting 5871.9 hectares of

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paddy crop area (DAO Morigaon, 2021).

Hence, cultivation of submergence tolerant paddy varieties like Ranjit Sub-1, Bahadur Sub-1, Swarna Sub-1 and Bina Dhan-11 having submergence tolerance ability for a period of 15 days would play a significant role in mitigating flood in those areas. Goswami *et al.* 2020^[2] reported that Ranjit Sub-1 has ability to tolerate submergence for a period of 15 days duration whereas the farmers' variety got damaged after 5-6 days of submergence.

Materials and Methods

On farm Trials: In the year 2016, one of the FPC named POOHAR, actively involved in paddy cultivation, contacted Krishi Vigyan Kendra Morigaon for seeking technical support to mitigate the damage caused by flood in their paddy grown areas. Keeping in view the loss faced by the farmers due to flood in cultivation of paddy during kharif season, KVK Morigaon took initiative to mitigate the situation and started one

On Farm Trial on Varietal Performance of Assam Agricultural University developed submergence tolerant varieties of Ranjit Sub-1 and Bahadur Sub-1 in an area of 0.4 ha in three different flood affected locations of the district. The crop varieties perform well even after complete submergence for a period of 12 days. Ranjit sub-1 recorded yield of 56 q/ha and Bahadur Sub-1 54 q/ha. Farmers were very much satisfied with the varieties tested. Fellow farmers of the village were also attracted by the performance of the varieties tested. They purchased paddy seeds produced under the trial at a price of Rs. 40.00 per kg for growing in the next season. The success of the programme was covered by print and electronic media for popularization of submergence tolerant varieties among the fellow farmers of the district

Capacity Development Programmes

After success of the OFT programme, KVK Morigaon conducted several training and awareness programmes to the farmers and farm women along with members of FPC and Extension Functionaries of Agriculture Department, Morigaon for widespread adoption of submergence tolerant varieties along with its scientific cultivation practices by the flood affected farmers.

Demonstration programmes: After success of On Farm Trial on submergence tolerant paddy designed by KVK and implemented by POOHAR FPC, the members of FPC were in constant touch with KVK and asked for further support. After observing their interest, the POOHAR FPC was handed over the Custom Hiring Centre formed by KVK Morigaon under APART (Assam Agribusiness and Rural Transformation Project)-IRRI (International Rice Research Institute) project. Since then various APART-IRRI supported demonstrations of stress tolerant variety of Ranjit Sub-1 was implemented by the FPC under the technical guidance of KVK, Morigaon in the year 2020-21 and 2021-22 in an area of 157 hectares covering 430 numbers of flood affected areas of the district (Figure 1). The demonstrated variety was able to draw the attention of flood affected farmers after successful implementation of demonstration programmes. Use of machines in cultivation also attracted a large group of farmers towards farm mechanization as machinery helps in reducing cost of cultivation and saves time.

Nursery Raising Techniques

For Normal Transplanting: Seed beds were prepared of length

10 meter and breadth 1.25 meter. The land is thoroughly puddled and 30 cm gaps were provided in between the beds. For nutrition of seedlings, 80 gram each of Urea and Single Super Phosphate and 40 gram MOP along with 20 kg cowdung or compost was applied in each bed. In each bed 650 gram to 1kg seed was sown depending on the size of grain. Seed requirement for transplanting in 1 hectare area is 40 kg. Irrigation water is provided in the beds as and when necessary (Package of Practice, 2021)^[4].

Mat Type Nursery for Machine Transplanting: Three numbers of seedbeds of size 16 meter length and 1 meter breadth were prepared for transplanting 1 hectare area. Removable iron frame of 1.5 cm height and other dimensions equal to the size of the tray of the machine was used to ensure uniform mat size. Polythene sheet was placed over the plot selected for raising seedlings. Removable frames were placed over the polythene sheet. Soil and FYM mixture in the ratio of 2:1 was used to fill up the frame over the sheet. Soil and FYM mixture were crushed, sieved and mixed thoroughly to ensure a homogenous mixture. Sprouted seeds were sown in the bed at the rate of 1 kg/sq mtr. The beds were covered for four days using paddy straw or jute bags and water was sprinkled under covered condition. After four days the covers were removed. Irrigation water is provided in the beds as and when necessary. Seedlings became ready for transplanting after attaining height of 15 cm with 3 to 4 leaves (aPackage of Practice, 2021)^[4].

Land preparation: Main field was prepared by ploughing three to four times followed by laddering. At the time of final ploughing fertilizers were applied at the rate of 60:20:40 kg N:P₂O₅:K₂O along with zinc at the rate of 5 kg/ha. Fertilizers were applied in the form of Urea, DAP, MOP and Zinc Sulfate. Nitrogenous fertilizer was applied in three splits. First split was applied as basal dose along with other fertilizers at the time of final land preparation. Second and third split was applied at tillering and panicle initiation stages.

Transplanting

Matured seedlings were transplanted manually or by using a Paddy Transplanter with a spacing of 20 cm x 15 cm (bPackage of Practice, 2021)^[5].

