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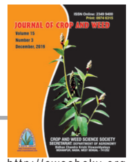

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Popularization of improved short duration rice variety Telangana Sona (RNR 15048) through frontline demonstrations in Nalgonda District, Telangana

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ABSTRACT

A total of 275 no's of frontline demonstrations on rice were conducted by Krishi Vigyan Kendra, Kampasagar during kharif season 2016 to 2019 at Nalgonda District, Southern Telangana Zone. The results revealed that grain yield was significantly high (6790.0 Kg ha^{-1}) with 12.0 per cent yield superiority in demonstration plots over the farmer's practice (6048.0 Kg ha^{-1}) during the four years of the study period. The technology gap ranged between 0.0 Kg ha^{-1} to 350.0 Kg ha^{-1} with a mean of 210.0 Kg ha^{-1}. The lowest and highest extension gaps were observed in kharif 2019 (518.0 Kg ha^{-1}) and kharif 2018 (1050.0 Kg ha^{-1}), respectively. The mean extension gap was 742.0 Kg ha^{-1} and the technology index was in the range of 0.0% to 5.0% with a mean of 3.0%. The average plant height, number of tillers m^{-2}, panicle length, and filled grains were high in improved practice as compared to farmers' practice. Whereas, effective tillers m^{-2}, chaffy grains panicle^{-1}, test weight per 1000 seeds and straw yield were low in improved practice. These results based on the comparison between demonstrations and farmer's practice indicated that the yield, gross returns, net income, and benefit-cost ratio were higher in frontline demonstrations than that of local farmer's practice.

Keywords: Rice, frontline demonstrations, yield, extension gap, technology gap, technology index, economics

Rice (*Oryza sativa* L) is still a staple food for more than half of the global population (Babatunde *et al.*, 2016). In India self-sufficiency in food grain production is achieved mainly through the rice. In India, it occupies an area of 43.78 m ha with a production of 118.43 mt and productivity of 2705 Kg ha^{-1}, whereas in Telangana, it is being cultivated in an area of 3.2 m ha, with a production of 11.9 mt and productivity of 3700 Kg ha^{-1}. In Nalgonda district, it occupies an area of 2.8 lakh ha with a production of 9.6 lakh tonnes annually with average productivity of 3440 Kg ha^{-1}. In the country, food grain production has been gradually raised from 209 MT in 2005-06 to 303 MT in 2020-21 (Anonymous, 2020). The productivity of rice has increased from 2102 Kg ha^{-1} in 2005-06 to 2705 Kg ha^{-1} in 2019-20. The self-sufficiency of rice production in India is due to the cultivation of short-duration high-yielding rice varieties, adoption of improved and location-specific agro technologies, the rapid expansion of rice crop into non-traditional areas because of increased irrigation facilities, developed infrastructure, use of optimum dosage of fertilizers, and minimum support price (Singh *et al.*, 2017).

Frontline demonstrations are the foremost effective and useful extension tool to demonstrate the latest improved technologies *i.e.,* High Yielding Varieties (HYV), integrated crop management practices to be followed on farmer's fields developed at research stations. Krishi Vigyan Kendras are field-based organizations that are actively contributing to the spread of technologies through the evaluation, improvement, and distribution of successful technologies in various agro-climatic environments or regions (Das, 2007) that result in yield enhancement by reducing the adoption gap.

Rice is the main crop under irrigated conditions in the Nagarjunasagar Left canal area during both *kharif* and *rabi* seasons in the Nalgonda District, Southern Telangana Zone. Farmers in the district mainly cultivate public-bred BPT 5204 (Samba mahsuri), a long duration variety and private bred short duration varieties like Ankur Pooja, HMT Sona, Kaveri Chintu, and Ankur

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Pooja Gold. Prof. Jayashankar Telangana Agricultural University (PJTSAU), Hyderabad prioritized research in the area of crop improvement constantly to cater the needs of the farming community of the state. In 2016, PJTSAU has released RNR 15048, a super fine grain high yielding short duration variety (120-125 days), which is being extensively cultivated by the farmers of Telangana, Andhra Pradesh and Karnataka. The variety is highly preferred under contingency crop situations i.e., late sown conditions after July 15th, delayed on set of monsoons and late release of canal water. The grain is short slender type with excellent cooking quality. Potential yield of this variety is 6500-7000 Kg ha^{-1} and is resistant to blast, tolerant to BPH and suitable for both *kharif* and *rabi* seasons (Tamilazhaki *et al.*, 2020; Chandramohan *et al.*, 2021).

