Oryza Vol. 52 No.1, 2015 (59-64)

Incremental yield and returns from rice variety Naveen in front line demonstrations- an analysis

Teekam Singh*, KB Pun, BS Satapathy, Kanchan Saikia and S Lenka

Regional Rainfed Lowland Rice Research Station, Gerua, Assam

****Email: tiku_agron@yahoo.co.in***

ABSTRACT

The study was conducted at Regional Rainfed Lowland Rice Research Station, Gerua in Lower Brahmaputra Valley and North Bank Plain Agro-climatic Zone of Assam during boro *season of 2013 and 2014 to evaluate the performance of rice variety Naveen at different locations in farmer's field. Front line demonstrations (FLD) were conducted with improved package of practices which was found superior to farmer's practices at all locations in terms of yield and economic returns. Naveen with improved production technologies in front line demonstrations, increased mean grain yield by an average of 29% over existing farmer's practice with only ₹1154 extra expenditure per hectare on inputs. The mean extension gap (1.17 t ha $^{-1}$) and mean B:C (17.56) are sufficiently high and farmers can easily be motivated for adoption of Naveen variety with recommended rice production technology.*

Key words: *Front line demonstration, extension gap, technology gap, technology index*

In India rice occupies about 43.9 m ha of area with total production of 106.5 million tonnes (GOI, 2015). The entire North East region is at the low level of economic development as against its tremendous potential to develop. Almost 100% farmers grow rice and rice is cultivated in about 80% of gross cultivated area. Entire livelihood is dependent on rice based farming systems. Rice is the main staple food grain crop of the North Eastern region followed by maize, occupying 3.51 million hectares which accounts for more than 80% of the total cultivated area of the region and 7.8 per cent of the total rice area in India while its share in national rice production is only 5.9 per cent (Ngachan *et al.* 2011). The total rice production of NE region is estimated to be around 5.50 million tonnes with average productivity of 2.1 t ha $^{-1}$, which is much below the national average of 2.9 t ha $^{-1}$ (Ngachan *et al.,* 2011).

Boro rice is known for high productivity (5-6 t ha $^{-1}$) in shallow lowland areas of Assam, where productivity has traditionally been very poor (<1 t ha $^{-1}$) during the wet season (Singh, 2002). This is mainly because *boro* is more manageable than the wet season rice. Low to moderate temperature during the crop growth and flowering facilitates the accumulation of photo-synthates to the sink, thereby increasing carbon: nitrogen ratio and grain yield. But the productivity of *boro* rice under shallow lowland is very low (2.1 t ha $^{-1}$) in north-eastern states which is comparatively lower than that of the national average productivity of 3.2 t ha $^{-1}$ (GOI, 2011). There are several factors responsible for the low productivity of rice, but the most important ones are the non adoption of high yielding varieties and improved production technology. The area under *boro* rice is increasing in north-eastern states due to availability of surface as well as ground water for irrigation during dry season and productivity is also higher than wet season. Moreover, crop is also assured if it does not coincide with flash floods and heavy rainfall at the time of maturity or at harvest.

Farmers are generally practising aged seedlings, imbalance use of fertilizers and poor weed management. Moreover, the existing local rice varieties such as Ranjit, Baismuthi, China *boro,* Kanaklata and other local landraces are grown during early *ahu* season (*boro*) which are long duration (>180 days) or poor yielders. Thus, there is tremendous opportunity for increasing the production and productivity of rice by adopting medium duration rice variety and improved production technologies. A vast gap has been observed between knowledge production and knowledge utilization. Front line demonstrations (FLD) on rice including recently released early maturing, high yielding, fine grained, disease resistant varieties with integrated nutrient management (INM), integrated weed management (IWM) and integrated pest management (IPM) in farmers' field may be helpful. Rice variety Naveen has the potential to provide 5.5-6.5 t ha^{-1} during *Boro/Ahu* season (Singh *et al*., 2014). It is suitable for cultivation under both favourable rainfed lowlands during wet season/*Sali* season as well as irrigated lands during *boro/Early ahu/ahu* season in the North East region. It matures in 145-150 days during *boro/ahu* season which helps to escape flooding at maturity. It has a semi-dwarf plant type (100 to 115 cm) with 10-15 ear bearing tillers and long panicle (24-25 cm). It is resistant to blast, gall midge biotype 5 and 1 and stem borer and tolerant to brown spot disease (Singh *et al*. 2014). The variety Naveen has medium bold grain size with 66.5% head rice recovery and elongation ratio of 1.76 (Singh *et al*., 2014). Hence RRLRRS, FLDs were conducted with rice variety Naveen during *boro* season of 2013 and 2014 with the aim to evaluate the performance of a high yielding variety with recommended package of practices and to correct and analyse feedback information for further improvement in research and extension programme of Lower Brahmaputra Valley and North Bank Plain Agro-climatic Zone.

