Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(6): 78-81

Received: 19-09-2018
Accepted: 21-10-2018

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An on-farm trial to evaluate the performance of improved rice varieties in Darjeeling district of west Bengal

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Abstract
An on-farm trial was conducted at Darjeeling district of West Bengal; to evaluate the performance of IARI released improved rice varieties. Two rice varieties were used for the study: Pusa-44 (non-lodging variety, 140-145 days) and Pusa Sugandh-5 (tolerance to shattering, 120-125 days). From the trial, it was observed that both the improved rice varieties recorded higher grain yield (Pusa-44: 3.54 t/ha and Pusa Sugandh-5: 3.01 t/ha) as compared to the farmers' practiced variety Kalonunia (1.93 t/ha). Among the yield components assessed, the number of effective tillers per plant; the number of grains per panicle and 1000 grain weight contributed more to the yield and are considered to be the most important factors responsible for yield gap difference. The increases in yield of Pusa-44 and Pusa Sugandh-5 over the farmers' practice were 85.3 percent and 54.4 percent, respectively. The technology gap was highest for Pusa-44 (39.6 q ha^{-1}) followed by Pusa Sugandh-5 (27.4 q ha^{-1}). The technology index values were almost same for both the improved varieties; Pusa-44 (52.8%) and Pusa Sugandh-5 (47.7%). This gap might be due to various constraints such as soil fertility, availability of low moisture content, sowing time and climatic hazards, etc. In economic point of views, the maximum B: C ratio of 1.65 was registered by Pusa-44 closely followed by Pusa Sugandh-5 (1.44), while it was lowest in local check i.e. Kalonunia.

Keywords: Performance, rice varieties, yield gap, technology gap, index

1. Introduction
Rice (*Oriza sativa* L.) is the vital staple food in India. West Bengal topped in the list of the rice producing states with respect to production and contributed 12.99% to the total national production, ranked 2nd in case of area, after UP and having 15.8% share with respect to national context but ranked 5th with respect to the productivity [1]. It is cultivated in almost all 18 districts of West Bengal, out of which Darjeeling district is under low productivity group [2]. The average productivity of the Darjeeling district is 1802.7 kg/ha. The crop is grown under wide range of climatic conditions largely depending on monsoon rains. But, non-availability of high yielding medium duration rice variety is the main concern among the farming community and due to this reason farmers are still using local variety like Joria, Japaka, Koiyabarua, Kalonunia, etc. for their cropping sequence. These local rice varieties are generally low yielder with low responsive towards external inputs and prone to disease-pest attack which leads to a reduction in yield and income. To overcome these problems, Krishi Vigyan Kendra, Darjeeling introduced two short duration improved rice varieties viz. Pusa Sugandh-5 and Pusa-44 under IARI-Post office linkage extension model and conducted an on-farm trial (OFT) on these improved rice varieties against locally available scented variety Kalonunia with an objective to evaluate production potentiality and to assess the adoptability of these improved varieties in the locality during the year 2015-16 and 2016-17. After getting significant results of On-Farm Trial (OFT) at the farmer's field, Krishi Vigyan Kendra, Darjeeling promoted these improved varieties for larger recognition.

2. Materials and Methods
Purposive cum random sampling technique was followed for selection of block and respondents. The Darjeeling district comprises of 12 community blocks, out of which Kharibari block was selected randomly for conducting On-Farm Trial (OFT). Under this agricultural block, six villages were selected based on preliminary survey where farmers were

using local variety (Kalonunia) in their rice based cropping system. The two progressive farmers were selected from each village purposively. Thus, total 12 farmers constituted the sample for the purpose of the OFT. The trial was conducted at six locations during the *kharif* season of 2015-16 and 2016-17. Three technological options were introduced for this on farm trail and critical inputs such as seeds of rice varieties viz. Pusa-44 and Pusa Sugandh-5 were distributed to the selected farmers. Using the recommended package of practices, trials were conducted on total area of 4.80 hectares.