The yield gap difference between actual and potential yield is very high due to cultivation in degraded low fertile soils (Ramachandra *et al.*, 2019), non-adoption of high yielding varieties, lack of awareness on the improved new technologies, and biotic and abiotic stresses. The low yields on farmer fields are due to delayed sowings, spurious seed, application of non-recommended dosage of fertilizers and hand weeding (Samant, 2017). Poor land leveling, bunding and weed management, inadequate nutrient management, cultivation of low yielding varieties, poor management practices to control pests and diseases also results in low yields on farmer fields (Tanaka *et al.*, 2017). Adoption of recently developed high yielding rice varieties with improved technologies may reduce the yield gap and increase rice production and productivity. Keeping in view of the above facts, KVK Kampasagar has conducted frontline demonstrations on recently released short-duration fine grain rice variety RNR 15048 by adopting latest crop production and protection technologies to assess its performance on the farmer fields in Nalgonda District, Telangana.

MATERIALS AND METHODS

A total of 275 numbers of frontline demonstrations in four villages *i.e.,* Islavath thanda, Bhalunaik thanda, Sitya thanda, and Kapuvarigudem of Nalgonda District, Telangana were carried out by KVK, Kampasagar under Tribal Sub Plan during *kharif* 2016 to 2019. The scientific staff of KVK collected baseline data from farmers in each village and problems associated with short, medium, and late duration rice varieties were discussed prior to conduction of frontline demonstrations on rice. Then, KVK scientists explained the advantages of cultivation of short-duration rice varieties and adoption of latest crop production technologies in rice. The farmers were selected through baseline survey, group discussion, interaction meetings, awareness programmes, and field visits. Finally, prepared a list of interested farmers was prepared and selected farmers' fields were visited and soil samples were collected at one meter depth in soil and analyzed. Each demonstration was organized on 0.4 ha area and adjacent field was treated as farmers' practice. The demonstrations consisted of seed rate of high yielding short-duration rice variety Telangana Sona @ 50 Kg ha^{-1} , sowing of green manure crop daincha @ 37.5 Kg ha^{-1} followed by in-situ incorporation in the soil before transplanting of rice, seed treatment with Carbendazim @1g l^{-1} of water, soil test based recommended dose of fertilizer application, application of pre-emergence herbicide Pretilachlor @ 1L ha^{-1}, adoption of need-based cultural practices *viz*., a 20 cm alleyways formation for every 2m at the time of transplanting, installation of pheromone traps @10 ha^{-1} at 25 days after transplanting (DAT) to monitor yellow stem borer moths, application of Carbofuran granules 3G @ 25 Kg ha^{-1} to control yellow stem borer and leaf folder. In demonstration plots, farmers were advised to follow recommended improved package of practices explained by KVK scientists and in farmer's practice conventional methods were adopted. KVK scientists organized extension activities *i.e.,* method demonstrations, farmer-scientist interactions, need-based training programmes, regular field visits to monitor incidence of pests and diseases, and field day was organized prior to harvest to involve more participation of local farmers in the popularization of the technology.

Data were recorded on both demonstrations and farmer's practice for growth, yield and yield attributes and growth parameters and per cent increase or decrease yield over the check, gross returns, net returns, additional net returns, benefit-cost ratio and yield gap I (Technology gap), yield gap II (Extension gap) and technology index were calculated as per standard formulae (Sawardekar *et al.*, 2003).