Weed Management

Pre-emergence herbicide Pretilachlor @ 0.75 kg/ha was applied three days after transplanting followed by two to three hand weeding (bPackage of Practice, 2021)^[5].

Observation of Records

Yield and yield attributing characters like plant height (cm), number of effective tillers per square meter, total numbers of grain per panicle and total number of filled grains were recorded at the time of harvesting of the demonstrated varieties as well as farmers' grown varieties. Comparison of the average data recorded for demonstrated varieties and farmers' varieties has been made. Crop cut data per five square meter from 3-4 numbers of locations in every demonstration plot was collected along with farmers' grown varieties. Extension gaps, technology gaps and technology index were calculated by using methodology used by Yadav *et al.* 2004^[8].

Extension gap = Demonstration yield-Farmer yield
Technology gap = Potential yield-Demonstration yield

Technology index = (Potential yield–Demonstration yield Potentialyield)/Potential Yield×100

Results and Discussion

Morigaon district receives plenty of rainfall during kharif season leading to damage to the traditional paddy varieties grown by the farmers due to intermittent flood. Monthly average rainfall received during the study period was depicted in Figure 2 which reveals that 65.73% of the total rainfall was received during kharif season (June to September). Introduction of submergence tolerant paddy varieties is the only way to cope with the situation. KVK Morigaon, after successful implementation of On Farm Trial on submergence tolerant varieties of Ranjit Sub-1 and Bahadur Sub-1, conducted large scale demonstrations of Ranjit Sub-1 under APART-IRRI project during the year 2020 and 2021 in flood affected areas of the district. Demonstrations conducted by KVK Morigaon revealed that in several locations the variety Ranjit Sub-1 survived submerged conditions for a period of 8 to 12 days whereas the farmers' grown varieties failed to perform. The variety also recorded higher yield than the traditional varieties in areas where submerged condition was not observed.

From the study conducted it was observed during 2020 that Ranjit Sub-1 recorded average yield 5.51 tons/ha with 317.00 numbers of effective tillers per meter square and 234.00 numbers of grains per panicle, whereas farmers' grown varieties recorded average yield of 4.54 tons/ha with 294.00 numbers of effective tillers per meter square and 180.00 numbers of grains per panicle. Likewise in the year 2021, average yield, numbers of effective tillers per meter square and numbers of grains per panicle for Ranjit Sub-1 was 5.50 tons/ha, 294 numbers and 218 numbers respectively, whereas farmers' grown varieties recorded average yield of 4.63 tons/ha with 273.00 numbers of effective tillers per meter square and 127.00 numbers of grains per panicle. Pooled data also revealed that Ranjit Sub-1 recorded a 20.04% increase in yield as compared to the farmers' grown varieties. (Table 1). Similar results were also reported by Goswami *et al.* 2020 [2] and Pandey *et al.* 2018 [6], where submergence tolerant varieties recorded higher yield than the farmers' grown varieties. Increase in yield was obtained due to the adoption of scientific management practices and also the demonstrated varieties have higher yield potential than the farmers' grown varieties.

The study revealed that a technology gap of 490 kg/ha was observed for Ranjit Sub-1 during 2020. In the year 2021, the demonstrated variety recorded a technology gap of 500 kg/ha (Table 2). The technology gap was attributed may be due to the differences in soil nutrient status and variation in weather condition. Similar findings were also reported by Meena *et al.* 2021 [3].

The extension gap of Ranjit Sub-1 during 2020 and 2021 was found as 970 kg/ha and 870 kg/ha respectively (Table 2). Similar findings were also documented by Pandey *et al.* 2018 [6]. In order to reduce the extension gap, farmers training and awareness programmes need to be organized for adoption of STRVs along with scientific cultivation practices in flood affected areas of the district.

Technology index of 8.17% and 8.33% for Ranjit Sub-1 was

observed during 2020 and 2021 respectively (Table 2). Lower technology index indicates higher feasibility of the technology in the farmers' field.

From the economical comparison between Ranjit Sub-1 and farmers' grown varieties it was observed that the net income gained from the demonstrated variety was Rs. 28,120.00 whereas average net income gained from farmers' grown variety was Rs. 16,480.00 during the year 2020. In the year 2021, average net income gained from Ranjit Sub-1 was Rs. 26,000.00 whereas Rs. 15,560.00 was the net income gained from the farmers' grown varieties (Table 3). Hence, it can be concluded that higher income can be gained by adoption of STRVs in cultivation of paddy during kharif season. In terms of benefit cost ratio, the demonstrated variety had a higher B:C ratio as compared to the farmers' grown varieties in both the cropping years. This is due to the higher yield potential of Ranjit Sub-1 as compared to the traditional varieties.