Table 1: Technological Options

Technology Option	Variety	Source of technology
TO – l	Kalonunia	Farmers' practice
TO – 2	Pusa – 44	IARI
TO – 3	Pusa Sugandh – 5	IARI

Table 2: Characteristics of Rice varieties selected for On Farm Trial (OFT)

Variety	Year of release	Seasonal suitability	Varietal characters
Pusa - 44	1994	Kharif	It is a dwarf variety, which matures in about 140-145 days. Its grains are long, slender and translucent. Good head rice recovery during milling. This is a very appropriate variety for combine harvesting because of sturdy stem and non-lodging habit. Yield: 7.0-8.0 t/ha.
Pusa Sugandh - 5	2005	Kharif	A semi-dwarf high yielding aromatic rice variety suitable for multiple cropping systems in northern India. It has extra-long grains and excellent cooking quality. It possesses tolerance to shattering. It is resistant to gall midge, brown spot and moderately resistant to leaf folder and blast disease. It matures in120-125 days. Yield: 5.5-6.0 t/ha.

Technology option wise data were collected from all selected locations and farmers i.e. 12 numbers on the basis of different growth and yield parameters. Each selected farmer was treated as one replication constituting total 12 replications. All the collected data were statistically analysed using Duncan's Multiple Range Test (DMRT) to determine the significant differences between treatments and tabulated on the basis of different growth and yield parameters. During the observations, the parameters like plant height (cm), the number of leaves per plant, days to 50% flowering, days to maturity, the numbers of effective tillers per plant, the numbers of seeds/grains per panicle, panicle length (cm), grain weight (1000 seed weight in g) and yield (t/ha) and benefit: cost ratio (BCR) were recorded. The total cost of cultivation and average gross returns were calculated from the average input cost and average market price of the produce during the period of investigation. Based on these, the net income and benefit: cost ratio were computed as follows –

Net return (Rs. ha^{-1}) = Gross cost (Rs. ha^{-1}) – Cost of cultivation (Rs. ha^{-1})

$$\text{B: C ratio} = \frac{\text{Gross return (Rs. ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs. ha}^{-1}\text{)}}$$

The demonstration yield was compared with the local or improved check. To estimate the extension gap, technology gap and technology index the following formulae were used [3].

1. Extension gap = Demonstration yield – Check yield
2. Technology gap = Potential yield (Pi) – Demonstration yield (Di)

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

3. Results and Discussion

3.1 Varietal performance

All the results of the trial on growth as well as yield attributing characters were calculated and depicted in Table 3. It was observed that the plant height was significantly varied with rice varieties. Both the improved varieties, Pusa-44 and Pusa Sugandh-5 recorded average plant height of 93.7 cm and 95.9 cm, respectively, which were less as compared to Kalonunia (128.6 cm). This might address the problem of lodging in the region in case of Kalonunia which caused low grain yield. The maximum number of leaves per plant was registered by Pusa-44 (44.8) which was significantly higher than rest of the varieties, Pusa Sugandh-5 (42.0) and Kalonunia (40.7). The number of effective tillers per plant, one of the most important yield determining character was recorded significantly the maximum of 14.0 by Pusa – 44 followed by Pusa Sugandh-5 (13.1) and Kalonunia (12.0). The decreasing trend of panicle length was found i.e. Kalonunia (27.7 cm)>Pusa Sugandh-5 (25.3 cm)>Pusa-44 (24.6 cm). Quantification of seeds/grains per panicle is the most yield attributing character, while varietal screening of rice is carried out. Significantly the maximum number of grains $panicle^{-1}$ was recorded in Pusa-44 (147.3) followed by Pusa Sugandh-5 (135.0), while it was found lowest in Kalonunia (128.1). A significant variation of grain weight (1000 seed weight) was recorded among rice varieties and it was found highest in Pusa-44 (24.17 g) followed by Pusa Sugandh-5 (20.98 g) and Kalonunia (17.70 g). Ultimately, among the rice varieties evaluated, the variety Pusa - 44 (3.54 t/ha) had high yield potentiality closely followed by Pusa Sugandh-5 (3.01 t/ha) and both these improved varieties significantly superior over the local aromatic rice Kalonunia (1.93 t/ha), contributing 85.3% (Pusa -44) and 54.4% (Pusa Sugandh-5) more grain yield over the local check (Kalonunia). The maturity period was also significantly varied with rice varieties. The variety, Pusa Sugandh-5 (136 days) was found 8 days ahead of farmers' variety, Kalonunia (144 days) which is proved to be very effective for land preparation of the next crop and towards improving cropping intensity in the district. An economic survey on evaluation of Pusa Rice Hybrids reported that the Pusa -44 had demonstrated yield of 4.7 t/ha [4]. Higher the number of effective tillers, the number of leaves per plant, the number of seeds/grains per panicle and 1000 grain weight might have resulted higher grain yield of Pusa-44 rice variety which are the major yield attributing traits of a variety. The variety Pusa-44 produced 290 numbers of effective tillers in m^{-2}, 27.99 g of 1000 grains weight and 5708 kg grain yield per hectare [5]. A varietal survey reported that the variety Pusa Sugandh-5 produced 103.4 cm plant height, 299.2 numbers of panicles per square meter, 5.7 tonnes/ha grain yield with 118.3 days to 50% flowering and 150.0 days to maturity at RRSS Khudwani, Jammu & Kashmir [6].