The collected data were analyzed through independent two sample t-test and standard deviation was calculated.

$$\text{Increase or decrease over the farmer's practice}(\%) = \frac{\text{Demonstration plot Yield}\left(Kg\ ha^{-1}\right) - \text{Farmer's practice yield}\left(Kg\ ha^{-1}\right)}{\text{Farmer's practice Yield}\left(Kg\ ha^{-1}\right)} \times 100$$

Yield Gap I (kg ha^{-1}) = Potential Yield (Kg ha^{-1}) – Demonstration Yield (Kg ha^{-1})

Yield Gap II (kg ha^{-1}) = Demonstration Yield (Kg ha^{-1}) – Farmer's practice Yield (Kg ha^{-1})

$$\text{Technology Index } (\%) = \frac{\text{Potential Yield}\left(Kg\ ha^{-1}\right) - \text{Demonstration Yield}\left(Kg\ ha^{-1}\right)}{\text{Potential Yield}\left(Kg\ ha^{-1}\right)} \times 100$$

Additional net returns (Rs ha^{-1}) = Demonstration net returns (Rs ha^{-1}) – Farmer's practice net returns (Rs ha^{-1})

RESULTS AND DISCUSSION

Yield

Frontline demonstrations on short-duration rice variety RNR 15048 revealed significant mean grain yield of 6709.0 Kg ha^{-1} in demonstration plots against farmer's practice (6048.0 Kg ha^{-1}). In the demonstration plots, high mean grain yields of 6650.0 Kg ha^{-1}, 7000.0 Kg ha^{-1}, 6825.0 Kg ha^{-1} and 6685.0 Kg ha^{-1} were obtained during *kharif* 2016, 2017, 2018 and 2019, respectively. But in farmer's practice, low mean grain yields 5950.0 Kg ha^{-1}, 6300.0 Kg ha^{-1}, 5775.0 Kg ha^{-1} and 6167.0 Kg ha^{-1}, were observed during *kharif* 2016, 2017, 2018 and 2019, respectively. During *kharif* 2017, highest mean grain yield was obtained both in demonstration plots (7000.0 Kg ha^{-1}) and farmers practice (6300.0 Kg ha^{-1}). The percent increase in yield over the farmer's practice were 12.2%, 11.0%, 18.0% and 8.0% during *kharif* 2016, 2017, 2018 and 2019, respectively with a mean of 12.0% (Table 1). Increased grain yield in demonstration plots were due to the adoption of recommended high yielding short-duration fine grain variety RNR 15048, seed treatment with Carbendazim @1g l^{-1} of water, nursery raising after July 15th, timely transplanting (21 days old seedlings), proper nursery management, timely application of weedicides to control weeds, prophylactic and need based plant protection measures. Practicing better agronomic practices boosted grain yields in improved practice (Stuart *et al.*, 2018) and high yields in demonstrations were due to the usage of high yielding short duration varieties with advanced proven technologies (Mohanty and Yamano, 2017). These results are in accordance with Jayalakshmi *et al.* (2021), Verma *et al.* (2016), Mitra *et al.* (2014), Singh *et al.*(2020a), Geeta *et al.* (2017), Mishra (2009) and Narendra Singh *et al.* (2021).

Growth and Yield attributes

Mean plant height of RNR 15048 was 43.1, 79.5 and 99.9 cm in demonstrations as compared to farmers' practice 43.5, 75.1 and 96.1 cm at 30, 60 and 90 DAT, respectively. Average number of tillers m^{-2} was low in improved practice *i.e.,* 290.5, 338.0 and 357.7 tillers m^{-2} against farmer's practice 304.4, 357.7 and 382.4 at 30, 60 and 90 DAT, respectively (Table 2). The averages of effective tillers (241.8 tillers m^{-2}), chaffy grains (12.2 g), test weight (18.6 g per 1000 seeds) and straw yield (4449.0 kg ha^{-1}) were low in improved practice than the averages of effective tillers (295.7 tillers m^{-2}), chaffy grains (14.2 panicle^{-1}), test weight (22.3 g per 1000 seeds) and straw yield (4956.3 kg ha^{-1}) in the farmer's practice (Table 3). The mean panicle length (20.9 cm) and filled grains (165.1 panicle^{-1}) were higher in improved practice against farmers' practice with mean panicle length of 20.8 cm and 110.3 filled grains panicle^{-1} (Table 3). High total number of grains and filled grains per panicle in demonstrations against the farmer's practice to higher grain yields in demonstrations. These results were accordance with Samant (2017) who observed higher plant height, more effective tillers, higher panicle length, more filled grains per panicle and less spikelet sterility in improved practice. Subramani *et al.* (2014) reported that taller plant height, more ear bearing tillers per panicle and higher test weight resulted in higher yields in improved varieties as compared local checks and Jyothi Swaroopa *et al.* (2016) mentioned that total number of grains and filled grains per panicle gave higher yields in demonstrations.