MATERIALS AND METHODS

Front line demonstrations in various Agro-climatic Zones of Assam were conducted during *boro* season of 2013 and 2014 to popularize the improved rice variety "Naveen" and production techniques so that rice yield and income of the farmers will be enhanced. The constraints in rice production in Lower Brahmaputra Valley and North Bank Plain Agro-climatic Zone of Assam were identified through participatory rural appraisal, field survey, farmers meetings, training programmes and field diagnostic visits during crop growth period in the previous years. It was observed that the low yield of rice conceived due to lack of suitable variety of rice, imbalanced use of fertilizers, aged seedling, infestation of weeds and improper crop geometry. Based on the problems identified, 115 front line demonstrations in farmers' fields under irrigated situations during *boro* season of 2012-13 and 2013-14 were conducted. The soils of the region are light black to sandy clay loam in texture, low in available N and P and medium in available K. The plot size under each demonstration was 0.4 ha. Rice variety "Naveen" seed, fertilizers (80:40:40 kg ha^{-1} N-P_2O_5-K_2O per hectore) and pre-emergence herbicide (pretilachlor) @ 1.0 kg a.i/ha were provided to the farmers as critical inputs with recommended technologies as intervention during the course of front line demonstration programme. Nursery was raised in the last week of December and second week of January. Rice seedlings of 45-50 days old were transplanted in the field during second fortnight of February, except Mukhkuchi where nursery raising and transplanting were delayed by one month due to non availability of irrigation water. The demonstrations on farmers' fields were regularly monitored from nursery raising to harvesting. In case of local check (control plots), existing farmers' practices were followed (Table1). A training programme was organized before conducting the demonstrations for the selected farmers of the respective villages to impart technological knowledge on "Improved rice production techniques". All other steps like site selection, layout of demonstrations, farmers' participation etc. were followed as suggested by Choudhary (1999). The observations including grain yield of demonstration plots as well as farmer's practice (local check) were recorded to calculate various indices as suggested by Yadav *et al*. (2004) and Singh *et al*. (2012). The details of these indices are below:

$$\text{Extension Gap} = \text{Demonstration yield } (D_1) - \text{Farmers' practice yield } (F_1)$$

$$\text{Technology Gap} = \text{Potential yield } (P_1) - \text{Demonstration yield } (D_1)$$

$$\text{Technology Index} = \frac{\text{Potential yield } (P_1) - \text{Demonstration yield } (D_1)}{\text{Potential yield } (P_1)} \times 100$$

Additional Return = Demonstration return (Dr) – Farmers' practice return (Fr)
Effective Gain = Additional return (Ar) – Additional cost (Ac)

$$B:C = \frac{\text{Additional return (Ar)}}{\text{Additional cost (Ac)}}$$

Table 1. Technological interventions followed under FLD and farmers practice in rice

Particulars	Technological Interventions in front line demonstrations	Farmers practice at different locations			
		Galdighala	Gorakhat	Hokradoba	Mukhkuchi
Land condition	Well irrigated and light black to sandy clay loam	Well irrigated sandy clay loam			
Variety	Naveen	Luit and Baismuthi	China boro (Local)	China boro (Local)	Luit and Baismuthi
Land preparation	3-4 ploughings	3-4 ploughings			
Seed rate (kg ha^{-1})	30.0	45.0	40.0	50.0	45.0
Seed treatment	Bavistin @ 2g kg^{-1} seed	No seed treatment			
Planting method	Line transplanting (20 x 15 cm)	No line transplanting			
Plant population (no. of hills m^{-2})	34	40-45	45-48	42-45	35-40
Fertilizer doses (kg ha^{-1})	80:40:40 ($N-P_2O_5-K_2O$)	65:25:25 ($N-P_2O_5-K_2O$)	60:30:20 ($N-P_2O_5-K_2O$)	50:20: 0 ($N-P_2O_5-K_2O$)	40:24:18 ($N-P_2O_5-K_2O$)
Weed management	Pre-emergence Pretilachlor @ 1.0 kg a. i. ha^{-1}	Partial two hand weedings at 35 and 60 days after transplanting			
Plant protection	Need based application of Carbofuran 3G @ 25 kg ha^{-1}	No plant protection measures			
Water management	Maintained thin film of water up to panicle initiation	Flooding during the crop growth period and irrigation water at flowering stage			

RESULTS AND DISCUSSION

The growth, unfilled grains per panicle and straw yield were significantly influenced by the different locations which may be due to variability in soil fertility (Table 2). The maximum plant height (118.7 cm) was recorded at Hokradoba (Udalguri) followed by Mukhkuchi (117.6 cm) and both found significantly higher over Galdighala and Gorakhat sites. The maximum number of tillers per hill, panicle length and filled grains per panicle were recorded at Gorakhat site while this site also produced maximum number of unfilled grains per panicle which was significantly higher over other three locations.

