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Evaluation of Cropping System of Medium Duration Rice Followed by Toria under Medium Land Situation

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ABSTRACT

The study was carried out during *Kharif* and *rabi* season of2016-17 and 2017-18 at different locations. Existing farmers' practices were treated as control for comparison with recommended practices. All the demonstrations have been carried out with an objective to demonstrate how double cropping can be adopted such as rice followed by toria which can be adjusted in a cropping system considering the early harvesting of the first crop rice so that toria seeds can be sown on recommended date as per package of practice. The improved technologies consisting use of medium duration rice variety TTB 404, Toria variety TS 36 and TS 38, balanced fertilizer application and other cultural practices. Rice and toria cropping system gave the average rice equivalent yield of33.15q/ha compared to 24.69q/ha obtained at farmer's practice. The average percentage increase of rice-toria system in two years recorded 34.3percentover farmer's practice. The cropping system with improved varieties recorded higher average gross return (Rs 92,064/-), net return (Rs.45,535/-)with higher benefit cost ratio(1.99)as compared to farmer's practices.

Key Words: Benefit cost ratio, Cropping system,Economics, Medium duration rice, Rice equivalent yield,

INTRODUCTION

There has been a rapid increase in the availability of improved and short duration varieties, early crop establishment techniques, pest management alternatives, farm machinery and supplemental irrigation. Rice fallows have a great potential for cultivation of oilseeds. However, very little efforts has been made to efficiently utilize these rice fallow with appropriate technical and developmental back-up. It is expected that nearly 3.0 million hectare area of rice fallows can be brought under cultivation, which can provide about 1.5±2.0 million tonnes of additional food grain production (Anonymous, 2013) and help in meeting the increasing demands of oilseeds. Development and popularization of improved varieties of oilseeds suiting to rice fallows of different agro-ecological regions coupled with improved agro-technology will boost production, and thus improve income and livelihood security as well as nutritional security of farming community. Moreover, introduction of oilseeds can provide a sustainable production base to the continued rice mono-cropped system, which is otherwise leading to decline in total factor productivity. Crop growth, development, water use, and yield under normal conditions are largely determined by weather during the growing season. Most pronounced effect of climate change is a drastic change in the rainfall pattern in the form of delayed monsoon, early withdrawal or inadequate precipitation with poor distribution leading to either drought or waterlogged conditions, particularly in rainfed ecosystem. Therefore, timing of rice transplanting plays an important role in getting higher yield of rice and sowing of succeeding dry season crops mainly oilseeds (Lal *et al,* 2017).

India is a predominantly agriculture based economy country. The productivity of crop increased in India due to increase in improved production technologies. Rice-rice and rice –fallows are no

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longer productive in Assam. Crop and varietal diversification of the rice based cropping systems may improve the productivity and profitability of the system. Diversification is also a viable option to mitigrate the risk of climate change. In Eastern India farmers cultivate rice during rainy season (June-Sept) and land leftover fallow after rice harvest in the post rainy season(Nov-May) due to lack of sufficient rainfall or irrigation amenities. However in low land areas, sufficient residue soil moisture are available in rice fallow in the post rainy season(Nov-March) which can be utilized for raising second crop in the region. Implementation of suitable crop /varietal diversification is thus very much vital to achieve this objective. Due to cultivation of long duration rice varieties timely sowing of toria is difficult. The medium duration rice varieties TTB 404(Shravani) has been taken with medium duration of 135-140 d and timely sown toria variety TS 36 and TS 38 has been taken to see the performance in cropping system to maximize the production utilizing optimum resources.

The study was undertaken in rainfed based cropping system in Morigaon district of Assam during, 2016-17 and 2017-18 with an objective to explore the possibility of growing medium duration rice variety followed by high yielding varieties of toria to for double cropping and timely sowing of crop as per recommended date.

MATERIALS AND METHODS

The study was carried in 8 locations in Morigaon district situated in central Brahmaputra zone (92^0 E to 95.5^0 E longitude and 26.15^0N to 26.5^0N latitude) during 2016 and 2017 of Assam covering total 8 villages with four hectare area. Farmers were selected based on land situation for double cropping. The required inputs were supplied, and regular visits to the demonstration fields by the KVK scientists ensured proper guidance to the farmers.