Technology gap

In the four years of study, the technology gap between the improved practice and farmer's practice was in the range of 0.0 Kg ha^{-1} to 350.0 Kg ha^{-1} with an average of 210.0 Kg ha^{-1} (Table 1) and wide technology gap could be due to climate change, differences in crop management practices among the farmers, instructional farm facilities at different locations, and soil heterogeneity (Ravikumar *et al.*, 2018). Non adoption of recommended package of practices by the farmer's, and lack of awareness on recently improved technologies in rice increased the technology gap. Singh *et al.* (2021b) reported that use of latest scientific technologies with the full recommended package of practices gave higher yields and more net returns. Singh *et al.* (2020b) also observed wider technology gap between improved and farmers' practice in chickpea frontline demonstrations.

Extension gap

Extension gap of 700.0, 700.0, 1050.0 and 518.0 Kg ha^{-1} were recorded with a mean of 742.0 Kg ha^{-1} during *kharif* 2016, 2017, 2018 and 2019, respectively (Table 1). Highest extension gap was observed in 2018 and low in 2019. The extension gap emphasized the importance of educating the farmer's through various extension methods *i.e.,* trainings and method demonstrations to adopt improved latest agro technologies to reduce extension gap and adoption of the new crop production technologies would change these alarming trends of galloping of extension gap. Higher yields were obtained in the demonstrations than farmers' practices is due to adoption of improved technology transfer. The extension gap can be bridged by encouraging the farmers to adopt improved practices while refining or modifying the existing technologies by the concerned scientists to address the socio-economic and environmental issues that bridge the research gap (Ramachandra *et al.*, 2019). These results

Table 1: Yield performance of rice variety RNR 15048 under Frontline demonstrations (FLDs) *vs* Famer's practice (FP)

Year	No. of Demos	Potential yield (kg ha^{-1})	Yield (kg ha^{-1})		Yield advantage over the control (%)	Technology gap (kg ha^{-1})	Extension gap (kg ha^{-1})	Technology Index (%)
			Demo	Check				
2016	25	7000	6650.0$^{\#}$	5950.0$^{\#}$	12.0	350.0$^{\#}$	700.0$^{\#}$	5.0$^{\#}$
2017	25	7000	7000.0$^{\#}$	6300.0$^{\#}$	11.0	0.0$^{\#}$	700.0$^{\#}$	0.0$^{\#}$
2018	200	7000	6825.0$^{\#\#}$	5775.0$^{\#\#}$	18.0	175.0$^{\#\#}$	1050.0$^{\#\#}$	2.5$^{\#\#}$
2019	25	7000	6685.0$^{\#}$	6167.0$^{\#}$	8.0	315.0$^{\#}$	518.0$^{\#}$	4.5$^{\#}$
Average	**275**	**7000**	**6790.0**	**6048.0**	**12.0**	**210.0**	**742.0**	**3.0**
Standard deviation			159.1	232.2				
t-value			5.27					
p-value			0.009*					

$^{\#}$Mean of 25 famers; $^{\#\#}$Mean of 200 farmers; *Significant at P=0.05.

were in agreement with Singh *et al.* (2021b) in rice, Singh *et al.* (2021a) and Mamta Singh *et al.* (2020) in wheat crop.