Table 3: Pooled average Growth and Yield Parameters of scented rice varieties recorded during 2015-16 and 2016-17

Varieties	Plant height (cm)	No. of leaves/ plant	No. of effective tiller/ Plant	Days to flowering (days)	Panicle length (cm)	No. of grains/ panicle	Crop duration (days)	1000 grain weight (g)	Yield (t/ha)
Pusa –44	93.7	44.8	14.0	88.5	24.6	147.3	143	24.17	3.54
Pusa Sugandh-5	95.9	42.0	13.1	81.0	25.3	135.0	136	20.98	3.01
Kalo-nunia	128.6	40.7	12.0	94.5	27.7	128.1	144	17.70	1.93
S. Em±	1.02	0.66	0.13	0.81	0.71	0.74	0.65	0.57	0.03
C.D.(5%)	2.19	1.42	0.28	1.73	1.52	1.59	1.42	1.42	0.05

3.2 Major Disease and Pest Phenomenon

The major diseases observed in all the varieties were leaf spot and leaf blast, whereas, the major pests recorded were Gandhi bug and stem borer but during 2016-17, false smut disease was also observed in Pusa Sugandh-5 rice variety. These are the very common problems of rice cultivation in all the regions and the IPM techniques will be very much helpful to address the issues.

Variety	Disease Observed	Pest Observed
Pusa-44	Leaf spot, leaf blast	Gandhi bug, stem borer
Pusa Sugandh-5	Leaf spot, leaf blast, false smut	Gandhi bug, stem borer
Kalonunia	Leaf spot, leaf blast	Gandhi bug, stem borer

3.3 Yield gap of different rice varieties

3.3.1 Technology gap and technology index

The technology gap as depicted in the Table 4, was highest for Pusa-44 (39.6 q ha^{-1}) followed by variety Pusa Sugandh-5 (27.4 q ha^{-1}). A good relationship was observed among the technology gap, potential yield of varieties and the farming situation on the varieties grown. Higher the potential yield resulted higher value of technology gap. Technology index can also be used as an indicator of feasibility of growing the varieties under real farming situation. Lower the technology index more is feasibility of growing the varieties. The technology index value was almost more or less same for both the varieties, Pusa-44 (52.8%) and Pusa Sugandh-5 (47.7%). The yield (genetic) potential of a cultivar is expressed as yield potential is equal to the function of environment and management i.e. [*Potential Yield = f* (*environment, management*)]. Thus, the yield potential of a cultivar depends on the existence of a favourable environment which will enable the cultivar to express its full potential in terms of the desired product [7]. The desired product, in the case of rice is the grain. The environment comprises soil type, weather, nutrient, disease and pests and any other factor that may prevent or enhance the expression of genetic yield potential during the season. Suitable management practices involve putting in place proper agronomic practices to manipulate the environmental factors to obtain an improved yield. Proper agronomic practices include correct and timely application of fertilizer, insect and weed control methods. Hence, to reduce the yield gap location specific recommendations for varieties, soil testing and proper management practices appears to be necessary.

3.3.2 Extension gap

Both the tested improved rice varieties (Pusa-44 and Pusa Sugandh-5) grown during both the years recorded higher grain yield over the check one i.e. Kalonunia. The percent increase in yield of tested improved varieties; Pusa-44 and Pusa Sugandh-5 were 85.3% and 54.4%, respectively over that of check variety (Table 4). Extension gap which represents the productivity gain possible with the existing technologies were 16.3 q ha^{-1} and 10.6 q ha^{-1}, respectively (Table 4). The value of the extension gap was recorded highest for Pusa- 44 as a result of higher demonstrated yield followed by Pusa Sugandh-5. This gap might be due to lack of awareness and knowledge on actual package of practices, disease-pest management strategies and lack of skill on modern rice cultivation techniques like line sowing, SRIs, etc. Therefore, widespread extension efforts need to be demonstrated among the rice growers on the appropriate technologies, package of practices and disease-pest management strategies to minimize the yield gap between demonstration and farmers field.