The sowing of rice was done during June in *kharif* season and harvested during October and

Table 1. Year wise sowing dates and harvesting dates of Rice and toria

Year	Demonstration					Farmer's practice				
	Rice			Toria		Rice			Toria	
	Sowing	Transplanting	Harvesting	Sowing	Harvesting	Sowing	Transplanting	Harvesting	Sowing	Harvesting
2016	21.06.16	13.07.16	10.11.16	20.11.16	22.02.17	21.06.16	13.07.16	04.12.16	15.12.16	20.03.16
2017	22.05.17	17.06.17	30.10.17	08.11.17	13.02.18	22.05.17	17.06.17	06.11.17	24.11.17	01.02.17

November whereas toria was sown within mid November in *rabi* season and harvested in February (Table 1).Using the recommended package of practices, total 8 demonstrations were conducted covering total area of 4.0 ha in both the years. Seeds were sown in rows in case of rice and broadcasted in case of toria.The soil was acidic and medium land situation. The demonstration (Demo) yield was compared with farmer's practice (FP) where long duration rice verities Aijung was practiced followed by toria. At maturity, ten plants of each treatment were randomly selected to measure yield attributes(excluding the border plants). Number of panicles was counted from each treatment, and five panicles per plant were randomly selected for measuring panicle length, number of spikelet per panicle and 1000 grain weight was determined. The rice crop was harvested and sun dried for 3 days, then total produce was weighed. The produce was then threshedand grains were separated, dried (up to 14% moisture content) and weighed for grain yield.The rice grain yield was determined with the moisture content being adjusted to 14%. Similarly yield of non-rice crops was also recorded.

Rice Equivalent yield(REY) was calculated to compare system performance by converting the yield to non-rice crops into equivalent rice yield on a price basis, using the formula REY=Yx (Px/Pr) where Yx is the yield of non-rice crops(q/ha),Px is the price of non-rice crop(Rs /q) and Pr is the price of rice.

Gross return: The total monetary returns of the economic produce obtained from the crop included in the system were calculated based on the local market prices. The total return was expressed in terms of unit area, usually one hectare

Net return: This has been calculated by subtracting the total cost of cultivation from the returns. This value gives the actual profit obtained by the farmer.

Return per rupee invested: This is befit-cost ratio or input-output ratio (Gross return/Cost of cultivation)

RESULTS AND DISCUSSION

Yield attributing charactersandYield

The yield attributing characters of demonstration plots were found to be more compared to farmers practices (Table 2). The average plant height of rice was found 112.5 cm in HYV of rice compared to FP of 121 cm. The number of tillers/plant(16.95), the number of spike per tiller (14.65).Spike length (23.8 cm), number of grains per tiller (298) and 100 grain weight (20.5 g) have been recorded in medium duration rice variety which were higher than the FP. Likewise the yield attributing characters of high yielding variety of toria were also found higher. The yield of individual crop rice (44 q/ha and 47 q/ha) and toria (11 q/ha and 11.8 q/ha) also found to be more in demonstration plots during 2016 and 2017 respectively compared to farmer's practice plots (Table 3). These may be due to use of high yielding varieties of rice and toria and adoption of improved packages and practices from sowing to harvesting. Among the crop production tools, proper time and method of sowing are the prerequisites that allow the crops to complete its life phase timely and successfully under a specific agro-ecology. Among the different components of agronomic packages for rice cultivation, the date of transplanting is one of the important factors as early or late transplanting may face different types of abiotic stress (Nahar *et al,* 2009). It is also crucial for successful dry season cropping following rice especially if conditions are dependent on rains, particularly at the end of the rainy season or the beginning of the dry season, the temporal variability within each site associated with rainfall could mask this trend (Ghosh *et al,* 1998). In this study timely planting (July) resulted in higher biomass accumulation, yield and productivity.

Rice Equivalent Yield

The average of three years data of rice-toria system, the demonstration plot has shownhigher rice equivalent yield of the system compare to the farmer's practice (Table 3). The average rice equivalent yield of 33.15q/ha recorded in rice and toria cropping.

Table 2. Yield attributing characters of Medium duration rice and toria during kharif& rabi season(Average of two years)

		Demonstration		Farmer's practice	
Sr. No	**Particular**	**Rice**	**Toria**	**Rice**	**Toria**
1	Plant height (cm)	112.5	39.2	121	29.7
2	No of tillers /plant	16.95	-	9.9	-
3	No of spike /tiller	14.65	-	8.85	-
4	Spike length(cm)	23.8	-	19.15	-
5	No of grains/tiller	298	-	173.5	-
6	1000 grain weight(g)	20.5	-	19.35	-
7	No of branches/plant	-	5.4	-	3.9
8	No of siliqua/plant	-	92.4	-	60.85
9	No of seeds/siliqua	-	7.65	-	5.1

System compared to average rice equivalent yield of 24.69 q/ha at farmer's practice. The average percentage increase of rice-toria system in two years recorded 34.3 per cent was over farmer's practice. The increases of the REY was mainly due to more yield of timely sown of toria , high yielding variety as per recommendation. But in case of farmer's practice the yield of toria was not as per due to late sowing as harvesting of long duration rice took place in late November or first week of December due to which toria couldn't be sown on normal time(mid Oct-mid Nov) and the yield of toria declined compared to demonstration plots.