Technology index

The technology index shows the utility of evolving technology in farmer fields. The higher value of the technology index, lower is the feasibility of the technology (Rajasekher *et al.*, 2022). The technology index of 5.0%, 0.0%, 2.5% and 4.5% were observed in *kharif* 2016, 2017, 2018 and 2019, respectively. The average technology index was 3.0% during the four years of the FLD programs (Table 1), and shows good adoption of technology with increasing rice yields (Deka *et al.*, 2018).

Economics

Data on cost economics of demonstration and farmers' practices were presented in Table 4. The average higher gross returns of Rs. 1,10,390.0, Rs. 1,19,700.0, Rs. 1,22,168.0 and Rs. 1,23,004.0 ha^{-1} were recorded in demonstrations as compared to Rs. 98,761.0, Rs. 1,07,730.0, Rs. 1,03,373.0 and Rs. 1,13,473.0 ha^{-1} on farmer's practice during *kharif* 2016, 2017, 2018 and 2019, respectively. The overall mean of four years indicated that the average gross return was significantly high in demonstration plots (Rs. 1,18,815.5 ha^{-1}) over the farmer's practice (Rs. 1,05,836.5 ha^{-1}). The higher gross returns observed in demonstrations were due to higher yields and low cost of cultivation *i.e.* low cost on inputs and adoption of recommended package of practices. While in farmers practice expenditure was more on cost of inputs due to recommended advisories followed through local pesticide dealers.

The higher net returns of Rs. 57,265, Rs. 69,075, Rs. 79,293 and Rs. 72,129 ha^{-1} were obtained in improved practice as compared to farmer's practice of Rs. 40,020, Rs. 51,480.0, Rs. 44,123 and Rs. 56,473 ha^{-1} during *kharif* 2016, 2017, 2018 and 2019, respectively. The mean net return was high in demonstrations (Rs. 67,191 ha^{-1}) against farmer's practice (Rs. 48,024 ha^{-1}) and the maximum net return of Rs. 72,129 ha^{-1} was found in *kharif* 2019 is due to variations in the price of agri-inputs and minimum support price for the produce. Average additional net return of Rs. 19,167 ha^{-1} was gained in demonstration plots and the benefit-cost ratio was higher in demonstrations when compared to farmer's practice during four years study period. The average benefit-cost ratio 2.3:1 was found in demonstrations against 1.8:1 in the farmer's practice (Table 4). Higher benefit-cost ratio in demonstration plots might be due to the cultivation of high yielding short-duration rice variety with improved practices against the conventional practices. In farmer's practice, more money was incurred on the purchase of pesticides to control pest and disease incidence, over dosage of fertilizer application, and also implementing conventional method of paddy cultivation. Whereas improved practice followed cultivation of recommended improved varieties, seed treatment with fungicides to control early stages of soil and seed-borne diseases, and recommended dose of weedicides, pesticides for managing weeds, pests, and diseases and optimum usage of fertilizers based on soil test results and the reduced cost on fertilizers might resulted in higher net returns and increased benefit-cost ratio (Singh *et al.*, 2021). These results indicated that improved practices are more profitable, economically viable and beneficial to rice growers under local agro-ecological situations. Raj *et al.* (2014) reported replacing old varieties with the latest improved varieties increases rice production and net income of the farmer and these results are in accordance with earlier workers by Jayalakshmi *et al.*(2021), Narendra Singh *et al.*(2021), Singh *et al.*(2021c), Deka *et al.*(2018), Singh *et al.* (2018), Verma *et al.*(2016), Mitra *et al.*(2014), Samant (2014) and Zamir Ahmed *et al.*(2014).