Table 4: Productivity, technology gap, extension gap and technology Index

Year	Name of varieties	Yield (q/ha)			% increase over local check	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index %
		Potential	Demonstration	Local check				
2015-16 & 2016-17	Pusa-44	75.0	35.4	19.1	85.3	39.6	16.3	52.8
2015-16 & 2016-17	Pusa Sugandh-5	57.5	30.1	19.5	54.4	27.4	10.6	47.7

3.4 Economics of cultivation

Irrespective of type of rice varieties, average net return as stated in the Table 5, was higher in demonstrated improved varieties over the check. The variety Pusa-44 in both the year recorded the maximum net return (Rs. 21,604 ha^{-1}) followed by Pusa Sugandh-5 (Rs. 14,214 ha^{-1}). The higher values of net return in case of Pusa-44 is attributed to the higher gross return (Rs. 57,870 ha^{-1}) followed by Pusa Sugandh-5 (Rs. 46,655 ha^{-1}). The benefit cost ratio of demonstrated varieties viz. Pusa-44 and Pusa Sugandh-5 were 1.65 and 1.44, respectively, which were also more over the farmers' practice (1.21).

Table 5: Economics of cultivation of two scented rice varieties recorded during 2015-16 and 2016-17 Average of two year (2015-16 & 2016-17)

Variety	Yield (t/ha)	Gross cost (Rs.)	Gross return (Rs.)	Net return (Rs.)	B:C Ratio
Pusa- 44	3.54	33266	54870	21604	1.65
PS - 5	3.01	32441	46655	14214	1.44
Kalonunia	1.93	28646	34740	6094	1.21

N.B: Pusa -44 & PS – 5 @ Rs. 15.50/- per kg and Kalonunia @ Rs.18.00/- per kg seed.

4. Conclusion

The level of production of any crop directly depends on the level of adoption of recommended technology of that particular crop. Both the improved varieties, Pusa-44 and Pusa Sugandh-5 recorded more number of productive tillers per plant, number of seeds/grains per panicle and 1000 seed weight which are the most important yield contributing parameters along with lower percent disease-pest incidence, contributed to the higher grain yield and higher B:C ratio. Moreover, the maturity period of Pusa Sugandh-5 (136 days) was found 8 days ahead of farmers' variety Kalonunia (144 days) which is proved to be very effective towards improving cropping intensity in the district. As a result, findings of the trial showed the high potential of improved technological options of rice over the check but non-adoption of them by the farmers due to any reasons is responsible for low productivity.

Thus, from the present study, it can be concluded that both production and productivity of rice in the area of flash flood and flood affected areas in the district could easily be increased by bridging the extension gap and technological gap through conduction of OFTs, front line demonstrations, farmers' training extensively for testing the suitability of the variety for doubling the farmers income. Adaptation of these varieties would enhance their income even affected by flood.

5. References

1. Anonymous. Estimates of area & production of principal crops in West Bengal. Evaluation wing, Directorate of Agriculture, Government of West Bengal, Kolkata, 2009b, 227.
2. Anonymous. Rice in India - A Status Paper. Directorate of Rice Development, Patna, May, 2002. 2002a.
3. Yadav YP, Singh B, Kumar A. Evaluation of frontline demonstrations on mustard in south-western region of Haryana. Haryana J. of Research. 1999; 29(1/2):39-42.
4. Singh HN, Singh S, Singh US, Singh J, Zaidi NW, Mohanty S. Economic evaluation of Pusa Rice Hybrid 10 cultivation: a micro-economic evidence of Uttarkhand, India Indian Journal of Traditional Knowledge. 2013; 12(3):472-477.
5. Singh DK, Gupta S, Nanda G, Sharma Y, Singh VV, Bisarya, D. Evaluation of Rice Varieties for Yield under Organic Farming in Tarai Region of Uttarkhand, India, Int. J Curr. Microbial. App. Sci. 2017; 6(4):734-738.
6. Husaini M, Parray GA, Rather AG, Sanghera GS. Performance of elite basnmati rice varieties of subtropical India under temperate valley conditions of Kashmir, International Rice Research Notes. 2009, 0117-4185.
7. De Datta S K. Principles and Practices of Rice Production. John Wiley and Sons Ltd, 1981, 89-145.