Grain and straw yield was significantly influenced by different locations. The maximum grain and straw yield was recorded at Galdighala followed by Gorakhat and Hokradoba and significantly higher yield was obtained from Mukhkuchi. The yield differences at different locations may be due to delayed transplanting especially at Mukhkuchi. Grain yield of rice was higher under demonstrations as compared to existing farmer's practice. Higher grain yield could be attributed to the fact that optimum and balanced utilization of all the production factors in the demonstrations accelerates better growth and yield attributes. The increase in grain yield under demonstrations was 21.25 to 43.42% (Table 3) over existing farmer's practice. Sujathamma *et al.* (2015) also recorded significantly better yield attributes which resulted in 16.5% higher grain yield over farmer's practices. On an average 28.8% yield advantage was recorded under front line demonstrations carried out with improved seed and improved package of practices as compared to farmer's traditional way of rice cultivation.

An extension gap of 0.88 to 1.65 t ha^{-1} in yield was found between demonstrated technology and farmers' practices at various locations. The extension gap was lowest (0.88 t ha^{-1}) at Mukhkuchi which was due to inadequate technology transfer to the farmers and insufficient extensions services for transfer of technology while the highest extension gap (1.65 t ha^{-1}) was observed at Hokradoba which may be due to higher yield of rice from demonstration plots. On an average 1.17 t ha^{-1} extension gap was observed which might be attributed to rice variety Naveen and adoption of improved production technology in the demonstration plots which resulted higher grain yield than the existing farmers' practices. The technology gaps were 0.68, 0.86, 1.05 and 2.12 t ha^{-1} for Galdighala, Gorakhat, Hokradoba and Mukhkuchi respectively. The mean technology gap of 1.18 t ha^{-1} found in 115 front line demonstrations was 18.15% of the potential yield of Naveen. The maximum technology gap observed could be due to variability in soil fertility, poor adoption of crop management practices and local climatic conditions while minimum technology gap showed proper adoption of technology and favourable local climatic conditions which resulted maximum grain yield (5.82 t ha^{-1}). Technology index shows the feasibility of the demonstrated technology at farmer's field. The technology index varied from 10.46 to 32.62%. On an average technology index observed was 18.12% at all four locations in front line demonstrations which indicates the efficacy of rice variety Naveen and technical interventions. Higher technology index at Mukhkuchi reflected the inadequate efficacy of rice variety Naveen and technical interventions while lower technology index at Galdighala and Gorakhat showed the feasibility of the technology. Similar findings on extension gap, technology gape and technology index for rice demonstrations were also reported by Sujathamma *et al.* (2015).

Seed, fertilizers and herbicide were considered as critical cash inputs for the demonstrations as well as farmer's practices. On an average, additional investment of ₹1153.50 ha^{-1} was made under demonstrations. Economic return is a function of grain yield and minimum support price (MSP) as sale price. Maximum returns were obtained at Galdighala demonstrations due to higher grain yield. The higher additional returns and effective grain obtained under demonstrations at Hokradoba could be due to improved rice variety Naveen and adoption of improved production techniques like timely transplanting and application of recommended doses of fertilizers. The highest benefit cost ratio (32.97) was observed at Galdighala which is due to low additional cost (Table 4). Nirmala and Muthuraman (2009) and Singh *et al* (2012) also found that adoption of improved techniques by farmers in rice production resulted in higher economic returns.

Based on the above findings it can be concluded that the cultivation of rice variety Naveen and improved production technology can reduce the technology gap to a considerable extent thus leading to increased productivity of rice in the region. With the adoption rice variety Naveen and production technologies farmers can increase the grain yield by 28.8% which incurred increment cost of '1153 ha^{-1}. This amount is so less that even small and marginal farmers can afford it. The mean extension gap (1.17 t ha^{-1}) and B:C (32.97) are sufficiently high to motivate the farmers for adoption of Naveen and rice production technology. Front line demonstration also produced significant positive results and provided the extension functionaries an opportunity to demonstrate the productivity potential and profitability of rice variety Naveen and latest production technology under actual farming situations. Thus, under sustainable agricultural practices, FLD programmes are very effective in changing attitude, skill and knowledge of improved package of practices of high yielding varieties of rice.