Table 2: Growth parameters of improved rice variety RNR 15048 under Frontline demonstrations (FLDs) *vs* Farmer's practice (FP)

Year	Plant height (cm)						Tillers m^{-2}					
	DEMO			CHECK			DEMO			CHECK		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	FINAL	30 DAT	60 DAT	FINAL
2016	52.0	89.0	98.0	51.0	85.0	100.0	346.0	357.0	373.0	321.0	344.0	339.0
2017	40.0	77.0	97.6	37.2	73.7	100.1	252.4	366.9	399.3	306.4	308.9	330.1
2018	46.0	80.0	103.0	42.0	68.7	92.7	296.0	336.0	356.0	306.0	403.0	438.3
2019	34.4	72.0	101.0	43.7	73.1	91.7	267.9	292.1	302.4	284.0	375.0	422.0
AVERAGE	**43.1**	**79.5**	**99.9**	**43.5**	**75.1**	**96.1**	**290.5**	**338.0**	**357.7**	**304.4**	**357.7**	**382.4**

Table 3: Yield attributes of improved rice variety RNR 15048 under Frontline demonstrations (FLDs) *vs* Farmer's practice (FP)

Year	Effective tillers m^{-2}		Panicle length (cm.)		Filled grains $panicle^{-1}$		Chaffy grains $panicle^{-1}$		Test weight (g.)		Straw yield (kg ha^{-1})	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check	Demo	Check
2016	221.0	249.0	20.6	21.9	170.0	108.0	9.6	10.8	22.8	24.9	4707.0	5139.0
2017	269.0	308.0	21.1	21.6	170.0	97.6	10.3	10.3	22.8	22.5	4351.0	4909.0
2018	216.0	308.3	20.7	20.4	171.0	111.6	13.0	18.3	14.0	20.6	4437.0	5079.0
2019	261.0	317.3	21.1	19.4	149.3	123.9	16.0	17.4	14.8	21.0	4301.0	4698.0
Average	**241.8**	**295.7**	**20.9**	**20.8**	**165.1**	**110.3**	**12.2**	**14.2**	**18.6**	**22.3**	**4449.0**	**4956.3**

Table 4: Economics and additional returns in rice variety RNR 15048 under Frontline demonstrations (FLDs) *vs* Farmer's practice (FP)

Year	Gross returns (Rs ha^{-1})		Cost of cultivation (Rs ha^{-1})		Net returns (Rs ha^{-1})		Additional net returns (Rs ha^{-1})	B: C ratio	
	Demo	Check	Demo	Check	Demo	Check		Demo	Check
2016	110390.0#	98770.0#	53125.0#	58750.0#	57265.0#	40020.0#	17245.0#	2.1#	1.7#
2017	119700.0#	107730.0#	50625.0#	56250.0#	69075.0#	51480.0#	17595.0#	2.4#	1.9#
2018	122168.0##	103373.0##	51875.0##	59250.0##	70293.0##	44123.0##	26170.0##	2.4##	1.7##
2019	123004.0#	113473.0#	50875.0#	57000.0#	72129.0#	56473.0#	15656.0#	2.4#	2.0#
Average	**118815.0**	**105836.0**	**51625.0**	**57813.0**	**67190.0**	**48023.8**	**19167.0**	**2.3**	**1.8**

#Mean of 25 famers; ##Mean of 200 farmers.

CONCLUSION

From this study, significant differences were noticed in rice productivity from improved and farmer's practices. In frontline demonstrations, cultivation of high yielding short duration rice variety RNR 15048 and adoption of latest crop production and plant protection technologies significantly increased grain yields, net returns, and benefit-cost ratio as compared to farmer's practice. With the introduction of the new agro-technologies to the farmers through a variety of extension approaches, yield levels were high in RNR 15048 compared to local checks and farmers should be encouraged to follow this recommended package of practices in order to increase their net returns. The extension and technology gaps were widened between improved and famers' practice and to bridge the gap, recommended package of practices with specific local recommendations, and cultivation of improved varieties with the latest agro technologies should be popularized. Replacement of old varieties with improved varieties will increase the net income and productivity. Finally, it is evident that the rice variety RNR 15048 is really a boon, suits well and can replace the existing varieties under similar agro-climatic situations. Hence, the popularization of new rice variety RNR 15048 through field demonstration is very useful for rice farming community.

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