Impact of the demonstration programme: Due to the KVK efforts, the Assam Agricultural University developed variety Ranjit Sub-1 gained popularity among the farmers of flood affected areas of the district. Quality seeds of Ranjit Sub-1 are in high demand in the district. After successful implementation of demonstration programmes under APART-IRRI project of KVK, the FPC POOHAR approached KVK Morigaon for seed production programme of the varieties having submergence tolerant abilities to meet the growing demand of quality seeds. KVK Morigaon allotted them seed production programmes under APART-IRRI project in the year 2021 and 2022. In both the years they were able to sell 90.05 tons of paddy seeds of Ranjit Sub-1 along with other submergence tolerant varieties of Bahadur Sub-1, Swarna Sub-1 and Bina Dhan 11 amounting Rs. 38,37,931.00. During the current year the POOHAR FPC is implementing a seed production programme in an area of 70 hectares. The Ranjit Sub-1 variety was also widely spread in the district through the efforts of the District Agriculture Office (DAO), Morigaon. During the current kharif season, the DAO, Morigaon is conducting demonstration of Ranjit Sub-1 in 3500 hectares of area covering 8750 numbers, of farmers. Currently KVK of farmers. Currently KVK, tolerant varieties in 202 hectares area along with seed production programme in an area of 35 hectares under APART-IRRI project of KVK, Morigaon.

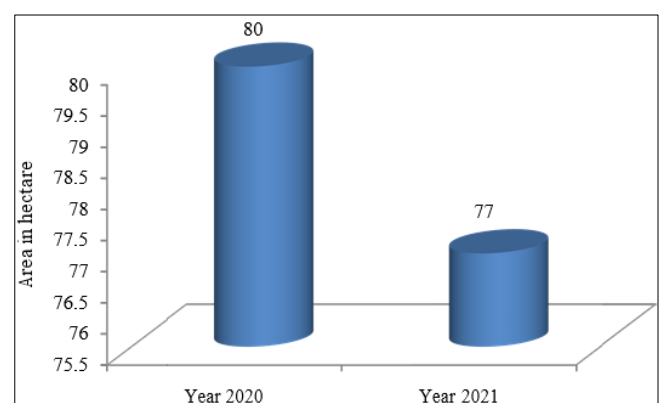


Fig 1: Year wise area covered under demonstration Ranjit Sub-1 of KVK under APART-IRRI project was as follows

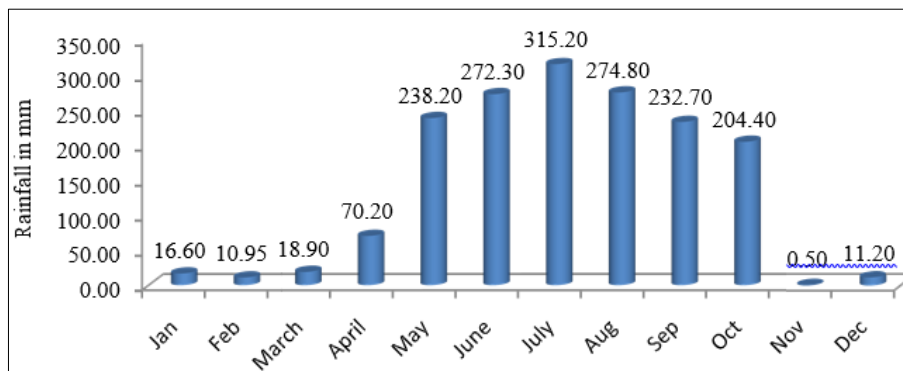


Fig. 2: Average rainfall data of 2020 and 2021:

Table 1: Yield and yield attributing characters of Ranjit Sub-1, Bahadur Sub-1 and farmers’ grown varieties demonstrated during 2020 and 2021

Parameters of demonstration	2020		2021		Pooled Data	
	RS 1	FP	RS 1	FP	RS 1	FP
Plant Height (cm)	141.00	142.00	126.00	123.00	133.50	132.50
Number of Effective Tillers (Nos/m ²)	317.00	294.00	294.00	273.00	305.50	283.50
Grain per panicle (Nos)	234.00	180.00	218.00	127.00	226.00	153.50
Filled grain per panicle (Nos)	219.00	170.00	201.00	117.00	210.00	143.50
Grain Yield (ton/ha)	5.51	4.54	5.50	4.63	5.51	4.59
Percent increase in yield (%)	21.36	-	18.79	-	20.04	-

Table 2: Technology gap, extension gap and technology index of Ranjit Sub-1 during 2020 and 2021.

Name of variety	2020			2021		
	Technology gap (kg/ha)	Extension gap (kg/ha)	Technology index (%)	Technology gap (kg/ha)	Extension gap (kg/ha)	Technology index (%)
Ranjit Sub-1	490	970	8.17	500	870	8.33
Name of variety	Gross Cost (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)	B:C ratio
	2020					
Ranjit Sub-1	38000.00		66120.00		28120.00	1.74
Farmers grown varieties	38000.00		54480.00		16480.00	1.43
	2021					
Ranjit Sub-1	40000.00		66000.00		26000.00	1.65
Farmers grown varieties	40000.00		55560.00		15560.00	1.39

Conclusion

From the present study it was clear that by adopting climate resilient technologies one can gain profit from adverse climatic aberrations. KVK Morigaon’s effort on successful implementation of trial and demonstration programmes motivated a large number of farmers of flood affected areas of the district towards adoption of high yielding submergence tolerant variety Ranjit Sub-1.

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