Table 2. Growth and yield attribute of rice variety Naveen under front line demonstrations in farmer's field (pooled data, 2013 and 2014)

Locations	No. of demonstrations	Plant height (cm)	Tillers hill^{-1}	Panicle length (cm)	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	Straw yield (t ha^{-1})
Galdighala	55	111.14	13.66	24.82	131.20	23.26	6.36
Gorakhat	21	107.60	13.20	25.14	138.38	32.84	6.26
Hokradoba	15	118.70	14.32	24.30	129.78	25.04	6.12
Mukhkuchi	24	117.58	10.54	24.82	131.20	23.26	4.96
CD ($P<0.05$)		5.47	NS	NS	NS	5.48	0.85

Table 3. Grain yield and gap analysis of rice variety. Naveen under front line demonstrations in farmers' field (pooled data, 2013 and 2014)

Location	Potential yield of Naveen (t ha^{-1})	Demonstration yield (t ha^{-1})	Farmers' practice yield (t ha^{-1})	Increase over Farmers' practices (%)	Extension gap (t ha^{-1})	Technology gap (t ha^{-1})	Technology index (%)
Galdighala	6.5	5.82	4.8	21.25	1.02	0.68	10.46
Gorakhat	6.5	5.64	4.5	25.33	1.14	0.86	13.23
Hokradoba	6.5	5.45	3.8	43.42	1.65	1.05	16.15
Mukhkuchi	6.5	4.38	3.5	25.14	0.88	2.12	32.62
Average	6.50	5.32	4.15	28.79	1.17	1.18	18.12

Table 4. Economic analysis of front line demonstrations on rice var. Naveen in farmers' field (two years pooled data)

Location	Cost of cash input		Additional cost in Front line demonstration (₹ ha^{-1})	Sale price (MSP) of grain (₹ ha^{-1})	Total Returns (₹ ha^{-1})		Additional Return (₹ ha^{-1})	Effective gain (₹ ha^{-1})	B:C
	Front line demonstration (₹ ha^{-1})	Farmers' practice (₹ ha^{-1})			Front line demonstration	Farmers' practice			
Galdighala	10046	9650	396	1280	74496	61440	13056	12660	32.97
Gorakhat	10046	9275	771	1280	72192	57600	14592	13821	18.93
Hokradoba	10046	8075	1971	1280	69760	48640	21120	19149	10.72
Mukhkuchi	10046	8570	1476	1280	56064	44800	11264	9788	7.63
Average	10046	8893	1154	1280	68128	53120	15008	13855	17.56

REFERENCES

Choudhary BN 1999. Krishi Vigyan Kendra- A guide for KVK managers. Publication, Division of Agricultural Extension, *ICAR. PP 73-78.*

GoI 2011. State-wise Area, Production and Productivity of Rice during 2006-07 to 2010-11. Directorate of Rice Development, Ministry of Agriculture, Government of India.

GoI, 2015. Economic Survey 2013-14. Ministry of Finance, Government of India. pp 77.

Ngachan SV, Mohanty AK and Pattanayak A 2011. Status Paper on Rice in North East India. ICAR Research Complex for North East Hill Region. Pp 1.

Nirmala B and Muthuraman P 2009. Economic and constraints analysis of rice cultivation in Kaithal District of Haryana. Indian Research Journal of Extension Education 9(1): 47-49.

Singh T, Singh R and Soni RL 2012. Performance of rice variety P 1460 in front line demonstrations under rainfed conditions in Southern Humid Region of Rajasthan. Annals of Agricultural Research 33(3):121-125.

Singh T, Satapathy BS, Pun KB, Lenka S and Saikia K 2014. Naveen: A high yielding rice variety – Package of practices for irrigated lands of Lower Brahmaputra Valley. RRLRRS (CRRI) Technology Bulletin-3.

Singh UP 2002. Boro Rice in Eastern India. Rice-Wheat Consortium Regional Technical Coordination Committee Meeting. 10-14 February 2002. Rice-

Wheat Consortium for the Indo-Gangetic Plains, New Delhi, India. Pp 2.

Sujathamma P, Reddy KD and Usharani G 2015. Yield gap analysis of rice for technological intervention. The Ecoscan 9 (1&2): 235-237.

Yadav DB, Kamboj BK and Garg RB 2004. Increasing the productivity and profitability of sunflower through frontline demonstrations in irrigated agro-ecosystem of eastern Haryana. Hayrana Journal of Agronomy 20 (1&2): 33-35.