Economics and Benefit-cost ratio

The economic analysis revealed that the highest cost of cultivation (Rs 51,546/-) incurred on rice –toria system during 2017 in demonstration compared to lowest(Rs 35,336/-) at farmer's field in 2016 (Table 5).The highest system gross return (Rs 96,928 /-)was recorded in demonstration in 2017 and lowest in farmer's field (Rs 62,135/-) in 2016 .The cropping system with improved varieties recorded higher average gross return (Rs 92,064/-), net return (Rs.45,536/-)with higher benefit cost ratio (1.99) as compared to farmer's practices where the average gross return (Rs.63,064/-) and net return (Rs 26,506/-) have been recorded with benefit cost ratio of 1.81.

Similarly when post-rainy crops were grown after rice in the same field the highest net return was achieved in rice-groundnut, rice-lentil and rice-rapeseed crop combination compared to farmer's practice reported by Singh *et al* (2014) reported. The benefit cost ration of the system was recorded highest(2.10) on demonstration plot in 2016 followed by 2017(1.88) whereas the farmer's plot recorded lowest (1.69) during 2017.This may be due to higher gross return received in 2017.Net returns were directly related to the system productivity and

Table 3. Economical yield of Rice and Toria and Rice Equivalent yield (q/ha) of the system (Average)

Year	**Economic yield of Demo(q/ha)**		**Economic yield of FP(q/ha)**		**REY of Demo (q/ha)**	**REY of FP (q/ha)**	**Percentage increase over FP**
	Rice	**Toria**	**Rice**	**Toria**			
2016	44.0	11.0	32.0	7.9	34.81	25.98	33.99
2017	47.0	11.8	35.0	7.8	31.5	23.40	34.61
Average	45.5	11.4	33.5	7.85	33.15	24.69	34.3

Table 4. Economics of individual crops (Average of both 2016 & 2017).

Sr. No	Particular	Demonstration		Farmer's Practice	
		Rice	Toria	Rice	Toria
1	Cost of cultivation (Rs/ha)	25899	20629	22359	14381
2	Gross return (Rs/ha)	49339	42725	35216	36887
3	Net return (Rs/ha)	23439	22096	12857	12506
4	B:C ration	2.01	2.15	1.58	1.89

the production cost, which may depend on the price that producer received for the product. Production cost of dry season crops was lower due to its low labour and less land preparation requirement which led to higher net return, B: C ratio and economic efficiency of the system (Hassan *et al,* 2003). The average of the two years data (Table 5) recorded the higher gross return (Rs 92,064/-) and net return (Rs 46,529/-)of the system in demonstration plots whereas Rs.63,555/- and Rs 26,506/-have been achieved in farmer's practice respectively. Therefore, intensification and diversification of cropping system with the proper use of available limited irrigation facility will provide higher yield as well as better net returns under the climatic conditions of Assam (Baishya *et a,l* 2016). Likewise the average benefit cost ration also found higher 1.99 compared to the farmer's practice of 1.81. The result can be supported by the findings of Kalita *et al* (2018).This may be due to higher production accompanied with higher price of good quality toria of high yielding variety.In cropping system; inclusion of pulse, oilseed and vegetable is more beneficial than cereals after cereals.

CONCLUSION

The high yielding variety of medium duration rice followed by toria was suitable for farmer's field to fit in the double cropping and it is a good cropping sequence which each and every farmer can adopt to higher the production in a system as well as higher return from the same area of land. Selection of high yielding variety and timely sowing will definitely enhance the yield of the crops and also will encourage the farmers to adopt a system. The farmers who generally keep fallow their field after rice can adopt the cropping system of medium duration rice followed by toria to maximize the production from the same land.

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Table 5. Economic and benefit cost ratio of the system.

Sr. No	Particular	Average of 2 years	
		Demonstration	Farmer's practice
1	Cost of cultivation (Rs/ha)	46528.5	36555
2	Gross return (Rs/ha)	92064	63063.5
3	Net return (Rs/ha)	45535.5	26506
4	B:C ratio	1.99	1.81

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